2016 5-Year Review:
Summary & Evaluation of
Puget Sound Chinook Salmon
Hood Canal Summer-run Chum Salmon
Puget Sound Steelhead

National Marine Fisheries Service
West Coast Region
Portland, OR

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5-Year Review: Puget Sound Species

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Chinook Salmon (*Oncorhynchus tshawytscha*)	*Puget Sound Chinook Salmon*
Chum Salmon (*O. keta*)	*Hood Canal Summer-run Chum Salmon*
Steelhead (*O. mykiss)*	*Puget Sound Steelhead*

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1 · General Information

1.1 Introduction

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

The ESA, under section 4(c)(2), directs the Secretary of Commerce to review the listing classification of threatened and endangered species at least once every five years. After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from threatened to endangered; or (3) have its status changed from endangered to threatened. The most recent listing determinations for most salmon and steelhead occurred in 2005 and 2006. This document describes the results of the review of the ESA-listed salmon and steelhead species in Puget Sound including: Puget Sound (PS) Chinook salmon, Hood Canal summer-run (HCS) chum salmon, and PS steelhead.

1.1.1 Background on listing determinations

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

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

Artificial propagation programs (hatcheries) are common throughout the range of ESA-listed West Coast salmon and steelhead. Prior to 2005, our policy was to include in the listed ESU or DPS only those hatchery fish deemed "essential for conservation" of the species. We revised that approach in response to a court decision and on June 28, 2005, announced a final policy addressing the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204) (hatchery listing policy). This policy establishes criteria for including hatchery stocks in ESUs and DPSs. In addition, it (1) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (2) requires that hatchery fish determined to be part of an ESU or DPS be included in any listing of the ESU or DPS; (3) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (4) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

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

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

1.2 Methodology used to complete the review

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

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

To further inform the reviews, we also asked salmon management biologists from our West Coast Region familiar with hatchery programs to consider new information available since the previous listing determinations. Among other things, they considered hatchery programs that have ended, new hatchery programs that have started, changes in the operation of existing programs, and scientific data relevant to the degree of divergence of hatchery fish from naturally spawning fish in the same area. 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 all relevant 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 the salmon and steelhead in Puget Sound; information submitted by the public and other government agencies; and the information and views provided by the geographically based management teams. The present report describes the agency's findings based on all of the information considered.

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

1.3.1 Federal Register Notice announcing initiation of this review

80 FR 6695; February 6, 2015

1.3.2 Listing history

Beginning in 1999, NMFS began listing salmonid species in Puget Sound under the ESA. Over the next several years, three species of salmonids in this area were listed as threatened (Table 1).

Table 1. Summary of the listing history under the Endangered Species Act for ESUs and DPS in Puget Sound.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Chinook Salmon (*O. tshawytscha*)	Puget Sound Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Threatened

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Chum Salmon (*O. keta*)	Hood Canal Summer-run Chum Salmon	**FR Notice:** 64 FR 14508 **Date:** 3/25/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005 **Classification:** Threatened
Steelhead (*O. mykiss*)	Puget Sound Steelhead	**FR Notice:** 72 FR 26722 **Date:** 5/11/2007 **Classification:** Threatened	N/A

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 PS Chinook salmon and HCS chum salmon in 2005, and for PS steelhead in 2016.

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 that prohibit take except in specific circumstances. In 2005, we revised our 4(d) protective regulations for consistency between ESUs and DPSs, and, to take into account our hatchery listing policy. In 2008, Puget Sound steelhead were afforded 4(d) protection.

Table 2. Summary of rulemaking for 4(d) protective regulations and critical habitat for ESUs and DPSs in Puget Sound.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Chinook Salmon (*O. tshawytscha*)	Puget Sound Chinook Salmon	**FR notice:** 65 FR 42422 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005 **Type:** Final

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Chum Salmon (*O. keta*)	Hood Canal Summer-run Chum Salmon	**FR notice:** 65 FR 42422 **Date:** 7/10/2000 **Revised:** 6/28/2005 (70 FR 37160)	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005 **Type:** Final
Steelhead (*O. mykiss*)	Puget Sound Steelhead	**FR Notice:** 73 FR 55451 **Date:** 9/25/2008	**FR Notice:** 81 FR 9252 **Date:** 2/24/2016 **Type:** Final

1.3.4 Review History

Table 3 lists the numerous scientific assessments of the status of the Puget Sound salmon and steelhead. 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 the ESU and DPS in Puget Sound.

Salmonid Species	ESU/DPS Name	Document Citation
Chinook Salmon (*O. tshawytscha*)	Puget Sound Chinook Salmon	NWFSC 2015 Ford et al. 2011 PSTRT 2006 Ruckelshaus et al. 2006 Good et al. 2005 PSTRT 2005 PSTRT and SSSG 2003 PSTRT 2002 NMFS 1999b Myers et al. 1998 NMFS 1998
Chum Salmon (*O. keta*)	Hood Canal Summer-run Chum Salmon	NWFSC 2015 Ford et al. 2011 Sands et al. 2009 Good et al. 2005 PSTRT and SSSG 2003 NMFS 1999a NMFS 1999b Johnson et al. 1997 NMFS 1996

Steelhead *(O. mykiss)*	Puget Sound Steelhead	NWFSC 2015 Hard et al. 2015 Myers et al. 2015 Ford et al. 2011 Hard et al. 2007 NMFS 2005 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 Plans for the ESUs and DPS in Puget Sound.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Chinook Salmon (*O. tshawytscha*)	Puget Sound Chinook salmon	**9**	**Title:** Puget Sound Salmon Recovery Plan Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/puget_sound/puget_sound_chinook_recovery_plan.html **Date:** January 19, 2007 **Type:** Final **FR Notice:** 72 FR 2493
Chum Salmon (*O. keta*)	Hood Canal Summer-run Chum salmon	**9**	**Title:** Hood Canal & Eastern Strait of Juan de Fuca Summer-run Chum Salmon Recovery Plan Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/puget_sound/hood_canal_summer-run_chum_recovery_plan.html **Date:** May 24, 2007 **Type:** Final **FR Notice:** 72 FR 29121

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Steelhead (*O. mykiss*)	Puget Sound Steelhead	**7**	N/A

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2 · Review Analysis

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

2.1 Delineation of species under the Endangered Species Act

Is the species under review a vertebrate?

ESU/DPS Name	YES	NO
Puget Sound Chinook Salmon	X	
Hood Canal Summer-run Chum Salmon	X	
Puget Sound Steelhead	X	

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

ESU/DPS Name	YES	NO
Puget Sound Chinook Salmon	X	
Hood Canal Summer-run Chum Salmon	X	
Puget Sound Steelhead	X	

Was the ESU/DPS listed prior to 1996?

ESU/DPS Name	YES	NO	Date Listed if Prior to 1996
Puget Sound Chinook Salmon		X	N/A
Hood Canal Summer-run Chum Salmon		X	N/A
Puget Sound Steelhead		X	N/A

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

In 1991, NMFS issued a policy on how the agency would delineate DPSs of Pacific salmon for listing consideration under the 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 Puget Sound steelhead DPS under the DPS policy in 2007, 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 Puget Sound ESUs/DPS

ESU/DPS Boundaries

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 boundaries of the PS Chinook salmon ESU, HCS chum salmon ESU, or the PS steelhead DPS (NWFSC 2015).

Membership of Hatchery Programs

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

For the ESUs and DPS in the Puget Sound Recovery Domain, the following programs are being recommended for addition to, or removal from the respective ESUs/DPS:

PS Chinook Salmon ESU

The PS Chinook salmon ESU includes all naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, Chinook salmon from 26 artificial propagation programs: the Kendall Creek Hatchery Program; Marblemount Hatchery Program (spring subyearlings and summer-run); Harvey Creek Hatchery Program (summer-run and fall-run); Whitehorse Springs Pond Program; Wallace River Hatchery Program (yearlings and subyearlings); Tulalip Bay Program; Issaquah Hatchery Program; Soos Creek Hatchery Program; Icy Creek Hatchery Program; Keta Creek Hatchery Program; White River Hatchery Program; White Acclimation Pond Program; Hupp Springs Hatchery Program; Voights Creek Hatchery Program; Diru Creek Program; Clear Creek Program; Kalama Creek Program; George Adams Hatchery Program; Rick’s Pond Hatchery Program; Hamma Hamma Hatchery Program; Dungeness/Hurd Creek Hatchery Program; Elwha Channel Hatchery Program; and the Skookum Creek Hatchery Spring-run Program (79 FR 20802).

Two hatchery programs have been recommended to be added to the ESU. The North Fork Skokomish River (spring-run) hatchery program is a conservation-directed Chinook salmon program. The Bernie Kai-Kai Gobin (Tulalip) Hatchery (spring-run) hatchery program is a harvest augmentation program (Jones 2015).

Two hatchery programs have been recommended to be removed from the ESU. The Rick's Pond Hatchery program in the Skokomish River watershed last released juvenile fish in 2012 and the last year adults will return to this hatchery is 2016. The Icy Creek Hatchery is recommended to be removed from the ESU and included in the Soos Creek hatchery program (Jones 2015).

Jones (2015) did not recommend any further review of the existing programs that are identified as part of the PS Chinook salmon ESU. We are not aware of any hatchery management practices that would result in divergence from the co-occurring, donor natural origin population for these programs.

HCS Chum Salmon ESU

The HCS chum salmon ESU includes all naturally spawned summer-run chum salmon originating from Hood Canal and its tributaries as well as from Olympic Peninsula rivers between Hood Canal and Dungeness Bay (inclusive). Also, summer-run chum salmon from four artificial propagation programs: the Hamma Hamma Fish Hatchery Program; Lilliwaup Creek Fish Hatchery Program; Tahuya River Program; and the Jimmycomelately Creek Fish Hatchery Program (79 FR 20802).

Two hatchery programs have been recommended to be removed from the ESU. The Hamma Hamma Fish Hatchery program has been terminated with the last adult fish produced returning in 2013. The Jimmycomelately Creek Fish Hatchery program has been terminated with the last adult fish produced returning in 2015 (Jones 2015).

Jones (2015) did not recommend any further review of the remaining existing programs that are identified as part of the HCS chum salmon ESU. We are not aware of any hatchery management practices that would result in divergence from the co-occurring, donor natural origin population for these programs.

PS Steelhead DPS

The PS steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, steelhead from six artificial propagation programs: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program (79 FR 20802).

Three hatchery programs that are currently part of the DPS (Hood Canal Supplementation-Dewatto River, Hood Canal Supplementation-Skokomish River, and Hood Canal Supplementation-Duckabush River) have been terminated with the last adult fish produced returning in 2019. Four other hatchery programs that are not considered part of the DPS were terminated with the last year's adult steelhead returning, or will return, in 2009 (Barnaby

Slough), 2012 (Whatcom Creek Hatchery), 2014 (Lower Elwha Tribe Hatchery), and 2016 (Marblemount Hatchery) (Jones 2015). For five other programs producing winter-run steelhead not considered part of the DPS (Kendall Creek Hatchery, Whitehorse Pond, Tokul Creek Hatchery, Reiter Ponds Hatchery, and Dungeness River Hatchery), smolt releases are on hiatus pending NMFS determinations regarding program effects on ESA-listed fish.

One new steelhead program has been proposed for the DPS. The Fish Restoration Facility winter-run steelhead program propagates winter-run steelhead native to the Green River to mitigate for lost natural-origin steelhead abundance and harvest levels associated with the placement and operation of Howard Hanson Dam (Jones 2015).

Jones (2015) did not recommend any further review of existing programs that are identified as part of the PS steelhead DPS. We are not aware of any hatchery management practices that would result in divergence from the co-occurring, donor natural origin population for these programs.

2.2 Recovery Criteria

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

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

ESU/DPS Name	YES	NO
Puget Sound Chinook Salmon	X	
Hood Canal Summer-run Chum Salmon	X	
Puget Sound 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
Puget Sound Chinook Salmon	X	
Hood Canal Summer-run Chum Salmon	X	
Puget Sound Steelhead	N/A	N/A

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

ESU/DPS Name	YES	NO
Puget Sound Chinook Salmon	X	
Hood Canal Summer-run Chum Salmon	X	
Puget Sound Steelhead	N/A	N/A

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 demographically independent populations (DIPs) 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 the PS Chinook salmon ESU, the Puget Sound Technical Recovery Team (PSTRT) identified 22 independent populations (Ruckelshaus et al. 2006) and separated these populations into five genetically similar major population groups (MPGs) populations (PSTRT 2002; Good et al. 2005). The Shared Strategy for Puget Sound submitted a recovery plan to NMFS in 2005, and NMFS prepared a final supplement for this recovery plan in 2006 (NMFS 2006). In 2007, NMFS adopted the Puget Sound recovery plan which consists of two documents: the Puget Sound Salmon Recovery Plan prepared by the Shared Strategy for Puget Sound (the Shared Strategy Plan; SSPS 2007), and NMFS' Final Supplement to the Shared Strategy Plan (Supplement; NMFS 2006) (72 FR 2493).

For HCS chum salmon ESU, the PSTRT identified two independent populations (Sands et al. 2009). The Hood Canal Coordinating Council (HCCC) submitted a recovery plan to NMFS in 2005, and NMFS prepared a final supplement for this recovery plan in 2007 (NMFS 2007). The Recovery Plan consists of two documents: the Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan prepared by the Hood Canal Coordinating Council (HCCC Plan; HCCC 2005), and a NMFS Final Supplement to the HCCC Plan (Supplement) (72 FR 29121).

For the PS steelhead DPS, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) has identified populations, MPGs, and their viability criteria (Hard et al. 2015; Myers et al. 2015). In 2013, NMFS developed a federal recovery outline (NMFS 2013) to guide and document the recovery planning process currently underway for the PS steelhead DPS.

PS Chinook Salmon ESU

The PS Chinook salmon ESU includes all naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in

Hood Canal, South Sound, North Sound and the Strait of Georgia. This ESU also includes Chinook salmon from 26 artificial propagation programs: the Kendall Creek Hatchery Program; Marblemount Hatchery Program (spring subyearlings and summer-run); Harvey Creek Hatchery Program (summer-run and fall-run); Whitehorse Springs Pond Program; Wallace River Hatchery Program (yearlings and subyearlings); Tulalip Bay Program; Issaquah Hatchery Program; Soos Creek Hatchery Program; Icy Creek Hatchery Program; Keta Creek Hatchery Program; White River Hatchery Program; White Acclimation Pond Program; Hupp Springs Hatchery Program; Voights Creek Hatchery Program; Diru Creek Program; Clear Creek Program; Kalama Creek Program; George Adams Hatchery Program; Rick's Pond Hatchery Program; Hamma Hamma Hatchery Program; Dungeness/Hurd Creek Hatchery Program; Elwha Channel Hatchery Program; and the Skookum Creek Hatchery Spring-run Program (79 FR 20802; Figure 1). The PS Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are extant (Ruckelshaus et al. 2006). The populations are distributed in five geographic regions, or MPGs, identified by the PSTRT (PSTRT 2002) based on similarities in hydrographic, biogeographic, and geologic characteristics of the Puget Sound basin (NWFSC 2015).

To lower the extinction risk of the PS Chinook salmon ESU, all existing independent populations of Chinook salmon will need to improve from their current condition, and some will need to attain a low risk status. The PSTRT recommended that viable populations of Chinook salmon be spread throughout the region to minimize the risk of a catastrophic loss. The PSTRT also recommended that at least two to four populations in each of the five biogeographical regions of Puget Sound attain a low risk status. To minimize further loss of genetic diversity and life history characteristics of PS Chinook salmon, the PSTRT recommended at least one population from each major genetic and life history group in each of the five regions be viable, based on the historical patterns present within that region.

HCS Chum Salmon ESU

The HCS chum salmon ESU includes all naturally spawned summer-run chum salmon originating from Hood Canal and its tributaries as well as from Olympic Peninsula rivers between Hood Canal and Dungeness Bay (inclusive). This ESU also includes summer-run chum salmon from four artificial propagation programs: the Hamma Hamma Fish Hatchery Program; Lilliwaup Creek Fish Hatchery Program; Tahuya River Program; and the Jimmycomelately Creek Fish Hatchery Program (79 FR 20802; Figure 2). The PSTRT identified two independent populations draining into the Strait of Juan de Fuca, and one which includes spawning aggregations within Hood Canal proper (Sands et al. 2009).

