4(d) Rule Limit 6
Evaluation and Recommended Determination

Title of RMP:	Joint Hatchery and Genetic Management Plans for Dungeness River, Nooksack River, and Stillaguamish River Hatchery Early-Winter Steelhead
RMP Submitted by:	Washington Department of Fish and Wildlife Jamestown S'Klallam Tribe Lummi Nation Nooksack Tribe Stillaguamish Tribe Tulalip Tribes
ESU/DPSs:	Puget Sound Chinook Salmon ESU Hood Canal Summer Chum Salmon ESU Puget Sound Steelhead DPS
4(d) Rule Limit:	ESA 4(d) Rule Limit 6
NMFS Tracking Number:	WCR-2015-2024

1 BACKGROUND

NOAA's National Marine Fisheries Service (NMFS) issued a final Endangered Species Act (ESA) 4(d) Rule adopting regulations necessary and advisable to conserve Puget Sound Chinook salmon and Hood Canal summer-run chum salmon (50 CFR 223.203(b); 70 FR 37160, June 28, 2005). The 4(d) protective regulations adopted for the two salmon evolutionary significant units (ESU) were subsequently applied to the Puget Sound steelhead distinct population segment (DPS) in a separate final rule (73 FR 55451, June 25, 2008) (both rules are referred to in this document as "the Rule"). Under limit 6 of the Rule, ESA section 9 take prohibitions for these listed salmonid species do not apply to hatchery activities that are undertaken in compliance with a resource management plan (RMP) developed jointly by the Tribes and the State of Washington that is consistent with the 4(d) Rule criteria. The Washington Department of Fish and Wildlife (WDFW) and Jamestown S'Klallam Tribe, Lummi Nation, Nooksack Tribe, Stillaguamish Tribe, and Tulalip Tribes as co-managers of the fisheries resource under *United States v. Washington* (1974) (hereafter referred to as "the co-managers"), have provided NMFS with three Hatchery and Genetic Management Plans (HGMP) for steelhead hatchery programs and associated monitoring and evaluation actions in the Dungeness, Nooksack, and Stillaguamish River watersheds that will affect Puget Sound Chinook salmon, Hood Canal summer chum salmon (Dungeness), and Puget Sound steelhead (Scott 2014; 2015) listed as threatened species under the ESA. The HGMPs provide the framework through which Washington State and Tribal jurisdictions can jointly manage hatchery operations for steelhead and associated monitoring and evaluation activities while meeting requirements specified under the ESA. The co-managers developed the plans jointly, and have provided the HGMPs for review and determination by NMFS as to whether they address the criteria of limit 6 of the 4(d) Rule. For the purposes of the proposed recommendation, NMFS considers the three joint HGMPs, submitted for consideration under limit 6, to be an RMP.

2 PROPOSED ACTION

The three HGMPs submitted to NMFS for consideration under limit 6 are designed to support recreational and tribal fishing only, and they are not intended to supplement natural spawning. They involve activities including the production and release of smolts, collection of hatchery-produced adults for broodstock, and associated monitoring and evaluation actions, that have the potential to affect ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon (Dungeness River only), and Puget Sound steelhead within the Dungeness, Nooksack, and Stillaguamish River watersheds. Applications for ESA authorizations under the section 4(d) Rule, limit 6, must provide the necessary information described in 50 CFR part 222.308. The HGMPs were reviewed upon their final submittal in updated form, and NMFS determined that they were sufficient for NMFS to proceed in its evaluation of effects of the plans on ESA-listed fish (Jones 2014).

The hatchery programs, as described in the HGMPs, mitigate for impacts on tribal and recreational fishing caused by past and on-going human developmental activities in these watersheds, and from climate change. They provide hatchery fish to: (1) meet regional recreational fisheries objectives for the citizens of Washington State, and (2) meet tribal fishery harvest allocations that are guaranteed through treaties, as affirmed in *United States v. Washington* (1974). All three proposed hatchery programs would use only hatchery fish for broodstock. These fish are "early winter" (Chambers Creek hatchery-lineage) steelhead (henceforth, "EWS") (WDFW 2014a; 2014b; 2014c) (Table 1). Fish produced through the programs are not included as part of the ESA-listed Puget Sound steelhead Distinct Population Segment (DPS) (72 FR 26722, May 11, 2007).

The proposed programs would also include monitoring of program performance and effects in the Dungeness, Nooksack, and Stillaguamish Rivers, while applying measures that would minimize risks of adverse genetic, demographic, or ecological effects on ESA-listed fish. If determined to be in compliance with limit 6 of the 4(d) Rule, the EWS hatchery programs would operate in conjunction with on-going habitat restoration and harvest management actions, implemented consistent with the objectives of ESA recovery plans for Puget Sound species and for individual watersheds within Puget Sound (SSPS 2005a; 2005b; 2005c; 2007) until healthy, natural-origin salmonid populations, that would sustain fisheries, are restored.

Table 1. Proposed hatchery programs for Dungeness, Nooksack, and Stillaguamish River hatchery winter steelhead.

Hatchery Program	Operator
Dungeness River Hatchery Early-Winter Steelhead Program (WDFW 2014a)	WDFW
Kendall Creek Hatchery Winter Steelhead Program (WDFW 2014b)	WDFW
Whitehorse Ponds (Stillaguamish) Winter Steelhead Program (WDFW 2014c)	WDFW

All EWS hatchery program actions and associated monitoring and evaluation activities proposed by the co-managers for the Dungeness, Nooksack, and Stillaguamish River watersheds are included in the HGMPs. Actions proposed in the HGMPs, including descriptions of the facilities where the majority of actions occur, are summarized below.

2.1 Dungeness River Hatchery Early Winter Steelhead

The HGMP actions and effects would occur in the Dungeness River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth, and including Dungeness Bay. This area includes the Dungeness River Hatchery, Hurd Creek Hatchery, the portions of the Dungeness River watershed where fish produced by the programs would be released as juveniles and return as adults, and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles. The affected area would include all freshwater and estuary areas used by the extant populations of ESA-listed Chinook salmon, summer chum salmon, and steelhead originating from the Dungeness River watershed.

The proposed Dungeness hatchery steelhead program would be based at WDFW's Dungeness River Hatchery, located adjacent to the Dungeness River at river mile (RM) 10.5 (Figure 1)(WDFW 2014a). Adult broodstock collection, spawning, rearing, and release occur at the Dungeness River Hatchery. As a satellite facility for the Dungeness River Hatchery, Hurd Creek Hatchery (RM 0.2 on Hurd Creek, a tributary to the Dungeness River at RM 2.7) would be used to support incubation and initial rearing of program fish. Surface water is withdrawn from the Dungeness River, Canyon Creek, and Hurd Creek to rear fish in the facilities. The Hurd Creek Hatchery also uses groundwater withdrawn from five wells to augment surface water sources for fish rearing. Hatchery facility effluent is released into the mainstem Dungeness River. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through Federal National Pollutant Discharge Elimination System (NPDES) permits issued where required to each facility.

Monitoring and evaluation actions associated with implementation of the proposed HGMP would include measures designed to assess hatchery program performance and effects. All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for positive identification and assessment of smolt-to-adult survival rates and to determine origin of adult returns. For operational and management purposes, mass-marking hatchery fish is

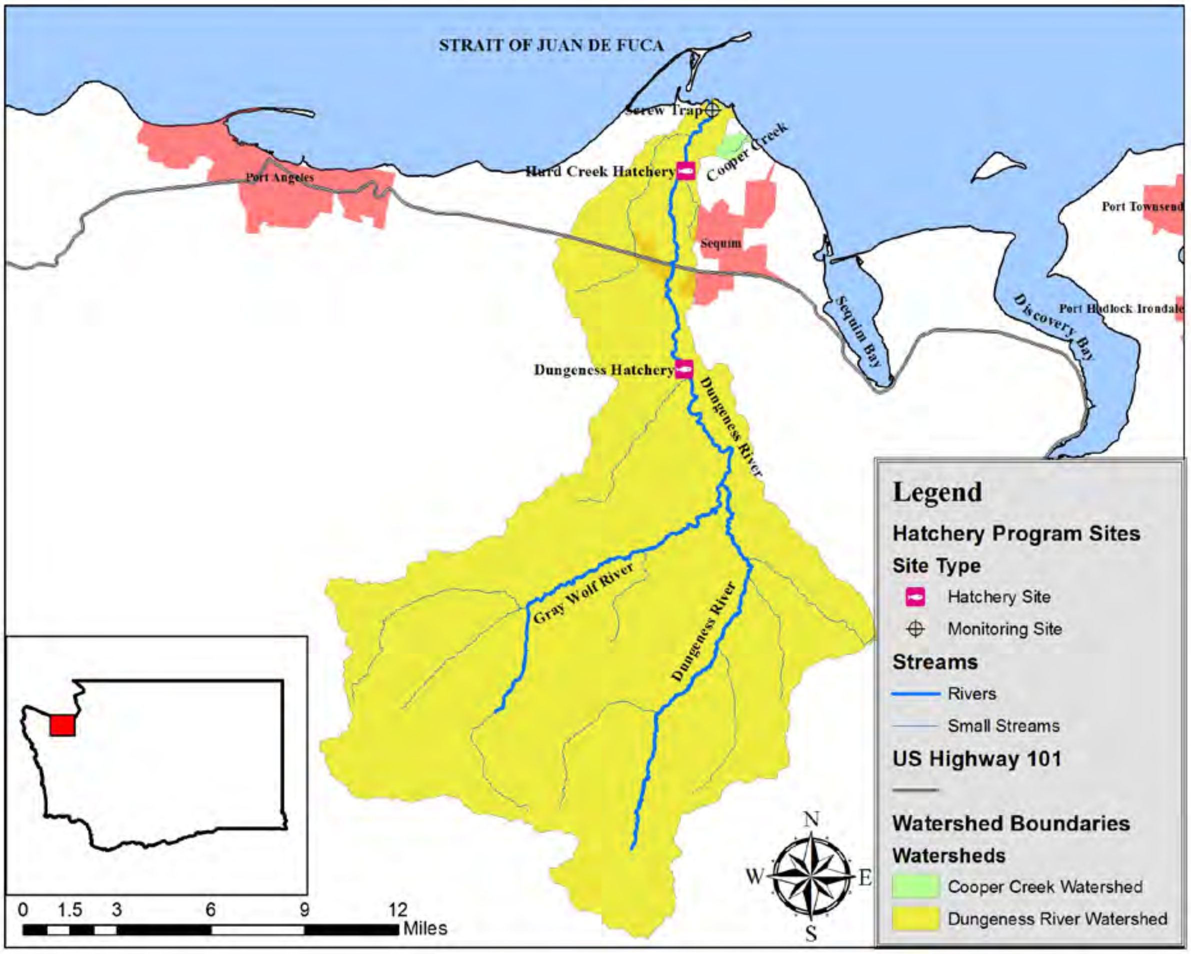

Figure 1. Action area for the proposed continued operation of the Dungeness Hatchery winter steelhead program in the Dungeness River watershed.

intended to save natural-origin steelhead from becoming hatchery broodstock and reduce the number of hatchery fish on spawning grounds, by selective fishing or other means. Mass-marking hatchery steelhead would also allow positive identification of steelhead by origin during the juvenile fish emigration periods. A juvenile out-migrant trap (screw trap) is operated annually at RM 0.5 on the Dungeness River (Figure 1) during the spring and summer months to identify and estimate numbers of seaward migrating smolts, enabling estimation of productivity and survival rates for hatchery and naturally produced salmon and steelhead. This out-migrant trap is operated under a separate annual ESA take authorization afforded through ESA 4(d) rule limit 7 (NMFS 2015a).

2.2 Kendall Creek Winter Steelhead

The HGMP actions and effects would occur in the Nooksack River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth (Figure 2). This area includes: the Kendall Creek Hatchery; McKinnon Pond; portions of the Nooksack River watershed where fish produced by the program would be released as juveniles and return as adults; and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles. The affected area would include all freshwater and estuary areas used by the extant populations of ESA-listed Chinook salmon and steelhead originating from the Nooksack River watershed.

Figure 2. Action area for the proposed continued operation of the Kendall Creek Hatchery winter steelhead program in the Nooksack River watershed.

The proposed Kendall Creek Hatchery steelhead program would be based at WDFW's Kendall Creek Hatchery, located at the mouth of Kendall Creek, a tributary to the North Fork Nooksack River at RM 46 (Figure 2). Adult broodstock collection, spawning, rearing, and release occur at the Kendall Creek Hatchery. As a satellite facility for Kendall Creek Hatchery, McKinnon Pond (RM 4.4 on the middle fork Nooksack River) would be used to support rearing of program fish.

Surface water is withdrawn from Kendall Creek and from Peat Bog Creek (MF Nooksack tributary) for McKinnon Pond. The Kendall Creek Hatchery also uses groundwater withdrawn from five wells to augment surface water sources for fish rearing. Hatchery facility effluent is released into Kendall Creek and Peat Bog Creek. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through NPDES permits issued where required to each facility.

Monitoring and evaluation actions associated with implementation of the proposed program would include measures designed to assess hatchery program performance and effects. All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for positive identification and assessment of smolt to adult survival rates and to determine the origin of adult returns. Mass marking is intended to save natural-origin steelhead from becoming hatchery broodstock and reduce the number of hatchery fish on spawning grounds, by selective fishing or other means. A juvenile out-migrant trap (screw trap) is operated annually by the Lummi Nation on the Nooksack River during the spring and summer months to collect information regarding the co-occurrence, out-migration timing, relative abundances, and relative sizes of hatchery-origin fish, ESA-listed natural-origin Chinook salmon and steelhead, and non-ESA-listed natural-origin coho, chum, and pink salmon. This out-migrant trapping program is operated under a separate annual ESA take authorization afforded for tribal research activities under ESA 4(d) rule limit 7 (NMFS 2009).

2.3 Whitehorse Ponds (Stillaguamish River) Winter Steelhead Hatchery

The HGMP actions and effects would occur in the Stillaguamish River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth and including the Snohomish estuary. This area includes the Whitehorse Ponds Hatchery, the portions of the Stillaguamish River watershed where fish produced by the programs would be released as juveniles and return as adults, and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles (Figure 3). The affected area would include all freshwater and estuary areas used by the extant populations of ESA-listed Chinook salmon and steelhead originating from the Stillaguamish River watershed.

The proposed Whitehorse Ponds hatchery steelhead program would be based at WDFW's Whitehorse Ponds Hatchery, located at RM 1.5 of Whitehorse Springs Creek, a tributary to the North Fork of the Stillaguamish River (RM 28)(WDFW 2014c)(Figure 3). Adult broodstock collection, spawning, rearing, and release all occur at the Whitehorse Ponds Hatchery.

Surface water is withdrawn from the spring-fed Whitehorse Spring Creek and ground water from a single on-site well. Hatchery facility effluent is released into lower Whitehorse Springs Creek. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through a NPDES permit issued to the facility.

Figure 3. Action area for the proposed continued operation of the Whitehorse Ponds hatchery winter steelhead program in the Stillaguamish River watershed.

Monitoring and evaluation actions associated with implementation of the proposed program would include measures designed to assess hatchery program performance and effects. All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for assessment of smolt-to-adult survival rates and to determine origin of adult returns. Mass marking is intended to save natural-origin steelhead from being used as hatchery broodstock and reduce the number of hatchery fish on the spawning grounds, by selective fishing or other means. The Stillaguamish Tribe operates a juvenile out-migrant trapping program (screw trap) on the North Fork Stillaguamish River and mainstem Stillaguamish River during the spring and summer months to collect information regarding the co-occurrence, out-migration timing, relative abundances, and relative sizes of hatchery-origin fish, ESA-listed natural-origin Chinook salmon and steelhead, and non-ESA-listed natural-origin coho, chum, and pink salmon. This out-migrant trapping program is operated under a separate annual ESA take authorization afforded for tribal research activities under ESA 4(d) rule limit 7 (NMFS 2009).

3 EVALUATION

The final 4(d) Rule for salmon and steelhead states that the prohibitions of paragraph (a) of the rule (50 CFR 223.203(a)) do not apply to actions taken in compliance with a RMP jointly developed by the States of Washington, Oregon, and/or Idaho and the Tribes, provided that elements of the rule are met, including the following:

- The Secretary of Commerce (Secretary) has determined pursuant to 50 CFR 223.209(b) [the Tribal 4(d) Rule] and the government-to-government processes therein that implementing and enforcing the joint tribal/state plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs and DPSs.

- In making that determination for a joint plan, the Secretary has taken comment on how any HGMP addresses the criteria in §223.203(b)(5).

