Science, Service, Stewardship

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

National Marine Fisheries Service
Northwest 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*
Chum Salmon (*O. keta*)	*Hood Canal Summer Chum*
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 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 and steelhead DPSs. On June 28, 2005, we issued final listing determinations for 16 ESUs of Pacific salmon. On January 5, 2006 we issued final listing determinations for 10 DPSs of steelhead.

1.2 Methodology used to complete the review

On March 18, 2010, we announced the initiation of five year reviews for 16 ESUs of salmon and 10 DPSs of steelhead in Oregon, California, Idaho, and Washington (75 FR 13082). We requested that the public submit new information on these species that has become available since our listing determinations in 2005 and 2006. 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 Center 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 (Ford et al. 2010).

To further inform the reviews, we also asked salmon management biologists from our Northwest 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 et al. 2011) describing their findings. Finally, we consulted biologists and other salmon management specialists from the Northwest 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 (Ford et al. 2010;); the report of the regional biologists regarding hatchery programs (Jones et al. 2011); 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

75 FR 13082; March 18, 2010

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
Chum Salmon (*O. keta*)	Hood Canal Summer 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 Hood Canal summer chum salmon in 2005. A critical habitat designation for PS steelhead is under development (76 FR 1392; January 10, 2011).

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)). For threatened salmonids, NMFS has adopted 4(d) regulations that prohibit take except in specific circumstances. In 2005, we applied 4(d) protective regulations to Puget Sound Chinook salmon and Hood Canal summer chum salmon; Puget Sound steelhead were afforded 4(d) protection in 2008.

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:** 70 FR 37160 **Date:** 6/28/2005	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Chum Salmon (*O. keta*)	Hood Canal Summer Chum Salmon	**FR Notice:** 70 FR 37160 **Date:** 6/28/2005	**FR Notice:** 70 FR 52630 **Date:** 9/2/2005
Steelhead (*O. mykiss*)	Puget Sound Steelhead	**FR Notice:** 73 FR 55451 **Date:** 9/25/2008	Under development **FR Notice:** 76 FR 1392 **Date:** 1/10/2011

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.

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	PSTRT 2006 Ruckelshaus et al. 2006 Good et al. 2005 PSTRT 2005 PSTRT and SSSG 2003 Ruckelshaus et al., 2002 NMFS 1999b NMFS 1998
Chum Salmon (*O. keta*)	Hood Canal Summer Chum Salmon	Sands et al. 2009 Good et al. 2005 PSTRT and SSSG 2003 NMFS 1999a NMFS 1999b NMFS 1997 NMFS 1996
Steelhead *(O. mykiss)*	Puget Sound Steelhead	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. We assess three criteria to determine a species' priority for recovery plan development, implementation, and resource allocation: (1) magnitude of threat; (2) recovery potential; and (3) existing conflict with activities such as construction and development. Table 4 lists the recovery priority numbers for the subject species, as reported in the *2006-2008 Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species* (available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esabiennial2008.pdf).

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	**1**	**Title:** Puget Sound Salmon Recovery Plan Available at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/PS-Chinook-Plan.cfm **Date:** January 19, 2007 **Type:** Final **FR Notice:** 72 FR 2493
Chum Salmon (*O. keta*)	Hood Canal Summer Chum salmon	**1**	**Title:** Hood Canal & Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan Available at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/Hood-Canal-Plan.cfm **Date:** November 15, 2005 **Type:** Final **FR Notice:** 72 FR 29121
Steelhead (*O. mykiss*)	Puget Sound Steelhead	**1**	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 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 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 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?

Not Applicable

2.1.1 Summary of relevant new information regarding the delineation of Puget Sound ESUs/DPS

ESU/DPS Boundaries

There is no new information suggesting that the ESU/DPS boundaries in the Puget Sound area should be revisited.

Membership of Hatchery Programs

In preparing this report, our management biologists reviewed the available information regarding hatchery membership of this ESU and DPS (Jones et al. 2011). 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.

Several new hatchery programs propagating listed PS Chinook salmon and PS steelhead have been initiated since the time of the last status review. All of the new programs use the extant native populations as donor broodstock, thus there is minimal divergence from the local populations.

PS Chinook Salmon

This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington, as well as twenty-six artificial propagation programs: the Kendal Creek Hatchery, Marblemount Hatchery (fall, spring yearlings, spring subyearlings, and summer run), Harvey Creek Hatchery, Whitehorse Springs Pond, Wallace River Hatchery (yearlings and subyearlings), Tulalip Bay, Issaquah Hatchery, Soos Creek Hatchery, Icy Creek Hatchery, Keta Creek Hatchery, White River Hatchery, White Acclimation Pond, Hupp Springs Hatchery, Voights Creek Hatchery, Diru Creek, Clear Creek, Kalama Creek, George Adams Hatchery, Rick's Pond Hatchery, Hamma Hamma Hatchery, Dungeness/Hurd Creek Hatchery, Elwha Channel Hatchery Chinook hatchery programs.

The Marblemount fall-run Chinook salmon and Big Beef Creek Chinook salmon hatchery programs were terminated during the current review period. The last years adults returned or will return to these hatcheries is 2013 and 2008, respectively.

Two new conservation-directed Chinook salmon programs have been established and are using the native natural-origin populations as broodstock. These are the Skookum Creek Hatchery (Nooksack River) and the Harvey Creek Hatchery (Stillaguamish River) programs. The new programs warrant consideration for inclusion in the ESU (Jones et al. 2011).

Jones et al. (2011) 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.

Hood Canal Summer Chum Salmon

This ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington, as well as eight artificial propagation programs: the Quilcene NFH, Hamma Hamma Fish Hatchery, Lilliwaup Creek Fish Hatchery, Union River/Tahuya, Big Beef Creek Fish Hatchery, Salmon Creek Fish Hatchery, Chimacum Creek Fish Hatchery, and the Jimmycomelately Creek Fish Hatchery summer-run chum hatchery programs.

Five Hood Canal summer chum hatchery programs were terminated since the last status review, including: the Quilcene National Fish Hatchery, Union River/Tahuya River, Big Beef Creek, Salmon Creek, and Chimacum Creek programs. The last adult fish produced through these terminated programs returned in 2008.

Jones et al. (2011) did not recommend any further review of the remaining existing programs that are identified as part of the Hood Canal summer 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

The DPS includes all naturally spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks.

The Lake Washington (native) and White River (Chambers stock) winter-run steelhead hatchery programs were terminated prior to the last status review. The Hamma Hamma River hatchery program and four other hatchery programs not considered part of the DPS (Puyallup River, Deschutes River, Eels Springs, and Morse Creek) were terminated during the last 5 years. The last years adult steelhead returned as a result of juvenile fish releases from these hatcheries were 2010 for Hamma Hamma, 2009 for Puyallup River, 2008 for Deschutes River, 2006 for Eels Springs, and 2006 for the Morse Creek program.