The PSTRT concluded that both historical populations of summer-run chum salmon (Hood Canal and Strait of Juan de Fuca) (Figure 2) need to achieve a low risk (i.e., viable) status in order for the ESU to have a negligible risk of extinction. The PSTRT provided viability criteria for the two summer-run chum salmon populations (Sands et al. 2009); the criteria describe characteristics predicted to result in a negligible risk of extinction in the long term (100 years). Also, state and tribal co-managers implementing the recovery plan adopted interim recovery goals for each of the eight stocks that together comprise the two listed HCS chum salmon

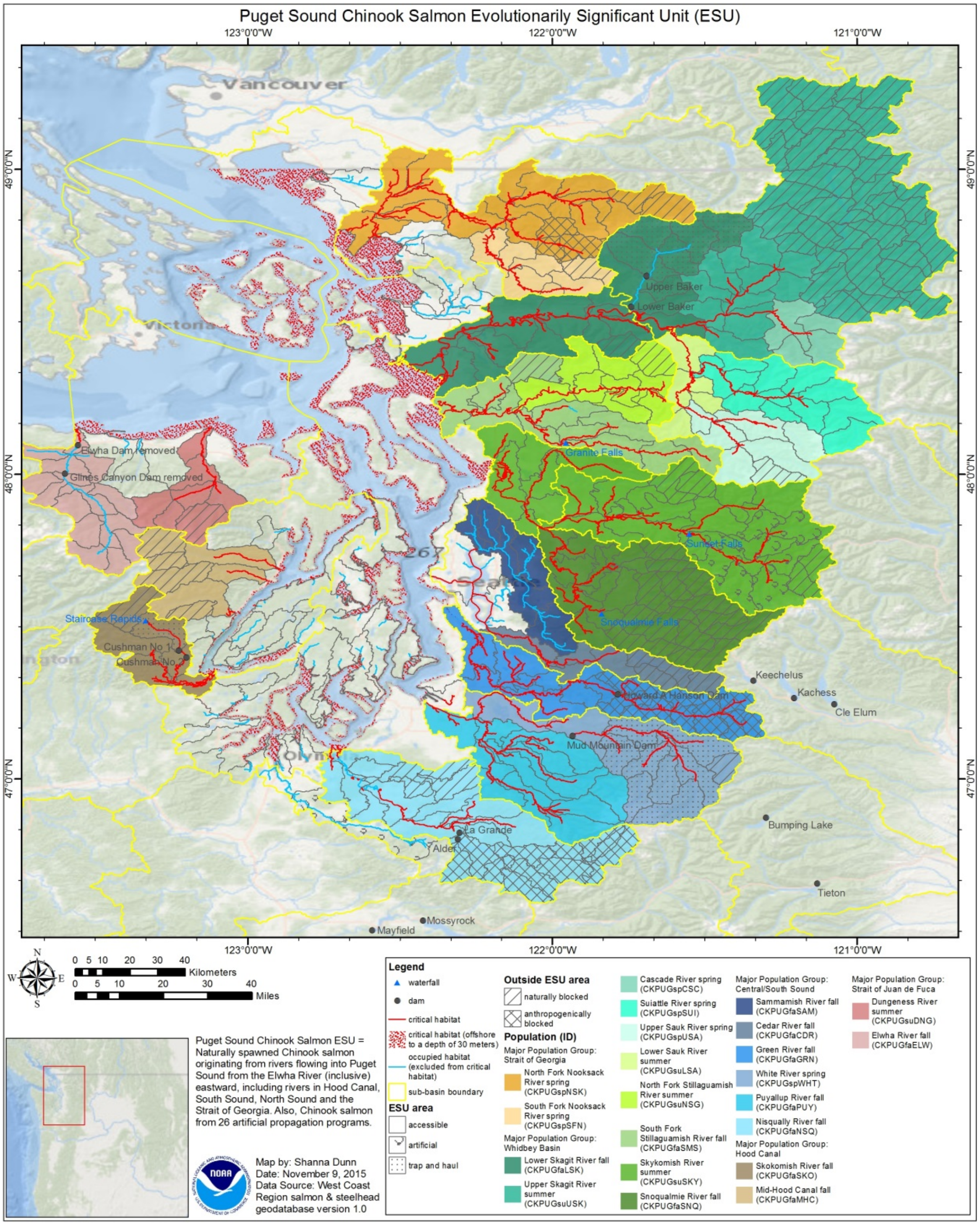

Figure 1. Puget Sound Chinook Salmon ESU population structure[1]

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

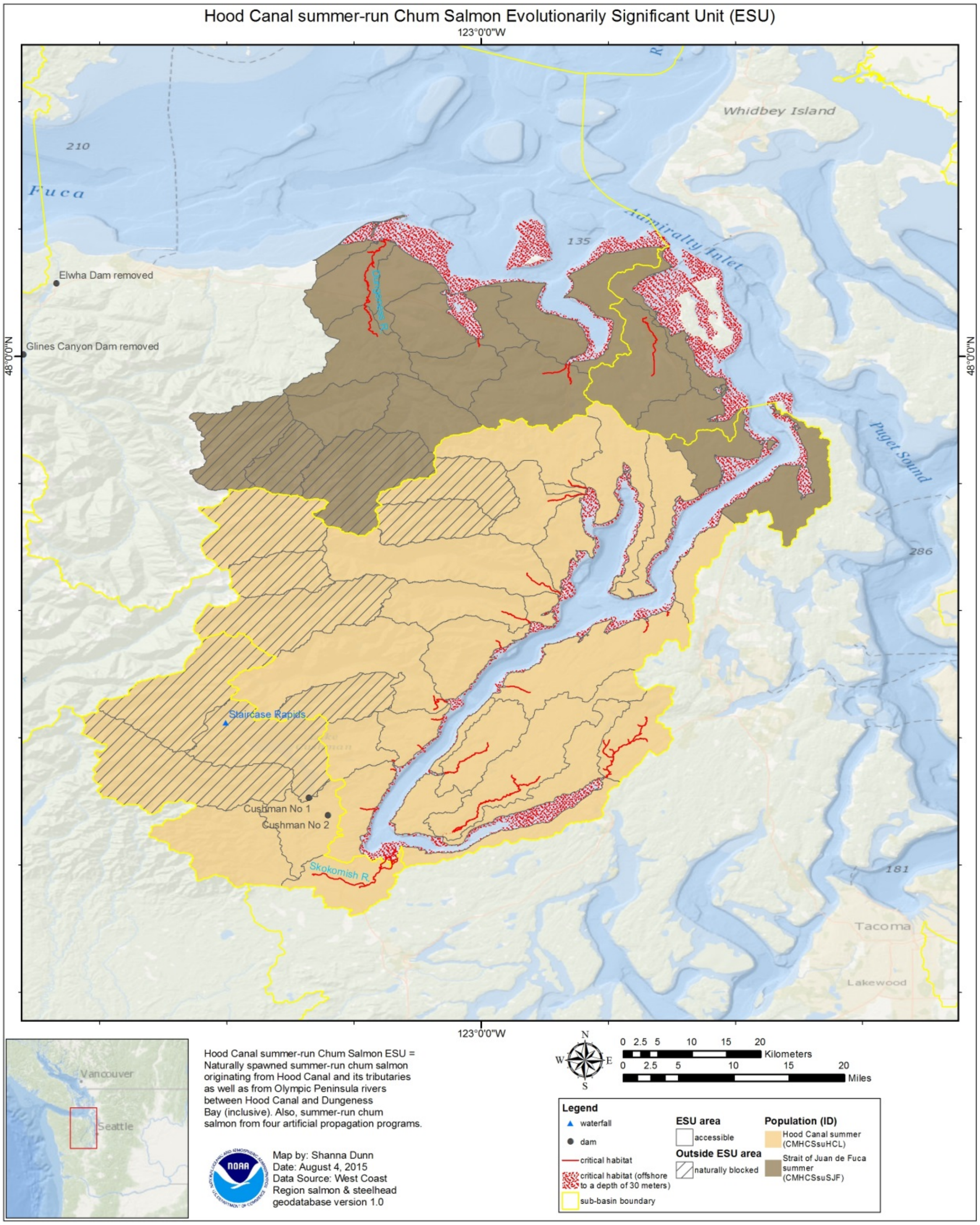

Figure 2. Hood Canal Summer-run Chum Salmon ESU population structure[2]

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[2] The map above generally shows the accessible and historically accessible areas for the Hood Canal summer-run chum salmon ESU. The area displayed is consistent with the regulatory description of the boundaries of this ESU 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.

populations. The PSTRT considered the co-managers' interim stock recovery goals to be compatible with an intermediate step toward the PSTRT's long-term viability criteria.

PS Steelhead DPS

The PS steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward (Figure 3), including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. This DPS also includes steelhead from six artificial propagation programs: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program (79 FR 20802; Figure 3). Myers et al. (2015) identified three MPGs in the PS steelhead DPS: Northern Cascades, Central and South Puget Sound, and Hood Canal and Strait of Juan de Fuca. The Northern Cascades MPG historically contained 16 DIPs (eight winter-run, three summer/winter-run, and five summer-run); the Central and South Puget Sound MPG historically contained eight winter-run DIPs; and, the Hood Canal and Strait of Juan de Fuca MPG historically contained eight DIPs (one summer/winter-run and seven winter-run, with two of these winter-runs possibly historically including summer-run components).

The PSSTRT (Hard et al. 2015) developed biological viability criteria for the PS steelhead DPS, defining a viable DPS as one that is unlikely (with less than an estimated five percent probability) to be at risk of extinction in the foreseeable future and adopting the VSP criterion of a 100-year timeline (McElhany et al. 2000) to evaluate risk of extinction.

For PS steelhead DPS viability (i.e., have a negligible risk of extinction), Hard et al. (2015) recommended that the three component MPGs achieve a low risk (i.e., viable) status. For an MPG to be considered viable, at least 40 percent (rounded up) of its component independent populations must be considered viable. Independent populations exhibiting major life history strategies (e.g., summer-run vs. winter-run) are considered separate components within an MPG. Therefore, 40 percent of summer-run populations and 40 percent of winter-run populations within an MPG that contains both life history types must be viable. Independent populations containing winter-run and summer-run subpopulations predominantly exhibit the winter-run life history strategy in Puget Sound are considered winter-run for the purposes of the above estimation. For an independent population to be considered viable, its probability of viability must be at least 85 percent over 100 years (Hard et al. 2015).

In order for the three MPGs of the PS Steelhead DPS to be viable and the DPS to have a negligible risk of extinction, Hard et al. (2015) recommended:

- Both the Central and South Puget Sound MPG, and the Hood Canal and Strait of Juan de Fuca MPG, with their eight independent populations each, must have at least four viable independent populations with no more than one non-viable independent population.

Figure 3. Puget Sound Steelhead DPS population structure[3]

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[3] The map above generally shows the accessible and historically accessible areas for the PS steelhead DPS. The area displayed is consistent with the regulatory description of the boundaries of the PS 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.

- The Northern Cascades MPG with 11 winter-run and five summer-run independent populations must have at least five viable winter-run and two viable summer-run independent populations and no more than one independent population of each life history type that is considered not viable.

2.3 Updated Information and Current Species' Status

In addition to recommending recovery criteria, the PSTRT also assessed the current status of each population of the listed salmonid ESUs and DPS within the Puget Sound region. Each population was rated against the biological criteria recommended by the PSTRT identified in the recovery plans and assigned a current viability rating. Our assessment of PS steelhead is based on the existing information developed during recovery planning.

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.

PS Chinook Salmon ESU

Updated Biological Risk Summary

All PS Chinook salmon populations are still well below the PSTRT planning ranges for recovery escapement levels. Most populations are also consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery. Across the ESU, most populations have declined in abundance since the last status review in 2011, and indeed, this decline has been persistent over the past 7 to 10 years. Productivity remains low in most populations. Hatchery-origin spawners are present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat monitoring and adaptive management planning efforts to develop monitoring plans was undertaken in all individual watersheds of Puget Sound in 2014. Watershed documents can be found on the Puget Sound Partnership website.[4] These reports and prior annual three-year workplans document the many habitat actions that were initially identified in the Puget Sound Chinook salmon recovery plan. The expected benefits will take years or decades to produce significant improvement in natural population viability parameters. Development of a monitoring and adaptive management program was required by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan, but this program is, as yet, not fully functional for providing assessment of watershed habitat restoration/recovery programs, nor of properly integrating the essentially discrete habitat, harvest and hatchery programs. Overall, new information on abundance, productivity, spatial structure and diversity since the 2010 review does not indicate a change in the biological risk category since the time of the last BRT status review (NWFSC 2015).

[4] http://www.psp.wa.gov/SR_threeyearworkplan.php

HCS Chum Salmon ESU

Updated Biological Risk Summary

Natural-origin spawner abundance has increased since ESA-listing and spawning abundance targets in both populations have been met in some years. Productivity was quite low at the time of the last review (Ford et al. 2011), though rates have increased in the last five years, and have been greater than replacement rates in the past two years for both populations. However, productivity of individual spawning aggregates shows only two of eight aggregates have viable performance. Spatial structure and diversity viability parameters for each population have increased and nearly meet the viability criteria. Despite substantive gains towards meeting viability criteria in the Hood Canal and Strait of Juan de Fuca summer-run chum salmon populations, the ESU still does not meet all of the recovery criteria for population viability at this time (NWFSC 2015).

PS Steelhead DPS

Updated Biological Risk Summary

Consideration of the above analyses indicates that the biological risks faced by the PS steelhead DPS have not substantively changed since the listing in 2007, or since the 2011 status review. Furthermore, the PS steelhead Technical Recovery Team (TRT) recently concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Although the most recent data available indicate some minor increases in spawner abundance or improving productivity over the last 2-3 years, most of these improvements are small and abundance and productivity throughout the DPS remain at levels of concern for demographic risk. Recent increases in abundance that have been observed in a few populations have been within the range of variability observed in the past several years. Trends in abundance of natural spawners remain predominantly negative. Particular aspects of diversity and spatial structure, including natural spawning by hatchery fish and limited use of suitable habitat, are still likely to be limiting viability of most PS steelhead populations.

In the near term, the outlook for conditions affecting PS steelhead is not optimistic. While harvest and hatchery production of steelhead in Puget Sound are currently at low levels and are not likely to increase substantially in the foreseeable future, some recent environmental trends not favorable to PS steelhead survival and production are expected to continue. The exceptionally warm marine waters in 2014 and 2015 and warm stream temperatures observed during 2015 were unfavorable for high marine or freshwater survival. The overall effects of these environmental conditions will not be known until adults return beginning this fall and continuing for the next few years. Nevertheless, a positive pattern in the Pacific Decadal Oscillation, which has been in place since January 2014, is expected to continue, and current El Niño conditions will probably persist through at least the end of 2015. These and other environmental indicators point to continued conditions of warming ocean temperatures, fragmented or degraded freshwater spawning and rearing habitat, reduced snowpack, altered hydrographs producing reduced summer river flows and warmer water, and low marine survival for salmonids in the Salish Sea. These conditions are almost certain to constrain any rebound in VSP parameters for PS steelhead in the near term (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 with the aid of new reporting techniques. Generally, it takes one to five decades to demonstrate such increases in viability.

Current Status and Trends in Habitat

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

PS Chinook Salmon ESU

1) Key Emergent or Ongoing Habitat Concerns

The Puget Sound region is a fast growing area, both within and outside of urban centers. By 2026, the forecasted population for Puget Sound will increase by over 750,000 people. Further, impervious surfaces are projected to increase to greater than 1,574 square miles or approximately 12% of the Puget Sound watershed (NWIFC 2016). The 2016 State of Our Watersheds report, produced by the Northwest Indian Fisheries Commission Member Treaty Tribes, reflects continuing and increasing concerns as habitat loss outpaces habitat restoration throughout the region, though they note that rate of habitat degradation has slowed over recent years. They sum their report in the following statement: “At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Puget Sound basin shows improvements for water quality and removal of forest road barriers but degradation in water quantity, marine shoreline habitat conditions and impervious surface areas” (NWIFC 2016). However, impaired water quality in both fresh and marine waters; continued lack of access to functional floodplains and marine shorelines; and impaired passage continue to dominate habitat concerns for the 22 independent populations in the PS Chinook salmon ESU.

- Water Quality: Water quality impairment is widespread in estuarine and freshwater environments. Stormwater reaching streams and rivers includes metals, polycyclic aromatic hydrocarbons (PAHs) and 25 other organic contaminants, including personal care products, pharmaceuticals, and industrial compounds. The 2014 State of Salmon in Watersheds Report provides water quality index scores over 19 years from 25 monitoring stations. Data from the Governor’s Salmon Recovery Office (GSRO) show a general stasis in poor water quality conditions, with only four rivers (Cedar, Skykomish, Snoqualmie, and Snohomish) consistently showing that they meet water quality standards for conventional pollutants (GSRO 2014). Contaminants in estuaries and the shallow marine waters near urban areas, such as the Puyallup River estuary and Sinclair Inlet, also include many pharmaceutical and personal care product compounds that appear in analyzed Chinook salmon tissue at concentrations which may cause adverse to fish (Meador 2014; Meador et al. 2016).

- Nearshore Habitat: Nearshore habitat loss from shoreline armoring (the practice of constructing bulkheads, seawalls and rock revetments) disrupts the natural process of erosion and longshore transport that supplies much of the sand and gravel that forms and maintains Puget Sound beaches. The Puget Sound Partnership, the state agency charged with recovering the Puget Sound Ecosystem by 2020, reports that more than 25% of Puget Sound shoreline is armored to protect public and private property, ports and marinas, roads and railways, and other uses.[5] Removal of shoreline armoring has increased since Washington Department of Fish and Wildlife (WDFW) started tracking it in 2005, but until 2014, the amount new armoring was greater than that being removed (NWIFC 2016; Carman et al. 2015). The U.S. Army Corps of Engineers (Corps) Seattle District uses the Mean Higher High Water (MHHW) mark rather than the Highest Astronomical

[5] http://www.psp.wa.gov/vitalsigns/shoreline_armoring.php

Tide line (HAT) as the jurisdictional boundary for Corps regulatory purposes. The MHHW mark is substantially waterward of HAT, leaving shoreline area that is important to salmonids and designated as Critical Habitat, outside of Corps jurisdiction. Accordingly, the Corps does not request NMFS' ESA review on projects that are installed above the MHHW mark. The net result of lack of alignment of jurisdictional boundaries is that many marine bulkheads are placed within designated critical habitat for PS Chinook salmon without the benefit of ESA consultation

- Instream Habitat: Bank armoring, insufficient instream flows, and the increasing amount of impervious surfaces throughout Puget Sound watersheds contribute to impairment and reduction of functional instream habitat for Puget Sound Chinook salmon. Habitat complexity is reduced by bank armoring: "Since the 2012 State of Our Watersheds Report, there has been an increase in freshwater shoreline modifications." (NWIFC 2016). Similarly, insufficient instream flows impair migration, spawning, and rearing in several river basins affected by water withdrawals for municipal supplies and agriculture (Dungeness, Nooksack, Puyallup-White, Snow and Snohomish).[6] Additional factors impairing instream flows include the increasing amount of impervious surface throughout Puget Sound watersheds, which reduce water percolation through the soil to replenish base flows and which contribute to "flashy" hydrograph by adding volume and velocity to stream flows during storm events.