As per the Tribal 4(d) Rule, NMFS consulted with the Jamestown S'Klallam Tribe, the Lummi Nation, the Nooksack Tribe, the Stillaguamish Tribe, and the WDFW during the development of the three HGMPs through government-to-government and technical work group meetings. These occasions presented the opportunity to provide technical assistance, to exchange information and discuss what would be needed to conserve the ESA-listed species, and to be consistent with legally enforceable tribal rights and with the Secretary's trust responsibilities to the treaty tribes.

The following discussion evaluates whether the submitted plans address the criteria in section 223.203(b)(5) of the 4(d) Rule for salmon and steelhead.

3.1 Limit 5 Criteria and RMP Evaluation

3.1.1 5(i)(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results.

Goals, performance objectives (standards), and performance indicators for the three hatchery winter steelhead programs are clearly described in sections 1.7, 1.9, and 1.10, respectively of each HGMP (WDFW 2014a; 2014b; 2014c).

The goals of the hatchery programs are to provide: (1) regional non-Indian recreational fishing opportunities and (2) support Jamestown S'Klallam, Lummi, Nooksack, and Stillaguamish tribal Treaty-reserved fishing rights and commercial, ceremonial, and subsistence needs. The hatchery programs are compensation for reductions in natural steelhead population viability.

Other goals and performance objectives that the HGMPs incorporate exist in Puget Sound-wide and watershed-scale salmon recovery planning documents that have been subject to considerable scientific and public scrutiny (SSPS 2005a; 2005b; 2005c). The HGMPs were designed to be consistent with salmon recovery, harvest management, and habitat management strategies and actions specified in these plans. Each HGMP (see section 3.0) is also designed to support and comply with: WDFW's agency mandate for restoration and recovery of natural origin indigenous salmonid runs; the Pacific Salmon Treaty, the Puget Sound Salmon Management Plan, WDFW's Statewide Steelhead Management Plan (WDFW 2008); annual fisheries management plans; the annual equilibrium broodstock documents agreed through *United States v. Washington* (1974), and other state, federal, and international legal obligations.

WDFW's Statewide Steelhead Management Plan (WDFW 2008) sets forth comprehensive approaches for each region, including Puget Sound, for preserving and restoring natural steelhead populations, and minimizing risks, including those associated with hatcheries. Among the measures included in the plan are designation of wild steelhead management zones where no hatchery production of the species would occur, and creation of gene-banking programs where hatchery, harvest and habitat management measures would be implemented to preserve and restore unique steelhead populations and habitats. Specifically, as part of the plan's policies, steelhead hatchery programs would be implemented to: "promote achievement of the plan's natural steelhead production policy and provide fishery-related benefits by implementing artificial production programs as a component of a comprehensive habitat, hydro, harvest, and hatchery strategy, and by assuring artificial production programs meet the following characteristics:

- Conservation Programs. Artificial programs implemented with a conservation objective shall have a net aggregate benefit to the diversity, spatial structure, productivity, and abundance of the target wild stock.
- Harvest Programs. Artificial production programs implemented to enhance harvest opportunities shall provide fishery benefits while allowing watershed-specific goals for the diversity, spatial structure, productivity, and abundance of wild stocks to be met (WDFW 2008)."

Program-specific performance standards derived from the Northwest Power Planning Council (NPPC) Artificial Production Review (APR) (NPPC 2001), and performance indicators that would be used to gauge compliance with each of the standards, are described in sections 1.9 and 1.10 of each HGMP (WDFW 2014a; 2014b; 2014c). These standards and indicators address potential benefits and risks specifically relating to EWS steelhead production in Puget Sound, and the watersheds where fish from the three programs would be released. Responsive monitoring and evaluation actions that would be implemented to collect information relevant to each indicator are also described in that section. Monitoring and evaluation actions are designed to: 1) validate compliance with implementation requirements set forth in each HGMP, 2) track and report on hatchery program performance relative to performance standards in the HGMPs, and 3) evaluate hatchery program performance, particularly for any effects on ESA-listed species, and adjust HGMP implementation accordingly. The HGMPs are designed to determine: program consistency with proposed hatchery actions and intended results (e.g. juvenile fish release numbers, adult return levels, and gene-flow between hatchery and natural-origin steelhead); measurement of the program's success or failure in attaining results; and, effects of the program on natural-origin fish populations in the Dungeness, Nooksack, and Stillaguamish River watersheds.

3.1.2 5(i)(B) The HGMP utilizes the concepts of viable and critical salmonid population thresholds, consistent with the concepts contained in the technical document entitled "Viable Salmonid Populations."

HGMPs proposed for consideration under the 4(d) Rule must use the concepts of viable and critical thresholds as defined in the NMFS Viable Salmonid Population (VSP) document

(McElhany et al. 2000). Application of these concepts is required in order to assess the effects, benefits and risks, of a hatchery program or programs on the viability of salmon and steelhead natural populations.

The three HGMPs adequately address this criterion. In Section 2 of each HGMP, effects of the hatchery program(s) on ESA-listed salmon and steelhead are evaluated at the major population group (MPG) and DPS scales. The HGMPs establish that in the course of mitigating for losses to tribal and non-tribal fishers, the hatchery programs take ESA-listed salmon and steelhead within the watersheds where they occur. The term "take" means to harass, harm, pursue, hunt, shoot, would, kill, trap, capture, or collect, or to attempt to engage in any such conduct (ESA section 3(C)(18). So that take is verified and adequately limited, such that the hatchery programs do not jeopardize any ESA-listed ESU or DPS, a series of very specific standards and indicators are included in each HGMP (Table 1.8.1 and Section 1.10, List of "Performance Indicators", designated by "benefits" and "risks").

Compliance with performance standards and monitoring of indicators related to effects of the programs on ESA-listed salmon and steelhead within each basin would gauge achievement of these goals during the on-station operation of the programs and throughout the juvenile emigration and adult return timeframes. See section 3.1.1, 5(i)(D) below, for specific information on the proposed measures and protocols to be implemented to minimize effects on listed natural-origin salmon and steelhead.

The HGMPs also provide information related to the status of ESA-listed salmon and steelhead populations in the three river basins where the programs are located. The plans describe the viability goals (where developed) for the individual listed populations, as well as the recovery goals for each of the ESUs or DPSs that encompass the affected populations.

Puget Sound ESA-listed anadromous salmonid ESUs and DPSs in the action area:

Puget Sound Chinook (*Oncorhynchus tshawytscha*): Listed as *Threatened* on March 24, 1999 (64 FR 14308); *Threatened* status reaffirmed on June 28, 2005 (70 FR 37160) and reaffirmed a second time on August 15, 2011 (76 FR 50448). Critical habitat for the ESU was designated on September 2, 2005 (70 FR 52630). The Puget Sound Chinook salmon ESU is composed of 31 natural populations, of which 22 are believed to be extant. The ESU includes all naturally-spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait 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 (Ford 2011), as well as fish propagated by twenty-seven artificial propagation programs (NMFS 2013 78 FR 38270). In the Strait of Juan de Fuca biogeographic region, a NMFS Technical Recovery Team (TRT) identified demographically independent populations (DIPs) in the Dungeness and Elwha River basins (Ruckelshaus et al. 2006). The Nooksack River basin harbors both independent populations delineated for the Georgia Strait biogeographic region - North Fork Nooksack and South Fork Nooksack. Of the 10 independent Chinook salmon populations identified within the Whidbey Basin biogeographic region, the Stillaguamish River watershed supports two populations - North Fork Stillaguamish and South Fork Stillaguamish.

Hood Canal summer chum (*Oncorhynchus keta*): Listed as *Threatened* on Mar. 25, 1999 (64 FR 14507); *Threatened* status was reaffirmed on June 28, 2005 (70 FR 37160) and again on August 15, 2011 (76 FR 50448). The final designation for summer chum critical habitat was published Sept. 2, 2005 (70 FR 52630), with an effective date of Jan. 2, 2006. The ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries, and natural populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington (Ford et al. 2011). The ESU also includes summer chum salmon from four hatchery programs: Hamma Hamma, Lilliwaup, Tahuya, and the Jimmycomelately summer-run chum salmon programs (NMFS 2013 78FR38270). The only watershed where the action area under this evaluation of EWS hatchery programs and the ESU for summer-run chum salmon overlap is the Dungeness River.

Puget Sound steelhead *(Oncorhynchus mykis*s): Listed as *Threatened* under the ESA on May 11, 2007 (72 FR 26722); reaffirmed *Threatened* on August 15, 2011 (76 FR 50448). The DPS includes all naturally-spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations below natural migration barriers in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. Critical habitat for the DPS was designated on February 24, 2016 (81 FR 9252). This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive) (Ford et al. 2011). The Puget Sound Steelhead DPS includes three extant MPGs containing a total of 32 "Demographically Independent Populations" (DIPs) based on genetic, environmental, and life history characteristics (Myers et al. 2015). DIPs can include summer steelhead only, winter steelhead only, or a combination of summer and winter run timing (i.e., summer/winter). The DPS also includes steelhead from six hatchery programs: Green River Natural; White River Winter Steelhead Supplementation; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery (NMFS 2013 78 FR 38270).

Below is a summary, by watershed, of the viability of each ESA-listed salmon and steelhead natural population that would be affected by the continued operation of the three EWS hatchery programs.

3.1.2.1 Dungeness River

Section 2.2.2 of the Dungeness River Hatchery EWS HGMP describes the status of the listed Dungeness Chinook salmon, summer chum salmon and steelhead populations relative to "critical" and "viable" population thresholds.

The Dungeness River Hatchery EWS HGMP was designed in consideration of the best available scientific information for viability goals. Goals for the viability of the Dungeness River salmon and steelhead natural populations were established by state and tribal co-managers and were used in planning and guiding the proposed implementation of the Dungeness River EWS hatchery program (WDFW 2014a). Viability goals, including specific goals for steelhead, will be updated upon the availability of new scientific information. Existing goals will be used as reference points for monitoring the status of salmon and steelhead natural populations during implementation of the hatchery program. The goals will also be used as reference points to gauge achievement of program performance and risk reduction objectives specified in the HGMP, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery program for EWS would be implemented, so as not to reduce the viability status of those listed salmon and steelhead populations, are provided in sections 3.1.4 and 3.1.5 of this document.

Dungeness River Chinook Salmon

The Dungeness Chinook salmon population is one of 22 natural populations of Chinook salmon in the region delineated by NMFS as part of the Puget Sound Chinook salmon ESU (Ruckelshaus et al. 2006). This population is grouped with one other natural population – Elwha - in the Strait of Juan de Fuca biogeographic region for Puget Sound Chinook salmon ESU recovery planning purposes (SSPS 2005a; NMFS 2007). Under NMFS recovery and delisting criteria for the Chinook salmon ESU, two or more natural populations within the biogeographic region need to be recovered to a low extinction risk status (NMFS 2007). Hatchery-origin Chinook salmon from the Dungeness River Hatchery program are included in the ESU (70 FR 37160, June 28, 2005). Hatchery fish with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU (70 FR No. 123, June 28, 2005, 37204).

The extant natural population of Dungeness Chinook salmon is considered a spring/summer-run timed (or "early") population, based on spawn timing (WDF and WWTIT 1993). Weir operations in 1997 and 2001 indicate that most adult Chinook salmon enter the river by early August (PSIT and WDFW 2010a). Spawning occurs from mid-August to mid-October (WDF and WWTIT 1994). Spawning begins about two weeks earlier in the upper Dungeness River and in the Gray Wolf River than in the main stem Dungeness River below its confluence with the Gray Wolf River (WDF and WWTIT 1994; Ruckelshaus et al. 2006). The area of spawning in the Dungeness River mainstem extends upstream to a falls just above the mouth of Gold Creek at RM 18.7. Chinook salmon also spawn in the lower 6.1 miles of the Gray Wolf River, although the river is accessible to migrating anadromous fish to RM 8.0 (WDF and WWTIT 1994; Haring 1999). Chinook salmon spawn in the lower Dungeness River downstream of Dungeness River Hatchery, and in lower Canyon Creek below the existing hatchery water intake dam at RM 0.08 (Haring 1999). Myers et al. (1998) reported that Chinook salmon from the natural population mature primarily at age four (63%), with age 3 and age 5 adults comprising 10% and 25%, of the annual returns, respectively. Recent scale analyses data indicate that adult hatchery-origin fish return to the river at the following age class proportions: for fish released as sub-yearlings: Age 2 (8%), 3 (36%), 4 (48%), 5 (8%), and 6 (0%); for fish released as yearlings: Age 2 (1%), 3 (17%), 4 (56%), 5 (23%), and 6 (3%). The natural population predominantly exhibits an ocean-type life history trajectory (95 to 99 percent of the total emigrating population, with juveniles emigrating seaward as sub-yearlings from mid-February through the end of July (Myers et al. 1998; Topping and Kishimoto 2008; Topping et al. 2008b). A very small portion of the population emigrates seaward as yearlings (Marlowe et al. 2001; SSPS 2005a). Through juvenile out-migrant trapping at RM

0.5 just above the point of tidal influence, (Topping et al. 2006) found two distinct peaks in natural-origin Chinook salmon seaward emigration, indicating newly emerged fry and sub-yearling smolt migration trends. Emigration peaks during mid-March for fry (average individual size of 39 mm fl) and early June for sub-yearling smolts (average size is 74 mm fl). Fry accounted for an estimated 24% of the emigrating juvenile population and 76% emigrated seaward as sub-yearling smolts (Topping et al. 2006).

For recovery planning purposes, goals for the four viability parameters—abundance, diversity, spatial structure, and productivity—were developed for each natural population in Puget Sound, including Dungeness Chinook salmon (Table 2) (SSPS 2005a; WDFW 2014a).

Table 2. Minimum natural-origin spawning abundance, abundance at equilibrium or replacement, and spawning abundance and productivity at maximum sustainable yield for a recovered state for the Dungeness River Chinook salmon natural population and for the entire Puget Sound Chinook salmon ESU.

Population – Region	**TRT Minimum Viability Abundance [e]**	**Status Under Properly Functioning Conditions (PFC)**			**NMFS Escapement Thresholds**	
		Equilibrium Abundance	Spawners at MSY	Productivity at MSY	Critical [a]	Rebuilding [b]
Dungeness	4,700	4,700	1,000	3	200 [c]	925 [d]
ESU	261,300	307,500	70,948	3.2	261,300	261,300

Source: (Ford et al. 2011; WDFW 2014a).

[a] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).

[b] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions. (McElhany et al. 2000; NMFS 2000).

[c] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

[d] Based on alternative habitat assessment. The TRT minimum viability abundance for the two Strait of Juan de Fuca populations, was the equilibrium abundance or 17,000, whichever was less.

Dungeness River Chinook salmon Abundance - The current abundance of natural-origin Dungeness Chinook salmon is substantially reduced from historical levels (SSPS 2005a). The historic equilibrium abundance level[1] for the Dungeness population is 8,100 fish (Ruckelshaus et al. 2002). From 1987 through 2000, the average total escapement, natural and hatchery-origin fish combined, in the watershed was 147 fish. Between 2001 and 2014, the estimated average total annual naturally spawning Chinook salmon escapement, natural-origin and hatchery fish combined, was 519 fish (Figure 4), with hatchery-origin Chinook salmon making up the majority of the annual naturally spawning adult escapement, averaging 72% for the basin in recent years (2001-2014), and ranging from 39% to 96% (WDFW 2014a; WDFW Score Database). Even when including hatchery-origin fish, the recent year escapement to the river is only 6.4% of the

1 "Historic equilibrium abundance" is the estimated maximum (upper level) number of naturally spawning Chinook salmon under properly functioning habitat conditions in the Dungeness River watershed. The lower level of the *planning* range for equilibrium spawner abundance is 4,700 fish.