Five new steelhead programs propagating native-origin fish for the purposes of preserving and recovering the populations also have been initiated. These programs support recovery of native winter-run steelhead in the White, Dewatto, Duckabush, North Fork Skokomish, and Elwha River watersheds. The new programs warrant consideration for inclusion in the DPS (Jones et al. 2011).

Jones et al. (2011) did not recommend any further review of existing programs that are identified as part of 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 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 Chum Salmon	X	
Puget Sound Steelhead		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 Chum Salmon	X	
Puget Sound Steelhead		N/A

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

PS Chinook Salmon

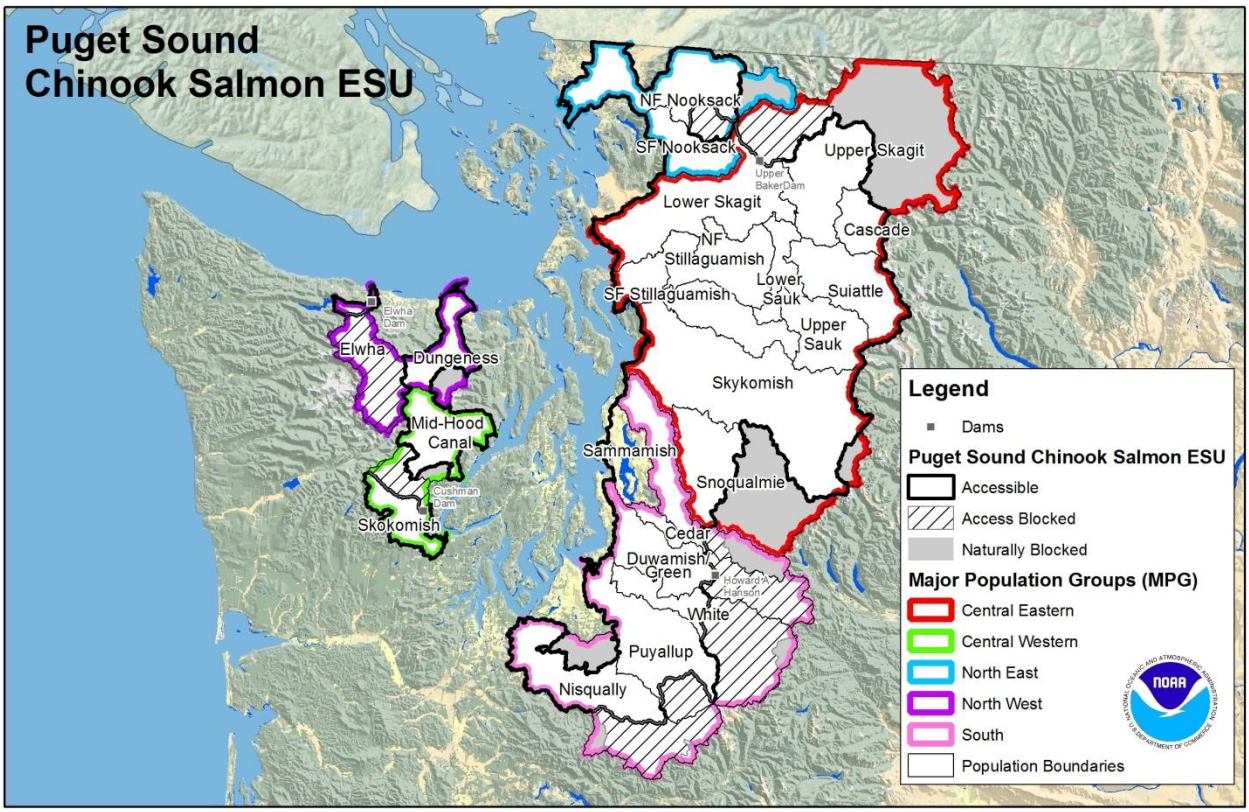

Figure 1. Puget Sound Chinook Salmon ESU population structure[1]

For the purposes of reproduction, salmon and steelhead typically exhibit a metapopulation structure (Schtickzelle and Quinn 2007, McElhany et al. 2000). Rather than interbreeding as one large aggregation, ESUs and DPSs function as a group of demographically independent populations separated by areas of unsuitable spawning habitat. For conservation and

[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.

management purposes, it is important to identify the independent populations that make up an ESU or DPS.

The Puget Sound Recovery Plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelhaus et al. 2002). The PSTRT identified 22 extant populations within the PS Chinook salmon ESU. They defined five biogeographical regions in Puget Sound within which the 22 populations occur (Figure 1). 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 5 regions be viable, based on the historical patterns present within that region.

The PSTRT's Biological Recovery Criteria will be met when the following conditions are achieved:

1. All watersheds improve from current conditions, resulting in improved status for the species;
2. At least two to four Chinook salmon populations in each of the five biogeographical regions of Puget Sound attain a low risk status over the long-term;
3. At least one or more populations from major diversity groups historically present in each of the five Puget Sound regions attain a low risk status;
4. Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario;
5. Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
6. Populations that do not meet the viability criteria for all VSP parameters (i.e., abundance, productivity, spatial structure, and diversity) are sustained to provide ecological functions and preserve options for ESU recovery.

The PSTRT provided population-level viability criteria for abundance, productivity, spatial structure and diversity. The PSTRT used historical information and technical models to recommend planning ranges for abundance and productivity that describe viability characteristics for each of the 22 Chinook populations in Puget Sound (Ruckelshaus et al. 2002). The PSTRT also described spatial structure and diversity characteristics of low risk populations. The VSP criteria and the rationale

supporting each are available at http://www.nwfsc.noaa.gov/trt/puget/trtpopesu.pdf.