- Floodplain Habitat: Impaired floodplain connectivity and function, resulting from roads, levees, dikes, bank armoring, and bridges remains a threat in all of the 15 rivers that drain into Puget Sound and that harbor independent populations of PS Chinook salmon (Beechie et al. 2015). Other factors of floodplain function that impair fish habitat values via reduced connectivity, and conversion floodplain land from open/natural space, silviculture, and agricultural uses to residential and commercial development is the altered pattern of soil saturation and hyporheic recharge that is necessary to maintain stream recharge with cool clean base flows (NMFS 2008).

- Fish Passage: Fish passage to upstream habitats remains an issue at a multitude of small manmade barriers and at dams such as the Middle Fork Nooksack Diversion Dam, at the Howard Hanson Dam[7] on the Green River, and the Buckley Diversion Dam[8] on the White River.

2) Specific Geographic Areas of Concern

Puget Sound is home to two-thirds of the state's population, with a projected population increase to six million by 2026 (WOFM 2014; NWIFC 2016). While development pressures on habitat values are present throughout the Puget Sound region, some geographies have more pressing concerns than others.

- Water Quality: In 2011, every urban stream watershed identified in the Snohomish River Salmon Conservation plan was degraded based on impervious surface levels greater than 12%. When the level of impervious surface in a watershed exceeds 10%, then systemic changes in hydrology and

[6] http://www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html
[7] http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/HowardHansonDam.aspx
[8] http://www.nws.usace.army.mil/Missions/CivilWorks/ProgramsandProjects/Projects/MudMountainDamFishPassage.aspx

water quality result. The overall trend for estuaries is the continued loss of functional habitat due to the increase in residential and commercial development in the lower watersheds, and the lack of completion of restoration projects (NWIFC 2016). For example, while projects were "underway" to restore Puget Sound river deltas in 2013 and 2014, none were officially completed.[9]

- Nearshore Habitat: Many small, coastal embayments have been eliminated throughout Puget Sound. The length of embayment shoreforms in Puget Sound declined nearly 46% from historical levels, with the greatest decline in length of embayment shoreforms occurring in North Central Puget Sound (62%) (Fresh et al. 2011). Data from WDFW indicate that the 68% of new marine armoring is for single family residences with 73% of new armoring occurring in Mason, Island, Kitsap, Skagit, and Pierce counties.[10] Armoring disconnects the critical supply of gravel and sand which replenish beaches and provide spawning habitat for sand lance and surf smelt. An example of the habitat implication of shoreline armoring can be found in Whatcom County – more than 99% of documented forage fish spawning in Whatcom County occurs on erosional drift cells, and 72% (121 of 169 miles) of the erosional drift cell shoreline is already armored or otherwise modified. Since 2011, 350 feet of new marine shoreline armoring has been built in Whatcom County. The likely trend for marine nearshore habitat is to continue toward degradation, with limited progress in meeting the restoration goals of the watershed-based salmon recovery plans that comprise the 2007 Puget Sound recovery plan (NWIFC 2016).

- Instream Habitat: The Upper Skagit Tribe recently completed its survey of hydro-modifications along streambanks within floodplains of the Skagit River watershed. With a focus on Chinook salmon rearing habitat, they surveyed 220 miles of stream and found 32.1 miles of hydro-modified bank. There is no clear evidence of riprap being removed from the middle Skagit River since 2005 (NWIFC 2016). Adequate instream flows also remain an issue of concern in the Dungeness, Nooksack, Puyallup-White, Snow, Snohomish, and Stillaguamish rivers and some of their tributaries.[11] Safe up- and downstream passage is notably absent at dams such as the Middle Fork Nooksack Diversion Dam and the Howard Hanson Dam on the Green River.

- Floodplain Habitat: Nearly 290,380 acres are currently estimated to be degraded. This represents 62 percent of the total 467,280 acres of Puget Sound floodplains.[12] As of 2013, the 10-year floodplain restoration targets for the Stillaguamish Salmon Recovery Plan were not met. Only 22.3 acres of a targeted 30 acres of floodplain area had been restored. Only 0.24 miles of a targeted 4.1 miles of bank armoring had been removed, while 0.43 miles of bank armoring had been added since 2005. Riparian forest cover in the Stillaguamish River floodplain remained at 23%, unchanged since 2006. This is less than a third of the 80% riparian forest cover that is considered a long-term Properly Functioning Condition in the Salmon Recovery Plan (NWIFC 2016). Spring-run Chinook salmon, in particular, have long freshwater residency and are documented to have increased growth and survival rates when they can access functional

[9] https://pspwa.app.box.com/s/dalllwj86ajpe4s8rx16fso55hmsjsv5
[10] http://www.psp.wa.gov/vitalsigns/shoreline_armoring_indicator1.php
[11] http://www.ecy.wa.gov/programs/wr/instream-flows/wacq.html
[12] http://www.psp.wa.gov/vitalsigns/flood_plains_indicator1.php

floodplain habitat during their rearing period (Jeffres 2008). Few populations of spring-run Chinook salmon remain in the Puget Sound region with essential populations occurring in the Nooksack (Whatcom County), Skagit, Dungeness, Elwha, and White rivers (Pierce County).

- Fish Passage: Concerns are high about continued obstruction at the Middle Fork Nooksack Diversion Dam, the Howard Hanson Dam[13] on the Green River, and the Buckley Diversion Dam on the White River (USACE 2015).

3) Key Protective Measures and Major Restoration Actions

Since adoption of the Puget Sound Recovery Plan in 2007, a variety of recovery measures have been undertaken among the collaborative regional partners. For actions taken in Hood Canal, please refer to the HCS chum salmon section.

- Water Quality: Untreated stormwater continues to be addressed by projects and programs at the local and regional levels, using a variety of newly tested methods. Since 2011, the Washington State Department of Transportation (WSDOT) has annually prepared Stormwater Reports to evaluate stormwater management practices and permit compliance. Highway projects in the Puget Sound Basin have more stringent retrofit requirements than the remainder of the state (WSDOT 2016). This requirement has resulted in roughly 43.85 acres of impervious surface in the Puget Sound Region being retrofitted for stormwater treatment or infiltration in 2015 (WSDOT 2016). The completion in 2012 of Seattle's third municipal waste treatment facility signals a new standard of treatment. Using membrane reactor biofilters, the facility treats and discharges into Puget Sound 36 million gallons each day, and, combined with source-control of many toxics, has substantially reduced the potential load of many chemicals of concern into Puget Sound.[14] In near marine and estuarine areas, the Ports of Tacoma and Seattle are seeing water quality conditions gradually improve at mouths of natal rivers where they continue to carefully remove contaminated sediments.[15] Additional projects include:
    - Budd Inlet (Thurston County) (2013) – 394 creosote pilings and 0.17 acres of overwater structure were removed along 1.2 mi of shoreline to restore 5.66 acres of nearshore habitat.[16]
    - San Juan Islands (San Juan County) (2012-2016) – Removal of 90 creosote pilings and 175 tons of beached creosote materials.[17]
- Estuarine Habitat: Multiple projects were conducted to improve estuarine habitat, including:
    - Ala Spit/Cornet Bay (Whidbey Island, Island County) (2009-2016) – Removed 0.16 mi of shoreline armoring and 0.21 mi of bulkhead, placed Large Woody Debris (LWD),

[13] http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/HowardHansonDam.aspx
[14] http://www.kingcounty.gov/environment/wtd/Construction/Completed/Brightwater.aspx
[15] http://www.ecy.wa.gov/programs/tcp/regs/SMS/2013/SMS-FAQ-Final.html
[16] http://www.theolympian.com/news/local/article25315990.html; http://waconnect.paladinpanoramic.com/project/150/18903
[17] http://waconnect.paladinpanoramic.com/project/190/14502

restored 3.8 acres of estuary (armor modification, regrading, nourishment), and replanted riparian vegetation.[18]

- Allison Springs estuary (Thurston County) (2009-2012) – Removed 0.1 mi of shoreline armoring and four tidegates, replanted five acres of estuarine habitat, and restored access to 0.1 mi of upstream habitat.[19]
- Clear Creek (Dyes Inlet, Kitsap County) (2011-2016) – Two 72 inch culverts were replaced with a 240 foot bridge to improve estuary function.[20]
- Fir Island (Skagit River delta, Skagit County) (2009-current) – When completed, 1.1 mi of dikes will be setback which will 131 acres of tidal marsh and channels.[21]
- Livingston Bay (Camano Island, Island County) (2010-2013) – One hundred feet of dike was removed and a tidal channel was excavated to reconnect a 10 acre pocket estuary to Puget Sound.[22]
- Milltown Island (SF Skagit River, Skagit County) (2005-2012) – 0.36 mi of dike was removed creating 0.93 mi of tidal channel and opening 212 acres to tidal processes.[23]
- Nisqually River delta (Nisqually River, Pierce/Thurston counties) (2003-2011) – The Billy Frank Jr. Nisqually National Wildlife Refuge removed 4.5 miles of dike to allow for natural regeneration of 21 miles of historic tidal channels and 762 acres of intertidal and riverine wetland.[24] The Nisqually tribe setback 1.14 mi of dike to restore 110 acres of estuary from diked pastureland.[25]
- Powel Shoreline (Port Madison, Bainbridge Island, Kitsap County) (2012-2015) – Removed 0.58 mi of shoreline armoring and plant 0.7 acres of riparian habitat.[26]
- Port Susan Bay (Stillaguamish River, Snohomish County) (2011-2012) – 1.3 mi of dike was removed to restore 150 acres of estuary at the mouth of the Stillaguamish River.[27]
- Qwuloolt Estuary (Snohomish River, Snohomish County) (2010-2015) – 0.3 mi of levee was lowered and 200 feet of levee was breached to reestablish 354 acres of intertidal marsh in the Snohomish River estuary.[28]

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[18] http://waconnect.paladinpanoramic.com/Project/200/2209; http://waconnect.paladinpanoramic.com/project/200/2218; http://waconnect.paladinpanoramic.com/project/200/19296
[19] http://waconnect.paladinpanoramic.com/project/150/12655
[20] http://waconnect.paladinpanoramic.com/project/210/18272
[21] http://wdfw.wa.gov/lands/wildlife_areas/skagit/fir_island_estuary_restoration.php
[22] http://waconnect.paladinpanoramic.com/project/200/16310
[23] http://waconnect.paladinpanoramic.com/project/280/1605
[24] http://waconnect.paladinpanoramic.com/project/220/5289
[25] http://waconnect.paladinpanoramic.com/project/220/80885
[26] http://waconnect.paladinpanoramic.com/project/210/17131
[27] http://waconnect.paladinpanoramic.com/project/270/12473
[28] http://waconnect.paladinpanoramic.com/project/260/12223; http://www.qwuloolt.org/

- Seahurst Park (Burien, King County) (2008-2014) – Removed 0.34 miles of shoreline armoring, added 25,000 tons of sand and gravel, planted 17,000 plants, and installed a fish ladder.[29]
- Turner's Bay (Fidalgo Island, Skagit County) (2007-2012) – A road and a tidegate were removed to reestablish 7.2 acres of salt marsh habitat to tidal inundation.[30]

- Instream Habitat: Multiple projects were conducted to improve instream habitat, including:
  - Canyon Creek (Nooksack River, Whatcom County) (2010-2014) – An existing levee was setback to improve fish passage. Approximately 0.35 mi of levee were setback, 14 engineered log jams were installed, the site was graded, and native vegetation was planted.[31]
  - Cherry Creek (Snoqualmie River, King County) (2008-2013) – Consolidated three floodplain ditches into a single naturalized stream channel for nearly one mile of the creek to improve riparian habitat diversity and complexity.[32]
  - Fobes Creek (NF Nooksack River, Skagit County) (2009-2012) – In 1.7 mi of creek bed, 28 engineered log jams were installed to improve stream habitat diversity.[33]
  - Green River (Riverview Park, City of Kent, King County) (2006-2012) – 0.19 mi of side channel was constructed and 0.38 mi of the riparian zone was planted.[34]
  - Greenwater River (Pierce County) (2008-2014) – Decommissioned a U.S. Forest Service road from the floodplain and installed 12 Engineered Log Jams (ELJs) within the river channel to improve habitat complexity.[35]
  - Lower Ohop Creek (Nisqually River, Pierce County) (2012-current) – Realignment of 2.8 mi of creek bed along with LWD installations and riparian plantings.[36]
  - Lower Skykomish River (Snohomish County) (2010-2015) – Enhance nine acres of river habitat (RM 10.2-13.0) by wood placement along in-channel, off-channel, and bank slope locations.[37]

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29 http://www.burienwa.gov/index.aspx?NID=471
30 http://waconnect.paladinpanoramic.com/project/280/11865
31 http://waconnect.paladinpanoramic.com/project/360/18947
32 http://waconnect.paladinpanoramic.com/project/260/1542
33 http://waconnect.paladinpanoramic.com/project/360/18144
34 http://waconnect.paladinpanoramic.com/project/250/9954
35 http://waconnect.paladinpanoramic.com/project/230/12611; http://waconnect.paladinpanoramic.com/project/230/17785
36 http://waconnect.paladinpanoramic.com/project/220/5294
37 http://waconnect.paladinpanoramic.com/project/260/15569

  - Meeker Creek (Puyallup River, Pierce County) (2012-2016) – A channelized section of the creek (0.19 mi) was restored to a natural, meandering, vegetated stream channel able to support juvenile salmonids.[38]

  - NF Nooksack River (Whatcom County) (2010-current) – From River Mile (RM) 48.2 to RM 54.8, 81 ELJs were placed in the river to restore 2.1 miles and 96.7 acres of channel structure.[39]

  - SF Nooksack River (Skagit County) (2014-2016) – From RM 19.6 to RM 21.2 (Larson's Reach), three miles of channel were reconfigured for connectivity creating 1.42 mile of off-channel habitat (24 acres) with 23 instream pools and 26 in-channel structures.[40]

  - South Prairie Creek (Pierce County) (2008-2013) – A 12.85 acre site was restored by removing floodplain fill, riprap, and a concrete weir; constructing a 0.15 mi of stream channel where the fill was removed; revegetating the site; and adding woody debris.[41]

- Floodplain Habitat: Multiple projects were conducted to improve floodplain habitat, including:

  - Bear Creek (King County) (2015) – Eighty-three acres of floodplain secured by the city of Redmond for a wetland mitigation bank.[42]

  - Cedar River (King County) (2005-current) – At Rainbow Bend, acquired and restored 38 acres of floodplain while removing 0.23 mi of levee.[43] In the lower Cedar River, 213 acres were treated for invasive plants while 28 acres were planted with native plants.[44] At RM 7.5, 18.6 acres were acquired (former mobile home park) for future restoration.[45]

  - Clear Creek (Kitsap County) (2011-current) – Five hundred feet of streambed were reconfigured to approximate the original streambed along with two culverts upgraded, 30 acres of floodplain restored and revegetated, LWD installed, and 30,000 cubic yards of material removed to restore proper grade.[46]

  - McElhoe Pearson Restoration (Snoqualmie River, King County) (2007-2012) – Five hundred feet of a levee was breached to connect an existing wetland which was connected to another wetland by installing a culvert to increase off-channel salmonid rearing habitat.[47]

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[38] http://waconnect.paladinpanoramic.com/project/230/16847
[39] http://waconnect.paladinpanoramic.com/project/360/17945; http://waconnect.paladinpanoramic.com/project/360/29579; http://waconnect.paladinpanoramic.com/project/360/18150; http://waconnect.paladinpanoramic.com/project/360/18149
[40] http://waconnect.paladinpanoramic.com/project/360/18658
[41] http://waconnect.paladinpanoramic.com/project/230/11093
[42] http://waconnect.paladinpanoramic.com/project/240/4807
[43] http://www.kingcounty.gov/depts/dnrp/wlr/sections-programs/river-floodplain-section/capital-projects/rainbow-bend.aspx
[44] http://waconnect.paladinpanoramic.com/project/240/17755
[45] http://waconnect.paladinpanoramic.com/project/240/4464
[46] http://pugetsoundblogs.com/waterways/2016/09/16/extensive-floodplain-restoration-brings-new-hope-to-clear-creek/
[47] http://www.kingcounty.gov/depts/dnrp/wlr/sections-programs/river-floodplain-section/capital-projects/mcelhoe-pearson.aspx

- Middle Skagit River (Skagit County) (2011-2013) – The floodplain was improved at Howard Miller Steelhead Park by controlling invasive plant species (12 acres), planting native riparian species (7 acres), reconfiguring the stream channel (0.82 mi), and connecting/adding off-channel/floodplain habitat (11.7 acres).[48]
- Puyallup River (2010-2014) – Part of the Calistoga Levee (0.34 mi) was setback to reconnect 53 acres of floodplain. Additionally, several log jams were installed along the river bank and the floodplain was planted with native vegetation.[49]
- SF Puyallup River (Pierce County) (2009-2014) – 0.36 mi of side channel were constructed along with the placement of five ELJs and several LWD clusters to reconnect 45 acres of floodplain to the river.[50]
- SF Stillaguamish River (Snohomish County) (2010-2014) – The Stillaguamish Tribe acquired the Klein Farm, removed 300 feet of bank armoring, added and planted 39.5 acres of floodplain, and reconfigured 0.57 mi of stream channel.[51]
- Snoqualmie River (King County) (2012-2014) – 0.30 mi of levee was removed and replaced with a 0.23 mi revetment to reconnect the river to 50 acres of forest floodplain.[52]

* Fish Passage: Multiple projects were conducted to make available upstream habitat, including:
  - Blackjack Creek (Kitsap County) (2013-2015) – An inadequate bridge was replaced to open up 2.2 mi of upstream habitat.[53]
  - Bridle Creek (Samish River, Whatcom County) (2013-2014) – Replaced one culvert to open up 1.23 mi of upstream habitat.[54]
  - Carpenter Creek (Kitsap County) (2010-2013) – Replaced an undersized culvert with a bridge to open access to 30 acres of estuary/saltwater marsh.[55]
  - Chico Creek (Kitsap County) (2014-2015) – Replaced a culvert with a bridge and opened up 12.4 acres of salmonid habitat.[56] Habitat improvements upstream of culvert replacement include LWD placement, riparian plantings, channel reconfiguration, log weir removal, and streambank stabilization.[57]