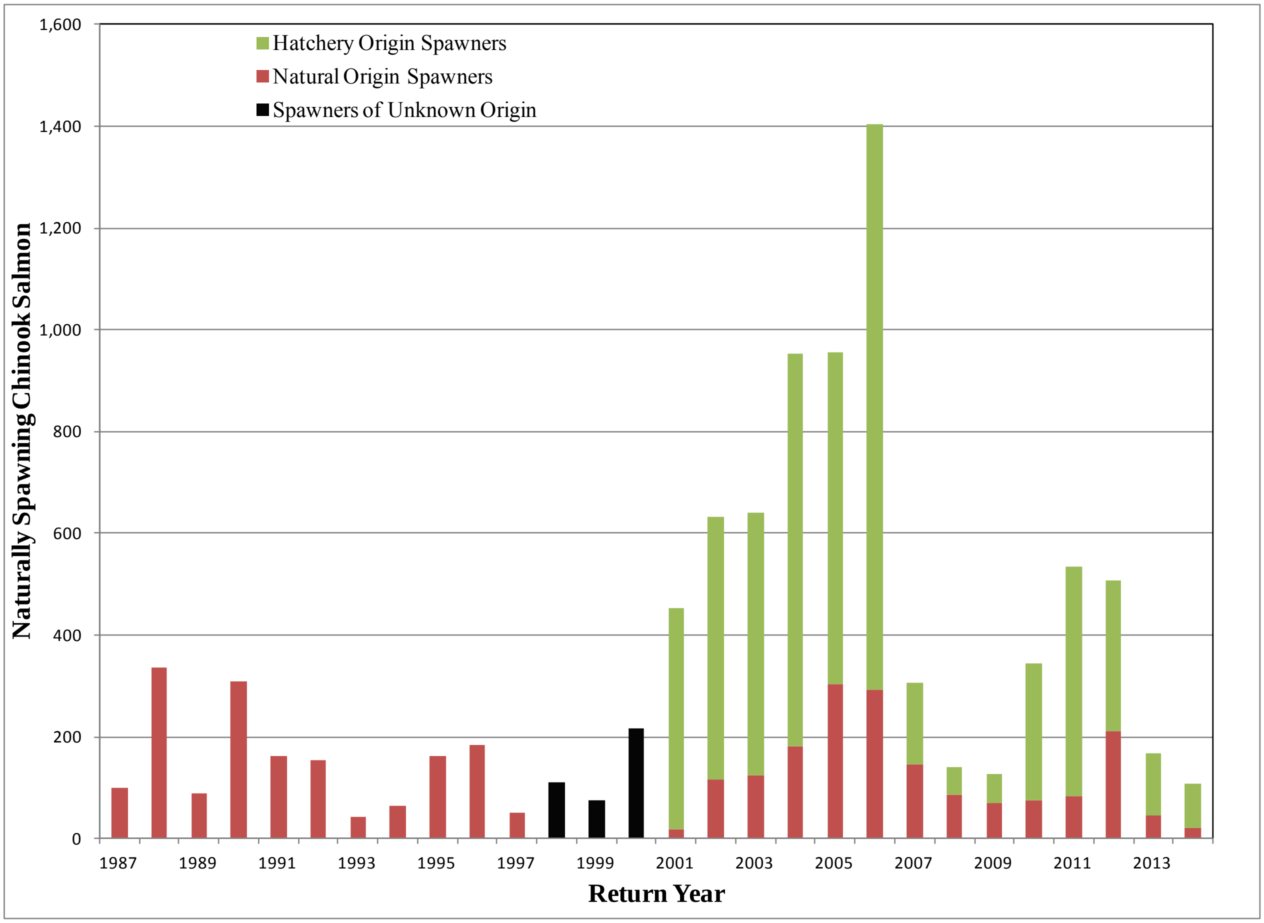

Figure 4. Estimated annual naturally spawning Chinook salmon escapement abundance in the Dungeness River for 1987 – 2013. Data sources: Data sources: PSIT and WDFW 2010; WDFW unpublished data 2015, accessed via: https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=1240

historic equilibrium abundance for the population. Under current habitat conditions, the Dungeness River can support approximately 699 (SSPS 2005a) to 925 (B. Sele, WDFW, pers. comm.) Chinook salmon spawners. When hatchery fish are included in an ESU, they are also considered in assessing risk to the ESU, however, "natural populations are the best indicator of a species' health" (70 FR 37204 June 28, 2005). A captive broodstock program initiated to preserve and rebuild the population was, by design, terminated after the 2003 brood (2006 return year), and escapements correspondingly decreased in return years 2007 through 2009. The highest observed hatchery-origin escapements (2001-2006) reflect years when adult fish progeny of captive broodstock Chinook salmon returned to spawn (PSIT and WDFW 2010a). Re-initiation of a hatchery program intended to supplement natural spawning and reduce demographic risk to the natural population, is accomplishing this objective and increasing adult returns and natural spawning levels (return years 2010 through 2014).

Dungeness River Chinook Salmon Productivity - Recent estimates of egg to juvenile out-migrant and recruit per spawner survival rates reflect a general low productivity for the natural population

(1999-2008 average: R/S = 0.7; S/S = 0.28) (NMFS 2013). Estimates for juvenile Chinook salmon outmigrant production for brood year 2004-2014 ranged from a high of 164,814 out-migrating fish in 2013 to a low of 3,870 outmigrants in 2015 (Volkhardt et al. 2006; Topping et al. 2008a; Topping et al. 2008b) (updates to annual juvenile abundance estimates presented in these reports accessed at: http://wdfw.wa.gov/conservation/research/projects/puget_sound_salmonids /dungeness/index.htm and from Pete Topping personal communication 2016). (Table 3). Estimated egg to migrant survival has ranged from 1.4% to 14.7% and averaged 4.9% for brood years 2004 through 2014 (NMFS 2014). For comparison, in the Skagit River, where natural Chinook salmon habitat productivity conditions are good relative to the Dungeness River, egg to smolt survival estimates

Table 3. Natural origin Freshwater Production Estimates for Chinook salmon in the Dungeness River 2005-2015.

Outmigration Year	Chinook Sub-yearling			
	Freshwater Production	CV	Fry[a]	Parr[a]
2005	72,040	5.26%	19,084	52,911
2006	136,724	12.79%	74,319	62,405
2007	109,445	7.23%	27,740	81,705
2008	11,506	7.79%	3,400	8,108
2009	20,196	5.77%	3,904	16,292
2010	9,674	8.01%	1,801	7,873
2011	10,222	NA	1,451	8,771
2012	70,697	5.60%	24,636	46,062
2013	164,814	NA	NA	NA
2014	26,513	NA	NA	NA
2015	3,870	NA	NA	NA
Average	57,791		19,542	35,516

Source: (WDFW 2014a; Pete Topping personal communication 2016).

[a] Fry and parr are both sub-yearling Chinook migrants, but represent different freshwater rearing strategies; fry ≤ 45 mm fork length.

were approximately two times higher, averaging over 10% from brood year 1990 to 2006 (Kinsel et al. 2008).

Productivity for Dungeness Chinook salmon, as gauged by returning adult fish levels, has remained relatively stable but at very low levels since the Puget Sound Chinook salmon ESU was listed under the ESA in 1999. Based on estimates derived from the Puget Sound TRT Abundance and Productivity database, the 2010 NMFS status review for the ESU found a slightly positive trend in Dungeness Chinook salmon productivity from 1982 through 2006, as measured by recruit per spawner and spawner to spawner rates (Table 4 (Table 3 from Ford et al. 2011). The most recent NMFS status review for the ESU found that productivity trends for the Dungeness Chinook

Table 4. Average productivity for the Dungeness River Chinook salmon population, and the entire ESU, for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S) for natural-origin fish. "ESU" refers to the aggregate Puget Sound Chinook evolutionarily significant unit.

Brood Years	**1982-1986**		**1987-1991**		**1992-1996**		**1997-2001**		**2002-2006**		**Trend**	
Population	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S
Dungeness	0.58	0.21	0.31	0.11	0.25	0.20	1.67	0.93	0.44	0.18	0.11	0.08
ESU	9.57	2.19	5.05	0.96	3.01	1.24	2.70	1.19	1.67	0.67	-1.81	-0.28

Source: (Ford et al. 2011). R/S, S/S, and trend findings based on assumptions for years where escapements were not sampled to determine actual hatchery: natural-origin escapement ratios.

population, as measured by recruit per spawner and spawner to spawner rates, are slightly positive(NWFSC 2015). Dungeness Chinook salmon productivity has increased but it is still well below a level where the natural population can grow or even maintain itself (i.e., the fish are not reproducing and surviving well enough to replace themselves).

Dungeness River Chinook Salmon Diversity - Indices of diversity for the Puget Sound Chinook salmon ESU have not been developed at the population level (Ford et al. 2011). Genetic diversity of the Dungeness Chinook salmon population has likely been substantially reduced by anthropogenic activities over the last century. Extensive human disruptions in the watershed, including sporadic releases of non-native hatchery fall Chinook salmon, are likely to have severely impacted a late-returning life history of Chinook salmon that existed in the watershed (Ruckelshaus et al. 2006, citing Williams et al. 1975 and Jamestown S'Klallam Tribe 2003).

Recent assessments indicate that only one Chinook salmon stock with no discontinuity in spawning distribution through time or space exists in the basin (Marlowe et al. 2001; Ruckelshaus et al. 2006). The Puget Sound Chinook salmon TRT concluded that the late-returning life history in the Dungeness River was a significant part of the historical diversity of the Chinook salmon natural population (Ruckelshaus et al. 2006). Evidence suggests that the Puget Sound Chinook Salmon ESU has lost 15 spawning aggregations that were either demographically independent natural populations or major components of the life history diversity of the remaining 22 extant independent natural populations (Ruckelshaus et al. 2006). Nine of the 15 putatively extinct spawning aggregations were thought to be spring or summer-run type Chinook salmon. The disproportionate loss of early-run life history diversity represents a particularly significant loss of the evolutionary legacy of the historical ESU. As a now rare race in the region, the substantially reduced abundance of the Dungeness spring/summer-run natural population, relative to historical levels, represents a risk to remaining Puget Sound Chinook Salmon ESU diversity.

Dungeness River Chinook Salmon Spatial Structure - Indices of spatial structure have not been developed at the population level (Ford et al. 2011). Spatial structure for the Dungeness Chinook salmon natural population has also been affected over time relative to historical levels. A weir spanning the full width of the river at RM 10.8 was a barrier to Chinook salmon migration beginning in the 1930s. The weir served to collect broodstock for the Dungeness River Hatchery program but it also restricted upstream access and spawning by anadromous fish in the upper Dungeness River watershed for 50 years, although some Chinook salmon were known to have regularly escaped upstream during that period (Haring 1999; SSPS 2005a). The weir was removed in the 1980s. Although Chinook salmon continue to have access to their historical geographic range of habitat, and now spawn throughout the entire river, recent year low adult return levels have led to underutilization of accessible areas, especially in the Gray Wolf River (SSPS 2005a).

Human development actions in the watershed have degraded available spawning and migration areas for adult fish and refugia for rearing juvenile salmon to the detriment of Chinook salmon survival (Haring 1999). Side channel habitat in the lower river, once available for spawning and rearing, has been lost due to diking and other land and water-use activities. Spatial structure for the population has been reduced because dikes, levees and other actions have degraded or completely eliminated habitat in the lower reaches of the Dungeness River and its tributaries. Water withdrawals for agricultural and municipal uses have substantially reduced flows needed during the adult salmon upstream migration and spawning periods, resulting in spawning redds (egg nests) being constructed in poor habitat that is extremely susceptible to sediment scour and deposition (Haring 1999; SSPS 2005a).

Hood Canal Summer Chum Salmon

The Hood Canal summer-run chum salmon ESU was listed as a threatened species under the ESA in 1999 (64 FR 14508, March 25, 1999) and reconfirmed in 2005 (70 FR 37160, June 28, 2005). The ESU includes all natural-origin summer-run chum salmon in the eastern Strait of Juan de Fuca and Hood Canal of western Washington. Based on genetic analysis, historical and present geographic distribution, straying patterns, and life history variation, Sands et al. (2009) identified two independent natural populations of summer-run chum salmon. One population (the Strait of Juan de Fuca population) occurs in eastern Strait of Juan de Fuca watersheds (including Chimacum Creek), and the second (Hood Canal population) occurs in Hood Canal watersheds. NMFS designated critical habitat for the Hood Canal summer-run chum salmon ESU to include the portions of the Dungeness River watershed accessible to summer chum salmon, Dungeness Bay, and adjacent nearshore marine waters (70 FR 52630, September 2, 2005).

The Puget Sound Recovery Implementation Technical Team (RITT) assembled viability goals for Hood Canal summer-run chum salmon that are part of the Strait of Juan de Fuca population (Sands et al. 2009); see Table 5). No specific viability goals were developed for the summer chum salmon spawning aggregation in the Dungeness River (Sands et al. 2009). Surveys in the Dungeness River suggest it has few summer chum spawners, representing 1% of the total spawning for the Strait of Juan de Fuca population in 2004 (Sands et al. 2009). However, the Dungeness River is considered an important watershed for restoring the diversity of the Strait of Juan de Fuca summer chum salmon population component of the listed ESU (Sands et al. 2009).

Table 5. Population viability parameters for the Strait of Juan de Fuca (JDF) summer chum salmon population of Hood Canal summer chum salmon.

Population – Region	**Spawner Abundance**		**Spatial Structure**	**Diversity**	**Productivity**
	TRT	HCCC			
Dungeness	-	-	Most spawning aggregations within 20 km of adjacent aggregations; Major spawning aggregations not more than 40 km apart	SJF population has one or more persistent spawning aggregations from the Dungeness & Sequim/Admiralty diversity units	≥ 1.0
Strait of JDF	4,500 – 6,400	2,080			

Source: (PNPTT and WDFW 2003; Sands et al. 2009)

The Strait of Juan de Fuca population includes a very small summer chum salmon aggregation that spawns in the Dungeness River. The Dungeness River is not included in the 1993 Puget Sound salmon stock inventory as currently supporting a summer chum salmon natural population (WDF and WWTIT 1993). Summer chum salmon have been periodically observed during the months of September and October in the Dungeness River in the course of monitoring and collecting Chinook and pink salmon escapement data. The Summer Chum Salmon Conservation Initiative (SCSCI) (WDFW and PNPTT 2000) rated Dungeness River summer chum salmon as "of special concern" in status because of the lack of historical or current stock assessment information. Summer chum salmon have been infrequently observed in small numbers in the Dungeness River, and the historical size of this spawning aggregation is unknown (WDFW and PNPTT 2000; WDFW 2014a). There is uncertainty about whether the Dungeness River represents a subpopulation or a minor spawning aggregation within the Strait of Juan de Fuca population (Sands et al. 2009). Under the SCSCI (WDFW and PNPTT 2000), the Dungeness River was not recommended for initiation of a hatchery-based supplementation program to accelerate recovery of the species in the watershed. No project was recommended until knowledge of the summer chum salmon population is available to make an assessment of the risks and potential for successful implementation of a supportive breeding program (WDFW and PNPTT 2000) . There is therefore no associated hatchery-origin summer chum salmon group.

Summer chum salmon adults likely enter the river beginning in late August with natural spawning to follow from late August through early October. Natural spawning generally is limited to the first 1 to 2 miles of river, but adults have been recovered, in some years, at Dungeness River Hatchery (RM 10.5) (WDFW and PNPTT 2000; NMFS 2002). Age class at return data are lacking for summer chum salmon in the Dungeness River. Most natural-origin summer-run chum salmon in the ESU return to spawn as either three or four year-old fish, with five year-olds comprising a smaller proportion (~5%) of the total annual returns (WDFW and PNPTT 2000). Juvenile life history data for summer chum salmon in the Dungeness River is also lacking, but natural-origin summer-run chum salmon fry in other watersheds within the Strait of Juan de Fuca portion of the ESU emerge from stream gravels predominantly in late March and April (Tynan

1997; WDFW and PNPTT 2000), and emigrate to marine waters, immediately, at 39-40 mm (fl) (Koski 1975; Schreiner 1977; Salo 1991).

The effects of continued operation of the Dungeness River steelhead program on the ESA-listed summer Chum salmon ESU were previously evaluated by NMFS through a separate ESA section 7 consultation process (NMFS 2002) and NMFS determined that the hatchery actions were not likely to jeopardize the continued existence of the ESA-listed Hood Canal summer chum salmon ESU or result in the destruction or adverse modification of their designated critical habitat (NMFS 2002).

Hood Canal Summer-Run Chum Salmon Abundance - Extensive monitoring of adult salmon spawning during August through October in the Dungeness River has occurred since at least 1986 and surveys from 1974 through 1978 suggest that the watershed had few to no summer chum spawners in most years. In 1976, 199 summer chum salmon were observed (WDFW and PNPTT 2000) but subsequent surveys confirmed very low annual abundances of the species, with estimated Dungeness River escapement representing 1.5% of the total spawning abundance for the Strait of Juan de Fuca population in 2004 and 0.02% in 2005 (Sands et al. 2009). It should be noted that survey conditions are typically rated as "poor to fair" during spawner surveys in the Dungeness River and the emphasis on other species sometimes results in incomplete coverage of potential summer chum holding and spawning areas (WDFW and PNPTT 2000). Since 1987, summer-timed chum salmon have been observed in the Dungeness River every year, with partial peak-count surveys ranging between 0 and 60 fish. For the most recent five years for which data are available (2007-2011), 0 to 3 summer chum salmon were observed annually during Chinook and/or pink salmon-directed spawning ground surveys. The potential contribution of summer chum spawning to the abundance of the Strait of Juan de Fuca natural population under recovered habitat conditions is unknown. However, the NMFS RITT estimated that the Dungeness River could support between 6,000 and 20,000 spawning fish considering the extent of accessible habitat and assuming its recovery to properly functioning (historical) conditions (Sands et al. 2009).