Hood Canal Summer Chum Salmon

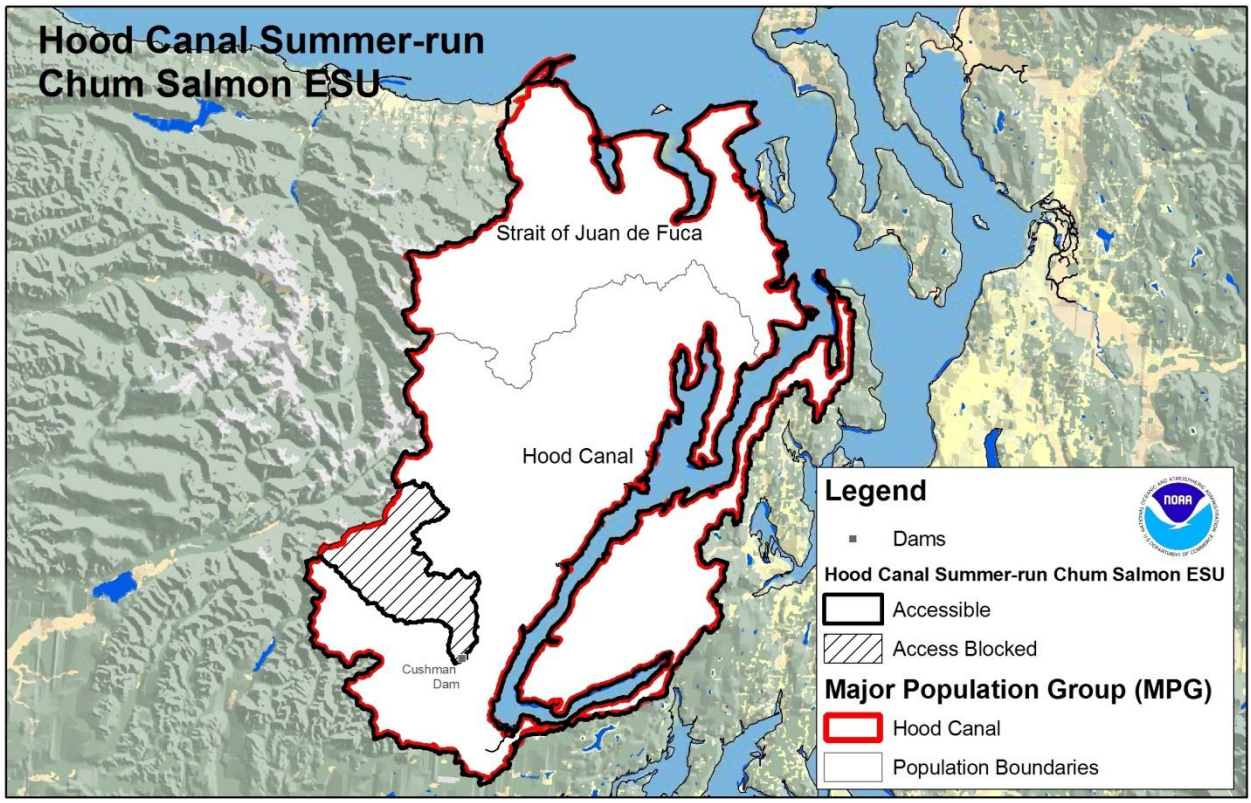

Figure 2. Hood Canal Summer Chum Salmon ESU population structure[2]

[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.

The PSTRT concluded that both historical populations of summer chum (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 chum 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 Hood Canal summer chum 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.

We approved the PSTRT's population-level recovery criteria in the final Hood Canal Summer Chum recovery plan. These criteria apply the four VSP parameters and are summarized as follows:

Abundance & Productivity

A population will have a low risk of extinction if it has sufficient naturally produced abundance and productivity to persist in the face of natural variability in returns caused by environmental and anthropogenic factors.

Spatial Structure

A viable population contains multiple persistent spawning aggregations. The number of persistent aggregations needed for viability depends on the historical biological characteristics of the population and the historical distribution of spawning aggregations of the population. A population that meets the criteria below is likely to have a negligible risk of extinction over a 100-year period (i.e., be viable):

- Spawning aggregations are distributed across the historical range of the population.
- Most spawning aggregations are within 20 km of adjacent aggregations.
- Major spawning aggregations are distributed across the historical range of the population and are not more than approximately 40 km apart.

Both larger and smaller spawning aggregations of summer chum are important. Although it may not be necessary to reestablish spawning aggregations in all rivers and streams where they historically occurred, meeting spatial structure population viability criteria will require reestablishing spawning aggregations in some major rivers and smaller streams and creeks where they have been extirpated. Particularly in the early stages of population and ESU recovery, production of summer chum from smaller streams may provide important contributions to the health of freshwater, estuarine, and marine ecosystems and to the maintenance of the viability of the population while degraded habitats in other rivers and creeks are recovering.

Diversity

The PSTRT estimates there likely were at least two ecological diversity groups within the Strait of Juan de Fuca population and at least four ecological diversity groups within the Hood Canal population. Depending on the geographic extent and ecological context of the population, a viable population includes one or more persistent spawning aggregations from each of the two to four major ecological diversity groups historically present within the two populations (see also McElhany et al. 2000). In all cases, with the possible exception of the Dungeness River aggregation within the Strait of Juan de Fuca population, summer chum spawning groups exist today that represent each of the ecological diversity groups within the two populations. The co-managers' interim recovery goals (WDFW and PNPTT 2003) include the following criteria. They state:

> No less than the extant 6 Hood Canal natural stocks and 2 Strait natural stocks must meet all the individual stock recovery criteria. The corollary to this criterion is that, on average, the ESU-wide abundance must meet or exceed the sum of all these individual stock thresholds and the ESU-wide spawning escapement must meet or exceed the sum of all these individual stock escapement thresholds. Also, on average, the ESU-wide productivity must meet or exceed 1.6 recruits per spawner. Ideally, recovery goals should be developed based on knowledge and assessment of the habitat and of how the habitat affects potential production, productivity and diversity of the stocks. Currently no such assessment exists that is adequate to tie the habitat directly to recovery goals. Studies should be undertaken in the future to develop quantitative relationships between habitat conditions and summer chum salmon performance within the watersheds and estuaries that then could provide knowledge for improving the recovery goals. (WDFW and PNPTT 2003)

For each stock, each of the following criteria must be met:

- The mean natural origin abundance and mean natural origin spawning escapement of each stock shall meet or exceed the above-described abundance and spawning escapement thresholds, over a period of the most recent 12 years.
- The natural origin abundance and natural origin spawning escapement of each stock shall be lower than the stock's respective critical thresholds (or, where applicable, minimum escapement flag) in no more than 2 of the most recent 8 years and, additionally, in no more than 1 of the most recent 4 years.
- Natural recruits per spawner shall average at least 1.6 over the 8 most recent brood years for which estimates exist and no more than 2 of the 8 years shall fall below 1.2 recruits per spawner.