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48 http://waconnect.paladinpanoramic.com/project/280/16860
49 http://waconnect.paladinpanoramic.com/project/230/15166
50 http://waconnect.paladinpanoramic.com/project/230/5476
51 http://waconnect.paladinpanoramic.com/project/270/12440
52 http://www.kingcounty.gov/services/environment/animals-and-plants/restoration-projects/upper-carlson-floodplain-restoration.aspx; http://waconnect.paladinpanoramic.com/project/260/18180
53 http://waconnect.paladinpanoramic.com/project/210/29531
54 http://waconnect.paladinpanoramic.com/project/280/18319
55 http://waconnect.paladinpanoramic.com/project/210/2057
56 http://waconnect.paladinpanoramic.com/project/210/19424
57 http://waconnect.paladinpanoramic.com/project/210/60303; http://waconnect.paladinpanoramic.com/project/210/16281

- Clear Creek (Kitsap County) (2011-2013) – Upgraded two culverts and replaced one culvert with a pedestrian bridge to improve access to upstream habitat.[58]
- Davis Slough (Skagit River, Skagit County) (2013-2016) – Replaced an undersized culvert with a 60 foot bridge opening accessibility to 1.7 mi of stream channel and 4.5 acres of high quality salmonid rearing habitat.[59]
- Dickerson Creek (Kitsap County) (2011-current) – Two culverts were replaced with larger fish-passable culverts to provide over a mile of accessible upstream habitat. Additionally, streambank armoring was removed, woody materials were added, and over 9,000 native trees and shrubs were planted. [60]
- Donkey Creek (Kitsap County) (2009-2013) – A 300 foot long culvert was excavated, daylighted, and replaced by a bridge to restore fish passage, the creek, and its estuary.[61]
- EF Walker Creek (Nookachamps Creek, Skagit County) (2014-2016) – An undersized culvert was replaced by a bridge opening up 2.04 mi of stream with an additional 1.5 acres of riparian habitat planted in the restoration effort.[62]
- Enetai Creek (Kitsap County) (2012-2016) – Three culverts were replaced by two bridges and a larger culvert to open up 0.67 mi of stream.[63]
- Gull Harbor (Thurston County) (2010-2013) – A concrete overflow structure and associated culvers were replaced with a bridge to restore 0.1 mi of upstream habitat.[64]
- Issaquah Creek (King County) (2005-2013) – The Issaquah Hatchery Intake Dam was removed and replaced with a series of rock weirs that allowed for upstream passage to 11 miles of high quality salmon habitat.[65]
- Lower Day Creek Slough (Middle Skagit River, Skagit County) (2013-2015) – Three undersized culverts were replaced with a 60 foot long bridge opening up 0.32 mi of salmonid habitat with 17.7 acres of riparian habitat planted.[66]
- Mapes Creek (King County) (2005-2016) – This creek was reconnected to Lake Washington by removing 300 feet of pipe and daylighting the stream.[67]

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[58] http://waconnect.paladinpanoramic.com/project/210/16480; http://waconnect.paladinpanoramic.com/project/210/16471; http://waconnect.paladinpanoramic.com/project/210/16472
[59] http://waconnect.paladinpanoramic.com/project/280/18426
[60] http://kitsap.paladinpanoramic.com/project/2231/44031; http://waconnect.paladinpanoramic.com/project/210/18445
[61] https://static1.squarespace.com/static/54945a33e4b0edcae6dd64f5/t/57a0f873725e259c55e22a9a/1470167160442/Donkey+Creek.pdf
[62] http://waconnect.paladinpanoramic.com/project/280/50274; http://waconnect.paladinpanoramic.com/project/280/39919
[63] http://waconnect.paladinpanoramic.com/project/210/18547
[64] http://waconnect.paladinpanoramic.com/project/150/8467
[65] http://www.govlink.org/watersheds/8/committees/1410/W8-Issaquah-FactSheet.pdf
[66] http://waconnect.paladinpanoramic.com/project/280/18807
[67] http://waconnect.paladinpanoramic.com/project/240/4516

- McCormick Creek (Pierce County) (2010-2012) – A 50 foot long, four foot diameter culvert was daylighted and replaced by a bridge to open up 1.5 mi of habitat.[68]
- Midway Creek (Goldsborough Creek, Mason County) (2010-2013) – Two culverts perched eight feet above the stream confluence were replaced with a single fish passable culvert that opens access to 0.6 mi of upstream habitat.[69]
- Minter Creek (Pierce County) (2002-2012) – Four culverts that impeded fish passage were replaced new culverts opening up 7.3 mi of salmonid habitat.[70]
- Ruby Creek (Kitsap County) (2013-2014) – Two 24-inch culverts were replaced with a single five foot arching, 70 foot long culvert to open up 2.3 miles of stream habitat.[71]
- Silver Creek (Samish River, Skagit County) (2013-2014) – A culvert that was blocking fish passage was replaced with a bridge to open up 2.3 miles of habitat.[72]
- Skrinde Creek (Samish River, Skagit County) (2014) – A three-foot culvert was replaced by a 40 foot bridge to improve access to 1.01 mi of stream habitat.[73]
- Starbird Creek (Skagit River, Skagit County) (2013-2015) – Two undersized culverts were replaced with a 50 foot bridge to open up 14.16 mi of stream habitat for salmonids.[74]
- Wildcat Creek (Kitsap County) (2011-2012) – A 60 inch culvert was replaced with an 85 foot bridge to improve fish passage upstream to Wildcat Lake and its tributaries.[75]

- Nearshore Habitat: Multiple projects were conducted to improve nearshore habitat, including:
    - Barlow Bay (San Juan County) (2008-2014) – Removal of 26 creosote pilings, 26 cubic yards of fill, and 1,200 sq. ft. of overwater structure from a derelict dock.[76]
    - Barnum Point (Camano Island, Island County) (2012-2013) – Acquired 52 acres of nearshore habitat and 0.6 mi of shoreline for conservation.[77]
    - Milwaukee Dock (Bainbridge Island, Kitsap County) (2008-2016) – Restored three acres of eelgrass habitat by filling dredged navigational channels and planting eelgrass.[78]

[68] http://waconnect.paladinpanoramic.com/project/210/14917
[69] http://waconnect.paladinpanoramic.com/project/160/18822
[70] http://waconnect.paladinpanoramic.com/project/210/11138
[71] http://waconnect.paladinpanoramic.com/project/210/29530
[72] http://waconnect.paladinpanoramic.com/project/280/18322
[73] http://waconnect.paladinpanoramic.com/project/280/29766
[74] http://waconnect.paladinpanoramic.com/project/280/40223
[75] http://waconnect.paladinpanoramic.com/project/210/16491
[76] http://waconnect.paladinpanoramic.com/project/190/6794
[77] http://waconnect.paladinpanoramic.com/project/200/15561
[78] http://waconnect.paladinpanoramic.com/project/210/7496

- Penrose Point (Pierce County) (2012-2014) – 0.13 of creosote bulkhead were removed, and the shoreline was restored through revegetation and wood placement.[79]

- South Lake Washington (King County) (2005-2014) – Removed the abandoned Shuffleton Power Plant flume structure (450 feet by 20 feet) and replaced it with a gentle sloping sand/gravel beach with ELJs to restore juvenile salmonid habitat.[80]

- Thatcher Bay (Blakely Island, San Juan County) (2007-2015) – 12,900 cubic yards of wood waste was removed from 1.8 acres of nearshore habitat to restore natural habitat function.[81]

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, land use regulations that affect habitat remain a significant concern, and the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

- Water Quality: Engage the Environmental Protection Agency (EPA) in consultation during its next triennial review of State water quality standards to identify comprehensive and systemic threshold water quality conditions necessary to maintain or reestablish habitat values suitable for listed fish.[82] The last triennial review of Washington State standards occurred in 2010.

- Nearshore Habitat: Identify in concert with the Corps and EPA appropriate jurisdictional boundaries for marine waters to ensure that marine shoreline armoring is regulated and evaluated through the applicable Corps permit and section 7 review processes.[83]

- Estuary Habitat: Continue to improve and restore estuary habitat throughout Puget Sound. Currently proposed projects include:

  - Leque Island (Stillaguamish River, Snohomish County) – A 2.4 mi dike surrounding the island will be removed to reintroduce tidal processes and create 250 acres of tidal channels and salt marsh.[84]

  - Smith Island (Snohomish River, Snohomish County) – Currently, a 1.08 mi setback dike is being constructed to protect adjacent properties including farmland, local businesses,

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[79] http://waconnect.paladinpanoramic.com/project/210/17126
[80] http://www.govlink.org/watersheds/8/committees/15TechFrm/RestorationMonitoring-RTabor-USFWS-2015.pdf; http://file.dnr.wa.gov/publications/em_fs12_005.pdf
[81] http://waconnect.paladinpanoramic.com/project/190/6802
[82] https://pspwa.app.box.com/2015-SOS-community-report; http://www.wsdot.wa.gov/Environment/WaterQuality/Research/
[83] https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=2300
[84] http://waconnect.paladinpanoramic.com/project/270/60326

and Interstate 5. After the completion of the setback dike, 0.85 mi of the older dikes will be breached to restore 315 acres of tidal marsh habitat.[85]

- Zis a ba Estuary (Stillaguamish River, Snohomish County) – By removing 2.62 mi of dike, the Stillaguamish Tribe propose to restore tidal and riverine influence to 88 acres.[86]

- Instream Habitat: Increase research and monitoring of instream flows in the Nooksack, Skagit and Stillaguamish rivers and tributaries by the Washington Department of Ecology (WDOE) for potential regulatory implications, such as insufficient base flows and potential use of regulatory authority to assure sufficient instream habitat values.[87]

- Floodplain Habitat: In general, it appears that floodplain creation or reconnection projects lead to survival rates for Chinook salmon that are equivalent to those found in natural floodplain habitats (Roni et al. 2014). To be consistent with the 2007 Puget Sound Recovery Plan goals and the Puget Sound Partnership target of restoring function to 43,557 acres by 2020 (15 percent of degraded floodplains), NMFS should establish multi-agency efforts (e.g., Federal Emergency Management Agency (FEMA), Corps, EPA, NMFS, and State agency partners) to: (1) better articulate the link between floodplain development impacts and declining habitat values, (2) disseminate this information within communities identifying future growth boundaries, and (3) develop mitigation strategies to achieve no net loss of floodplain habitat function. An additional project includes:

  - Clear Creek (Puyallup River, Pierce County) – Three miles of new levee are proposed to be built along with removing a flood gate at the confluence of the Puyallup River and Clear Creek to reconnect up to 500 acres of floodplain habitat to tidal influence.[88]

- Fish Passage: Improve fish passage at the Ballard Locks,[89] as well as upgrade inadequate fish passage facilities at the Howard Hanson Dam[90] (Green River) and the Buckley Diversion Dam (White River) (USACE 2015) as funds become available.

HCS Chum Salmon ESU

1) Key Emergent or Ongoing Habitat Concerns

Many of the same concerns discussed in the PS Chinook salmon section are concerns for HCS chum salmon. These limiting factors include degraded water quality, estuarine habitat, degraded instream habitat features (such as channel structure and complexity), degraded riparian areas and LWD recruitment, degraded stream substrate and flow, and degraded floodplain connectivity and function (WDFW and PNPTT 2000).

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[85] http://snohomishcountywa.gov/1150/Smith-Island-Restoration-Project
[86] http://waconnect.paladinpanoramic.com/project/270/60336
[87] http://www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html
[88] http://waconnect.paladinpanoramic.com/project/230/40010
[89] http://www.govlink.org/watersheds/8/reports/default.aspx
[90] http://www.nws.usace.army.mil/Missions/CivilWorks/LocksandDams/HowardHansonDam.aspx

- Water Quality: Water quality is important for HCS chum salmon, but contaminants found in urban stormwater do not pose the same degree of freshwater threat as is found among other listed salmonids. Unlike coho salmon spawners, spawning chum salmon adults do not show mortality when exposed to stormwater; however, concerns do remain about potential detrimental stormwater effects among redds and alevin (Scholz et al. 2011). Loss of high quality riparian zones also cause elevated stream temperatures and sometimes reductions in dissolved oxygen, both of which reduce water quality (Lestelle 2015).

- Estuarine Habitat: Estuarine habitats are generally functional; however, a few sites near natal rivers and along the approximately 500 miles of marine nearshore used by the two populations have been impaired by fills from roads, marinas, and shoreline armoring (Lestelle 2015). Problems referred to in WDFW and PNPTT 2000 and HCCC 2005 continue to be significant, including: road crossing of natal rivers (impairs estuaries and lower rivers) and development of tidal areas through diking, roads, homes, and commerce (loss and degradation of rearing habitat).

- Instream Habitat: In the Dungeness, Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish rivers, structural and habitat diversity has been lost compared to their historic condition to varying extents depending on river. This has resulted in changes in channel and substrate stability, loss of pool habitat and other habitat types, and coarsening of channel substrates (or fining of substrates in some cases). In the Skokomish River, a major increase in flood frequency now exists due in part to extreme aggradation (a buildup in the streambed due to sediment deposition). In altered reaches of these rivers, historic pool-riffle morphology has devolved into plane-bed morphology with elongated riffle/glide sections resulting in reduced channel sinuosity and length (with corresponding losses in habitat diversity and quantity). This has resulted in declines in fish population performance at all freshwater life stages and over the entire life cycle (Lestelle 2015).

- Floodplain Habitat: Major parts of the floodplains for the Dungeness, Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish rivers have been disconnected from their active channels within the alluvial valleys due to various channel and flood control measures. To a large extent, these floodplains have been converted to agriculture, rural residential lands, or urbanized areas (as in the lower Dungeness River valley). Loss in floodplain function can significantly degrade in-channel conditions, which in turn, can adversely affect adult migration, spawning, incubation, and juvenile salmonid habitat quality (Lestelle 2015).

- Fish Passage: In all streams and rivers in the region to varying degrees, poorly designed or deteriorating culvert and bridge installations, as well as other barriers to upstream passage, can block or impede passage of juvenile and/or adults. These barriers block or limit access to upstream habitats that were used historically by a species, resulting in reduced population abundance due to loss in available habitat (Lestelle 2015).

- Ocean Conditions: Johnson (2015) identified variable ocean conditions as a key factor influencing HCS chum salmon survival. See Terrestrial and Ocean Conditions and Marine Survival under

Listing Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence in this document for additional information.

2) Specific Geographic Areas of Concern

- Water Quality: Chimacum Creek falls short of state water quality standards for fecal coliform. While some of the coliform is due to livestock, the larger source is from the large number of septic systems that have not been regularly inspected for failure. There are more than 2,300 known septic systems in the Chimacum Creek watershed, the majority constructed before 1995. Monitoring in the 2015-2016 wet season at 31 stations showed that there were 15 failed state standards, seven of these on Chimacum Creek mainstem.[91].

- Estuarine Habitat: Hood Canal is unique in its number of river deltas and associated estuarine wetlands. Once prevalent coastal embayments have been extensively modified. Extensive armoring and nearshore roads, particularly along southern Hood Canal, account for much of the shoreline alteration (Simenstad et al. 2011). Anthropogenic impacts to natural processes in estuarine habitats have limited natural HCS chum salmon production in Big Quilcene River.

- Instream Habitat: Big Beef Creek is degraded. Most of the Tahuya River and the lower portion of Big Beef Creek are downcut (entrenched or incised) or aggraded (Lestelle 2015). Recent instream placements of wood piles at the mouth of the Dosewallips River aimed at rearing habitats for steelhead and Chinook salmon appear to displace spawning habitat for HCS chum salmon.[92] In the Skokomish River, a major increase in flood frequency now exists due in part to extreme aggradation (a buildup in the streambed due to sediment deposition). Aggradation has also been significant in the lower Dungeness and Big Quilcene rivers (Lestelle 2015).

- Floodplain Habitat: Major parts of the floodplains for the Dungeness, Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish rivers have been disconnected from their active channels. All streams smaller than the Hamma Hamma River in the region have been heavily altered and/or disconnected from the active channels by the placement of roads and driveways, land conversion, streambank protection measures, and other land use practices (Lestelle 2015).

- Fish Passage: Notable spawning streams (the Tahuya and Union rivers) lack sufficient instream flows for adult migration to spawning areas and juvenile outmigration.[93] Poorly designed or deteriorating culvert and bridge installations, as well as other barriers to upstream passage, that block or impede passage of juvenile and/or adults are found throughout the region (Lestelle 2015).

3) Key Protective Measures and Major Restoration Actions

The HCCC annually selects projects to protect and restore habitats in specific streams, with specific habitat restoration actions a mix of planned and completed for each stream. While

[91] http://www.ptleader.com/news/bacteria-battled-in-chimacum-creek-septic-systems-a-focus/article_cd70f81c-6f00-11e6-b0c8-a77102661d65.html
[92] http://www.hws.ekosystem.us/
[93] http://www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html

restoration projects completed over the past two decades continue to recover and improve habitat for HCS chum salmon, only projects active over the past five years will be discussed further.