Primary factors that contributed to declines in summer chum salmon abundance were habitat degradation, logging, over-harvest in fisheries, and climate effects (NMFS 2006b). The specific factors responsible for the current, poor status of summer chum salmon in the Dungeness River are unknown, but likely similar to those habitat-related factors identified above for Chinook salmon and below for steelhead.

Hood Canal Summer-Run Chum Salmon Productivity

There are no productivity estimates available for summer-run chum salmon in the Dungeness River. Productivity estimates available for the Strait of Juan de Fuca natural population encompassing the Dungeness River aggregation indicate the population is replacing itself (Table 6). The 5-year geometric mean abundance for the Strait of Juan de Fuca population was 4,020 natural -origin adults from 2005 through 2009 and 6,169 from 2010 through 2014; indicating an overall increase of 53% (from Table 63 *in* NWFSC 2015). The proportion of the total naturally spawning chum salmon escapements that were of natural-origin within the following 3 time

Table 6. Short and long term population trend and growth rate estimates for the Strait of Juan de Fuca population of the Hood Canal Summer Chum salmon ESU.

Population	Years	Trend Natural Spawners (C.I.)	Hatchery Fish Success =0		Hatchery Fish Success =1	
			Lambda w/CI	p>1	Lambda w/CI	p>1
Strait of Juan de Fuca	1995-2009	1.184 (1.06 - 1.324)	1.139 (0.242 - 5.365)	0.76	1.009 (0.255 - 3.989)	0.53
	1971-2009	1.013 0.984 - 1.043)	1.028 (0.872 - 1.211)	0.65	0.99 (0.867 - 1.129)	0.43

Source: Ford et al. 2011 in (WDFW 2014a). These are based on analyses reported by Ford et al. (2011) that are not necessarily agreed to by WDFW and the Tribes. "Lambda" is a measure of population growth rate. See Ford et al. (2011) for explanation of the columns.

periods - 2000-2004, 2005 -2009, and 2010-2014 - averaged 53%, 76%, and 74%, respectively (from Table 65 *in* NWFSC 2015)

Other Hood Canal Summer-Run Chum Salmon Viability Parameters (diversity, spatial structure)

There are no other population viability data available for summer chum salmon in the Dungeness River due to the species' sporadic and low level of occurrence in the Dungeness River watershed.

Dungeness River Steelhead

The Puget Sound Steelhead Technical Recovery Team (PSSTRT) delineated one extant steelhead natural population in the Dungeness River watershed and part of the Puget Sound steelhead DPS: Dungeness River Summer/Winter-Run (Myers et al. 2015). A summer-run component of the steelhead return to the Dungeness River is thought to have existed historically in the upper accessible reaches of the mainstem Dungeness River and Gray Wolf River (Haring 1999), but it is uncertain whether the race still persists in the watershed. In a recent evaluation of Washington steelhead populations, WDFW reported that the summer-run race in the Dungeness River is still extant (Scott and Gill 2008a). The population delineated recently by the PSSTRT includes both summer-run and winter-run steelhead, the group concluded that further monitoring is needed to establish whether native summer-run fish are still present and if they are part of a combined summer/winter natural population or represent an independent population (Myers et al. 2015). Under DPS viability criteria developed by the PSSTRT, at least one winter-run and one summer-run natural population of the six populations in the Olympic MPG must be restored to a low extinction risk status for recovery and delisting of the DPS (Hard et al. 2015). The PSSTRT's viable population abundance goal for Dungeness River steelhead is 1,232 natural-origin adult fish (Table 7). Hatchery-origin steelhead released from Dungeness River Hatchery are not derived from the native Dungeness River winter-run population, and are not included in the DPS. They are not intended to spawn naturally and do not contribute to Dungeness River steelhead population viability.

Table 7. Puget Sound Steelhead TRT DIP (and DPS) abundance goals for natural-origin steelhead in Puget Sound.

Population Basin				**Quasi Extinction Threshold**	**Low Abundance**	**Viable**	**Capacity**
Population Name	Area km^2	Mean Elevation (m)	Total Stream Length (m)		1% SAS	5% SAS	20% SAS
Dungeness R	564	978	306,740	30	246	1,232	4,930
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2015 in (WDFW 2014a).

For all but a few putative PS steelhead populations, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10 percent annually—and extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high, especially for populations in the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPGs. Ford et al. (2011) found that most populations within the DPS continue downward trends in estimated abundance, a few sharply so. The 2015 status review (NWFSC 2015) concluded that the most recent data available indicate some minor increases in spawner abundance and/or improving productivity over the last two to three years; however, most of these improvements are viewed as small and abundance and productivity throughout the DPS remain at levels of concern from demographic risk. NWFSC (2015) found that recent increases in abundance observed in a few populations have been within the range of variability observed in the past several years and trends in abundance of natural spawners remain predominately negative. Declining production of both summer-run and winter-run hatchery steelhead, as well as reduced harvest have limited biological risks to the natural spawners in recent years. In general, the biological risks faced by the Puget Sound Steelhead DPS have not substantively changed since the listing in 2007, or since the 2011 status review (NWFSC 2015).In a recent review by the PSTRT, productivity for the Dungeness DIP was considered to be declining, and the estimated probability that the Dungeness River winter-run steelhead population would decline to 10% of its current fish abundance, within 100 years was determined to be very high (Hard et al. 2015). State and tribal co-managers consider 125 adult fish to be the minimum escapement level for maintaining a minimum number of successful breeders (at least 50 fish), assuming a ratio of effective breeders to spawner census number of at least 0.40 (WDFW 2014a). The viable threshold for the population, reflecting a level of population abundance associated with a very high probability of persistence, or conversely, a very low risk of extinction, ranges from 500 to 750 natural-origin fish, annually (PSIT and WDFW 2010b).

Dungeness River Steelhead Abundance - Due to chronic high turbidity and low visibility conditions, the ability to conduct spawner surveys in the Dungeness River when natural steelhead spawn is limited. The Jamestown S'Klallam Tribe has conducted spawner surveys in each year beginning in 2010. Prior to 2010, the last escapement estimate for Dungeness River winter steelhead was in the 2000/2001 season with an estimated escapement of 183 based on redd counts in index areas. The Jamestown S'Klallam Tribe completed estimates of post March 10th spawners for the years 2009/10, 2010/2011, 2012/2013, 2013/2014, 2014/2015. These counts reflect natural-origin steelhead escapement, since hatchery-origin EWS that escape to spawn naturally generally complete spawning before March 10 (WDFW 2014a). Preliminary natural-origin winter-run steelhead escapement estimates for return years 2009/10, 2010/2011, 2012/2013, 2013/2014, and 2014/15 averaged 750 fish; ranging from 484 fish (2009/2010) to 1,001 fish (2012/2013) (C. Burns, Jamestown S'Klallam Tribe, and M. Haggerty, Haggerty Consulting, unpublished draft escapement estimates, February 2016). Dungeness River steelhead spawning escapement estimates are available for 17 years over the period 1988 through 2015. An estimate of the intrinsic potential-based spawner capacity indicates that the Dungeness River watershed could support between 2,465 and 4,930 natural-origin steelhead (Myers et al. 2015).

Dungeness River Steelhead Productivity - In a recent review by the PSTRT, productivity for the Dungeness DIP was considered to be declining, and the estimated probability that the Dungeness River winter-run steelhead population would decline to 10% of its current fish abundance, within 100 years was determined to be very high (Hard et al. 2015) (Table 3). However, this analysis does not account for steelhead escapements after 2001, and incorporates unexpanded redd counts for 1996 (expands for 1.62 steelhead per redd) and raw redd counts for 2000 and 2001. WDFW juvenile out-migrant trapping at the Dungeness River mouth from 2005 to 2014 showed an average annual production of natural-origin steelhead of 10,860; the most recent fiver year annual production has averaged 12,717 smolts (Table 8). Annual steelhead smolt productivity appears to be trending upwards based on these short term annual observations.

Dungeness River Steelhead Diversity - Available data indicates that steelhead diversity in the Dungeness River watershed has declined, largely because the historically extant summer-run component of the steelhead return has declined to very low levels or has become extirpated. As with Chinook salmon in the watershed, a combination of factors including changes in habitat conditions and past harvest and hatchery practices have likely reduced the diversity of the species in general relative to historical levels. For example, although there are no genetic data that show introgression from the planting of hatchery fish (WDFW 2014a), it could be that fitness of the winter-run race has been reduced by releases of non-native Chambers Creek steelhead from the Dungeness River Hatchery (Ford et al. 2011). More recent demographically based analyses by WDFW indicate that any effects associated with Dungeness River hatchery EWS production on native winter-run Dungeness steelhead genetic diversity have likely been small (Hoffmann 2014).

Dungeness River Steelhead Spatial Structure - The Dungeness River winter-run steelhead natural population includes fish spawning in the mainstem Dungeness and Gray Wolf Rivers (Myers et al. 2015). Dungeness River winter steelhead spawning distribution extends from an impassable

Table 8. Natural origin Freshwater Production Estimates for steelhead in the Dungeness River 2005-2014.

Outmigration Year	Steelhead Smolts	
	Freshwater Production	Coefficient of Variation (CV)
2005	9,192	n/a
2006	6,125	16.96%
2007	11,445	7.80%
2008	8,155	16.59%
2009	10,101	20.72%
2010	17,486	14.70%
2011	19,600	14.54%
2012	5,521	11.04%
2013	7,812	NA
2014	13,167	NA
Average	10,860	14.62%

Source: (WDFW 2014a; Pete Topping personal communication 2016

natural barrier on the Dungeness River at RM 18.7, downstream to the upper extent of tidewater (Haring 1999). Winter steelhead distribution is assumed to also include the Bell, Gierin, Cassalery, Cooper, Meadowbrook, Matriotti, Beebe, Lotsgazell, Woodcock, Mud, Bear, Hurd, Bear, Canyon, and Gold creek watersheds, and the Gray Wolf River.

Spatial structure of the winter-run steelhead natural population has been reduced by habitat loss and degradation to the same degree, and for many of the same reasons mentioned above for Dungeness River Chinook salmon. One exception is that due to their later run timing (relative to Chinook salmon), spatial structure for the winter-run steelhead population was not likely affected by seasonal operation of the Dungeness River Hatchery weir from the 1930s through the 1980s (i.e., the weir was removed in advance of the steelhead upstream migration). Summer-run steelhead distribution in the watershed may have been adversely affected by the weir when it was in operation over that period.

3.1.2.2 Nooksack River

Section 2.2.2 of the Kendall Creek Hatchery EWS HGMP describes the status of the ESA-listed Nooksack River Chinook salmon and steelhead natural populations relative to “critical” and “viable” population thresholds.

The Kendall Creek Hatchery EWS HGMP was designed in consideration of the best available scientific information for viability goals. Goals for the viability of the Nooksack River watershed salmon and steelhead natural populations were established by the state and tribal co-managers, and used in planning and guiding the proposed implementation of the Kendall Creek Hatchery program (WDFW 2014b). The viability goals for steelhead will be updated upon the availability of new scientific information. For the purposes of this analysis, existing viability goals will be used as reference points for monitoring the status of salmon and steelhead natural populations during implementation of the hatchery program. The goals will also be used as reference points to gauge achievement of program performance and risk reduction objectives specified in the HGMP, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery program for EWS would be implemented, so as not to reduce the viability status of those listed salmon and steelhead populations, are provided in section 3.1.5 of this document.

Nooksack River Chinook Salmon

Nooksack River Chinook salmon are included in the Georgia Basin Recovery Region for the ESA-listed Puget Sound Chinook salmon ESU. The Nooksack River basin contains two Chinook salmon natural populations – North Fork Nooksack (also referred to as North/Middle Fork Nooksack early Chinook) and South Fork Nooksack. Both of these natural populations are early-returning or spring run-timing Chinook salmon. These are the only Chinook salmon populations within the Georgia Basin biogeographic region (SSPS 2005d; NMFS 2006a). Abundance of Nooksack River basin Chinook salmon is a fraction of historical levels (SSPS 2005d), with the South Fork at critical status and the North Fork near critical (critical status for the last five years where data are available) (Table 9).

Table 9. Critical Escapement Thresholds and Recovery Abundance and Productivity targets for Nooksack Chinook Salmon natural populations.

Region	**Population**	**NMFS Escapement Thresholds**		**Recovery Planning Natural-Origin Chinook salmon Abundance Target in Spawners (productivity)[3]**
		Critical[1]	Rebuilding[2]	
Georgia Basin	NF Nooksack SF Nooksack	200[4] 200[4]	- -	3,800 (3.4) 2,000 (3.6)

[1] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000)
[2] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).
[3] Source for Recovery Planning productivity target is the final supplement to the Puget Sound Salmon Recovery Plan (NMFS 2006a); measured as recruits/spawner associated with the number of spawners at Maximum Sustained Yield under recovered conditions.
[4] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

Supportive breeding programs are operated as a means to preserve and help restore both populations using native natural-origin fish as broodstock. As NMFS has stated “Hatchery programs, under certain circumstances can provide short-term benefits to the abundance, productivity, spatial structure, and diversity of an ESU” (70 FR 37204 June 28, 2005). Fish produced by the two conservation programs – Kendall Creek Hatchery Program, and Skookum Creek Hatchery Spring-run Program—are ESA-listed and protected with the natural populations (79 FR 20802, April 14, 2014). Table 9 identifies critical and recovery target abundance and productivity goals for Nooksack Chinook salmon.

Nooksack River Chinook Salmon Abundance - A supportive breeding hatchery program for the North Fork population has operated at the Kendall Creek Hatchery since 1981 (PSIT and WDFW 2010a). Peak production included up to 142,500 unfed fry, 2.3 million fingerlings, and 348,000 yearlings. The program has evolved, through time, and now releases a total 750,000 sub-yearlings divided between three release locations: Kendall Creek, Boyd Creek (tributary to the North Fork at RM 63), and McKinnon Pond (tributary to the Middle Fork at RM 4.75 (WDFW 2014b). During the most recent five years, the South Fork natural population has averaged only 56 natural-origin spawners (13% of the naturally spawning Chinook salmon) (PSIT and WDFW 2013; 2014). Due to low abundance a captive broodstock-based hatchery recovery program was established in 2006 (PSIT and WDFW 2010a). The program is now transitioning to a more conventional smolt release program designed to supplement the number of natural spawners. Hatchery programs like this one can "conserve the genetic resources of depressed natural populations, reduce their risk of extirpation, and thereby mitigate the immediacy of an ESU's extinction risk" (70 FR 37204 June 28, 2005). The hatchery program is based at the Lummi Nation's Skookum Creek Hatchery, located on the SF Nooksack River.

The Nooksack Chinook salmon natural populations are well below minimum escapement levels identified as required for recovery (Table 9). The TRT estimated that geometric mean escapement levels were 1,535 total natural spawners, with 85% being hatchery-origin, in the North Fork Nooksack River DIP, and 392 (1999-2013) total natural spawners, with 84% being hatchery-origin, for the South Fork Nooksack River DIP (WDFW 2014b) (Table 10). DNA-based analyses of Chinook salmon returning to the South Fork Nooksack River indicate that only a small proportion are South Fork Chinook salmon, with the majority being North Fork Nooksack natural and hatchery-origin strays, and localized natural-origin summer-fall Chinook salmon (WDFW and PSTIT 2014). The 1999-2013 average annual natural escapement of South Fork Nooksack Chinook to the South Fork Nooksack River is 67 fish based on genetic analyses of stock origin.

Nooksack River Chinook Salmon Productivity - The most recent NMFS status review estimates of naturally spawning Chinook salmon abundance and productivity trends for the Nooksack Basin populations are summarized in Table 11.