PS Steelhead

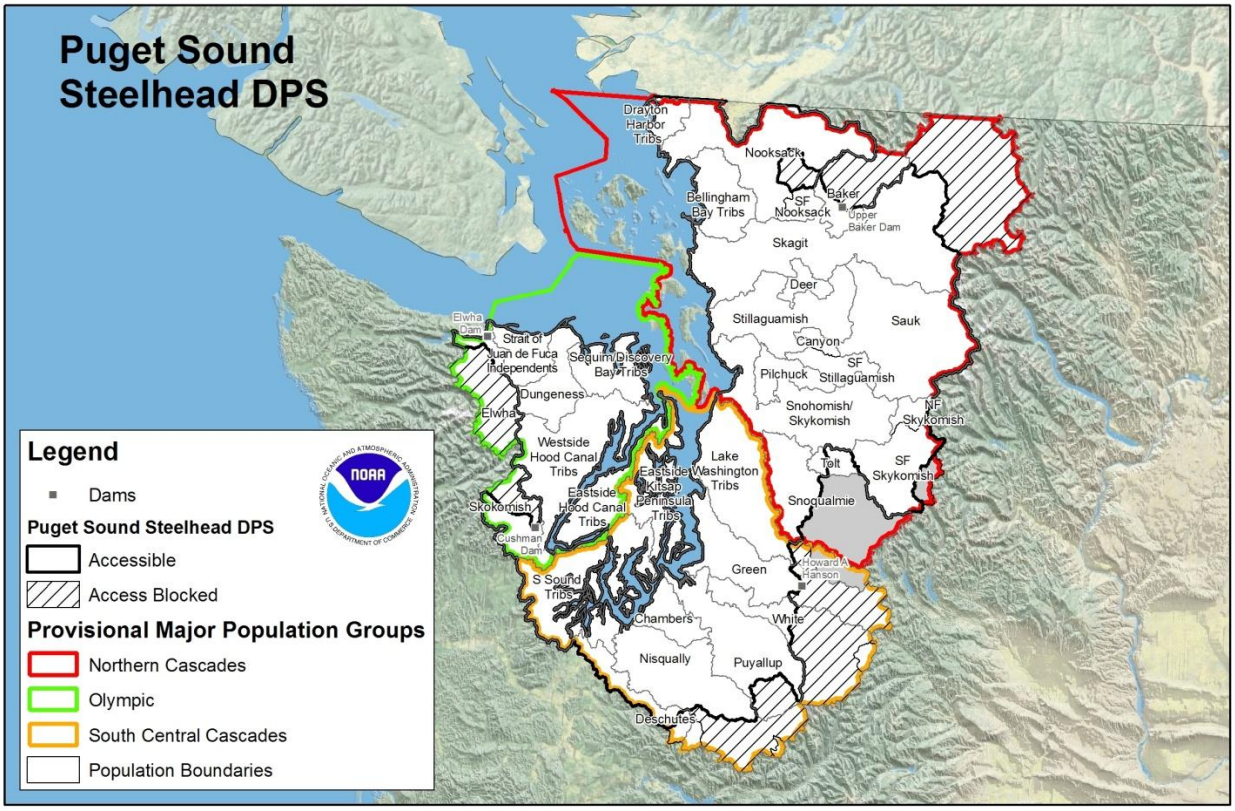

Figure 3. Puget Sound Steelhead Putative DPS population structure[3]

PS steelhead were listed in 2007 and we convened a Steelhead Technical Recovery Team (TRT) in 2008. The TRT is nearing completion of population identification and biological viability criteria for the PS Steelhead DPS. The putative population structure contains 3 major population groups with approximately 35 populations (Figure 3). We will develop a recovery plan in coordination with regional partners when the TRT concludes its technical work.

[3] The map above generally shows the accessible and historically accessible areas for the PS steelhead. 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.

2.3 Updated Information and Current Species' Status

The PSTRT developed biological recovery criteria that describe the characteristics of a viable Puget Sound salmon ESUs (Ruckelshaus et al. 2002). NMFS based its status assessment on the biological recovery criteria and an evaluation of PS Chinook salmon and Hood Canal summer chum salmon abundance, productivity, spatial structure and diversity as identified in the VSP concept (McElhany et al. 2000). NMFS described the conditions under which the ESU status will have a low risk of extinction based on an integrated assessment of the four VSP parameters. Our assessment of PS steelhead is based on the existing information developed during recovery planning. The information below is summarized from our Northwest Fisheries Science Center assessment– *Status Review Update for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Northwest* (Ford et al. 2010).

2.3.1 PS Chinook Salmon

Abundance & Productivity

Productivity estimates are based on cohort run reconstruction using the PSTRT Abundance and Productivity data (Sands 2009). The Northwest Fisheries Science Center examined median recruits per spawner and spawners per spawner for each population over five 5-year intervals. Recruits were estimated for brood years through 2006. Since coded-wire-tag data are only available through 2009, estimates of 2005 age 5 returns and 2006 age 4 and 5 returns were made using forecast methods. The estimates for these two years are not as precise as for earlier years.

While natural origin recruit escapements have remained fairly constant during this time period (1985-2009), total natural origin recruit abundance and productivity have continued to decline. Median recruits per spawner for the last five-year period (brood years 2002-2006) is the lowest over any of the five year intervals. However, results vary across populations in the ESU with some populations showing stronger trends than others.

Spatial Structure & Diversity

Indices of spatial distribution and diversity have not been developed at the population level. The Northwest Fisheries Science Center used a diversity index at the ESU level to determine changes in distributions of abundance among the 22 populations and among the five bio-geographical regions. Spatial structure and diversity are measured for the ESU as a whole to indicate whether the total Chinook salmon abundance is being distributed in a healthy pattern among populations and bio-geographical regions within Puget Sound. The Northwest Fisheries Science Center used a diversity index (Shannon H index) to measure diversity of spatial distribution.

Diversity is greatest when there is uniform distribution among populations, but this typically is not the natural condition since larger streams will naturally have a greater abundance than small systems. If most recovery occurs in a particular area (such as the Skagit River Basin) then the distribution of salmon throughout Puget Sound is disproportionately emphasized in that area and this is indicated by reduced diversity across the ESU.)

The Northwest Fisheries Science Center estimated the diversity index for 5 year time intervals over the 25 year time span of the available data. In general, a higher diversity value indicates a healthier distribution of salmon among the streams and rivers in the ESU. Current estimates of diversity show a decline over the past 25 years, indicating a decline of salmon in some areas and increases in others. Salmon returns to the Whidbey Region increased in abundance while returns to other regions declined. In aggregate, the diversity of the ESU as a whole has been declining over the last 25 years.

Population Viability

The estimated spawner recruit functions are based on survival patterns experienced in the early 1990s. Those survival patterns appear relevant to current conditions because marine survival (as measured by returns of hatchery releases) has been relatively low since the mid-1980s.

ESU Summary

All PS Chinook salmon populations are well below escapement abundance levels ("planning ranges") identified as required for recovery to low extinction risk in the recovery plan. In addition, most populations are consistently below the productivity goals identified in the recovery plan as necessary for recovery. Although trends vary for individual populations across the ESU, most populations have declined in total natural origin recruit abundance since the last status review; and natural origin recruit escapement trends since 1995 are mostly stable. Several of the risk factors identified in the previous status review (Good et al. 2005) are still present, including high fractions of hatchery fish in many populations and widespread loss and degradation of habitat.