- Water Quality: The Hood Canal Regional Stormwater Retrofit Plan identifies, prioritizes, and plans for retrofit of high priority stormwater infrastructure to provide important environmental and public health benefits, limit runoff and pollution of surface waters, and increase infiltration of rainwater in the Hood Canal watershed.[94] An additional project includes:
    - Port Gamble Bay (2015-current) – Cleanup of environmental waste from the Port Gamble sawmill (1853-1995) by removal of 3,314 creosote pilings and 41,400 cubic yards of contaminated sediment and wood waste.[95]
- Estuarine Habitat: Multiple projects were conducted to improve estuarine habitat, including:
    - Beards Cove estuary (2013-2016) – The project removed fill, structures, infrastructure, and invasive plants; restore grade and side-channel habitat; and plant native species.[96]
    - Chimacum Creek estuary (2000-2013) – Over six acres of estuary were restored by removing non-native fill and replacing it with clean native fill.[97]
    - Dabob Bay (2012-2014) – One and one-half acres of saltmarch and riparian forest shoreline were restored.[98]
    - Lynch Cove estuary (2010-2015) – Over 44 acres of unprotected land were acquired for protection by WDFW.[99]
    - Big/Little Quilcene River estuary (2008-2015) – Over 20 acres of unprotected land were acquired for protection and removal of existing structures.[100] Over four acres of tidal marsh and channels were restored.[101]
    - Skokomish River estuary (2007-2014) – Over 300 acres of estuary were restored through dike removal, recreating and reconnecting tidal channels, and culvert removal.[102]

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[94] http://hccc.wa.gov/content/hood-canal-regional-stormwater-retrofit-plan
[95] http://waconnect.paladinpanoramic.com/project/170/60313
[96] http://waconnect.paladinpanoramic.com/project/170/18176; http://archive.kitsapsun.com/news/local/mason/beards-cove-estuary-restoration-nearly-complete-ep-1263691635-354486861.html
[97] http://waconnect.paladinpanoramic.com/project/170/8995
[98] http://waconnect.paladinpanoramic.com/project/170/18248
[99] http://waconnect.paladinpanoramic.com/project/170/14621
[100] http://hwsconnect.ekosystem.us/Project/170/7267; http://pnwsalmoncenter.org/project/big-quilcene-river-flood-plain-restoration/
[101] http://waconnect.paladinpanoramic.com/project/170/14248
[102] https://salishsearestoration.org/wiki/Skokomish_Delta_Restoration; http://waconnect.paladinpanoramic.com/project/170/15605

  - Snow/Salmon Creek estuaries (2012-2015) – Over four acres of estuary were restored by removal of railroad trestles and pilings, industrial fill, rip-rap, and a tidal gate; relocation of water mains; and revegetation.[103]
  - Union River estuary (2012-2014) – Over 29 acres of estuary were restored through dike breaching, regrading to adjacent marsh conditions, and accommodating stormwater drainage.[104]
- Instream Habitat: Multiple projects were conducted to improve instream habitat, including:
  - Big Beef Creek (2009-current) – Ten acres of riparian habitat were acquired, and 11 acres of wetland were restored.[105]
  - Chimicum Creek (2002-2015) – Over 67 acres of habitat were restored with native riparian vegetation.[106]
  - Donovan Creek, Quilcene Bay (2012-2013) – Over 26 acres of land were acquired with over 17 acres of riparian habitat and 1.1 miles of streambank restored and 20 LWD structures installed.[107]
  - Leland Creek, Quilcene Bay (2002-2012) – Over four acres and 0.26 miles of stream were restored.[108]
  - Little Anderson Creek (2013-2016) – One mile of stream channel was treated with addition of woody material.[109]
  - Little Quilcene River (2009-2013) – Five LWD structures were installed and 2.7 acres of riparian habitat were restored.[110]
  - Salmon/Snow creeks (2007-2015) – Over 13 acres were restored through planting of native riparian vegetation.[111]

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[103] http://waconnect.paladinpanoramic.com/project/170/7262; http://historylink.org/File/11109
[104] http://waconnect.paladinpanoramic.com/project/170/14620
[105] http://waconnect.paladinpanoramic.com/project/170/12181; http://waconnect.paladinpanoramic.com/project/170/18617
[106] http://waconnect.paladinpanoramic.com/project/170/8946; http://waconnect.paladinpanoramic.com/project/170/8968; http://waconnect.paladinpanoramic.com/project/170/18189; http://waconnect.paladinpanoramic.com/project/170/18141; http://waconnect.paladinpanoramic.com/project/170/17294; http://waconnect.paladinpanoramic.com/project/170/17293; http://waconnect.paladinpanoramic.com/project/170/8941; http://waconnect.paladinpanoramic.com/project/170/16053; http://waconnect.paladinpanoramic.com/project/170/8950; http://waconnect.paladinpanoramic.com/project/170/8970; http://waconnect.paladinpanoramic.com/project/170/8972; http://waconnect.paladinpanoramic.com/project/170/8973; http://waconnect.paladinpanoramic.com/project/170/8974; http://waconnect.paladinpanoramic.com/project/170/8975; http://waconnect.paladinpanoramic.com/project/170/8978
[107] http://waconnect.paladinpanoramic.com/project/170/19359; http://waconnect.paladinpanoramic.com/project/170/12978
[108] http://waconnect.paladinpanoramic.com/project/170/7599
[109] http://waconnect.paladinpanoramic.com/project/170/18613
[110] http://waconnect.paladinpanoramic.com/project/170/7295; http://waconnect.paladinpanoramic.com/project/170/14670
[111] http://waconnect.paladinpanoramic.com/project/170/7240; http://waconnect.paladinpanoramic.com/project/170/7241

- Skokomish River (2007-current) – Over 229 acres and nine miles of riparian habitat were revegetated through removal of invasive species, tree planting, and placement of woody debris.[112] An additional 161 acres were acquired for conservation at the confluence of the SF and NF Skokomish River.[113] LWD was installed along 0.9 mi of streambank along Five Mile Creek near the confluence of the SF Skokomish River.[114]
- Snow Creek (2005-2015) – Restoration of over six acres of native riparian vegetation to improve stream temperature, reduce erosion, and recruit LWD.[115]

- Floodplain Habitat: Multiple projects were conducted to improve floodplain habitat, including:
  - Chimicum Creek (2011-2014) – Five acres of floodplain were acquired and restored through trail decommissioning, weed control, and riparian planting.[116]
  - Dosewallips River (2008-2014) – Placement of three ELJs at RM 8.1 to improve fluvial and floodplain habitat function.[117] Over 100 acres of floodplain were acquired for restoration purposes.[118] Over 14 acres of riparian floodplain were restored along with 0.29 mi of streambank.[119]
  - Duckabush River (2013-2015) – Over ten acres of floodplain were restored through removal of invasive species and planting of native species.[120] An additional 18 acres were acquired for conservation.[121]
  - Snow Creek (2010-2016) – Over nine acres of riparian and floodplain were planted, and an additional 20 acres were acquired for future restoration.[122]
  - Tahuya/Union River headwaters (2008-2015) – Acquisition and lease of 2,290 acres of stream habitat for conservation.[123]
- Fish Passage: Two projects were conducted to improve access to upstream habitat, including:

[112] http://waconnect.paladinpanoramic.com/project/170/13467
[113] http://waconnect.paladinpanoramic.com/project/170/18490
[114] http://waconnect.paladinpanoramic.com/project/170/14128
[115] http://waconnect.paladinpanoramic.com/project/170/7243; http://waconnect.paladinpanoramic.com/project/170/7240
[116] http://waconnect.paladinpanoramic.com/project/170/16821
[117] http://waconnect.paladinpanoramic.com/project/170/14768
[118] http://waconnect.paladinpanoramic.com/project/170/12984; http://waconnect.paladinpanoramic.com/project/170/14723
[119] http://waconnect.paladinpanoramic.com/project/170/14629
[120] http://waconnect.paladinpanoramic.com/project/170/18620
[121] http://waconnect.paladinpanoramic.com/project/170/12977; https://secure.rco.wa.gov/prism/search/projectsnapshot.aspx?ProjectNumber=09-1630
[122] http://waconnect.paladinpanoramic.com/project/170/7240; http://waconnect.paladinpanoramic.com/project/170/14624; http://waconnect.paladinpanoramic.com/project/170/17807
[123] http://waconnect.paladinpanoramic.com/project/170/14135

  - Salmon Creek (2015-current) – Replacement of a culvert with a bridge to open access to an additional 0.75 mile of spawning habitat (doubling of available habitat).[124]

  - Tahuya River (1999-2016) – Twenty-five miles of river was made accessible through the removal of 21 barriers and the construction of one fish ladder.[125]

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, land use regulations that affect habitat remain a significant concern, and the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

We expect the HCCC to continue to annually identify the conservation outcomes needed, an implementation plan with strategic priorities and performance measures, and funding and resources needed to recover HCS chum salmon. Specific recommended actions include:[126]

- Water Quality: Provide additional support for inspecting, repairing, and upgrading individual septic systems throughout the Hood Canal. Decreasing sediment loading from run off and culvert failures which decrease downstream water quality for spawning habitat.

- Estuarine Habitat: Continued (1) acquisition and conservation leases of estuarine habitat for conservation and (2) restoration of habitat, including Big Beef Creek, Big Quilcene River, Cattail Creek, Devil's Hole Creek, Dewatto River, Dosewallips River, Duckabush River, Lilliwaup Creek, and Tahuya River.

- Instream Habitat: Continued (1) acquisition and conservation leases of instream habitat for conservation and (2) restoration of habitat; including: Big Beef Creek, Dosewallips River, Duckabush River, Hamma Hamma River, Lilliwaup Creek, Salmon Creek, Snow Creek, and Vance Creek.

- Floodplain Habitat: Continued (1) acquisition and conservation leases of floodplain habitat for conservation and (2) restoration of habitat, including the Duckabush, Hamma Hamma, and Skokomish rivers.

- Fish Passage: Removal and replacement of instream barriers in the Dosewallips River, Frigid Creek, Hamma Hamma River, Lilliwaup Creek, McTaggert Creek, Penny Creek, Pierce Creek, Skokomish River, Tahuya River, and Tarboo Creek.

[124] http://waconnect.paladinpanoramic.com/project/170/14612
[125] http://waconnect.paladinpanoramic.com/project/170/13475
[126] http://www.hws.ekosystem.us/projects?site=170

PS Steelhead DPS

1) Key Emergent or Ongoing Habitat Concerns

In both the 2007 listing document (72 FR 26722) and again in the 2013 federal recovery outline (NMFS 2013) guiding and documenting the recovery planning process currently underway for the PS steelhead DPS[127], NMFS noted that the habitat factors leading to the decline of Puget Sound steelhead were also the factors limiting species recovery:

- Continued destruction and modification of steelhead habitat.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of LWD.
- Continued urban development in the lower reaches of many Puget Sound rivers and tributaries causing increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows.
- Altered stream hydrology resulting in gravel scour, bank erosion, and sediment deposition.
- Dikes, hardening of banks with riprap, and channelization, reduced river braiding and sinuosity, and increased the likelihood of gravel scour and dislocation of rearing juveniles because of dikes, hardening of banks with riprap, and channelization.

Information reviewed by NWFSC 2015 did not identify any new key emergent habitat concerns for the PS steelhead DPS since the 2011 status review. The PS steelhead TRT recently concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs. Recent environmental trends not favorable to PS steelhead survival and production are expected to continue. The exceptionally warm marine waters in 2014 and 2015 coupled with the warm stream temperatures observed during 2015 were unfavorable for high marine or freshwater survival (Hard et al. 2015). See Listing Factor E: Other Natural or Manmade Factors Affecting its Continued Existence in this document for details on terrestrial and ocean conditions and marine survival.

2) Specific Geographic Areas of Concern

There is no additional information available since the previous 2011 status review that identifies specific geographic areas of concern for PS steelhead.

3) Key Protective Measures and Major Restoration Actions

Many of the key protective measures and restoration actions listed above for PS Chinook salmon and HCS chum salmon also benefit PS steelhead. The following protective measures and major

[127] NMFS anticipates releasing a draft PS steelhead recovery plan for public review by 2018. http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/puget_sound/overview_puget_sound_steelhead_recovery_2.html

restoration actions since the 2011 5-year status review are listed in the NMFS 2013 federal recovery outline for PS steelhead are listed below:

- In 2011, the White House Council on Environmental Quality designated the Regional Administrators of the EPA and NMFS and the State Conservationist for the United States Department of Agriculture's Natural Resource Conservation Service as co-leads for a federal effort to accelerate habitat protection and restoration in the Puget Sound and the Washington coast. This endeavor responds to concerns raised by Western Washington Treaty Tribes about continued habitat losses and associated diminishment of fishery resources. In May 2012, the Puget Sound Action Plan was developed to strengthen federal partnerships and solidify a strategy for collective action to restore habitat.[128]

- In 2012, the Salmon Recovery Funding Board funded recovery actions for PS steelhead that are currently underway to (1) study marine survival and (2) develop watershed-level recovery plans for the Hood Canal and Nisqually River Valley watersheds.

- As an ongoing collaborative effort, the NWFSC is working with the United States Geological Survey, National Park Service, WDFW, the Lower Elwah Klallam Tribe, and others to document steelhead colonization of the Elwah River following dam removal. This work involves fish ecology and genetics research and habitat monitoring (NMFS 2013).

We suspect that further habitat actions have been implemented for PS steelhead since the last status review in addition to those listed in the NMFS 2013 federal recovery plan outline for the species. However, at this time we do not have information available that would allow us to identify additional the key protective measures or major restoration activities for steelhead habitat in Puget Sound.

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, land use regulations that affect habitat remain a significant concern, and the implementation and effectiveness of regulatory mechanisms has not been adequately documented. See Listing Factor D: Adequacy & Inadequacy of Regulatory Mechanisms, and Protective Efforts in this document for details.

5) Recommended Future Actions

The greatest opportunity to advance recovery of PS steelhead is to:

- Develop a recovery plan that includes site-specific recovery actions, measurable criteria for de-listing the listed DPS, and identification of high priority watershed reaches.

- Implement the recovery plan and systematically analyze the amount of habitat addressed by recovery actions against those watershed reaches identified as high priorities in the recovery plan.

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[128] http://www.westcoast.fisheries.noaa.gov/habitat/conservation/puget_sound_action_plan.html

- Continue to research poor marine survival rates of juvenile PS steelhead (Moore et al. 2010) and its possible causes [i.e. climate (NWFSC 2015), predation (Berejikian et al. 2016)].

Listing Factor A Conclusion

New information available since the last status review indicates there is improvement in freshwater and estuary habitats utilized by PS Chinook salmon and HCS chum salmon with many of these improvements also benefitting PS steelhead. Continued improvements to fish passage and numerous tributary habitat restoration projects should result in improved survival for all three species. We therefore conclude that the risk to the species' persistence because of habitat destruction or modification has improved slightly since the last 2011 status review.

Throughout Puget Sound, listed salmonid species have been impacted by urban development and natural resource utilization through impaired water quality; degraded estuarine, instream, nearshore, and floodplain habitats; and restricted fish passage. Water quality has been impaired by pollutants, contaminants, and impervious surfaces especially near urban areas. Efforts through regulations and infrastructure upgrades have improved water quality. Estuarine habitats have been degraded by development, farming, and channelization. Recent efforts in the Nisqually, Skagit, Skokomish, and Snohomish river deltas to remove dikes and reestablish tidal channels have increased estuary acreage. Instream and floodplain habitats have been impacted by channelization and straightening of rivers and streams which simplifies stream structure. Land acquisition, revegetation, levee setbacks, stream channel reconfiguration, and installation of ELJs and LWD have helped restore proper stream function. Nearshore habitats have been impaired by bulkheads, lumber mills, and derelict docks. By removing mill debris and contaminants, creosote pilings, and bulkheads, these habitats have been improved. For fish passage, undersized culverts blocking upstream fish passage is a major problem. By daylighting streams, replacing culverts with bridges, and installing larger culverts, the amount of spawning habitat has increased throughout Puget Sound especially on the Kitsap Peninsula.

For PS steelhead, future five year assessments would benefit from the development of a recovery plan that identifies (1) specific goals for habitat protection and restoration activities, and (2) priority watershed reaches targeted for the identified habitat protection and restoration activities.

Such information would allow for a systematic review and quantitative analysis of the amount of habitat addressed to track progress against plan objectives. Similarly, future 5-year assessments for PS Chinook and HCS chum salmon would benefit from identification of priority watershed reaches targeted for habitat protection and restoration activities in the 2007 recovery plans to allow for a systematic review and quantitative analysis of the amount of habitat addressed to better track progress against plan objectives.

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

Harvest

PS Chinook salmon

PS Chinook salmon are harvested in ocean salmon fisheries, Puget Sound fisheries, and terminal fisheries in the rivers. They migrate to the north, so nearly all of the ocean fishery impacts occur in Canada and Alaska where they are subject to the Pacific Salmon Treaty. Fisheries within Puget Sound are managed by the state and tribal co-managers under a resource management plan. Fishery impact rates vary widely among regions within Puget Sound primarily because of different terminal area management. Hood Canal and South Puget Sound stocks support relatively intense terminal area fisheries directed at hatchery fish produced largely to support tribal and recreational fisheries (NWFSC 2015).

Most Puget Sound populations show a similar pattern of declining exploitation rates in the 1990s with increasing exploitation rates since then. This is primarily a result of Canadian interceptions of PS Chinook salmon off the West Coast of Vancouver Island (WCVI). During the 1990s, Canada sharply reduced fisheries off WCVI in response to depressed Canadian stocks. Since then, WCVI stock status has improved somewhat and Canadian managers have changed the temporal pattern of fishing to avoid WCVI stocks. This has resulted in increased impacts on Puget Sound Chinook salmon populations. The notable exception to this pattern is the North Puget Sound populations who migrate through the Strait of Georgia and avoid the WCVI fishery. Canadian stocks in the Strait of Georgia have not recovered and most fisheries in Canadian inside waters for Chinook and coho salmon have been shut down. The most recent Pacific Salmon Treaty Chinook salmon agreement took effect in 2009 includes 30 percent reductions in Chinook salmon catch ceilings off WCVI and 15 percent reductions in southeast Alaska (NWFSC 2015).