Nooksack River Chinook Salmon Diversity - Indices of diversity have not been developed at the population level, though diversity at the Puget Sound Chinook salmon ESU level is declining (Ford et al. 2011). The Nooksack River may have lost some the Chinook salmon population diversity that once occurred, as historical evidence suggests that a later-returning life history was once present Williams et al. (1975) in (Ruckelshaus et al. 2006) describe a summer-fall Chinook salmon which entered the river starting in July, with spawning occurring in mid-September through October. The current presence of a summer-fall return timing component likely reflects adult returns and straying resulting from long term propagation of non-native Green River lineage stock at several hatcheries in the Nooksack River basin and immediately adjacent areas. The extant Nooksack River early-run Chinook salmon populations represent a much-reduced and

Table 10. Estimates of Geometric Mean Total Escapement, Natural-origin Escapement Levels, Productivity, and Average % Hatchery-origin spawners for Run-years 1999 through 2014. Source: NWFSC 2015

Region	**Population**	**1999 to 2014 Geometric mean Escapement (Spawners)**		**Average % hatchery fish in escapement 1999-2013 (min-max)[3]**
		Natural[1]	Natural-Origin (productivity[2])	
Georgia Basin	NF Nooksack	1,535	207 (0.2)	85 (63-94)
	SF Nooksack	392	51 (1.1)	84 (62-96)

[1] Includes naturally spawning hatchery fish.
[2] Source for 1999-2011 productivity is Abundance and Productivity Tables (tab Cohort RR) from Puget Sound TRT database; measured as the mean of observed recruits/observed spawners over the 1999-2011 period (1995-2007 brood years).
[3] Estimates of the fraction of hatchery fish in natural spawning escapements are from the Puget Sound TRT database and co-manager postseason reports on the Puget Sound Chinook Harvest Management Plan (WDFW and PSTIT 2005; 2006; 2007; 2008; 2009; 2010; 2011) and the 2010-2014 Puget Sound Chinook Harvest Management Plan (PSIT and WDFW 2010a).

Table 11. Recent Abundance and Productivity Trends for Nooksack River Chinook Salmon. Source NWFSC 2015

Region	**Population**	**Natural Escapement Trend[1] (1990-2013)**	**Growth Rate[2] (1990-2011)**	
			Return (Recruits)	Escapement (Spawners)
Strait of Georgia	NF Nooksack (early)	1.14	1.03	1.02
	SF Nooksack (early)	1.05	1.02	1.01

[1] Long-term, reliable data series for natural-origin contribution to escapement are limited in many areas. Escapement trend is calculated based on all spawners (i.e., including both natural origin spawners and hatchery-origin fish spawning naturally) to assess the total number of spawners passed through the fishery to the spawning ground.
[2] Growth rate (λ) is calculated based on natural-origin production assuming the reproductive success of naturally spawning hatchery fish is equivalent to that of natural-origin fish (for populations where information on the fraction of hatchery fish in natural spawning abundance is available). Source: Abundance and Productivity Tables-Puget Sound TRT).

important life-history element of the ESU. The disproportionate loss of early-run life history diversity represents a particularly significant loss of the evolutionary legacy of the historical ESU. As two of the remaining six populations of early and moderately-early run-time Chinook salmon in Puget Sound, the substantially reduced abundance of the Nooksack spring-run populations, relative to historical levels, represents a risk to remaining ESU diversity.

Nooksack River Chinook Salmon Spatial Structure - Indices of spatial structure for Puget Sound Chinook salmon have not been developed at the population level (Ford et al. 2011). Due to fish habitat loss and degradation resulting from human developmental activities in the watershed (see Smith 2002), it is likely that the spatial structure of the two Nooksack River Chinook salmon natural populations, including access to spawning habitat and the availability of rearing habitat, is reduced from historical levels. The most recent estimate is that Nooksack River Chinook salmon have access to 92.4% of their historical habitat (Ned Currence and Mike Maudlin, Nooksack Tribe, pers. comm., January 18, 2016). The North Fork Nooksack River natural population currently spawns from late-July through September in the North Fork from the confluence with the South Fork (RM 36.6) to Nooksack Falls (RM 65), and in the lower Middle Fork to RM 7.2 (where a diversion dam blocks migration), as well as in numerous larger tributaries including: Deadhorse, Boyd, Thompson, Cornell, Canyon, Boulder, Maple, MacDonald, Racehorse, and Canyon Lake creeks (SSPS 2005b). The highest spawning densities are in the North Fork from RM 45.2 to RM 63 (SSPS 2005b). The South Fork Nooksack population spawns from mid-August through September in the South Fork from the confluence with the North Fork (RM 0) to Sylvester's Falls (RM 25) (SSPS 2005b). In many years spawning occurs upstream of the falls to RM 30.4. The highest spawning densities are typically between RM 8.5 and RM 20.7. Spawning also occurs in the larger tributaries including: Hutchinson, Skookum, Deer, and Plumbago creeks.

Nooksack River Steelhead

The Nooksack River basin includes two steelhead DIPs: Nooksack winter-run and South Fork Nooksack summer-run (Myers et al. 2015). The DPS viability criteria developed by NMFS (Hard et al. 2015), require that at least 40 percent of the steelhead populations within each MPG achieve viability (restored to a low extinction risk), as well as at least 40 percent of each major life history type (e.g., summer-run and winter-run) historically present within each MPG achieve viability. The TRT-derived minimum abundance goals for viable populations are 11,023 natural-origin fish for the Nooksack River winter-run population and 568 fish for the South Fork Nooksack River summer-run population (Table 12).

Nooksack River Steelhead Abundance - Suspended sediment and high turbidity, due in part to the glacial hydrology, makes it difficult to monitor steelhead spawners in this system. Adult spawner data has only been collected for Nooksack winter steelhead in recent years and when conditions allow. These data suggest that population abundance for winter steelhead is relatively stable (Table 13). For summer steelhead, visibility is even worse making spawning ground surveys difficult to impossible and thus there are no abundance trend data for SF Nooksack summer steelhead, and their status remains unknown (SaSI, (WDFW 2014b)). Based on a habitat-based intrinsic potential (IP) analysis by the Meyers et al. (2015), the estimated historical capacity for winter steelhead in this system was between 22,045 and 44,091 fish and up to 2,273 fish for summer steelhead (Table 12). In recent years (2010-2015) combined mean escapement for the winter-run population in the Nooksack River basin is 1,820 fish(WDFW Score Database; Ned Currence, pers. comm. Feb 2016), or 8.2 and 4.1 percent of the low and high IP capacity for the basin. Natural-origin smolt production in 2012 and 2013 for the entire Nooksack River watershed

Table 12. DIP abundance goals for natural-origin Nooksack River steelhead and the Puget Sound steelhead DPS.

Population Basin				Quasi Extinction Threshold	Low Abund-ance	Viable	Capacity
Population	Area Km^2	Mean Elevation (m)	Total Stream Length (m)		1% SAS	5% SAS	20% SAS
Nooksack River	1,982	619	1,257,480	73	2,205	11,023	44,091
SF Nooksack River	172	926	99,347	27	114	568	2,273
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2015.

Table 13. Nooksack River winter steelhead natural spawning escapement 2004-2015 (natural and hatchery-origin spawners combined).

Return Year	Escapement
2004	1,574
2005	NA
2006	NA
2007	NA
2008	NA
2009	NA
2010	1,897
2011	1,774
2012	1,747
2013	1,901
2014	1,521
2015	2,081
Average	1,785

Source: WDFW Score Database; Ned Currence, pers. comm. Feb 2016.

was estimated to average 77,128 smolts (LNRD 2013), which is approximately 33 percent of the estimated IP capacity for the basin (including both summer- and winter-run populations).

Nooksack River Steelhead Productivity - The 2015 status review report (NWFSC 2015) concluded that the most recent data available indicate some minor increases in spawner abundance and/or improving productivity over the last two to three years; however, most of these improvements are viewed as small and abundance and productivity throughout the DPS remain at levels of concern from demographic risk. NWFSC (2015) found that recent increases in abundance observed in a few populations have been within the range of variability observed in the past several years and trends in abundance of natural spawners remain predominately negative. For all but a few putative Puget Sound steelhead natural populations, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10 percent annually—and extinction risk within 100 years for most natural populations in the DPS is estimated to be moderate to high (Hard et al. 2015). There are no estimates of productivity or extinction risk for Nooksack River populations.

Nooksack River Steelhead Diversity - Available data indicate that steelhead diversity in the Nooksack River watershed has likely declined relative to historical levels due to degradation and loss of steelhead habitat in the watershed and past harvest practices that disproportionately affected the earliest returning fish. Genetic introgression, resulting from past planting of EWS, could have reduced the fitness of the winter-run natural population (Ford et al. 2011), but the magnitude of any actual effects is unknown. More recent analyses by WDFW indicate that any gene flow effects associated with Kendall Creek Hatchery EWS production on the Nooksack River winter-run steelhead natural population have been negligible or very low (Warheit 2014). There have been no releases of Skamania-origin summer steelhead into the South Fork Nooksack River that would affect genetic diversity of the South Fork Nooksack River summer-run steelhead natural population.

Nooksack River Steelhead Spatial Structure - Human developmental activities in the Nooksack River basin have reduced steelhead population spatial structure. Access to habitat and the degradation of habitat both can reduce spatial structure. Scott and Gill (2008b) reported that the distribution of winter-run steelhead in the basin had been reduced from 1% to 14% (currently 407 miles) from the pre-development distribution of 411 to 474 miles of riverine habitat. Winter-run steelhead spawn throughout the mainstem, South Fork, North Fork, and Middle Fork, as well as in side-channels and the larger tributaries (e.g., Skookum, Kenny, Racehorse, Kendall, Maple, Boulder, Canyon, Cornell, Thompson, and Deadhorse creeks).

Little is known about the South Fork Nooksack summer-run steelhead population. Their primary spawning habitat is thought to be quite limited and upstream of a partial barrier at RM 25. Summer steelhead also access spawning habitat upstream of RM 30.4 on the South Fork Nooksack River, where there is a flow/velocity barrier to winter-run steelhead migration. Spawning has been observed upstream of Wanlick Creek (RM 34.1) in March.

3.1.2.3 Stillaguamish River

Section 2.2.2 of the Whitehorse Ponds EWS HGMP describes the status of the listed Stillaguamish Chinook salmon and steelhead natural populations relative to “critical” and “viable” population thresholds.

The Whitehorse Ponds EWS HGMP was designed in consideration of the best available scientific information for viability goals. Goals for the viability of the Stillaguamish River watershed salmon and steelhead natural populations were established by the state and tribal co-managers and used in planning and guiding the proposed implementation of the Whitehorse Ponds EWS program (WDFW 2014c). The viability goals for steelhead will be updated upon the availability new scientific information. The existing viability goals will be used as reference points for monitoring the status of salmon and steelhead natural populations during implementation of the hatchery program. The goals will also be used as reference points to gauge achievement of program performance and risk reduction objectives specified in the HGMP, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery program for EWS would be implemented, so as not to reduce the viability status of those listed salmon and steelhead populations, are provided in section 3.1.5 of this document.

Stillaguamish River Chinook Salmon

There are two DIPs of Chinook salmon, one in the North Fork Stillaguamish and another in the South Fork Stillaguamish River (Ruckelshaus et al. 2006). Abundance and productivity goals for both natural populations (Table 14) have been derived by the TRT (Ruckelshaus et al. 2002). Both Stillaguamish River basin natural populations are ocean-type Chinook salmon with 98 to 100 percent of the juveniles emigrating seaward as sub-yearlings (Stillaguamish Implementation Review Committee [SIRC] 2005; Griffith et al. 2009; Griffith and Van Arman 2010; Scofield and Griffith 2013). A supportive breeding program for the North Fork Stillaguamish population was initiated in 1986 (Stillaguamish Tribe 2015a). The maximum annual smolt release level for the program is 220,000 sub-yearlings from WDFW’s Whitehorse Springs Hatchery (Stillaguamish Tribe 2015a). A captive broodstock-based supplementation program for the South Fork Stillaguamish population was initiated in 2007 (Stillaguamish Tribe 2015b). The maximum annual smolt release level for the program is 200,000 sub-yearlings from the Stillaguamish Tribe’s Brenner Creek Hatchery (Stillaguamish Tribe 2015b).

NMFS included Whitehorse Springs Hatchery summer Chinook salmon and Brenner Creek Hatchery fall Chinook salmon as part of the listed Puget Sound Chinook ESU (79 FR 20802, April 14, 2014). The broodstocks were founded recently from the natural populations inhabiting the same area, and both hatchery populations are no more than moderately diverged from their associated natural populations (71 FR 20802, April 14, 2014; Jones 2015).

Stillaguamish River Chinook Salmon Abundance - In the North Fork Stillaguamish River, the total Chinook salmon spawning escapement (natural-origin and hatchery-origin fish combined) from 1986 through 2015 ranged from 371 fish (2015) to 1,408 fish (2000); averaging 900 fish (WDFW 2014c; WDFW Score Database). Natural-origin spawners during this period (where estimates are available) ranged from 141 fish (2014) to 1,123 fish (2004); averaging 598 fish.

Table 14. Stillaguamish River Chinook salmon minimum viability natural-origin spawning abundance at equilibrium or replacement, and spawning abundance and productivity at MSY.

Region and population	**TRT minimum viability abundance**	**Under properly functioning conditions (PFC)**			**NMFS Escapement Thresholds**	
		Equilibrium abundance	Spawners at MSY[1]	Productivity at MSY[1]	Critical[2]	Rebuilding[3]
NF Stillaguamish	17,000	18,000	4,000	3.4	300	552
SF Stillaguamish	15,000	15,000	3,600	3.3	200[4]	300
ESU	**261,300**	**307,500**	**70,948**	**3.2**	**3,875**	**2,785**

Source: Ford 2011; NMFS 2011b (as cited in (WDFW 2014b).

[1] Determined by EDT analyses of properly functioning conditions and expressed as a Beverton-Holt function. The TRT minimum viability abundance was the equilibrium abundance or 17,000, whichever was less.

[2] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000) .

[3] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).

[4] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

The proportion of hatchery-origin spawners in the total escapement of natural spawners has ranged from a low 5 percent in 1992 to a high of 66 percent in 2014. During the most recent five years (2011-2015), the North Fork Stillaguamish population has averaged 406 natural-origin spawners (53% of the total naturally spawning Chinook salmon population) (WDFW and PSTIT 2013; 2014; WDFW Score Database).

The present abundance of South Fork Stillaguamish River basin Chinook salmon is a fraction of historical levels and is considered critically low (SSPS 2005d). The total number of natural spawners has been below 200 adults for eleven of thirteen years between 2003 through 2015 and has ranged from 20 (2010) to 353 (2002); averaging 171 (WDFW 2014c; WDFW Score Database). During the most recent five years, the South Fork Stillaguamish population has averaged only 95 naturally spawning (natural-origin and hatchery-origin fish combined) Chinook salmon (WDFW and PSTIT 2013; 2014).

Stillaguamish River Chinook Salmon Productivity - As indicators of productivity, the natural populations of North Fork Stillaguamish and South Fork Stillaguamish Chinook salmon have escapement trends at or slightly below 1.0 (1.0 is the value at which a population is not growing or declining but only replacing itself). Calculated growth rates, for both recruits and for spawners, are equal to or below 1.0 (Table 15 and Table 16). The North Fork Stillaguamish Chinook salmon supportive breeding program, in combination with on-going habitat restoration efforts have not yet led to rebuilding of natural adult return abundance. The poor population response is likely

Table 15. Estimates of Geometric Mean Total Escapement, Natural-origin Escapement Levels, Productivity, and Average % Hatchery-origin spawners for Run-years 1999 through 2014. Source: NWFSC 2015

Region	Population	1999 to 2014 Geometric mean Escapement (Spawners)		Average % hatchery fish in escapement 1999-2013 (min-max)[3]
		Natural[1]	Natural-Origin (productivity[2])	
Whidbey Basin	NF Stillaguamish	952	582 (0.9)	35 (8-62)
	SF Stillaguamish	110	104 (.7)	NA

[1] Includes naturally spawning hatchery fish.
[2] Source for 1999-2011 productivity is Abundance and Productivity Tables (tab Cohort RR) from Puget Sound TRT database; measured as the mean of observed recruits/observed spawners over the 1999-2011 period (1995-2007 brood years).
[3] Estimates of the fraction of hatchery fish in natural spawning escapements are from the Puget Sound TRT database and co-manager postseason reports on the Puget Sound Chinook Harvest Management Plan (WDFW and PSTIT 2005; 2006; 2007; 2008; 2009; 2010; 2011) and the 2010-2014 Puget Sound Chinook Harvest Management Plan (PSIT and WDFW 2010a)

Table 16. Recent Abundance and productivity trends for the Stillaguamish River Chinook salmon natural populations.