Overall, the new information on abundance, productivity, spatial structure and diversity since the last review does not indicate a change in this ESU's biological risk category. Over the last five years, the PS Chinook salmon ESU has made little progress toward meeting the recovery criteria and current trends in abundance are negative. However, available information does not indicate that extinction risk has increased significantly. Although this ESU's total abundance is a greatly reduced from historic levels, recent abundance levels do not indicate that the ESU is at immediate risk of extinction. This ESU remains relatively well distributed over 22 populations in 5 geographic areas across the Puget Sound. Although current trends are concerning, the available information indicates that this ESU remains at moderate risk of extinction.

2.3.2 Hood Canal Summer Chum Salmon

Abundance & Productivity

Spawning abundance is available from 1968 for the Hood Canal population and from 1971 for the Strait of Juan de Fuca population. Escapement estimates prior to 1974 are less precise due to sampling procedures.

The Northwest Fisheries Science Center examined average escapements (geometric means) for five-year intervals and estimates of trends over the intervals for all natural spawners and for natural-origin only spawners. For both populations, abundance was relatively high in the 1970s,

lowest for the mid period (1985-1999), and high again for the most recent 10 years. The overall trend in spawning abundance is generally stable (close to one) for the Hood Canal population (all natural spawners and natural-origin only spawners) and for the Strait of Juan de Fuca population (all natural spawners). Only the Strait of Juan de Fuca population's natural-origin only spawners shows a significant positive trend.

Using the Salmon Population Analyzer (SPAZ) model[4] trend analysis, the Northwest Fisheries Science Center determined the only abundance trend that appears to be positive occurs during a short time span (1995-2009) is the Juan de Fuca population. This supports the above analyses based on 5 year interval data. None of the average growth rate (lambda) estimates indicate positive average growth rates.

Productivity in the last 5-year period (2005-2009) has been very low, especially compared to the relatively high productivity observed during the 5-10 previous years (1994-2004).

Spatial Structure & Diversity

The Northwest Fisheries Science Center measures spatial distribution using the Shannon diversity index. Higher diversity values indicate a more uniform distribution of the population among spawning sites, which provides greater robustness to the population. Values were generally lower in the 1990s for both populations, indicating that most of the abundance occurred at a few spawning sites. The overall linear trend appears to be negative which is not desirable. However, the last five year interval shows the highest average value for both populations. This results in part from the addition of one reintroduced spawning aggregation in the Strait of Juan de Fuca population and two in the Hood Canal population.

Population Viability

The recovery plan included abundance and productivity viability criteria for the Hood Canal summer chum populations based on: (1) an assumption of density independence and a replacement growth factor of 1:1; and (2) an assumption of density dependence which provides a series of viable spawner recruit functions (Sands et al. 2009). The PSTRT used 1974-2001 brood year data in their analyses. The minimum viability levels assuming density independence were 12,500 for the Strait of Juan de Fuca population (this has not been attained in the years 1971 to

[4] The Salmon Population AnalyZer is a tool for analysis of time series data from salmon populations. The program is not a single model, but is rather a collection of multiple methods that can be used to fit population growth models to data and to simulate future salmon population growth for the purpose of assessing population viability and setting population goals. Information available at: http://www.nwfsc.noaa.gov/trt/wlc/spaz.cfm

present) and 24,700 for the Hood Canal population (this has been attained four times since 1971, twice since 2003).

The Northwest Fisheries Science Center expressed viable abundance and productivity as a Beverton-Holt spawner recruit function defined by the parameters of intrinsic productivity and capacity abundance and estimated to represent a recovered state. Different functions were given for different levels of desired harvest exploitation after attaining recovery. Plotting the two parameters from the functions produced a series of lines on a graph illustrating viability at various exploitation rates. Estimates of intrinsic productivity and capacity from the spawner-recruit functions determined for three over lapping time periods (representing recent habitat conditions) were plotted on the graphs from Sands et al. (2009) in order to compare them with the viability lines. The associated average exploitation rates for the three time periods were noted with the plotted points to illustrate which viability line the point should be compared against. The plotted points representing current status of the populations all fall within the non-viable section of the graph for both populations. Sands et al. (2009) expressed viability for spatial distribution and diversity as a need to maintain a diverse aggregation of subpopulations within each population. If current relatively high diversity index values were to be maintained over time it would increase the probability of satisfying that criteria.

ESU Summary

The spawning abundance of this ESU has increased since the time of listing, although the recent abundance is down from the previous 5 years. Spawning abundances have remained relatively high compared to the low levels in the early 1990s. Diversity is increasing from the low values seen in the 1990s. This is due to the reintroduction of spawning aggregates and the more uniform relative abundance between populations, and an improvement in viability in terms of spatial structure and diversity. Survey data shows the spawning distribution within most streams has been extended further upstream as abundance has increased (WDFW and PNPTT 2007). However, the ESU has not consistently met the recovery criteria. Overall, the new information we considered does not indicate a change in the biological risk category since the time of the last status review. This ESU remains at moderate risk of extinction.

2.3.3 PS Steelhead

For all but a few putative demographically independent populations of steelhead in Puget Sound, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10% annually. Extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high, especially for draft populations in the putative South Sound and Olympic major population groups. Collectively, these analyses indicate that steelhead in the Puget Sound DPS remain at risk of extinction throughout all or a significant portion of their range in the foreseeable future, but are not currently in danger of imminent extinction.

Our Biological Review Team identified degradation and fragmentation of freshwater habitat, with consequent effects on connectivity, as the primary limiting factors and threats facing the PS steelhead DPS. In the three years since listing, the status of threats has not changed appreciably.

The status of the listed PS steelhead DPS has not changed substantially since the 2007 listing. Most populations within the DPS are showing continued downward trends in estimated abundance, a few sharply so. The limited available information indicates that this DPS remains at a moderate risk of extinction.

2.3.4 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: (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) the inadequacy of existing regulatory mechanisms; or (5) 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.

Present or threatened destruction, modification or curtailment of its habitat or range

Tribal, federal, state and local governments in partnership with others have implemented a number of habitat restoration projects since the last status review. Ultimately, these efforts are expected to improve the survival and productivity of listed salmon and steelhead throughout Puget Sound. However, we do not have information demonstrating that these projects led to increased population or ESU viability during the 5-year status review period. We expect to make a stronger correlation between habitat restoration projects and salmonid population response as project implementation and monitoring continue.

We identified several significant habitat actions implemented since the previous status review. We found that the Hood Canal Coordinating Council, Puget Sound Partnership, Puget Sound tribes, local governments and others are funding and implementing multiple habitat restoration and protection projects. In the Skagit River basin, tidegate and stream restoration work is resulting in a significant expansion of functional habitat for both local populations and those from other biogeographical regions within Puget Sound.