HCS chum salmon

There are no directed fisheries on HCS chum salmon. However, they are taken incidentally in fisheries directed at other salmon species in the Strait of Juan de Fuca, Hood Canal, and Canada. Because the Strait of Juan de Fuca population are not subject to the Chinook and coho salmon fisheries in Hood Canal, the Strait of Juan de Fuca population experiences lower overall harvest rates in general. From the mid-1970s through the 1980s, the Strait of Juan de Fuca population experienced harvest rates on the order of 10-30 percent with rates as high as 50 percent in individual years. The Hood Canal population was subject to harvest rates that were typically on the order of 50 percent to 70 percent with rates in individual years approaching 90 percent (Johnson et al. 1997; NWFSC 2015).

In response to severely depressed runs of summer-run chum salmon, the State of Washington and the Western Washington Treaty Tribes took measures in 1991 to curb the incidental harvest of summer-run chum salmon and harvest rates fell dramatically. The co-managers have implemented a Base Conservation Regime (BCR) and continued to constrain harvest impacts as runs have approached or returned to historic levels, leading to escapements that have exceeded historic levels. Under the BCR, harvest rates have declined to about 2 percent to 15 percent for Hood Canal summer-run chum salmon and to less than 2 percent for the Strait of Juan de Fuca summer-run chum. Harvest rates have been below the BCR harvest rate limits for all years in the Strait of Juan de Fuca fisheries and for all years except 2004 in Hood Canal fisheries. From 2000 through 2013, the harvest rate for the ESU has averaged about 8 percent (PNPTT and WDFW 2014; NWFSC 2015).

PS steelhead

Puget Sound steelhead are harvested in terminal tribal gillnet fisheries and in recreational fisheries. Fisheries are directed at hatchery stocks, but some harvest of natural origin steelhead occurs incidentally to hatchery-directed fisheries. Winter-run hatchery steelhead production is primarily of Chambers Creek stock, which for several generations has been selected for earlier run timing than natural stocks to minimize fishery interactions. Hatchery production of summer-run steelhead is primarily of Skamania River (lower Columbia River Basin) stock, which has been selected for earlier spawn timing than natural summer-run steelhead to minimize interactions on the spawning grounds. In recreational fisheries, retention of wild steelhead is prohibited, so all harvest impacts occur as the result of release mortality and non-compliance. In tribal net fisheries, most fishery impacts occur in fisheries directed at salmon and hatchery steelhead (NWFSC 2015).

Most Puget Sound streams have insufficient catch and escapement data to calculate exploitation rates for natural steelhead. Populations with sufficient data include those in the Skagit, Green, Nisqually, Puyallup, and Snohomish rivers. Exploitation rates differ widely among the different rivers, but all have declined since the 1970s and 1980s. Exploitation rates on natural steelhead during the earlier period averaged between 10 percent and 40 percent, with some populations in the central and south parts of Puget Sound, such as the Green and Nisqually river populations, experiencing exploitation rates over 60 percent. Exploitation rates on natural steelhead over the past decade have been stable and generally less than 5 percent. Current exploitation rates are low enough that they unlikely to substantially reduce spawner abundance for most steelhead populations in Puget Sound, and these rates are expected to continue for the near future (NWFSC 2015).

Research and Monitoring

Much of the scientific research and monitoring being conducted for PS Chinook salmon, HCS chum salmon, and PS steelhead 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 percent of any PNW ESA-listed salmonid ESU/DPS. For natural-origin salmonid juveniles, in 2014, researchers were approved to take up to 416,305 PS Chinook salmon (16.81% of total abundance), 578,536 HCS chum salmon (21.46% of total abundance), and 69,571 PS steelhead (5.31% of total abundance) with an overall 1.67 percent mortality rate for authorized take (0.27% mortality rate for abundance of all three species combined). 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 percent of requested take and 11.07 percent of requested mortalities were used in PNW Section 10a1A permits from 2008 to 2014). Thus, the research mortality rate for ESA-listed juvenile natural-origin salmonids in Puget Sound is actually closer to 0.03 percent. The majority of the requested nonlethal juvenile take has been and is expected to continue to be captured with incline plane traps (53 percent), screw traps (39 percent), beach seines (4 percent), purse seines (1 percent), and electrofishing units (1 percent) (NMFS APPS database; https://apps.nmfs.noaa.gov/). Our records from the past nine years indicate that mortality rates for incline plane and screw traps are typically less than 1 percent and backpack electrofishing typically less than 3 percent. Researchers deploy incline plane and 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 ESUs/DPS, the potential mortality levels are typically low. These effects are spread out over various channels and tributaries of the Puget Sound and thus, no single population is likely to experience a disproportionate amount of these losses. Therefore, the research would likely have only a very small impact on overall population 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 -- the overall research effect on listed populations has not changed substantially over the last five years since 2011. Therefore, we conclude that the risk to the species' persistence because of utilization related to scientific studies remains essentially unchanged since the last five-year status review.

Listing Factor B Conclusion

New information available since the previous 2011 ESA status review indicates harvest and research impacts have remained constant. The risk to the species' persistence because of harvest remains the same since the last status review for all three species. For PS Chinook, increased harvest from the Canadian WCVI fisheries have impacted most Puget Sound populations (except for the North Puget Sound populations). Further, there is greater uncertainty associated with this threat for PS Chinook salmon due to shorter term harvest plans and exceedance of management objectives for some Chinook salmon populations essential to recovery (discussed further in Listing Factor D). Therefore, harvest remains a limiting factor for PS Chinook salmon; but it is not as a significant limiting factor for PS steelhead and HCS chum salmon due to their more limited fisheries.

Since the 2011 five-year status review, research impacts have remained mostly constant (NMFS APPS database: https://apps.nmfs.noaa.gov/). Overall, research impacts remain minimal due to the low mortality rates authorized under research permits and that the research is spread out geographically throughout Puget Sound.

Listing Factor C: Disease or predation

Predation

Killer Whale

Fish are the major dietary component of resident killer whales in the northeastern Pacific (Scheffer and Slipp 1948; Ford et al. 1998 and 2000; Saulitis et al. 2000; Ford and Ellis 2006). Resident killer whales, which include the Northern and Southern Resident populations, occur in large social groups (the Northern Resident population consist of approximately 200 whales, whereas the Southern Resident population numbers in the 1980s). The Northern Residents reside primarily from central Vancouver Island to southeastern Alaska (Dahlheim et al. 1997; Ford et al. 2000), although animals occasionally venture as far south as the Strait of Juan de Fuca, San Juan Islands, and the west coast of Washington (Barrett-Lennard and Ellis 2001; Calambokidis et al. 2004; Wiles 2004; J. K. B. Ford, unpubl. data, NWFSC unpubl. data). Southern Residents range from southeast Alaska to California, but reside for part of the year in the inland waterways of Washington State and British Columbia principally during the late spring, summer, and fall (Bigg 1982; Ford et al. 2000; Krahn et al. 2002).

Resident killer whales consume a variety of fish species, but salmon are identified as their primary prey, particularly Chinook salmon (Ford and Ellis 2006; Hanson et al. 2010). Genetic analysis of the Hanson et al. (2010) samples indicate that when Southern Resident killer whales are in inland waters of Washington and British Columbia from May to September, they consume Chinook salmon stocks that originate from the Fraser River, Puget Sound, the Central British Columbia Coast and West and East Vancouver Island. Ongoing studies also confirm a shift to chum salmon in fall (Ford et al. 2010; Hanson et al. 2010). Assuming a diet of solely Chinook salmon, it was estimated that the Southern Resident killer whale population can consume up to 347,000 Chinook salmon per year (Noren 2011). The preference for Chinook salmon was also noted among all age and sex classes of Northern Residents, despite the much lower abundance of Chinook salmon in the inland waters in comparison to other salmonids (primarily sockeye salmon). Although recent studies have found a significant relationship between Chinook salmon abundance and the survival and fecundity rates of the killer whales (Vélez-Espino et al. 2014; Ward et al. 2013), the effects of killer whale predation on Chinook salmon productivity remains unclear.

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 2014a).[129]

Puget Sound

Since 2011, there has been a steady influx of pinnipeds, especially harbor seals, Steller sea lions, and California sea lions in Puget Sound waters (NMFS 2014a; Wiles 2015). Harbor seal abundance in greater Puget Sound increased significantly between the 1970s (2,000-3,000 seals) and 1999 (nearly 14,000 animals; Jeffries et al. 2003), but appears to have remained stable since that time (S. J. Jeffries unpubl.data; Berejikian et al. 2016). The most recent population estimates of Steller sea lions indicate that the overall population was at 70,174 animals in 2010, up from 18,313 animals in 1979 (Wiles 2015). For California sea lions, abundances have ranged from zero (1978) to 1,200 (2005) in Puget Sound (Chasco et al. In press).

Chinook Salmon Predation – Chasco et al. (In press) in estimating Chinook salmon consumption in Washington State inland waters, found that by 2015, these three pinniped species consumed double that of resident killer whales, and six times greater than the combined commercial and recreational catches. The estimates suggest that the total Chinook salmon adult returns within Washington State inland waters during 2015 would be diminished by 1,000 individuals because of predation by California sea lions; by 1,900 individuals because of predation by Steller sea lions; and, by 158,700 individuals because of predation by harbor seals. Summed across all pinnipeds, the total annual potential mortality increased from 18,800 in 1970 to 161,600 in 2015. Chasco et al. (In press) reports these estimates to be similar to the commercial and recreational catches from the early 1990s to the early 2000s; however, due to large decreases in the number of returning adults, both fisheries have since been reduced. Commercial catches of Chinook salmon from Washington State inland waters have declined from approximately 250,000 adult salmon in 1980 to 100,000 in 2007, and recreational catches within Puget Sound have declined from approximately 150,000 to 50,000 (PSIT and WDFW 2010). Since 2007, the average annual catches by tribal fisheries have been about 5,000-10,000 adults, and the average recreational catches in marine waters are approximately 20,000 adults – fewer than are consumed by harbor seals (Chasco et al. In press).

While several factors such as increasing temperatures in inland waters (Beamish et al. 2012), competition (Ruggerone and Goetz 2004) and changes in productivity (Mantua et al. 1997) have also been correlated with the declines PS Chinook salmon numbers. The scale and consistent abundance trend suggest that harbor seals should not be overlooked as potential contributors to declining marine survival.

[129] 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 2014a), when the population growth rate was estimated at 7 percent (NMFS 2014a).

Steelhead Predation – Research suggests that significant steelhead smolt emigration mortality, likely from predation by birds and seals, occurs in the Salish Sea, the body of water extending from the Strait of Georgia to the south end of Puget Sound and west to the mouth of the Strait of Juan de Fuca (Moore et al. 2015). Berejikian et al. (2016) suggest that harbor seals may contribute to PS steelhead predation in the marine environment.

Disease

Disease rates over the past five years are believed to be consistent with the previous five-year status review. 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 increase disease rates.

Nanophyetus salmincola is a freshwater trematode that can impair salmonid immune function and resistance to the marine pathogen *Vibrio anguillarum* (Roon et al. 2015). In the southern Puget Sound, steelhead from the Green and Nisqually rivers have a high prevalence of *N. salmincola* which is believed to be resulting in low marine survival and return rates (Chen et al. 2016).

Listing Factor C Conclusion

Although Chinook salmon are identified as the primary prey of resident killer whales, the effects of killer whale predation on PS Chinook salmon productivity remains unclear (Vélez-Espino et al. 2014; Ward et al. 2013). In addition, recent studies indicate that predation by pinnipeds on PS steelhead is an emerging threat (Berejikian et al. 2016; Moore et al. 2015), necessitating expanded monitoring and evaluation efforts in Puget Sound to assess predator-prey interactions between pinnipeds and listed species.

Disease rates over the past five years are believed to be consistent with the previous five-year status review, although climate change impacts such as increasing temperature may increase susceptibility to diseases (See Listing Factor E: Other natural or manmade factors affecting its continued existence: climate change in this document for details). Recent reports indicate the spread of a new strain of IHNV along the Pacific coast may increase disease related concerns for Puget Sound salmonids in the future (Kurath 2012). Further, *N. salmincola* is highly prevalent in PS steelhead from southern Puget Sound rivers (Chen et al. 2016).

Our overall conclusion is that risk related to disease or predation remains unchanged since the previous five-year status review, but that the risk from predation on PS Chinook salmon and steelhead may have increased somewhat since 2011.

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

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

Habitat

Improvements in Operations and Fish Passage at Federal Energy Regulatory Commission-licensed Hydropower Facilities and Dams

Since 2010, fish passage facilities have been developed and tested for Chinook salmon and steelhead at the North Fork Skokomish River (Cushman Dams).[130] Fish passage facilities at five other Federal Energy Regulatory Commission (FERC)-licensed dams have been monitored and adjusted per recommendations from stakeholder groups.

Puget Sound Energy's Baker River Hydroelectric Project

In October 2008, the FERC issued Puget Sound Energy (PSE) a new 50-year operating license for the Baker River Hydroelectric Project. The license contains specific requirements about many aspects of the hydroelectric project, including structures, equipment, water quality and other environmental issues, wildlife and fisheries programs, operating procedures, stream flow, and more.

New floating surface collectors are the central feature on new downstream fish passage facilities for the capture and transport of outmigrating juvenile salmonids from both Project reservoirs. The Upper Baker Floating Surface Collector was launched in 2008. The Lower Baker Floating Surface Collector followed in 2012. Balancing and evaluation of screen channel hydraulics in a normal part of the commissioning of any screened facility; this process took 2-4 years for Upper Baker and Lower Baker, respectively.

PSE together with NMFS's and many other state, Federal and Tribal collaborative efforts contributed to the recovery of a unique sockeye salmon stock that as recently as the mid-1980s was at risk of extinction. The stock has recovered to record levels, as evidenced by the mounting numbers of outmigrating juvenile salmon and returning adults, which have enabled significant tribal and recreational harvests for the first time in decades.

Examples of this success are captured by the following comparisons:

[130] http://www.mytpu.org/tacomapower/fish-wildlife-environment/cushman-hydro-project/cushman-fisheries-program.htm

- There were 71 sockeye outmigrants counted in 1987 when complete monitoring began, to the outmigration of over 1 million in 2014; and
- There were 99 returning adults captured in the trap in 1985 to a terminal area return of over 50,000 in 2015.

Tacoma Power's Cushman Hydroelectric Project

In 2010, after more than 36 years, Tacoma Power received an acceptable 50-year federal license for its Cushman Hydroelectric Project. FERC issued the license, and made it retroactive to 1998. It includes the terms of the settlement agreement that Tacoma Power and other government agencies signed with the Skokomish Tribal Nation in January 2009.

In 2011, the relicensing Settlement Agreement to restore fish populations began. The project includes the construction of an adult collection facility, a juvenile collection system, two new hatcheries, and habitat restoration where reduced flows have impeded the passage of spawning fish.[131] For downstream passage, juveniles hatched (and reared) above the Cushman Dams will be collected in a floating surface collector on Lake Cushman. The Cushman Floating Surface Collector was launched in August 2014 and began testing/operation in 2015. The new hatchery is under construction.

The Corps Mud Mountain Dam and Buckley Diversion Structure

NMFS's biological opinion, conference opinion, and Magnuson Stevens Fishery Conservation and Management Act consultation for the continued operation and maintenance of the Mud Mountain Dam project was completed in October 2014.

Mud Mountain Dam is a flood control dam protecting the lower White and Puyallup River valleys from flooding. Fish passage at Mud Mountain Dam, both downstream and upstream, is severely limited at this time. A derelict diversion dam serves as a barrier to migrating fish and directs them into a trap-and-haul system. It has exposed rebar and numerous voids in its approach apron that injure and kill adult fish seeking a passage route upstream. Additionally, the existing fish trap-and-haul system is antiquated and undersized (i.e., does not have capacity to handle the number of fish that rely on it, or future fish abundance associated with recovery trajectories), resulting in significant delay, increasing injury and mortality. Pink salmon, which are not listed under the ESA, also use the facility. In odd-numbered years, almost one million pink salmon ascend the White River, overwhelming the limited capacity of the existing fish trap. In turn, this leads to extensive passage delay at the diversion dam and large numbers of fish being injured or killed.

In 2012, the Corps re-initiated ESA consultation with NMFS because continued maintenance of the existing barrier structure constituted an impact on listed species that was not considered in the 2007 Biological Opinion. That ESA consultation was completed in 2014.

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[131] https://www.mytpu.org/file_viewer.aspx?id=907

Through the most recent consultation process, NMFS determined that the proposed future operation and maintenance of the project jeopardizes the continued existence of PS Chinook salmon and PS steelhead, and adversely modifies the critical habitats of PS Chinook salmon and Southern Resident killer whales. To that end, the Corps agreed to measures to improve downstream and upstream fish passage, including but not limited to changing dam operations, making interim repairs to the diversion structure and subsequently designing and building a new diversion structure and fish handling facility.

Snoqualmie Falls Hydropower Project

The FERC issued a new 40-year license for the Snoqualmie Falls Project on June 29, 2004. Meeting the many requirements in the license will continue to be a day-by-day job during the entire 40-year term, as PSE addresses the environmental, cultural, recreational, and public-safety provisions in the license.

A new bypass flow-control system was added to the rebuilt Plant 2. Now if either generator is shut down abruptly, the system transfers water so there is continuity in water flow and fish (primarily Chinook salmon and steelhead) won't experience a drop in the river level. To further protect the fish, PSE modified the Plant 1 tailrace at the base of the falls so there were no pockets or ponds where fish could get trapped.

Federal Land Management

Roughly 34 percent of land in Puget Sound is in Federal ownership, with 87 percent of those lands managed for protection as National Park or Wilderness. Federal land managers have taken a number of measures to protect and restore habitat throughout the range of the Puget Sound salmon ESUs and steelhead DPS. Since the last status review, habitat improvements and restoration activities continue to occur on Federal lands through implementation of project-scale closures of roads and a few small habitat restoration projects. The biggest restoration projects involving federal lands have been removing the two large hydroelectric dams on the Elwha River and restoring the Nisqually Delta.