Region	Population	Natural Escapement Trend[1] (1990-2013)	Growth Rate[2] (1990-2011)	
			Return (Recruits)	Escapement (Spawners)
Whidbey Basin	NF Stillaguamish R. (early)	1.01	0.96	1.00
	SF Stillaguamish R[3] (moderately early)	0.96	0.90	0.94

[1] Long-term, reliable data series for natural-origin contribution to escapement are limited in many areas. Escapement trend is calculated based on all spawners (i.e., including both natural origin spawners and hatchery-origin fish spawning naturally) to assess the total number of spawners passed through the fishery to the spawning ground.
[2] Growth rate (λ) is calculated based on natural-origin production assuming the reproductive success of naturally spawning hatchery fish is equivalent to that of natural-origin fish (for populations where information on the fraction of hatchery fish in natural spawning abundance is available) (Abundance and Productivity Tables-Puget Sound TRT database).
[3] Estimate of the fraction of hatchery fish in time series is not available for use in λ calculation, so trend represents that in hatchery-origin + natural-origin spawners.

caused by poor and likely deteriorating freshwater and estuarine habitat conditions that suppress survival and productivity of the naturally spawning aggregation (WDFW and PSTIT 2013).

Stillaguamish River Chinook Salmon Diversity - Indices of Diversity have not been developed at the population level, though diversity at the Puget Sound Chinook salmon ESU level is declining (Ford et al. 2011). Age composition analyses of returning North Fork Stillaguamish Chinook salmon from 1985 to 1991 indicates that the majority of Chinook salmon return at age-4 (PSIT and WDFW 2010a). Age at return distributions for the period were: age-2 (5%), age-3 (32%), age 4 (55%), age-5 (8%), and age-6 (<1%) (Stillaguamish 2015b). Adult North Fork Stillaguamish Chinook salmon return to spawn from June through August (Myers et al. 1998). Spawning starts in late-August, peaking in mid-September, and extending into mid-October (Stillaguamish 2015b).

A supportive breeding program for the North Fork Stillaguamish Chinook salmon population was initiated in 1986 (Stillaguamish 2015b). The maximum annual release of hatchery fish is 220,000 sub-yearlings from the Whitehorse Hatchery (Stillaguamish 2015b). As mentioned above, annual escapement for the natural-origin component of the North Fork Stillaguamish population has declined in recent years because of poor and likely deteriorating freshwater and estuarine habitat survival and productivity conditions (WDFW and PSTIT 2013).

The South Fork Stillaguamish Chinook salmon population is at a high risk of extirpation due to very low adult abundances, a decreasing abundance trend, low productivity, reduced diversity and fitness from interbreeding with out-of-area Chinook salmon including North Fork Stillaguamish Chinook salmon, and degraded freshwater and estuarine habitat conditions (Stillaguamish 2015b). A captive broodstock hatchery program was initiated in 2007 to preserve the population, and maintain existing diversity, until the factors for decline are rectified (WDFW and PSTIT 2013).

Stillaguamish River Chinook Salmon Spatial Structure - Indices of spatial structure for the Puget Sound Chinook salmon ESU have not been developed at the population level (Ford et al. 2011). The current spatial structure for the two Stillaguamish River Chinook salmon natural populations is reflected by observed spawning distribution, which presumably also reflects juvenile rearing distribution. Spawning by the North Fork Stillaguamish population occurs in the mainstem North Fork Stillaguamish River (RM 0.0 to 34.4), with the highest density of spawning between RM 14.3 and 30.0. Boulder River and Squire Creek are the two tributaries in the watershed with the highest density of spawners. North Fork Stillaguamish Chinook salmon also spawn in French, Deer, and Grant Creeks. Spawning, and presumably rearing by the South Fork Stillaguamish Chinook salmon population takes place in the mainstem Stillaguamish River and South Fork Stillaguamish Rivers, and Jim, Pilchuck, and lower Canyon creeks.

Stillaguamish River Steelhead

The Stillaguamish Basin includes three steelhead DIPs: Stillaguamish River winter-run; Deer Creek summer-run; and Canyon Creek summer-run (Myers et al 2015). In addition, there is a non-native summer-run aggregation (Columbia River Skamania hatchery-origin) which spawns above Granite Falls in the South Fork Stillaguamish River. Because of introgression from interbreeding with Columbia River Skamania stock hatchery fish, South Fork Stillaguamish summer-run steelhead are more than moderately diverged from the pre-existing natural population in the watershed and are not included in the Puget Sound steelhead DPS. The DPS viability criteria developed by NMFS (Hard et al. 2015), require at least 40 percent of the steelhead populations within each MPG to achieve viability (restored to a low extinction risk). At least 40 percent of each major life history type (e.g., summer-run and winter-run) historically present within each MPG must also be restored to a low extinction risk for the DPS to be considered viable. Interim abundance goals have been developed for the Stillaguamish River steelhead populations (Table 17).

Table 17. Interim abundance goals for steelhead populations in the Stillaguamish River Basin and for the Puget Sound steelhead DPS.

Population Basin				Quasi Extinction Threshold	Low Abundance	Viable	Capacity
Population Name	**Area km^2**	**Mean Elevation (m)**	**Total Stream Length (m)**		**1% SAS**	**5% SAS**	**20% SAS**
Stillaguamish R	1,230	398	927,234	67	1,912	9,559	38,236
Deer Creek	180	761	105,313	31	157	786	3,144
Canyon Creek	100	864	47,716	24	100 (12)	250 (60)	243
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2015.

Analyzing the extinction risk for steelhead in the Stillaguamish Basin, based on data through 2011, Hard et al. (2015) estimated the probability that this steelhead population would decline to a QET of 67 fish is high, about 90% within 25 years. With an estimated mean population growth rate of −0.075 (λ = 0.928) and process error of <0.001, the authors were highly confident ($P < 0.05$) that a 90% decline in this population will not occur within the next 30 years, and that a 99% decline will not occur within the next 55 years. However, a 50% decline is highly likely within 10 years and a 90% decline within 35 years (Hard et al. 2015).

Stillaguamish River Steelhead Abundance - The estimated total escapement for Stillaguamish River winter-run steelhead from 2001 through 2015 averaged 1,852 fish, and ranged from a low of 487 fish in 2009 to a high of 3,002 fish in 2004 (Table 18). Very little data is available on the status of summer-run steelhead in Deer and Canyon Creeks. Based on low juvenile outmigrant densities, the Deer Creek population was considered to be depressed in 2002, while the status of the Canyon Creek population is currently unknown (SaSI, cited in WDFW 2014c).

Table 18. Annual Stillaguamish River Natural-Origin Winter-Run Steelhead Escapement Estimates.

Year	Index Escapement	Total Escapement
2001	630	2,556
2002	354	1,436
2003	660	2,678
2004	740	3,002
2005	462	1,874
2006	676	2,743
2007	NA	NA
2008	306	1,241
2009	120	487
2010	372	1,509
2011	362	1,469
2012	340	1,379
2013	514	2,085
2014	362	1,468
2015	566	2,296
Average	**457**	**1,873**

Source: WDFW 2014c and WDFW Score Database.

Stillaguamish River Steelhead Productivity - Information on the productivity of DIPs within the Northern Cascades MPG is extremely limited, with mean growth rate estimates available for seven of the MPG's 16 populations. (Table 19). Mean growth rate estimates for those DIPs within the MPG for which estimates have been made are declining except for the Tolt River, and its abundance is very low. Risk assessment by the PSSTRT indicated three populations are at high risk of extinction and four are at low risk (Table 19). However, more populations are at lower risk in this MPG than the other MPGs in the DPS (NWFSC 2015).

Stillaguamish River Steelhead Diversity and Spatial Structure - No new estimates of spatial structure and diversity of Puget Sound steelhead have been made available since the last NMFS ESA status review (Ford et al. 2011). Loss of diversity and spatial structure were judged to be "moderate" risk factors due to reduced complexity and diminishing connectivity among populations, interbreeding with non-native steelhead produced by hatchery programs, and the low numbers of summer steelhead populations in the Puget Sound DPS (Hard et al. 2007). Although there are currently no data indicating that introgression associated with planting of EWS produced by the Whitehorse Ponds program has occurred (WDFW 2014c), there are observations of hatchery and natural-origin fish interbreeding. Recent analyses however by WDFW (Warheit 2014)indicate that any gene flow effects associated with Whitehorse Ponds EWS production on native Stillaguamish River steelhead have been unsubstantial (Warheit 2014).

Table 19. Naturally spawning steelhead abundances and trends for DIPs within the North Cascades MPG for which information is available. Populations within the action area are bolded. Note WR=winter-run, SUR=summer run, and SWR=summer/winter run population.

Population (Run Timing)	2005-2009 Geometric Mean Escapement (Spawners)[1]	2010-2014 Geometric Mean Escapement (Spawners)[1]	Percent Change[1]
Nooksack R WR	**NA**	**1,834**	**NA**
Pilchuck R WR	597	614	3%
Samish R WR	534	846	58%
Skagit R SWR[2]	4,767	5,123	7%
Snohomish/Skykomish WR	3,084[3]	930	-70%
Snoqualmie R. WR	1,249	680	-46%
Stillaguamish R. WR[4]	327	392	20%
Tolt River SUR	73	105	44%

1 Source: NWFSC 2015
2 Skagit data includes four DIPs: Skagit, Nookachamps, Baker, and Sauk.
3 Does not include return years 2007-2009 which were among the lowest abundance for Snohomish Basin populations.
4 Only includes the estimated number of naturally spawning steelhead in the North Fork Stillaguamish River index segments.

Because the HGMPs use VSP criteria as standards and indicators for program effects, and because there is monitoring and reporting of the standards and indicators, the HGMPs are consistent with this 4(d) rule criterion.

3.1.3 5(i)(C) Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities i.e., broodstock collection effects on an ESA-listed donor population.

Broodstock collection actions proposed for the three programs reflect appropriate priorities to safeguard ESA-listed fish populations. No natural-origin, ESA-listed fish are collected or used for hatchery broodstock. All broodstock used by the programs would be EWS localized to the hatchery release sites. EWS are not part of the Puget Sound steelhead DPS and therefore are not listed and protected under the ESA.

The HGMPs describe measures that are applied to safeguard the health and abundance of ESA-listed salmon and steelhead in the Dungeness, Nooksack, and Stillaguamish Rivers that may be affected incidentally by broodstock collection activities associated with the proposed EWS hatchery programs. Those measures are described below under 3.1.4.

3.1.4 5(i)(D) The HGMP includes protocols to address fish health, broodstock collection, broodstock spawning, rearing and release of juveniles, deposition of hatchery adults, and catastrophic risk management.

The three HGMPs comply with 5(i)(D) criteria. This criterion is primarily focused on the adequacy of HGMPs for programs that utilize ESA-listed fish in the hatchery program and the need to operate the program in a manner that adequately safeguards ESA-listed fish while under propagation. The proposed isolated EWS programs do not include the spawning, rearing, or acclimation and release of ESA-listed steelhead. Additionally, the issue of catastrophic risk management, focused on the risk to ESA-listed fish while under propagation, is not included in the HGMPs, except as related to safeguarding non-listed program fish. Below are the elements where the proposed program HGMPs identify protocols or "best management practices" (BMP) to address potential incidental effects on ESA-listed fish relating to: Fish Health, Broodstock collection, Release of juveniles, and disposition of hatchery adults.

Fish Health

BMPs addressing fish health, including fish health maintenance and hatchery sanitation procedures applied during broodstock collection, mating, fish incubation, rearing, and release, are detailed in performance standard and indicator, adult management, and fish rearing and release sections of each HGMP. Fish health monitoring and evaluation measures are also described in those HGMP sections.

The hatchery programs would be operated in compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" protocols (WDFW and NWIFC 1998). The co-manager policy delineates Fish Health Management Zones and defines inter and intra-zone transfer policies and guidelines for eggs and fish that are designed to limit the spread of fish disease pathogens between and within watersheds (WDFW and NWIFC 1998). They would also comply with standard fish health diagnosis, maintenance and hatchery sanitation practices referenced in the policy (as per Pacific Northwest Fish Health Protection Committee (PNFHPC) (1989) and AFS (1994) guidelines) to reduce the risks of fish disease pathogen amplification and transfer within the hatchery and to fish in the natural environment. For all of the steelhead hatchery programs, fish health specialists and pathologists from the WDFW Fish Health Section would provide fish health management support and diagnostic fish health services (WDFW 2014a; 2014b; 2014c).

BMPs for monitoring the health of fish in hatcheries specified in the co-managers' fish health policy (WDFW and NWIFC 1998) help reduce the likelihood of fish disease pathogen transmission from hatchery salmonids to naturally produced fish. When implemented, these BMPs would help contain any fish disease outbreaks in the hatcheries, minimizing the release of diseased fish from the hatcheries, and reducing the risks of fish disease pathogen transfer and amplification to natural-origin fish (NMFS 2012).

Broodstock Collection

Sections 6 and 7 of the HGMPs describe BMPs for broodstock selection and collection, carrying forth steelhead production goals and objectives for the hatchery programs, and addressing adult fish capture, transport, holding, and handling practices.

Fish that are collected for use as hatchery broodstock are not ESA-listed and are adult early winter-run, hatchery-origin fish returning to Dungeness River Hatchery, Kendall Creek Hatchery, and Whitehorse Ponds Hatchery. Steelhead that are part of the Puget Sound Steelhead DPS are not collected for hatchery broodstock. The steelhead used for hatchery broodstock were raised and acclimated at the hatcheries and return there as adults from December through March when ESA-listed species like Chinook salmon and summer chum salmon (Dungeness R.) are not present. They seek out and volunteer into traps located in off-channel locations away from the areas that ESA-listed steelhead from natural populations use. For this reason, encounters with ESA-listed Puget Sound steelhead at the off-channel broodstock collection locations are a rare event.

At the Dungeness Hatchery, WDFW (2014a) indicates that an average of four ESA-listed adult natural-origin steelhead, between the years 2006-2012, have been handled, and released annually with no observed injury or mortality. The Kendall Creek and Whitehorse Pond HGMPS (WDFW 2014b; 2014c), respectively, indicate that there have been no natural-origin steelhead observed in the traps during broodstock collection operations over that last 12 years. Operational protocols are in place to return natural-origin fish back to the natural environment as quickly as possible and unharmed when and where encounters inadvertently occur.

Release of Juveniles

BMPs for hatchery steelhead rearing and release are described in sections 9 and 10 of the HGMPs. Rearing and release practices proposed for implementation would help ensure that hatchery fish are released as healthy seawater-ready smolts that emigrate downstream rapidly after release, leading to minimal interactions with natural-origin fish and high hatchery smolt survival rates.

Effects from ecological interactions between hatchery-origin steelhead and natural-origin salmon and steelhead are described in Section 2.0 of the HGMPs. To meet natural fish risk reduction objectives, BMPs would be implemented through the plans to reduce the duration and effects of interactions between hatchery and natural-origin salmon and steelhead to negligible or very low levels. Ecological interactions that have the greatest potential for adverse effects include competition between juvenile hatchery-origin steelhead and natural-origin salmon and steelhead for food and space, and juvenile hatchery fish predation on natural-origin fish. Section 10.11 of the HGMPs describes BMPs that are tailored to avoid or minimize the risk of EWS smolt competition and predation in the Dungeness, Nooksack, and Stillaguamish watersheds. These BMPs are: 1) reductions in the number of hatchery fish that would be released at each location relative to recent past levels; 2) elimination of off-station smolt releases to reduce the number of areas that may be affected by hatchery smolt interactions with natural juveniles; 3) elimination of fry and sub-yearling releases and mandatory rearing and release of only yearling smolts in migratory condition, promoting rapid out-migration that minimizes the time spent in the river, thereby minimizing or eliminating interactions with rearing and migrating natural-origin salmonids; 4) use of volitional release practices to foster rapid seaward migration and limit residualism and freshwater interactions with juvenile salmon and steelhead, bull trout, and other naturally-produced salmonids; 5) mass-marking all EWS smolt release groups to allow monitoring of hatchery and natural fish interactions and selective removal of EWS upon return as adults; 6) release steelhead smolts no earlier than April 15th, to allow listed juvenile Chinook salmon and steelhead to emigrate to the ocean and clear the area, and/or provide time for additional growth to minimize the potential for hatchery fish to prey on natural-origin fish; and, 7) continuation of monitoring, research and reporting of hatchery smolt migration performance behavior, and interactions with natural origin fish to assess and adjust, if necessary, hatchery production and release strategies to minimize effects on natural origin fish.