The Washington State Forest Practices Habitat Conservation Plan (HCP) was approved in June 2006, assuring lands managed for industrial timberland production and regulated by the State Department of Natural Resources will improve conditions for salmon during the next 50 years. The HCP covers 3.5 million acres, 43% of the total land area in Puget Sound. The Snoqualmie and Dungeness River basins recently adopted levee and stream restoration efforts to support salmon recovery. Habitat restoration efforts in the Nisqually and Skokomish River estuaries continue to advance, consistent with the PS Chinook and Hood Canal Summer Chum recovery plans.

Despite ongoing efforts by multiple parties to improve habitat conditions in Puget Sound, habitat in all ESUs and DPS remains far below those needed to sustain viable populations of listed fish. Habitat loss and degradation continue to impede recovery of PS Chinook salmon and steelhead and Hood Canal summer chum salmon. A recent NMFS review of recovery plan implementation status indicates that the quality of PS Chinook salmon habitat is still declining, and protection of remaining habitat needs improvement (NMFS 2011). For example, approximately 4 miles of shoreline habitat was lost to new bank hardening projects since adoption of the Recovery Plan. The review also concluded that habitat restoration work that is underway is heavily weighted towards capital restoration projects, at the expense of non-capital projects that are equally important for ESU recovery. Funding levels are also inadequate to fully implement short term actions proposed to address high priority restoration actions specified in the NMFS-approved recovery plan. We expect many of the habitat and hatchery actions identified in the PS Chinook salmon recovery plan will take years or decades to be implemented and produce significant improvements in natural population attributes. The observed trends are consistent with these expectations.

Puget Sound salmon and steelhead recovery will require further protection of remaining functional habitat and restoration of both freshwater and nearshore areas. For instance, one recent study (Roni et al. 2010) used a new technique to estimate the amount of restoration needed within a Puget Sound watershed to cause a significant increase in steelhead and coho salmon production. These authors found that the percentage of floodplain and in-channel habitat that would have to be restored in a modeled watershed to detect a 25 percent increase in coho salmon and steelhead smolt production was 20 percent. Although 20 percent may seem like a low value, restoring 20 percent of floodplain and in-channel habitat in any disturbed watershed in the Pacific Northwest would be very costly (Roni et al. 2010). The results of this study highlight the need to protect high quality habitat while strategically improving degraded areas with active restoration.

Improvement in monitoring and reporting of habitat restoration metrics will be necessary to document changes in viability as a response to changes in habitat condition. New information that has become available since the last status review indicates that there have been important improvements in freshwater and estuary/nearshore habitat condition from restoration actions and additional habitat protection projects. However, habitat concerns remain throughout the range of the Puget Sound ESUs and DPS particularly in regards to water quality, water quantity, freshwater riparian corridors and marine shorelines. We therefore conclude that the risk to the species' persistence because of habitat destruction or modification has not changed appreciably since the last status reviews.

Overutilization for commercial, recreational, scientific, or educational purposes

Research and Monitoring

Authorized take of ESA listed species for research in Puget Sound represents a minor component of overutilization. Although effects vary from year to year, they are generally increasing. Mortality due to research typically is restricted to less than 5 percent of the fish handled and, in most cases, is less than 1% of the handled fish. Scientific research and monitoring provides information necessary to determine status and trends of listed species and has not been identified as a factor for decline or threat affecting recovery.

Harvest

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) 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. The harvest plan does not include the specific details of the annual fishing regime, but provides 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 plan 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 previous harvest management plan (2004-2010) was adopted as the harvest component of the Puget Sound Salmon Recovery Plan which includes the PS Chinook salmon ESU. The newly approved PS Chinook salmon harvest plan will replace the previous plan as the harvest component of the Puget Sound Salmon Recovery Plan. The harvest management plan for Hood Canal summer-run 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).

PS Chinook Salmon

Harvest rates over the past 20 year show a generally decreasing trend. However, exploitation rates in some regions of Puget Sound increased over the past 10 years. The recent increases primarily are due to higher harvest levels in northern fisheries. The 2008 Pacific Salmon Treaty includes provisions to reduce the allowable annual catch in the Southeast Alaskan and West Coast Vancouver Island fisheries by 15 percent and 30 percent, respectively, compared to the previous agreement. These provisions are expected to benefit PS Chinook salmon (NMFS 2008a).

Hood Canal Summer Chum Salmon

There are no directed fisheries for Hood Canal summer chum salmon, although they are taken indirectly in other fisheries. Co-managers have constrained harvest impacts on fisheries for other species since the 1990s in order to protect Hood Canal summer chum salmon.

PS Steelhead

Fisheries for steelhead are directed at hatchery stocks, but some harvest of natural origin steelhead occurs as incidental to hatchery-directed and other salmon fisheries. Retention of wild steelhead is prohibited in recreational fisheries. Steelhead are also impacted in terminal tribal gillnet fisheries and in recreational fisheries. Where available, exploitation rates on natural steelhead in recent years have been stable and generally less than 5%. Washington Department of Fish and Wildlife's 2010-2012 Fishing Regulations include no directed fisheries for steelhead.

New information available since the last ESA status review indicates harvest impacts have decreased somewhat, and research impacts have remained constant. The risk to the species' persistence because of overutilization has decreased slightly since the last status review. Harvest still remains a limiting factor for PS Chinook salmon but it is not a significant limiting factor for PS steelhead and Hood Canal summer chum salmon.

Disease or predation

Disease rates over the past five years are believed to be consistent with the previous review period. Climate change impacts such as increasing temperature may increase susceptibility to diseases. Recent reports indicate the spread of a new strain of infectious haematopoietic necrosis virus along the Pacific coast which may increase disease related concerns for PS steelhead in the future. Improvement in flow and temperature management in the Elwha basin may reduce outbreak and spread of disease which are exacerbated by warmer water temperatures.

Predation remains a concern due to a general increase in pinniped populations along the West Coast. California sea lion populations are growing rapidly, and there is potential that these predators could reduce the abundance of several salmon and steelhead ESUs/DPSs. The available information indicates that adult salmon contribute substantially to the diets of pinnipeds in the lower Columbia River and estuary, especially in the spring, late-summer, and fall seasons when Chinook salmon are most abundant (Scordino 2010). The effect of marine mammals on the productivity and abundance of Puget Sound ESA-listed salmon and steelhead populations has not been quantitatively assessed.

Reduction in hatchery production of yearling coho and Chinook salmon since the previous review has likely decreased piscivorous predation impacts although no analysis or documentation is currently available.

Non- indigenous fishes affect salmon and their ecosystems through many mechanisms. A number of studies have concluded that many established non-indigenous species (in addition to

smallmouth bass, channel catfish, and American shad) pose a threat to the recovery of ESA-listed Pacific salmon (Sanderson et al. 2009). Threats are not restricted to direct predation; non-indigenous species compete directly and indirectly for resources, significantly altering food webs and trophic structure and potentially altering evolutionary trajectories (Sanderson et al. 2009; NMFS 2010).