Clean Water Act

The Federal Clean Water Act addresses the development and implementation of water quality standards, the development of Total Maximum Daily Load (TMDL), filling of wetlands, point source permitting, the regulation of stormwater, and other provisions related to protection of U.S. waters. The Clean Water Act is administered in the Washington State with oversight by the EPA. State water quality standards are set to protect beneficial uses, which include several categories of salmonid use. Each state has a water quality certification program under section 401, which it reviews projects that will discharge dredged or fill materials into waters of the U.S. and issues certifications that the proposed action meets State water quality standards and other aquatic protection regulations, if appropriate. Each state also issues National Pollution Discharge Elimination System (NPDES) permits under section 402, and develops water quality cleanup plans TMDL to address contaminants (such as toxins regulated under the Federal Insecticide, Fungicide and Rodenticide Act, and all other anthropogenic inputs exceeding water quality standards) including in water bodies. The state and federal clean water acts regulate the level of pollution within streams and rivers in the Puget Sound Region, as well as within Puget Sound itself.

- Washington State Use-based (e.g., aquatic life use) Surface Water Quality Standards, Washington Administrative Code (WAC) 173-201A. The EPA approved the Washington State's updated Water Quality Assessment 305(b) report and 303(d) list in 2012.[132]

National Flood Insurance Program (NFIP) and Federal Emergency Management Agency (FEMA)

This program is a federal benefits program which extends, in exchange for communities adopting local land use and development criteria consistent with federally established minimum standards, access to federal monies or other benefits, such as federally backed homeownership loans for dwellings located in floodplains, flood disaster funds, and subsidized flood insurance. Under this program, development within floodplains continues to be a regional concern. Development proceeding in compliance with National Flood Insurance Program (NFIP) minimum standards ultimately results in impacts to floodplain connectivity, flood storage/inundation, hydrology, and to habitat forming processes via stream bank armoring and stream channel alteration projects designed to protect private property in floodplains. These development consequences combine to prevent streams from functioning properly and result in degraded habitat. It is important to note that, where it has been analyzed, floodplain development that occurs consistently with the NFIP's minimum criteria has been found to jeopardize listed PS Chinook salmon, PS steelhead, HCS chum salmon, and as a corollary, the Southern Resident killer whale DPS (NMFS 2008). NMFS continues to work with FEMA and NFIP participating communities in the Puget Sound region, as the agency implements the NFIP. Compliance continues to be implemented inconsistently across the 122 NFIP jurisdictions, with some jurisdictions showing greater levels of floodplain protection, such as Whatcom, Pierce and King counties, while other jurisdictions still strive to avoid, or adequately mitigate, impacts of floodplain protection. NMFS anticipates the loss of floodplain function and connectivity will continue to slow as the measures identified in the biological opinion are implemented over time.

Coastal Zone Management Act of 1973 (CZMA)

The Coastal Zone Management Act of 1973 (CZMA) is a federal benefits program that provides grant funding to states that adopt coastal zone management programs (CZMP), which must, at a minimum, incorporate state clean water and air laws and regulations pursuant to the federal clean water act and clean air statutes. Washington's CZMP includes state water quality laws, air quality laws, the Shoreline Management Act (SMA), the State Environmental Policy Act (SEPA), and the Ocean Resources Management Act (ORMA). The CZMA was intended to buttress environmental stewardship and protection in areas that influenced fisheries resources, and created an opportunity through its "federal consistency" requirements, for states to review and certify that federal actions within the state's coastal zone complied with the adopted state criteria. Washington State's coastal zone is comprised of the 12 counties that border salt water, including all the cities therein. Strengths and weaknesses of the CZMP's effectiveness are

[132] http://www.ecy.wa.gov/programs/Wq/303d/index.html

derived from the successes and shortcomings of the underlying state laws mentioned above, in achieving resource stewardship and protection.

Non-Federal Tributary and Floodplain Land Management

Washington Shoreline Management Act of 1971, Ch. 90.58 RCW (SMA)

In 1971, the Washington State Legislature passed the Washington Shoreline Management Act of 1971 (SMA), which was adopted by public referendum in 1972. The purpose of the SMA 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. In 2003, the WDOE promulgated more protective shoreline requirements. 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. However, as of 2015, budget cuts permanently eliminated staff to provide technical assistance to local government planning and grant funding to complete SMPs.

This program regulates, via locally adopted criteria, uses within 200 feet of streams at or greater than 20 cubic feet per second, and lakes greater than 20 acres in size, giving preference to single family residences (RCW 90.58.020) and the shore and bank armoring which protect them from risk of erosion (RCW 90.58.030.(3)(e)(ii)). The statutory preference for these uses trends toward degradation of nearstream and nearshore habitat over time through incremental loss, though watershed restoration activities (RCW 90.58.515) and shoreline restoration activities (RCW 90.58.580) also have process exemptions in to facilitate their implementation. Implementing regulations at WAC 173-26 also speak to the goal of no net loss of shoreline ecological function; and the regulations have avoidance, minimization, and mitigation criteria, which are intended to slow the rate of incremental loss.

While restoration plans are also required under this program, implementation of these is voluntary at the local government level. “Some local rules are clear, such as the prohibition or effective temporal prohibition of land subdivisions that will require shoreline stabilization, although the language may differ by jurisdiction. Others, such as references to ecological functions, shoreline functions, and variations on this concept vary widely across jurisdictions. Local communities, the state, the tribes, other levels of government, and permit applicants would benefit from improved commonality of regulatory and management language across jurisdictions” (Uravitch 2015). This statute and its regulations, along with state clean water laws, are part of the Washington State’s CZMP.

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

As with the SMA, the Washington Growth Management Act (GMA) also has an update process for city and county critical areas ordinances (CAOs). Most CAOs were originally adopted following the GMA’s enactment in 1990/1991. CAOs are typically amended more often than shoreline master programs. Required updates continue to be implemented as required by the ordinance. CAOs are required for Wetlands and Aquifer Recharge Areas, Geologically Unstable Areas, Frequently Flooded Areas, and Fish and Wildlife Conservation Areas. Many jurisdictions in the Puget Sound region rely on the NFIP minimum standards, which were found to jeopardize species, as their critical area ordinances for frequently flooded areas, though some key jurisdictions such as King, Pierce, and Whatcom counties, have criteria that exceed the NFIP national standards. SMA development criteria, outlined above, and CAOs under the GMA, have a complex interrelationship regulatorily, with CAOs becoming part of the shoreline master programs by statute (RCW 36.70A.480 and RCW 90.58.61).

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

The WDFW protects fish life by using its authority to provide approvals for construction or other work that might affect the flow or bed of waters of the state. The 1994 rules for this authority were amended in 2014 to substantially improve fish protection. The amended rules incorporate new science in the design and construction standards for hydraulic projects such as stream bank protection, culverts and bridges, shoreline armoring, docks and other overwater structures. These standards include using the least impacting technically feasible alternative for bank protection and shoreline armoring, designing water crossings to avoid measurably impacting expected channel functions and processes, and designing and locating overwater structures to protect fish habitats of special concerns. These habitats include spawning, feeding and rearing (refugia) areas and migration corridors. In 2013, WDFW began monitoring new and replacement culverts on fish-bearing streams in western Washington and new and replacement marine shoreline armoring in Puget Sound. In 2014, monitoring indicated for the first time that the amount of marine armoring removed exceeded the amount of new armoring, with the removal occurring largely on publicly owned land.

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 WSDOT, Washington Department of Natural Resources, Tribes, city and county governments, and the GSRO. In developing the statewide strategy, the board has been working closely with salmon recovery organizations to approve statewide guidelines. Highlights of the Board’s work include:

- Approving two project pathways: 1) Watershed Pathway - Remove multiple barriers within a stream system. 2) 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.

Washington Forest Practices Regulations

Since NMFS approved the State's Forest Practice Rules as ESA-compliant by signing the Forest Practice Rules Habitat Conservation Plan (HCP) in 2006, we have helped the state implement that HCP which protects all species of salmonids on commercial forestlands in Puget Sound. A total of 3.7 million acres of commercial forestlands promote salmon recovery in Puget Sound, including state-owned forestlands managed per another HCP approved 1999. Each of these HCPs has compliance monitoring components, with annual reporting. The Forest Practices HCP annual report for 2015-2016[133] reveals that on small timber landholdings, in the preceding year 20 fish passage barriers were removed, re-establishing 44 additional miles of accessible fish habitat; compliance increased to 90 percent on measureable criteria such as road abandonment, no harvest zones, and desired future conditions; and that forest roads continue to be improved to meet forest practices standards. For large forest landowners, in calendar year 2015, 1,307 miles of forest road were improved and 356 fish passage barriers removed (WDNR 2016). One remaining weakness, however, is a difficulty in establishing agreed criteria for stream typing in forested areas, which is a preliminary step to determining appropriate buffer criteria to be applied at the site scale.

Harvest

Pacific Fisheries Management Council Harvest Management

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

The constraints on take of ESA-listed species authorized under incidental take statements and reasonable, prudent alternatives are collectively referred to as consultation standards. These

[133] Forest Practices HCP annual reports from 2011-2015 are available at: http://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan

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). The current FMP does not manage for steelhead because they are so rarely caught in ocean fisheries and retention of steelhead in non-treaty fisheries is currently prohibited. Based on currently available information, NMFS has concluded that ocean fishery management actions beyond those already in place that seek to shape fisheries to minimize impacts to steelhead are not necessary (Stelle 2015).

Puget Sound Harvest Management

Changes in fisheries management since the previous status review include increasing attention to natural origin Chinook salmon and steelhead protection in harvest management plans (PSIT and WDFW 2010; Grayum and Anderson 2014; Grayum and Unsworth 2015) and adoption of the most recent Chinook salmon and steelhead harvest resource management plans as a part of recovery planning. Since 2000, NMFS has adopted a series of salmon species-specific harvest plans that provide the framework within which the tribal and state jurisdictions jointly manage all salmon and steelhead fisheries within the greater Puget Sound area. In May 2011, NMFS determined that a new PS Chinook salmon harvest plan (in effect May 2011 through April 2014) met the requirements of the salmon and steelhead ESA 4(d) Rule. In general, these plans do not include the specific details of the annual fishing regime, but provide the management objectives against which the state and tribal co-managers develop annual action-specific fishing regimes to protect listed PS Chinook salmon. Harvest objectives specified in the harvest plans account for fisheries-related mortality of PS Chinook salmon throughout its migratory range, from Oregon and Washington to southeast Alaska. The plan also includes implementation, monitoring, and evaluation procedures designed to ensure fisheries are consistent with its management objectives. The co-managers provide annual reports and multi-year assessments of plan performance that may be used to revise management and inform future management plans. The harvest management plan (2010-2014) serves as the harvest component of the Puget Sound Salmon Recovery Plan. Since 2014, the co-managers have been unable to agree on a longer-term harvest plan. Instead, they have relied on several one year plans that carry forward most of the provisions of the 2010-2014 harvest plan with addendums for specific Puget Sound populations. The harvest management plan for HCS chum salmon has remained unchanged since the last status review, and actions remain effective in protecting listed summer-run chum salmon as specified in the recovery plan adopted by NMFS (NMFS 2007).

Listing Factor D Conclusion

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

- Lack of documentation or analysis of the effectiveness of land-use regulatory mechanisms and land-use management plans.

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

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

Climate Change (NWFSC 2015)

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

Projected Climate Change

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

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

Impacts on Salmon

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

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

The Warm Blob

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

Pacific Decadal Oscillation

The PDO describes the most prominent mode of variability in the North Pacific sea surface temperature (SST) field (Mantua et al. 1997). Positive PDO values are characterized by warm SSTs along the West Coast of North America and cold SSTs in the central North Pacific and are associated with warm and dry 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 Effect

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

PS Chinook Salmon

Most Puget Sound hatchery programs propagating Chinook salmon are operated for harvest augmentation purposes, using either native stocks that are part of the listed ESU (e.g., Wallace River Hatchery; Tulalip Bay Hatchery) or localized stocks that are not listed (e.g., Samish River Hatchery; Soos Creek Hatchery) (NMFS 2014b). Nine programs are operated for conservation purposes to supplement or reintroduce natural spawning of the natural populations that are native to regional watersheds. Since the previous status review, hatchery releases of Chinook salmon have remained relatively stable, as have releases of other species that may affect the status of natural Chinook salmon populations through ecological effects (coho, chum, pink, and sockeye salmon). Juvenile steelhead release abundances that may pose competition and predation risks to Chinook salmon have decreased over the same period. Emerging hatchery program effect considerations and concerns since the last status review include:

- Continued implementation of new hatchery risk minimization/reform measures have likely decreased hatchery-related risks to natural Chinook salmon populations.

- Conservation hatchery programs for the North Fork Nooksack, South Fork Nooksack, North Fork Stillaguamish, South Fork Stillaguamish, White, Dungeness, and Elwha Chinook salmon populations have maintained or increased total abundances of adult fish, and preserved remaining genetic resources that is threatened by the extremely low abundance status of the natural components of each population (NMFS 2014c; NMFS 2016; WDFW 2016a; Lummi Nation 2016; Stillaguamish Tribe 2015).
- There is uncertainty regarding the use for conservation purposes of hatchery stocks that are part of the listed ESU, but are not native to the basins where the conservation programs are located. Unknown is whether such programs will be successful, and whether the out-of-watershed-origin stocks used are the most suitable stocks for creating locally adapted genetic resources beneficial to ESU recovery.
- Straying from harvest augmentation-directed programs producing subyearling Chinook salmon at high proportions of total escapements may pose genetic and fitness loss risks to natural Chinook salmon populations, but more studies are needed to identify the degree and magnitude of actual effects (NWFSC 2015).
- There is continued risk of competition and predation effects on rearing and migrating natural Chinook salmon posed by hatchery Chinook and coho salmon, and steelhead released high in Puget Sound watersheds, especially for fish released at the yearling life stage (e.g., NMFS 2014c).
- For conservation programs, more studies are needed to understand to what extant natural spawning by hatchery Chinook salmon is contributing to the abundance of natural juvenile and adult progeny (e.g., NMFS 2014c).
- For harvest augmentation programs, the extent to which production by naturally spawning strays is contributing to natural Chinook salmon abundance, and consequent masking of native population status and trends, requires further study.
- Continued budget restrictions may impact the ability to continue hatchery programs supporting at risk stocks and within ESU stocks, and to support needed hatchery performance and effects monitoring and research.
- Challenges continue regarding the need to manage hatcheries to support natural Chinook salmon population recovery goals, while also supporting tribal treaty-reserved fishing rights (NWIFC 2013).

HCS Chum Salmon

Reintroduction efforts in Chimacum Creek have been successful in restoring a self-sustaining natural-origin spawning aggregation. Salmon Creek was used as the broodstock source for the Chimacum Creek reintroduction program. Supplementation was conducted in the Union River to bolster the abundance of the HCS chum salmon population in the river and provided surplus fish to reintroduce a spawning aggregation into the Tahuya River, where the native population had become extirpated in the 1970s. The Tahuya reintroduction program, using adult returns established in the Tahuya River as broodstock, is ongoing. Two HCS chum salmon supplementation programs implemented to conserve spawning aggregations at moderate or high extinction risk were terminated, consistent with the planned terms of their operation (Jones 2015). The programs resulted in increased natural origin recruit based production relative to pre-supplementation years (1990-1994) (PNPTT and WDFW 2014). The now terminated Union River supplementation effort, achieved its goal. The now terminated supplementation effort for HCS chum salmon in the Hamma Hamma River was successful in bolstering natural-origin production of HCS chum salmon.

The two remaining hatchery programs (Lilliwaup and Tahuya) propagating HCS chum salmon are operated for conservation purposes, using native stocks that are part of the listed ESU. Since the previous status review, hatchery releases of HCS chum salmon have been reduced (NWFSC 2015). Releases of other species that may affect the status of HCS chum salmon through ecological effects (coho, chum, and pink salmon) have remained stable (NMFS 2014b). Juvenile steelhead release abundances that may pose predation risks have decreased over the same period (NWFSC 2015). Emerging hatchery program effect considerations since the last status review include:

- Continuing conservation hatchery programs for Lilliwaup and Tahuya HCS chum salmon populations have maintained or increased total abundances of returning and spawning adult fish, and preserved remaining genetic resources (PNPTT and WDFW 2014).
- HCS chum salmon originating from hatchery supplementation and reintroduction projects, and their naturally produced progeny, appear to be providing increasing benefits to ESU abundance, diversity, spatial structure, and (for reintroduced populations) productivity (PNPTT and WDFW 2014).

PS Steelhead

Steelhead hatchery programs in Puget Sound are operated for harvest augmentation (nine programs) and conservation (four programs) purposes. The conservation programs propagate native stocks that are part of the listed DPS. In all but one instance (the Muckleshoot Tribe’s Fish Restoration Facility winter-run steelhead program), the harvest augmentation programs produce early winter-run (Chambers lineage) (five programs) or Skamania summer-run steelhead (three programs) that are not part of the listed DPS (Jones 2015). Since the previous status review, hatchery releases of steelhead have declined, while releases of other species that may affect the status of natural steelhead populations through ecological effects (coho, chum, pink, and sockeye salmon) have remained stable (NMFS 2014b). Emerging hatchery program effect considerations and concerns since the last status review include:

- Conservation hatchery programs for the Elwha River, White River, Dewatto River, Duckabush River, and South Fork Skokomish River winter-run steelhead populations have maintained or increased total abundances of returning and spawning adult fish, and preserved remaining genetic resources (NMFS 2014c; Muckleshoot and Puyallup 2014; Berejikian et al. 2011; WDFW and LLTK 2012).

- Enhanced implementation of hatchery risk minimization/reform measures have likely decreased hatchery-related risks to natural steelhead populations. Nearly all Puget Sound region salmon and steelhead Hatchery and Genetic Management Plans have now been updated to address hatchery-related effects on listed steelhead.