Adult Management and the Disposition of Returning Hatchery Fish

There are two intentions for hatchery-origin adults; compensate for lost fishing opportunities because of reduced abundances and provide broodstock to perpetuate the hatchery programs. Hatchery fish from these programs are not intended to spawn naturally and the HGMPs include BMPs to minimize the number of hatchery fish that escape to spawning grounds. Those BMPs include: 1) reduced production and release of hatchery fish, 2) weirs and traps at the hatcheries would remain open for the entire EWS migration period (November through March) to maximize removal of hatchery steelhead and thus minimize the number that escape to spawn naturally, and 3) there would no longer be any “recycling” of adult hatchery steelhead, i.e., hatchery fish that are trapped and then returned to the river to provide additional fishing opportunity. Protocols for the disposition of adult hatchery steelhead are described in section 7.5 of the HGMPs. If available, food-grade surplus fish may be donated to charitable organizations and local tribes for ceremonial and subsistence purposes. Non-food-grade carcasses would be distributed in local streams for nutrient enhancement purposes, if approved by WDFW Fish Health Program staff.

3.1.5 5(i)(E) The HGMP evaluates, minimizes, and accounts for the propagation programs’ genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by straying of hatchery fish.

The three EWS HGMPs comply with 5(i)(E) criteria. They provide detailed evaluations of the likely genetic and ecological effects on natural populations of Chinook salmon, summer chum salmon, and steelhead in section 2.0 and each HGMP includes risk minimization measures (in Sections 6-10) that would reduce the likelihood for substantial adverse effects on ESA-listed fish species from disease transfer, competition, predation, and interbreeding. What follows is a summary of the effects of the three hatchery programs, relating to genetic and ecological effects, as well as risk minimization measures proposed in the HGMPs.

Genetic Effects

EWS hatchery fish that are not harvested in tribal and recreational fisheries and that fail to return to their hatchery of origin are expected to spawn naturally. They would primarily spawn with other hatchery EWS because of their advanced spawn timing (i.e., early spawners spawn with other early spawners), compared with steelhead from natural populations in the Nooksack, Dungeness, and Stillaguamish River basins. However, complete isolation of hatchery fish from natural populations of steelhead has not been achieved and interbreeding is known to occur. Steelhead of any kind (hatchery or natural-origin) do not interbreed with any of the salmon species or bull trout and therefore implementation of the HGMPs does not pose any risk of genetic effects on these species.

The subject HGMPs use best available scientific information to identify and propose a suite of practices that are expected to result in low genetic effects. Information that is particularly crucial to an analysis of genetic effects is the fact pattern and circumstances that are unique to each HGMP including the geology, hydrology, and the quality and quantity of habitat for fish and the VSP status or condition of each natural population likely to be affected by the HGMP. Other examples are the location and operational considerations unique to every hatchery facility and the behavior of the fish themselves. To the extent this information is available, it is included in the HGMPs.

Loss of Within-Population Diversity

Loss of within-population genetic diversity (variability) is defined as the reduction in quantity, variety and combinations of alleles in a population (Busack and Currens 1995). Quantity is defined as the proportion of an allele in the population and variety is the number of different kinds of alleles in the population. Genetic diversity within a population can change from random genetic drift and from inbreeding. Random genetic drift occurs because the progeny of one generation represents a sample of the quantity and variety of alleles in the parent population. Since the next generation is not an exact copy of the parent generation, rare alleles can be lost, especially in small populations where a rare allele is less likely to be represented in the next generation (Busack and Currens 1995).

The hatchery programs under consideration produce steelhead that are not included as part of the ESA-listed Puget Sound steelhead DPS (Jones 2011). Adult fish produced are not intended to spawn naturally nor contribute to the viability of any Puget Sound steelhead population as part of an integrated recovery effort. Only EWS produced by the programs (identified by early return timing and presence of an adipose fin clip mark) will be used as broodstock, and no natural-origin steelhead will be collected and spawned.

Risk to the within-population diversity of natural steelhead populations is much more of a concern in integrated programs than in isolated programs such as those in the Proposed Action. However, within-population diversity of the natural steelhead populations may be affected by hatchery-origin fish from the proposed programs spawning with natural-origin steelhead. Within-population diversity is influenced strongly by the effective size of the population[2]. Population effective size could either increase or decrease from hatchery-origin fish spawning in the wild, depending on the effective number of breeders that produced the hatchery-origin and natural-origin fish, the relative spawning success of the hatchery-origin and natural-origin fish, and the background level of diversity in the natural-origin and hatchery-origin fish. Effective size changes are generally a concern only when the relative abundance of hatchery-origin fish on the spawning grounds far exceeds that of natural-origin fish, which is not expected to be the case for the programs described in the HGMPs under review. As with the genetic risk of outbreeding depression and hatchery-influenced selection (described below), risks posed to within-population diversity of natural populations of steelhead are further mitigated through measures that reduce the number of naturally spawning hatchery-origin fish, in general, and in particularly those fish that would overlap spatially and temporally with natural-origin spawners (See *Risk Minimization of Genetic Effects* below).

Outbreeding Effects and Hatchery-Influenced Selection

Gene flow from EWS hatchery fish could impact natural steelhead populations through outbreeding effects and hatchery-influenced selection. Although the relative contribution of the two types of effects cannot be cleanly determined, the potential effect is the same: reduction in fitness of natural populations. The measures applied to reduce both types of risk are also the same, all aimed at minimizing gene flow opportunities.

Outbreeding effects are a concern whenever the hatchery-origin and natural-origin fish are from different populations. This is the case with the proposed, early winter hatchery steelhead and the natural steelhead populations in the basins of operation. The early winter hatchery steelhead are considered so diverged genetically from natural steelhead that they are not considered part of any steelhead DPS (NMFS 2003). The basis of this is the fact that they have been subjected to many years of intense artificial selection for early smolting, which has resulted not only in smolting predominantly at one year of age, but also earlier spawning time (Crawford 1979).

Hatchery-influenced selection (commonly called “domestication”) results in fitness loss and phenotypic change caused by differences between the hatchery and natural environments (includes intentional selection and relaxation of selection), and sampling “errors” during fish culture (includes advertent or inadvertent selection of traits for fish under propagation). Hatchery-induced selection may lead to changes in quantity, variety, and the combination of alleles between a hatchery population and its source population that are the result of selection in the hatchery environment (Busack and Currens 1995). This hazard is also defined as the selection for traits that favor survival in a hatchery environment and that reduce survival in natural environments NMFS (2012). The concern is that hatchery-induced selection effects will decrease the performance of hatchery fish and their descendants when exposed to natural selection conditions in the wild.

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[2] Effective population size is the size of a breeding population adjusted for variation in sex ratio and reproductive success to reflect the rate at which genetic diversity is lost. The maximum genetic diversity which can be maintained by a population is determined by its effective population size as is the rate at which genetic diversity is lost by chance due to random fluctuations in allele frequencies known as genetic drift.

For both effects, risks to natural steelhead populations are controlled by measures that reduce the number of naturally spawning hatchery-origin fish, in general, and in particularly those fish that would overlap spatially and temporally with natural-origin spawners. Genetic effect analyses included with the HGMPs, and cited in the body of the plans, indicate that adult EWS produced by the programs, as previously implemented, have contributed and are expected to contribute very few fish to the associated naturally spawning populations in the watersheds where the fish are released (Hoffmann 2014; Warheit 2014). Specifically, for the three proposed programs, the analysis of genetic data indicate that gene flow from early winter hatchery steelhead to natural steelhead populations should be under 2% in all the natural-origin steelhead populations affected by the programs, and this finding is supported by gene flow projections based on demographic parameters. Cumulatively, findings presented in the HGMPs and accompanying analyses (Hoffmann 2014; Warheit 2014) indicate the proposed EWS programs would not pose substantial fitness loss risks through gene flow to listed Dungeness, Nooksack, or Stillaguamish river steelhead populations to the extent that effects would impair the survival or recovery of these populations (NMFS 2016).

Measures Applied to Minimize Genetic Effects

The HGMPs address genetic effects posed by the continued operation of these programs in Sections 1.10.2, 2.2.3, 6.3, 7.9, and 11.1.1. The plans propose a series of specific operational actions designed to minimize the likelihood of unharvested adult hatchery steelhead escaping to stray into natural spawning areas and interacting reproductively with natural-origin steelhead in the Dungeness, Nooksack, or Stillaguamish River basins. These actions include:

- An 11% reduction in releases of EWS smolts, relative to 2006 levels, will reduce the number of hatchery fish that have the potential to stray and spawn in areas used by natural steelhead.
- Cessation of off-station smolt releases, including truck planting, reducing the number of smolt release locations, and confining releases to the main hatchery rearing sites only. These reductions promote homing fidelity to the hatchery sites, where returning adult fish can be removed, reducing the potential for EWS straying to natural steelhead spawning areas.
- Elimination of EWS adult recycling, with removal of all adult fish recruiting to the hatcheries required to prevent straying that potentially resulted from this past practice of returning adult fish to the rivers to increase recreational fishing opportunities.
- Only fish returning to the hatchery of origin will be used for hatchery broodstock and this will promote fidelity of adult fish homing to the hatchery location where the fish were propagated and reduce straying to natural spawning areas.
- Collection of all eggs to sustain each program from hatchery-origin, marked EWS returning to the facilities prior to January 31, of each year, to promote and maintain temporal separation in the spawn-timing of hatchery and natural origin steelhead.

- Maintenance of all hatchery traps in open, operating condition through mid to late March each year to attract and remove as many adult hatchery fish as possible and reduce straying to natural spawning areas.

The HGMPs also include protocols for minimizing the number and rate of hatchery smolts that fail to emigrate from the system. These protocols are designed to reduce the risk that the newly released hatchery fish do not emigrate seaward, but instead “residualize” in the rivers. Hatchery steelhead that residualize present not only risks of competition and predation (addressed below under Ecological Effects), but also may pose interbreeding risks with natural populations of steelhead if the hatchery fish later mature to spawn as jacks in freshwater. The BMPs described in the Competition and Predation sections below are applied to reduce this risk.

Measuring and Monitoring for Genetic Effects

The HGMPs include monitoring and evaluation actions that would be implemented to verify compliance with gene flow criteria and measure and monitor genetic effects resulting from the proposed hatchery steelhead programs. Through these actions, the level of gene flow from the hatchery EWS steelhead population into the natural listed steelhead populations would be determined in each of the basins where these fish are proposed for release. The HGMPs propose that the steelhead hatchery programs will not exceed a gene flow of 2% in each watershed. Two methods (Hoffmann 2014; Warheit 2014) are proposed to estimate annual gene flow rates, and validate whether gene flow remains under 2%. Collection of data necessary to derive gene flow rates will be accomplished through a significant, annual sampling effort to obtain thorough and representative tissue samples for DNA analyses from both juvenile and adult wild steelhead in each of the basins (Anderson et al. 2014a).

Ecological Effects

As called for under this criterion, ecological effects resulting from implementation of the HGMPs are also evaluated, minimized (through application of operational practices), and accounted for in the HGMPs (section 2.0 in WDFW 2014a; 2014b; 2014c). Ecological effects of concern include fish disease pathogen transfer, resource competition, and predation effects on ESA-listed Chinook salmon, summer chum salmon, and steelhead that may result from implementation of the three steelhead HGMPs.

Disease

The three HGMPs address general threats from disease transfer in section 2.0 of each plan. Fish disease transfer and amplification risk reduction measures are more specifically addressed for broodstock selection and collection actions in sections 6.0 and 7.0; incubation and rearing actions in section 9; and for fish release actions in section 10.0. Within these sections, the plans describe fish disease pathogen issues of concern and actions that would be implemented to minimize risks of fish disease pathogen transfer and amplification. As noted in the plans, all hatchery actions would be implemented in accordance with the “Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State (WDFW and NWIFC 1998). Protocols described in the policy and applied through the programs would help reduce risks of fish disease to propagated and natural fish populations through regular fish health monitoring and reporting, and application of best management practice measures to reduce fish health risks. The health of steelhead under propagation would be monitored and managed consistent with fish health policy practices. Under the fish health plan, professional fish pathologists from the WDFW Fish Health Section would visit the hatchery rearing locations monthly, or as needed to perform routine monitoring of adult and juvenile fish, advise hatchery staff on disease findings, and recommend disease treatments when appropriate. All fish monitored for fish health assessment purposes would be sampled consistent with the co-manager policy and procedures referenced in the policy, to minimize the proportion of the total rearing population exposed to handling and non-lethal and lethal sampling. In addition, all WDFW hatchery personnel are trained in standard fish propagation and fish health maintenance methods to help ensure that fish under propagation are adequately protected from catastrophic loss due to poor hatchery practices, adverse water quality conditions, or fish health issues associate with poor water quality or inadequate water quantity.

Competition

Release of hatchery–origin species into a listed species' habitat, or where they may access the habitat of listed species, may harm listed species and therefore constitutes a "take" under the ESA (NMFS 1999). Among the mechanisms of potential harm is competition (Tatara and Berejikian 2012). Competition occurs when the demand for a resource by two or more organisms exceeds the available supply. If the resource in question (e.g., food or space) is present in such abundance that it is not limiting, then competition is not occurring, even if both species are using the same resource. Adverse impacts of competition may result from direct interactions, whereby a hatchery-origin fish interferes with the accessibility to limited resources by naturally produced fish, or through indirect means, as when utilization of a limited resource by hatchery fish reduces the amount available for naturally produced fish (SIWG 1984). Specific hazards associated with adverse competitive impacts of hatchery salmonids on listed naturally produced salmonids may include food resource competition, competition for juvenile rearing sites, and, to a lesser extent, competition for spawning sites NMFS (2012). For these competition risks to occur, substantial levels of spatial and temporal overlap, and limited resources shared by the fish must exist (Tatara and Berejikian 2012). The relative sizes of juvenile hatchery EWS and natural-origin salmon and steelhead (and size-determined diet preference differences) and their relative densities in migration reaches, would also determine competition risks in freshwater areas where the groups overlap spatially and temporally.

The HGMPs include BMPs designed to avoid or reduce competition in freshwater between fish from natural populations and hatchery-origin steelhead. They are:

- All hatchery steelhead produced by the programs for release in the action area watersheds would be released as seawater-ready smolts as a measure to foster rapid emigration seaward. The release of seawater-ready smolts only is expected to reduce the duration of interaction with natural-origin steelhead and salmon that are at a life stage vulnerable to competition for food or space.

- All smolt release groups will meet the minimum size criteria of 5 to 6 fish per pound (fpp), or 198 to 210 mm fork length (fl) established by Tipping (2001) (as cited in (WDFW 2014a; 2014b; 2014c)) to ensure the fish are at size that has been demonstrated to promote downstream migration. As described in the HGMPs, all smolt populations would be released at a uniform average size of 5 or 6 fpp.
- Hatchery- and natural-origin juvenile steelhead and salmon emigration timing and abundance would be monitored each year through operation of WDFW and tribal juvenile outmigrant trapping programs to evaluate hatchery fish emigration rates, co-occurrence levels with natural-origin fish, and the potential for harmful ecological interactions. Information collected would be used to develop as needed, alternate hatchery steelhead release timings or other mitigation measures would be developed to avoid or limit such interactions.
- All hatchery-origin steelhead smolts produced by Kendall Creek Hatchery and Whitehorse Ponds Hatchery would be volitionally released from hatchery rearing ponds to minimize residualization, and associated competition risks to natural fish. The HGMPs provide sufficient information, some of which is based on 30 years of hatchery program implementation and monitoring, supporting the efficacy of volitional release for meeting actively migrating smolt release and residual minimization objectives. As indicated in the HGMPs, WDFW is conducting research on the effects of volitional release practices in the Upper Columbia River region. Preliminary results suggest faster downstream migration for volitionally released smolts and substantially reduced rates of residualism relative to force-released steelhead (Snow et al. 2013). Volitional releases would begin when steelhead display cues of outward physical signs and behaviors reflecting a state of active smoltification, including loss of parr marks, banding of the caudal fin, and increased attraction to pond edges, inflow, and outflow areas. When these conditions are observed after May 1st, rearing pond end-screens would be removed to provide the opportunity for migration-ready steelhead smolts to exit downstream. Any EWS smolts that do not exit rearing ponds volitionally would be removed (culled) and planted into landlocked lakes to enhance recreational fishing opportunities. Dungeness River Hatchery EWS would be forced released, but juvenile out-migrant trapping data in the Dungeness River show that most hatchery fish leave freshwater for the estuary in under 14 days (Topping et al. 2006, Topping and Kishimoto 2008, Topping et al. 2008). The lower watershed release location (RM 10.5) and rapid seaward emigration of newly released steelhead indicate that the duration of interaction between EWS smolt and natural-origin fish, and the risk of predation, would be unsubstantial.