New information available since the last status review indicates there is a slight increase in the level of pinniped predation on Puget Sound salmon and steelhead. At this time we do not have information available that would allow us to quantify the change in extinction risk due to predation. We therefore conclude that the risk to the species' persistence because of predation has increased by an unquantified amount since the last status review

Inadequacy of existing regulatory mechanisms

New information available since the last status review indicates that the adequacy of some regulatory mechanisms has improved. For example:

- Washington State Use-based (e.g., aquatic life use) Surface Water Quality Standards, Washington Administrative Code (WAC) 173-201A. The 2003 standards were amended in 2006 to provide additional spawning and incubation temperature criteria of salmon, trout, and char. The standards include an Anti-degradation Policy, which was approved by the US Environmental Protection Agency (EPA) in May 2007. The EPA approved the Washington State's 2008 Water Quality Assessment 305(b) report and 303(d) list in January 2009. Washington's 2010 water quality report is scheduled for submission to EPA in the fall of 2011.

- Federal Emergency Management Agency Floodplain Management (FEMA) Biological Opinion (BiOp). NMFS continues to work closely with FEMA as it implements the National Flood Insurance Program. Local jurisdictions in Puget Sound are working with FEMA to ensure their local floodplain regulations are consistent with measures in NMFS' BiOp on FEMA's National Flood Insurance Program. Jurisdictions need to be in compliance by September 22, 2011. NMFS anticipates floodplain protection will be substantially improved if the measures identified in the biological opinion are implemented as designed.

At the same time, there are a number of concerns regarding existing regulatory mechanisms, including:

- Lack of reporting and tracking of enforcement for local regulations and permits.

- Funding/budget limitations at the local, state and federal level may further limit resources for enforcing regulations and providing critical monitoring data.

- Continued inadequacy of stormwater management and regulatory enforcement.

- NMFS has not reviewed the majority of non-federal actions that have the potential to degrade habitat. Critical area ordinances, shoreline permitting, and conditional use permits are all under the purview of local and state regulatory agencies (non-federal actions).

We conclude that the risk to the species' persistence because of the adequacy of existing regulatory mechanisms has decreased slightly, based on the improvements noted above. However, many ongoing threats to salmon and steelhead habitat could be ameliorated by strengthening existing regulatory mechanisms

Other natural or manmade factors affecting its continued existence

Climate Change

Current research by Mote and Salathé (2010), and other members of the University of Washington Climate Impacts Group, is providing insights to potential future climate change impacts for the Pacific Northwest region. Although the values or severity of these changes may be uncertain, and their biological impacts on salmonids have yet to be demonstrated, there is general scientific agreement regarding the impacts already evident in the last 40 years of climatological data and expected trends.

Expected climate change impacts for freshwater conditions and salmon and steelhead populations include:

- Increase in water temperatures.
- Decreases in snow pack causing a shift of peak flows from summer to spring, and a decrease in summer flows. Shifts in the timing of peak flows will likely result in changes in outmigration timing, changes in survival, changes in distribution, and changes in the availability of spawning and rearing habitats.
- Peak flows will be flashier, likely resulting in channel scouring and increased risk of sedimentation.
- Likely increase in winter flooding events.
- Under future climate scenarios, higher elevation areas will likely continue to provide habitat conditions within the biological tolerances of salmonids. However, lower and transitional areas will experience increasing temperatures reducing the available spawning and rearing habitats, altering distribution, and diminishing survival.

Expected climate change impacts to ocean conditions include:

- Increasing ocean acidification (although there is uncertainty about the downstream effects on marine food webs and salmonid survival in the ocean).
- Ocean temperatures will increase resulting in changes in the distribution and abundance of warm- and cold-water species. There is uncertainty about the effects on marine food webs and ocean survival of salmonids.
- Likely changes to a variety of processes such as the pattern and cycle of the Pacific Decadal Oscillation and the intensity and patterns of upwelling.

Over the past 40 years climate change has degraded environmental conditions for Pacific Northwest salmon and steelhead. The certainty in modeled climate change impacts has increased as has our understanding of likely impacts of these changes on salmonid populations. While climate change impacts remain a recovery concern over the long term, it is unknown whether climate change impacts have changed in the few years since the last review.

Hatchery Effects

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.

Puget Sound has a mixture of production (for harvest) and conservation (to supplement natural spawning of the natural populations) hatchery releases. Since the previous status review, hatchery releases of Chinook, chum, and coho salmon have been trending down in Puget Sound. Changes to hatchery programs since the last status review include:

- Five Hood Canal summer chum supplementation and reintroduction programs implemented to conserve spawning aggregations at moderate or high extinction risk were terminated, consistent with the planned terms of their operation. The programs resulted in increased natural origin recruit based production relative to pre-supplementation years (1990-1994), and re-established natural origin recruit based adult returns in two watersheds where the native populations had become extirpated (Chimacum and Big Beef Creeks).
- Seven new conservation programs (5 for steelhead and 2 for Chinook salmon) have been implemented to preserve at-risk populations.
- Production is stable or decreased for harvest augmentation programs.
- Implementation of new hatchery risk minimization/reform measures have likely decreased risks to natural fish.
- Implementation of conservation hatchery actions under the Elwha Fish Restoration Plan will preserve, and assist in the restoration of native populations during and after the dam removal project.

There is increasing empirical evidence demonstrating risks to natural populations resulting from natural spawning and production by hatchery origin spawners. Specific concerns regarding hatchery programs include:

- Genetically diverged and/or exogenous Skamania and Chambers creek stocks pose threats to natural origin steelhead population viability.

- Natural spawning by first generation hatchery origin fish at high proportions of total escapements may decrease the genetic diversity and fitness of some populations of Chinook salmon.
- Continued risk of competition and predation effects posed by hatchery fish released high in Puget Sound watersheds.
- Budget restrictions may impact ability to continue hatchery programs supporting at risk stocks and within ESU and DPS stocks.

Based on new information that has become available since the last ESA status review, we concluded that the risk of hatchery effects to Puget Sound ESUs' and DPS' persistence has decreased, but benefits to the viability of the ESUs and DPS are uncertain.

Efforts being made to Protect the Species

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

In the final listing determinations for salmon (70 FR 37160) and steelhead (71 FR 834), we noted that while many of the ongoing protective efforts are likely to promote the conservation of listed salmonids, most efforts are relatively recent, have yet to demonstrate their effectiveness, and for the most part do not address conservation needs at scales sufficient to conserve entire ESUs or DPSs. Therefore, we concluded that existing protective efforts did not preclude listing several ESUs of salmon and several DPSs of steelhead.