- Termination of five early winter-run steelhead hatchery programs over the last five years has reduced genetic introgression and genetic diversity loss risks for natural steelhead in the DPS (Jones 2015; J. Scott, WDFW, K. Cunningham, WDFW, I. Tinoco, Muckleshoot Tribe, to NMFS SFD, pers. comm. 2015).

- Other substantive changes implemented in early winter-run steelhead hatchery programs that have reduced risks to natural steelhead associated with the programs relative to the risk level identified in the 2011 Status Review (NWFSC 2015) are reduced smolt release numbers by half in several watersheds, cessation of off-station early winter-run steelhead smolt releases altogether (on-station hatchery releases only, no more truck plantings shown to increase hatchery steelhead straying), cessation of "recycling" hatchery-origin adults trapped at the hatcheries and transported downstream to enhance sport fisheries, and maintenance of hatchery traps open for the entire duration of the hatchery early winter-run steelhead adult return period to remove the fish and reduce straying risks (NWFSC 2015).

- Recent genetic analyses indicate straying by hatchery-origin Skamania stock summer-run steelhead in the Snohomish River and Stillaguamish River watersheds has adversely affected natural summer-run steelhead population genetic diversity (NWFSC 2015).

- Recent genetic research has shown that effects of early winter-run (Chambers Creek lineage) hatchery steelhead gene flow on natural is in nearly all cases low (Warheit 2014).

- Continued monitoring and evaluation of gene flow effects for early winter-run steelhead programs is planned to better understand population-specific risks (Anderson et al. 2014), and to develop responsive changes in hatchery program operation that will reduce genetic risks for those natural steelhead populations that are most affected (e.g., WDFW 2016b).

- There is continued risk of competition and predation effects on rearing and migrating natural steelhead posed by hatchery Chinook and coho salmon, and steelhead released high in Puget Sound watersheds, especially for fish released at the yearling life stage.

- Monitoring and evaluation programs in south Puget Sound and Hood Canal have benefited understanding of steelhead smolt migration behavior, early marine survival, and factors limiting freshwater and early marine survival (Moore et al. 2010).

- Sustained monitoring and more robust sampling levels are essential to understand genetic impacts of stray early winter-run hatchery steelhead on local natural steelhead populations (Anderson et al. 2014).

- Continued budget restrictions may impact the ability to continue hatchery programs supporting at-risk steelhead stocks and to support needed hatchery performance and effects monitoring and research.
- Challenges continue regarding the need to manage hatcheries to support natural steelhead population recovery goals, while also supporting recreational fishing opportunities and tribal treaty-reserved fishing rights (NWIFC 2013).

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 the National Oceanic and Atmospheric Administration'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

We conclude that the risk to the species' persistence that may be attributable to hatchery-related effects has decreased since the last Status Review, based on hatchery risk reduction measures that have been implemented, and new scientific information regarding genetic effects noted above (NWFSC 2015). Improvements in hatchery operations associated with on-going ESA review and determination processes are expected to further reduce hatchery-related risks. Further, hatchery releases of PS Chinook salmon have remained stable while releases of HCS chum salmon and PS steelhead have declined.

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), steelhead (71 FR 834), and PS steelhead (72 FR 26722), we noted that while many of the ongoing protective efforts are likely to promote the conservation of listed salmonids, most efforts are relatively recent, have yet to demonstrate their effectiveness, and for the most part do not address conservation needs at scales sufficient to conserve entire ESUs or DPSs. Therefore, we concluded that existing protective efforts did not preclude listing several ESUs of salmon and several DPSs of steelhead.

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

2.4 Synthesis

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

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

PS Chinook Salmon

The updated status reviews completed by our Northwest Fisheries Science Center (NWFSC 2015) indicate that all PS Chinook salmon populations continue to be well below the PSTRT planning ranges for recovery escapement levels. Most populations are also consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery. Across the ESU, most populations have declined in abundance since the last status review (Ford et al. 2011), and this decline has been persistent over the past seven to ten years. Productivity remains low in most populations.

Hatchery-origin spawners are present in high fractions in most populations outside the Skagit River watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat monitoring and adaptive management planning efforts to develop monitoring plans was undertaken in all individual watersheds of Puget Sound in 2014.[134] These reports and prior annual three-year workplans document the many habitat actions that were initially identified in the PS Chinook salmon recovery plan. The expected benefits will take years or decades to produce significant improvement in natural population viability parameters. Development of a monitoring and adaptive management program was recommended by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan. This program is not yet fully functional for providing assessment of watershed habitat restoration/recovery programs, nor for properly integrating the essentially discrete habitat, harvest and hatchery programs. Overall, new information on abundance, productivity, spatial structure and diversity since the last review (Ford et al. 2011) does not indicate a change in the biological risk category since the time of the last five-year status review (NWFSC 2015).

HCS Chum Salmon

The Northwest Fisheries Science Center (NWFSC 2015) reported that natural-origin spawner abundance has increased since ESA-listing, and spawning abundance targets in both populations have been met in some years. Productivity was low at the time of the last review (Ford et al. 2011), though rates have increased in the last five years, and have been greater than replacement rates in the past two years for both populations. However, productivity of individual spawning aggregates shows only two of eight aggregates have viable performance. Spatial structure and diversity viability parameters for each population have increased and nearly meet the viability criteria. Despite substantive gains towards meeting viability criteria in the Hood Canal and Strait

[134] http://www.psp.wa.gov/SR_threeyearworkplan.php

of Juan de Fuca summer-run chum salmon populations, the ESU still does not meet all of the recovery criteria for population viability at this time.

The 2005 recovery plan for Hood Canal and Eastern Strait of Juan de Fuca Summer-run Chum salmon currently guides habitat protection and restoration activities for HCS chum salmon recovery. Despite gains in habitat protection and restoration, the co-managers remain concerned that given the pressures of population growth, existing land use management measures through local governments (i.e., shoreline management plans, critical area ordinances, and comprehensive plans) may be compromised or not enforced. The HCCC and co-managers advocate for the development of a strong habitat monitoring and adaptive management program as part of the recovery plan and recommend it be integrated to complement the existing stock assessment, harvest and hatchery management programs. The HCCC and co-managers propose there are sufficient new data and assessments which warrant revision of the current recovery plan, including updating recovery goals, prioritizing future habitat protection and restoration actions, addressing harvest goals, continuing reintroduction efforts, and continuing monitoring and evaluation for the HCS chum salmon ESU.

PS Steelhead

The Northwest Fisheries Science Center (NWFSC 2015) reported that the biological risks faced by the PS steelhead DPS have not substantively changed since the listing in 2007, or since the 2011 status review. Furthermore, Hard et al. 2015 recently concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs. Although the most recent data available indicate some minor increases in spawner abundance or improving productivity over the last 2-3 years, most of these improvements are small and abundance and productivity throughout the DPS remain at levels of concern for demographic risk. Recent increases in abundance that have been observed in a few populations have been within the range of variability observed in the past several years. Trends in abundance of natural spawners remain predominantly negative. Particular aspects of diversity and spatial structure, including natural spawning by hatchery fish and limited use of suitable habitat, are still likely to be limiting viability of most PS steelhead populations. Available new information confirms that this DPS remains at moderate risk of extinction. The forthcoming recovery plan for this DPS will identify specific viability criteria that will need to be met in order for this DPS to be considered recovered.

In the near term, the outlook for conditions affecting PS steelhead is not optimistic. While harvest and hatchery production of steelhead in Puget Sound are currently at low levels and are not likely to increase substantially in the foreseeable future, some recent environmental trends not favorable to PS steelhead survival and production are expected to continue. The exceptionally warm marine waters in 2014 and 2015 and warm stream temperatures observed during 2015 were unfavorable for high marine or freshwater survival. This and other environmental indicators point to continued conditions of warming ocean temperatures, fragmented or degraded freshwater spawning and rearing habitat, reduced snowpack, altered hydrographs producing reduced summer river flows and warmer water, and low marine survival for salmonids in the Salish Sea. These conditions are almost certain to constrain any rebound in VSP parameters for PS steelhead in the near term.

After considering the biological viability of the PS Chinook salmon ESU, the HCS chum salmon ESU, PS steelhead DPS, and the current status of the ESA section 4(a)(1) factors, we conclude that the status of these ESUs and DPS has not changed significantly since they were listed. Implementation of sound management actions in each H—habitat, hatcheries, and harvest—are essential to the recovery of Puget Sound salmon and steelhead and must continue. The biological benefits of habitat restoration and protection efforts 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 species and, in turn, contribute to the recovery of these ESUs and DPS. The Puget Sound Salmon Recovery Plan for Chinook salmon and the Hood Canal and Eastern Strait of Juan de Fuca Summer-run Chum Recovery Plan are the primary guides for identifying future actions to target and address PS Chinook salmon and HCS chum salmon limiting factors and threats. Over the next five years, it will be important continue to implement these actions and monitor our progress. A similar recovery plan is being developed for PS steelhead. This plan will serve the same function for this DPS once the plan is complete.

2.4.1 ESU/DPS Delineation and Hatchery Membership

The Northwest Fisheries Science Center's review found that no new information has become available that would potentially justify a change in boundaries of the Puget Sound salmon ESUs or steelhead DPS. On Oct. 21, 2016, NMFS proposed to change some hatchery program ESU/DPS statuses for all three Puget Sound salmonid species (81 FR 72759).

PS Chinook Salmon ESU

Currently, there are 37 hatchery programs for PS Chinook salmon with 26 of them listed in the ESU (Jones 2015). Two non-listed hatchery programs have been recommended for ESU inclusion [Bernie Kai-Kai Gobin (Tulalip) Hatchery-Cascade (spring-run) and NF Skokomish River (spring-run)] while two programs have been recommended for removal [Rick's Pond Hatchery and Icy Creek Hatchery (included in the Soos Creek program)]. Four other hatchery programs were renamed: (1) Soos Creek Hatchery changed to Soos Creek Hatchery (subyearlings and yearlings), (2) Keta Creek Hatchery changed to Fish Restoration Facility, (3) Tulalip Bay Program changed to Bernie Kai-Kai Gobin (Tulalip) Hatchery-Skykomish, and (4) Hupp Springs Hatchery changed to Hupp Springs Hatchery-Adult Returns to Minter Creek. One listed hatchery program has been terminated, Rick's Pond Hatchery (fall-run), with the last year of hatchery-origin adult returns in 2016. Two non-listed hatchery programs have been terminated, Bernie Kai-Kai Gobin (Tulalip) Hatchery (fall-run) and UW Portage Bay Hatchery (fall-run), with the last year of hatchery-origin adult returns in 2008 (Jones 2015).

HCS Chum Salmon ESU

Currently, there are four hatchery programs for HCS chum salmon with all of them listed in the ESU (Jones 2015). Two of the hatchery programs have been recommended for removal – Hamma Hamma Fish Hatchery and Jimmycomelately Creek Fish Hatchery. Both of these programs have been terminated with the last year of hatchery-origin adult returns in 2013 and 2016, respectively (Jones 2015).

PS Steelhead DPS

Currently, there are 20 hatchery programs for PS steelhead with six of them listed in the DPS (Jones 2015). One non-listed hatchery program has been recommended for DPS inclusion – Fish Restoration Facility. Three listed hatchery programs have been terminated (Hood Canal Supplementation-Dewatto River, Skokomish River, and Duckabush River) with the last of year of hatchery-origin adult returns in 2019 for all three programs. Four non-listed hatchery programs have been terminated (Barnaby Slough, Whatcom Creek Hatchery, Lower Elwha Tribe Hatchery, and Marblemount Hatchery) with the last year of hatchery-origin adult returns in 2009, 2012, 2014, and 2016, respectively (Jones 2015).

2.4.2 ESU/DPS Viability and Statutory Listing Factors

- The Northwest Fisheries Science Center's review of updated information does not indicate a change in the biological risk category for the Puget Sound salmon ESUs and the steelhead DPS since the time of their last status reviews (NWFSC 2015).
- Our analysis of the ESA section 4(a)(1) factors indicates that the collective risk to the persistence of Puget Sound salmon and steelhead has not changed significantly since our final listing determinations in 2005 and 2007. The overall level of concern remains the same.

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3 · Results

3.1 Classification

Listing status:

Based on the information identified above, we determine that no reclassifications for Puget Sound salmon and steelhead are appropriate. Therefore:

- The PS Chinook salmon ESU should remain listed as threatened.
- The HCS chum salmon ESU should remain listed as threatened.
- The PS 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 boundaries for the PS Chinook salmon ESU, HCS chum salmon ESU, or PS steelhead DPS.

Hatchery membership:

Based on the information identified above, the following hatchery membership recommendations are proposed:

PS Chinook Salmon ESU

- Two non-listed hatchery programs have been recommended for ESU inclusion – Bernie Kai-Kai Gobin (Tulalip) Hatchery-Cascade (spring-run) and NF Skokomish River (spring-run).
- Two programs have been recommended for removal – Rick's Pond Hatchery and Icy Creek Hatchery (included in the Soos Creek program).
- Four hatchery programs were renamed: (1) Soos Creek Hatchery changed to Soos Creek Hatchery (subyearlings and yearlings), (2) Keta Creek Hatchery changed to Fish Restoration Facility, (3) Tulalip Bay Program changed to Bernie Kai-Kai Gobin (Tulalip) Hatchery-Skykomish, and (4) Hupp Springs Hatchery changed to Hupp Springs Hatchery-Adult Returns to Minter Creek.
- One listed hatchery program has been terminated, Rick's Pond Hatchery (fall-run), with the last year of hatchery-origin adult returns in 2016.
- Two non-listed hatchery programs have been terminated, Bernie Kai-Kai Gobin (Tulalip) Hatchery (fall-run) and UW Portage Bay Hatchery (fall-run), with the last year of hatchery-origin adult returns in 2008.

HCS Chum Salmon ESU

- Two of the hatchery programs have been recommended for removal, Hamma Hamma Fish Hatchery and Jimmycomelately Creek Fish Hatchery.
- The Hamma Hamma Fish Hatchery and Jimmycomelately Creek Fish Hatchery programs have been terminated with the last year of hatchery-origin adult returns in 2013 and 2016, respectively.

PS Steelhead DPS

- One non-listed hatchery program has been recommended for DPS inclusion – Fish Restoration Facility.
- Three listed hatchery programs have been terminated (Hood Canal Supplementation-Dewatto River, Skokomish River, and Duckabush River) with the last of year of hatchery-origin adult returns in 2019 for all three programs.
- Four non-listed hatchery programs have been terminated (Barnaby Slough, Whatcom Creek Hatchery, Lower Elwha Tribe Hatchery, and Marblemount Hatchery) with the last year of hatchery-origin adult returns in 2009, 2012, 2014, and 2016, respectively.

3.2 New Recovery Priority Number

Since the previous five year plan, NMFS revised the recovery priority numbers from one (NMFS 2009) to new recovery priority numbers of seven for the PS steelhead DPS and nine for the PS Chinook salmon and HCS chum salmon ESUs (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 actions that are critical to improving the status of the Puget Sound ESUs and DPS. Implementation of the Final Recovery Plans for PS Chinook salmon and HCS chum salmon and development of a Recovery Plan for PS steelhead are the most important actions to be taken over the next 5 years. Additional actions recommended are as follows:

- Research specific causes of mortality in smolted Puget Sound steelhead populations.
- Develop and complete recovery plan for Puget Sound steelhead.
- Systematically review and quantitatively analyze the amount of habitat restored versus the priority watershed reaches identified for protection and restoration activities in the 2007 Puget Sound Chinook salmon recovery plan in order to track progress against plan objectives.
- Engage EPA in consultation during its triennial review of State water quality standards to identify comprehensive and systemic threshold water quality conditions necessary to maintain or reestablish habitat values necessary for listed fish.
- Develop, in concert with COE and EPA, program scale protocols for marine shorelines such as a regional general permit, or a programmatic consultation, for marine shore protection that places greater reliance on WDFW 2014 and WDOE 2014 shoreline protection guidance documents and methods.
- Complete a programmatic consultation on culvert replacement/habitat restoration with the Corps to expedite removal of culverts blocking smaller streams that would serve as suitable habitat for steelhead independent of a completed recovery plan.
- Partner with other federal agencies (e.g., Corps, FEMA) to better identify floodplain reductions and corollary fish life-history impacts, and to develop both mitigation criteria and triggers for when is required, to reduce such impacts.
- Distribute habitat protection and restoration strategically among the areas affecting the Strait of Juan de Fuca and Hood Canal populations and their subpopulations to balance the need to 1) reduce the performance gaps for subpopulations projected to be below viability thresholds and 2) strengthen performance in the core subpopulations for the sake of bolstering overall population abundance (HCCC 2014).

5 · References

5.1 Federal Register Notices

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

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

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

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

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

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

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

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

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

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

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

January 19, 2007 (72 FR 2493). Notice of Availability: Endangered and Threatened Species; Recovery Plans.

May 11, 2007 (72 FR 26722). Final Rule: Endangered and Threatened Species: Final Listing Determination for Puget Sound Steelhead.

May 24, 2007 (72 FR 29121). Notice of Availability: Endangered and Threatened Species; Recovery Plans.

September 25, 2008 (73 FR 55451). Final Rule: Endangered and Threatened Species: Final Protective Regulations for Threatened Puget Sound Steelhead.

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

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

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

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

October 21, 2016 (81 FR 72759). Proposed Rule: Revisions to Hatchery Programs Included as Part of Pacific Salmon and Steelhead Species Listed Under the Endangered Species Act.

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National Marine Fisheries Service
5-Year Review

Puget Sound Chinook Salmon
Hood Canal Summer-run Chum Salmon
Puget Sound Steelhead

Conclusion:

Based on the information identified above, we conclude:

- The Puget Sound Chinook salmon ESU should remain listed as threatened.
- The Hood Canal Summer-run chum salmon ESU should remain listed as threatened.
- The Puget Sound steelhead DPS should remain listed as threatened.

REGIONAL OFFICE APPROVAL

Approve: ______________________ Date: 6 April 2017

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