Predation

Risks to naturally produced salmon and steelhead attributable to direct predation (direct consumption) or indirect predation (increases in predation by other predator species due to enhanced attraction) can result from hatchery salmonid releases (NMFS 2012). Hatchery-origin fish may prey upon juvenile naturally produced salmonids at several stages of their life history. Newly released hatchery steelhead smolts have the potential to consume naturally produced fry and fingerlings that are encountered in freshwater during downstream migration. Hatchery smolts that do not emigrate and instead take up stream residence near the point of release (residuals) have the potential to prey on rearing natural-origin juvenile fish over a more prolonged period. In general, naturally produced salmonid populations will be most vulnerable to predation when naturally produced populations are depressed and predator abundance is high, in small streams, where migration distances are long, and when environmental conditions favor high visibility (NMFS 2012).

Hatchery-origin steelhead smolt predation on natural-origin juvenile fish is dependent upon three factors: 1) the hatchery fish and their potential natural-origin prey must overlap temporally; 2) the hatchery fish and their prey must overlap spatially; and, 3) the prey should be less than 1/3 the length of the predatory fish (NMFS 2012).

The EWS HGMPs would reduce temporal and spatial overlap and the potential for predation on listed juvenile salmon and steelhead through application of the following measures:

- All hatchery steelhead produced by the programs for release in the action area watersheds would be released as seawater-ready smolts as a measure to foster rapid emigration seaward. The release of seawater-ready smolts only is expected to reduce the duration of interaction with juvenile natural-origin steelhead and salmon that are at life stages and sizes vulnerable to predation by EWS smolts of an average size of 5 to 6 fish per pound (fpp).
- All smolt release groups will meet the minimum size criteria of 5 to 6 fpp, or 198 to 210 mm fl, established by Tipping (2001) (as cited in (WDFW 2014a; 2014b; 2014c)) to ensure the fish are at size that will promote rapid downstream migration.
- Hatchery- and natural-origin juvenile steelhead and salmon emigration timing and abundance would be monitored each year through operation of WDFW and tribal juvenile outmigrant trapping programs to evaluate hatchery fish emigration rates, co-occurrence levels with natural-origin fish, and the potential for harmful ecological interactions. Information collected would be used to develop as needed, alternate hatchery steelhead release timings or other mitigation measures would be developed to avoid or limit such interactions.
- All hatchery-origin steelhead smolts produced by Kendall Creek Hatchery and Whitehorse Ponds Hatchery would be volitionally released from hatchery rearing ponds to minimize residualization, and associated predation risks to natural fish. The plans provide sufficient information, some of which is based on 30 years of hatchery program implementation and monitoring, supporting the efficacy of volitional release for meeting actively migrating smolt release and residual minimization objectives. As indicated in the HGMPs, WDFW is conducting research on the effects of volitional release practices in the Upper Columbia River region and preliminary results suggest faster downstream migration for volitionally released smolts, and substantially reduced rates of residualism relative to force-released steelhead (Snow et al. 2013). Volitional releases would begin when steelhead display cues of outward physical signs and behaviors reflecting a state of active smoltification, including loss of parr marks, banding of the caudal fin, and increased attraction to pond edges, inflow, and outflow areas. When these conditions were observed after May 1st, rearing pond end-screens would be removed to provide the opportunity for migration-ready steelhead smolts to emigrate for the ocean. Any EWS smolts that do not exit rearing ponds volitionally would be removed (culled) and planted into landlocked lakes to enhance recreational fishing opportunities. Dungeness River Hatchery EWS would be forced released, but juvenile out-migrant trapping

data, in the Dungeness River, shows that hatchery fish leave freshwater for the estuary in under 14 days (Topping et al. 2006, Topping and Kishimoto 2008, Topping et al. 2008). The lower watershed release location (RM 10.5) and rapid seaward emigration of newly released steelhead indicate that the duration of interaction between EWS smolt and natural-origin fish, and the risk of predation, would be unsubstantial.

3.1.6 5(i)(F) The HGMP describes interrelationships and interdependencies with fisheries management.

The three HGMPs describe the relationship of the proposed actions with fisheries management in section 3.0 of each plan. The HGMPs indicate that all WDFW-managed hatchery programs in the Puget Sound region, including the three proposed programs, would operate consistent with the *United States* v. *Washington* (1974) fisheries management framework. This legal framework sets forth required measures for coordinating State and tribal implementation of agreed hatchery programs, defining artificial production objectives, and maintaining treaty-fishing rights through the court-ordered Puget Sound Salmon Management Plan (PSSMP 1985). This fisheries resource co-management process requires that both the State of Washington and the Puget Sound Tribes develop salmon hatchery program goals and objectives, and reach agreement on the function, purpose, and fish production strategies for all Puget Sound hatchery programs.

The NMFS evaluation and authorization for 'take' of ESA-listed steelhead associated with fisheries in the Nooksack, Stillaguamish and Dungeness rivers occurs through a separate ESA consultation process (for spring 2015 through spring 2016, see NMFS 2015b).

3.1.7 5(i)(G) Adequate artificial propagation facilities exist to properly rear progeny of naturally spawned broodstock, to maintain population health and diversity, and to avoid hatchery-influenced selection and domestication.

This criterion does not apply to the EWS hatchery programs. The criterion under limit 5 of the 4(d) Rule was intended to address programs that include ESA-listed fish. The three hatchery programs rear steelhead that are not included in the ESA-listed Puget Sound steelhead DPS (72 FR 26722, May 11, 2007; Jones 2011).

3.1.8 5(i)(H) Adequate monitoring and evaluation exist to detect and evaluate the success of the hatchery program and any risks potentially impairing the recovery of the listed ESU.

Adequate monitoring and evaluation actions are proposed in the three HGMPs to evaluate the performance and effects of each program in meeting program implementation requirements and performance objectives, including verification of the effects on ESA-listed species (Anderson et al. 2014b). These actions are summarized in Section 1.10, and are further described in Section 11.0 of each HGMP (“Monitoring and Evaluation of Performance Indicators”), and in the Anderson et al. (2014b) report included in the co-manager submittal of the HGMPs for NMFS review. Included in HGMP section 1.10 are descriptions of monitoring and evaluation measures that would be implemented to assess hatchery program performance indicators.

In addition to the monitoring and evaluation proposed within the HGMPs, the WDFW and Puget Sound Tribal staffs engage in annual monitoring activities (approved and authorized under the ESA) directed at the status of ESA-listed Chinook salmon, summer chum salmon (Dungeness R.), and steelhead that would occur in each of the affected watersheds. These include:

- Annual surveys to census steelhead spawning abundance, count redds, and sample carcasses to identify fish origin in natural spawning areas, and adult fish abundance and distribution.
- Annual scale sampling of returning adult fish and fish carcasses for age composition analysis.
- Annual operation of downstream juvenile outmigrant traps in the mainstem Dungeness, Nooksack, and Stillaguamish rivers that would provide estimates of natural-origin smolt production and emigration rates for hatchery-origin fish, and assess natural spawning success of the steelhead natural populations.
- Collection of adult steelhead return abundance, timing, sex ratio, mark status, disposition, holding mortality, and fish health condition data at all hatchery facilities to monitor the effects of the programs.
- Annual juvenile outmigrant trapping programs and/or carcass sampling in natural spawning areas would provide a source of tissue samples for DNA analyses to determine gene flow levels between EWS and associated natural-origin steelhead populations. Within the Dungeness River watershed, genetic samples would be collected from steelhead smolts only each year and analyzed to compare the number of hybrid and hatchery-ancestry fish observed from smolt sampling. Within the Nooksack River and Stillaguamish River watersheds, genetic sampling of steelhead smolts would occur each year. Genetic sampling of adult steelhead within subbasins of the Stillaguamish River (Deer Creek and Canyon Creek) and Nooksack River (South Fork Nooksack River) watersheds would be conducted on a rotating basis every three years.

The proposed monitoring and evaluation of hatchery implementation requirements (e.g., maximum smolt release levels), hatchery performance and the verification of hatchery effects on ESA-listed species, along with annual, natural population status and trends monitoring, will enable the co-managers to detect and evaluate the success of the proposed programs as well as any deleterious effects of the programs on ESA-listed species.

3.1.9 5(i)(I) The HGMP provides for evaluating monitoring data and making any revisions of assumptions, management strategies, or objectives that data show are needed.

The HGMPs include the investments and commitments necessary to comply with this criterion. The HGMPs provide for regular monitoring and reporting, and responsive adaptive management. Key provisions of the HGMPs are implementation of BMPs, monitoring and evaluation of program performance, and adjustment of the hatchery programs accordingly. Each of the three

HGMPs identify objectives and actions needed to determine hatchery program performance in meeting stated production objectives for the specific species that are the focus of each HGMP (HGMP sections 1.10), and effects on non-target natural-origin fish populations in the Dungeness, Nooksack, and Stillaguamish River watersheds. In compliance with this 4(d) Rule criterion, the HGMPs would apply adaptive management and risk management approaches in their implementation of hatchery actions.

Under the HGMPs, annual data collected relating to hatchery program performance and effects would be evaluated by WDFW and the Jamestown S'Klallam, Lummi, Nooksack, Stillaguamish, and Tulalip Tribes to determine whether the three EWS programs were meeting HGMP objectives and performance criteria. As identified in Sections 1.10 and 11 of the HGMPs, monitoring and evaluation results would be used to determine whether performance standards addressing program benefits and risks (performance and effects) were met. The co-managers indicate in the HGMPs that funding and staff resources would be committed to monitor and evaluate the programs through review by the WDFW Fish Program and Jamestown S'Klallam, Lummi, Nooksack, Stillaguamish, and Tulalip tribal technical staffs.

The HGMPs also include actions to report on program performance and effects on listed fish and to monitor compliance with plan objectives (sections 1.10.2 and 10). The co-managers would report: numbers of hatchery (marked) and natural (unmarked) steelhead returning to the hatcheries, number of broodstock collected, and surplus returns; EWS smolt release information consistent with Equilibrium Broodstock Document requirements (number, location, method and age class); levels of compliance with applicable fish health standards and criteria; effluent discharge water quality and water withdrawal levels compared to permit standards and allowances; and, hatchery smolt migration behavior, and EWS smolt interactions with natural origin fish. In addition, annual levels of gene flow between EWS and natural-origin steelhead populations in the Dungeness, Nooksack, and Stillaguamish river basins would be monitored (Anderson et al. 2014a). DNA analyses results for juvenile and adult steelhead samples collected in the Nooksack, Stillaguamish, and Dungeness basins would be analyzed and reported to allow for evaluations of whether gene flow limitation criteria in the HGMPs are met, and whether adjustments to the programs are necessary. As stated in the HGMPs, the co-managers propose to continue monitoring, research and reporting of hatchery program performance to assess, and adjust, if necessary, hatchery production and release strategies to minimize genetic and ecological effects on ESA-listed natural-origin fish populations. As a requirement under any ESA determination regarding the proposed HGMPs, NMFS would review all reports provided annually for compliance with stated HGMP objectives, and post the reports on the NMFS website for public information purposes.

3.1.10 5(i)(J) NMFS provides written concurrence of the HGMP which specifies the implementation and reporting requirements.

Written concurrence with the RMP, and the HGMPs of which it is composed, is a requirement specific to Limit 5 of the 4(d) Rule, rather than of Limit 6, under which this RMP is considered. Instead, under Limit 6, NMFS' role is to make a determination as to whether implementing and enforcing the joint tribal/state plan will appreciably reduce the likelihood of survival and recovery of affected threatened ESUs, including consideration of how the HGMPs address the criteria of Limit 5. With the current document, and through the biological opinion for this action (NMFS 2016), NMFS has supported its determination. NMFS will notify the co-managers of our determination and of implementation and reporting requirements specified herein [50 CFR 223.203(b)(5)(J)].

In particular, NMFS' letter of concurrence will describe the following implementation and reporting requirements necessary to ensure that the program continues to perform in a manner consistent with NMFS' analysis. On or before October 1 of each year, tribal and state co-managers must submit an annual report to the NMFS Anadromous Production and Inland Fisheries Branch in Portland, Oregon and that report must address the information requirements in sections 3.1.8 and 3.1.9 of this determination including but not limited to:

(1) The annual abundance, diversity, spatial structure, and productivity status of the natural steelhead populations that may be affected by the EWS hatchery programs relative to NMFS Puget Sound Steelhead DPS population viability objectives (Hard et al. 2015) to guide decisions regarding adjustment or continuation of the EWS hatchery programs.

(2) The level of gene flow between naturally spawning EWS and the associated natural-origin steelhead populations in the Dungeness, Nooksack, and Stillaguamish river watersheds through analyses of natural and EWS steelhead demographic (natural spawning abundance, spatial and temporal spawn timing), mark/tag, and genetic (DNA) data collected from adult returns.

(3) The level of competition and predation between EWS hatchery smolts and juvenile steelhead and Chinook salmon from natural populations through analysis of the weekly incidence of EWS hatchery-origin smolts in downstream areas relative to the total number of EWS smolts released, and the emigration timings and individual fish sizes for EWS smolts, and natural-origin juvenile steelhead and Chinook salmon encountered through juvenile outmigrant trapping in the lower Dungeness, Nooksack, and Stillaguamish rivers.

(4) Success in mass marking and/or tagging EWS smolts released each year through the hatchery programs as described in the HGMPs to allow for the differentiation of hatchery- and natural-origin juvenile and adult steelhead in the natural environment, assessment of hatchery program effects on listed fish, and monitoring and evaluation of program performance in meeting stated conservation or fisheries harvest augmentation objectives.

(5) The degree to which annual EWS smolt release levels have been maintained consistent with the maximum abundance levels described in the proposed HGMPs.

(6) The numbers, pounds, dates, tag/mark information, and locations of EWS smolt releases; results of monitoring and evaluation activities that occur within the hatchery environment; adult return numbers by fish origin to any naturally spawning area and to the hatchery programs; analyses of any scientific research data collected in direct association with the hatchery programs; documentation of any problems that may have arisen during conduct of the authorized activities; a statement as to whether or not the activities had any unforeseen effects; and steps that have been and that will be taken to coordinate research or monitoring activities with those of other researchers.

3.1.11 5(i)(K) The HGMP is consistent with plans and conditions set within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

These HGMPs were developed by WDFW and the Jamestown S'Klallam, Lummi Nation, Nooksack, Stillaguamish, and Tulalip Tribes pursuant to the *United States v. Washington* (1974) fisheries and hatchery management framework.

There are no other plans or conditions set within Federal court proceedings, including memorandums of understanding, court orders or other management plans, that direct operation of the proposed EWS hatchery programs.

4 NOTICE OF PENDING RECOMMENDATION

As required by Limit 6 of the 4(d) Rule, the Secretary sought comment from the public on the pending determination as to whether or not the RMP would appreciably reduce the likelihood of survival and recovery of the following threatened species; the Puget Sound Steelhead DPS, the Puget Sound Chinook Salmon ESU, and the Hood Canal Summer Chum Salmon ESU, together with a discussion of the biological analysis underlying that determination (80 FR 15984 (March 26, 2015). Comments were received and were considered in developing this final recommended determination.

5 RECOMMENDED DETERMINATION

NMFS has reviewed the three EWS plans provided by WDFW, the Jamestown S'Klallam Tribe, Lummi Nation, Nooksack Tribe, Stillaguamish Tribe, and Tulalip Tribes pursuant to limit 6 of the 4(d) Rule, and evaluated them together against the requirements of the 4(d) Rule. Based on this review and evaluation, the biological opinion for this action, and NMFS' previous biological opinion regarding the effects of the Dungeness HGMPs on Hood Canal summer chum, NMFS' determination is that activities implemented as described in the three plans adversely affect but would not appreciably reduce the likelihood of survival and recovery of ESA-listed Puget Sound steelhead, Puget Sound Chinook salmon, and Hood Canal summer chum salmon, and that the plans address all of the criteria specified in Limit 5 of the 4(d) Rule. If the Regional Administrator concurs with this recommended determination, take prohibitions for listed steelhead and salmon populations in the Dungeness River, Nooksack River, and Stillaguamish River watersheds would not apply to activities implemented in accordance with the three co-manager HGMPs composing the hatchery RMP.

6 Reevaluation Criteria

NMFS will reevaluate this determination if: (1) the actions described by the HGMPs are modified in a way that causes an effect on the listed species that was not previously considered in NMFS' evaluation; (2) new information or monitoring reveals effects that may affect listed species in a way not previously considered; or (3) a new species is listed or critical habitat is designated that may affect NMFS' evaluation of the HGMPs.

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