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

2.4 Synthesis

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

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

The updated status reviews completed by our Northwest Fisheries Science Center indicate that the PS Chinook salmon ESU has made little progress toward meeting the recovery criteria and current trends in abundance are negative. Several more populations in this ESU will need viability improvements in order to meet the recovery criteria. The Science Center concluded, after reviewing the available new information, that the biological risk category for this ESU has not changed since the time of the last status review. Although this ESU remains at moderate risk of extinction, its trend in status is concerning and additional conservation actions will be needed to recover this ESU.

The Northwest Fisheries Science Center reported that the abundance of Hood Canal summer chum salmon abundance has improved since the time of listing, although in the last five years, abundance has been down slightly. This ESU has shown improvements in spatial structure and diversity, but low productivity for the last five years. While these improvements are encouraging, this ESU has not consistently met the recovery criteria, and remains at moderate risk of extinction. Increased abundance, particularly in the Hood Canal population, will be required for this ESU to reach viable status.

The Northwest Fisheries Science Center reported the populations in the PS steelhead DPS are showing continued downward trends in estimated abundance, a few sharply so. This DPS remains distributed over a large geographic area but current trends in abundance are concerning. 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.

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. Numerous habitat restoration projects have been completed in many Puget Sound tributaries. Harvest rates remain relatively low and stable for PS steelhead and Hood Canal summer chum salmon. The protection afforded by some regulatory mechanisms, such as adoption of more protective stream temperature standards, has increased. Conversely, new information indicates that habitat quality in the Puget Sound is still declining and many more habitat improvements are likely needed to achieve ESU and DPS viability. Many existing regulatory mechanisms could be improved to better protect salmon and steelhead habitat. In addition, predation from an increase in pinniped populations and significant avian impacts remain a concern, as do the impacts that climate change poses to long-term recovery.

After considering the biological viability of the PS Chinook salmon ESU, the Hood Canal summer 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. However, the implementation of sound management actions in each H—habitat, hatcheries, and harvest—are essential to the recovery of the Puget Sound salmon and steelhead and must continue. The biological benefits of habitat restoration and protection efforts, in particular habitat restoration, have yet to be fully expressed and will likely take another five to 20 years to result in measurable improvements to population viability. By continuing to implement actions that address the factors limiting population survival and monitoring the effects of the action over time, we will ensure that restoration efforts meet the biological needs of each species and, in turn, contribute to the recovery of these ESUs and DPS. The Puget Sound Salmon Recovery Plan is the primary guide for identifying future actions to target and address PS Chinook salmon and Hood Canal summer 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 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.

Hatchery Membership

PS Chinook Salmon

- The Marblemount Hatchery fall-run Chinook salmon and Big Beef Creek programs have been terminated. Hatchery fish produced by the Big Beef Creek program are no longer present, and the program should no longer be listed as producing fish that are part of the ESU. The last adult fish from the Marblemount Hatchery fall-run Chinook salmon program will return in 2013. At this time, we recommend beginning the process to remove the Marblemount Hatchery program from

the PS Chinook salmon ESU. By the time this regulatory process is complete, the last adult salmon from this program will be returning.

- Two new hatchery programs (Skookum Creek and Harvey Creek) should be considered for inclusion in the ESU.

Hood Canal Summer Chum Salmon

- Five hatchery programs (Quilcene National Fish Hatchery, Union River/Tahuya River, Big Beef Creek, Salmon Creek, and Chimacum Creek) have been terminated and should be removed from the ESU.

PS Steelhead

- The Hamma Hamma Fish Hatchery has been eliminated and should be removed from the DPS.
- Five new hatchery programs designed to support recovery of White River winter-run, Hood Canal winter-run (Dewatto, Duckabush, North Fork Skokomish River), and, Elwha River native winter-run steelhead populations should be considered for inclusion in the DPS.

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 (Ford et al. 2010).
- 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.

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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 Hood Canal summer chum salmon ESU should remain listed as threatened.
- The PS Steelhead DPS should remain listed as threatened.

ESU/DPS delineation: No change

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

PS Chinook Salmon

- The Marblemount Hatchery and Big Beef Creek Hatchery fall-run Chinook salmon program have been terminated and should be removed from the ESU.
- Two new hatchery programs (Skookum Creek and Harvey Creek) should be considered for inclusion in the ESU.

Hood Canal Summer Chum Salmon

- Five hatchery programs (Quilcene National Fish Hatchery, Union River/Tahuya River, Big Beef Creek, Salmon Creek, and Chimacum Creek) have been terminated and should be removed from the ESU.

PS Steelhead

- The Hamma Hamma Fish Hatchery has been eliminated and should be removed from the DPS.
- Five new hatchery programs designed to support recovery of White River winter-run, Hood Canal winter-run (Dewatto, Duckabush, North Fork Skokomish River), and, Elwha River native winter-run steelhead populations should be considered for inclusion in the DPS.

3.2 New Recovery Priority Number

There are no changes in the recovery priority number listed in Table 4 for the PS Chinook salmon ESU, the Hood Canal summer chum salmon ESU, or the PS steelhead DPS.

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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 Hood Canal summer 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:

1. Implement Research Monitoring and Evaluation actions to address critical uncertainties.
    - Quantitative analysis of net habitat loss and restoration
    - Assessment of the effectiveness of salmon habitat protection efforts
    - Plan implementation effectiveness
    - Steelhead stock status monitoring; improve lack of data
    - Secure funding for status monitoring for other species
    - Audit effectiveness of regulatory mechanisms and enforcement reporting
    - Need for relative reproductive success, relative fitness, and gene flow studies directed at sub-yearling hatchery program-origin Chinook salmon
    - Identify important gaps in specific watershed chapters of the Puget Sound Chinook salmon recovery plan, e.g., stormwater, floodplain restoration, instream flows, etc.
2. Encourage participation of Federal, state, local and tribal partners in Recovery Plan implementation.
3. Finalize, fund, and implement adaptive management components of recovery plans.
4. Ensure Mid-Hood Canal and Sammamish Chinook salmon population delineations are reviewed in light of new information.
5. Work with FEMA on their implementation of the Puget Sound National Flood Insurance Program Biological Opinion (NMFS 2008b) and compliance monitoring of FEMA's program.
6. Develop and implement management solutions to address conflicts between Marine Mammal Protection Act and ESA species (e.g. predation, pile driving).
7. Provide technical support to local entities responsible for development, implementation and enforcement of stormwater management standards consistent with the recovery needs of Puget Sound salmon and steelhead.

8. Complete NEPA and ESA review and determination processes for Puget Sound hatchery salmon and steelhead programs affecting populations of Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, and Puget Sound steelhead.

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National Marine Fisheries Service
5-Year Review

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

REGIONAL OFFICE APPROVAL

Northwest Regional Administrator, NOAA Fisheries

Approve:  Date: *July 26, 2011*