4(d) Rule Limit 6
Proposed Evaluation and Pending
Determination

Title of RMP:	Joint Hatchery and Genetic Management Plans for Elwha Channel Hatchery Elwha River Summer/Fall Chinook Fingerlings and Yearlings, Lower Elwha Fish Hatchery Native Steelhead, Lower Elwha Fish Hatchery Coho Salmon, Lower Elwha Fish Hatchery Fall Chum Salmon, and Elwha River Odd and Even Year Pink Salmon.
RMP Provided by:	The Lower Elwha Klallam Tribe and the Washington Department of Fish and Wildlife
ESU/DPSs:	Puget Sound Chinook Salmon ESU Puget Sound Steelhead DPS
4(d) Rule Limit:	ESA 4(d) Rule Limit 6
NOAA Fisheries Tracking Numbers:	T/NWR/2011/05614, T/NWR/2011/05955, T/NWR/2011/05620, T/NWR/2011/05621, and T/NWR/2011/05618

1. BACKGROUND

NOAA Fisheries issued a final Endangered Species Act (ESA) 4(d) Rules adopting regulations necessary and advisable to conserve Puget Sound Chinook salmon (50 CFR 223.203(b); 70 FR 37160, June 28, 2005). The 4(d) protective regulations adopted for Puget Sound Chinook salmon were subsequently applied to Puget Sound steelhead in a separate final rule (73 FR 55451, June 25, 2008). 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. In summer, 2012, the Lower Elwha Klallam Tribe (LEKT) and Washington Department of Fish and Wildlife (WDFW), as co-managers of the fisheries resource under *United States v. Washington* (1974) (hereafter referred to as "the co-managers"), provided NOAA Fisheries with five Hatchery and Genetic Management Plans (HGMP) for supportive breeding and associated monitoring and evaluation actions in the Elwha River watershed that will affect ESA-listed Puget Sound Chinook salmon and Puget Sound steelhead.

The HGMPs provide the framework through which the tribal and the state jurisdictions can jointly manage Elwha River salmon and steelhead hatchery, monitoring, and evaluation activities while meeting requirements specified under the ESA. The proposed plans are interrelated and interdependent through shared population preservation and recolonization objectives and hatchery-influenced effects; broodstock collection locations and actions; fish rearing and release sites; monitoring and evaluation actions; and funding sources. The co-managers have provided the HGMPs for review and determination by NOAA Fisheries as to whether the joint plans address the criteria of Limit 6 of the 4(d) Rule, and whether limitation of application of ESA section 9 take prohibitions will therefore apply for hatchery and associated monitoring and evaluation actions

operating consistent with the HGMPs. Building from the Elwha River Fish Restoration Plan (ERFRP – Ward et al. 2008) as the overarching scientific framework for proposed supportive breeding activities, these comprehensive hatchery resource management actions for Elwha River salmon and steelhead are described by the co-managers for NOAA Fisheries' consideration in the form of HGMPs. For the purposes of this document, the co-managers' joint HGMPs will therefore also together be referred to as a RMP.

NMFS' evaluation of the 2012 HGMPs initially resulted in a determination that the HGMPs would not appreciably reduce the likelihood of survival and recovery of Puget Sound Chinook salmon and Puget Sound steelhead (77 FR 75611, December 21, 2012). As a result of ongoing litigation, NMFS decided to re-issue its Environmental Assessment of the proposed decision to approve the HGMPs, publishing notice of the new Assessment's availability in the Federal Register on June 20, 2014 (79 FR 35318). As part of that process, NMFS is hereby reissuing its Proposed Evaluation of Pending Determination (PEPD) pursuant to Limit 6 of the 4(d) Rule. This document is largely drawn from the 2012 PEPD (NMFS 2012e) reflecting the existing HGMPs, with clarifications to one component of steelhead and coho salmon smolt release practices, as well as some updated information including the role of weirs.

2. EVALUATION

The final 4(d) Rule for the Puget Sound Chinook Salmon Evolutionarily Significant Unit (ESU) and Puget Sound Steelhead Distinct Population Segment (DPS) 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:

> (1) The Secretary of Commerce (Secretary) has determined pursuant to 50 CFR 223.209 [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.
>
> (2) In making that determination for a joint plan, the Secretary has taken comment on how any hatchery and genetic management plan addresses the criteria in §223.203(b)(5).

As per the Tribal 4(d) Rule, NOAA Fisheries consulted regularly with the LEKT and WDFW during the development of the five HGMPs composing the RMP 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 listed species, and to be consistent with legally enforceable tribal rights and with the Secretary's trust responsibilities to the treaty tribes.

The 4(d) Rule for the Puget Sound Chinook Salmon ESU and Puget Sound Steelhead DPS states that the prohibitions of paragraph (a) of the rule do not apply to activity associated with artificial propagation programs provided that criteria specified in 223.203(b)(5)(i) of the Rule are met. NOAA Fisheries will approve a HGMP if it adequately addresses the criteria specified in 5(i)(A) through 5(i)(K) of the 4(d) Rule for the two listed threatened species (70 FR 37160, and as extended to steelhead - 73 FR 55451). The following is an evaluation of whether the RMP (HGMPs) meets the criteria specified in §223.203(b)(5)(i), as referenced under Limit 6 of the final 4(d) Rule (70 FR 37160).

Limit to Take Prohibitions Criteria and RMP Evaluation

3.1 (5)(i) A state or Federal Hatchery and Genetics Management Plan (HGMP) has been approved by NOAA Fisheries.

The five HGMPs submitted by the co-managers describe proposed Elwha River salmon and steelhead population supportive breeding and associated monitoring and evaluation actions affecting listed Puget Sound Chinook salmon, Puget Sound steelhead, and eulachon within the Elwha River watershed, estuary, and immediate near-shore marine waters. Applications for ESA authorizations under the section 4(d) rule, limit 6 must provide the necessary information described in 50 CFR part 222.308, or 50 CFR 223.203, respectively. The HGMPs were reviewed upon their final submittal, and on September 25, 2012, NOAA Fisheries determined that they were sufficient for NOAA Fisheries to proceed evaluating effects of the plans, positive and negative, on listed fish (NMFS 2012d). The five supportive breeding programs were proposed by the co-managers for evaluation and determination for their consistency with 4(d) Rule limit 6 criteria only for the two initial phases of fish restoration – the preservation and recolonization phases. NOAA Fisheries' evaluation of whether the HGMPs together meet the criteria specified under Limit 6 of the final 4(d) Rule (70 FR 37160) would therefore only consider whether ESA section 9 take prohibitions for the listed salmonid species do not apply to hatchery activities that are undertaken in compliance with the HGMPs for these initial two phases.

In 2012, NOAA Fisheries completed an evaluation of whether the HGMPs together met the criteria specified under Limit 6 of the final 4(d) Rule (70 FR 37160). On December 10, 2012, NOAA Fisheries determined that the HGMPs provided by the Lower Elwha Klallam Tribe and WDFW for Elwha River Chinook salmon, steelhead, coho salmon, fall chum salmon, and pink salmon met all of the requirements for HGMPs under Limit 6 of the ESA 4(d) Rule, and that ESA take prohibitions under the 4(d) Rule therefore do not apply to the supportive breeding activities specified in the five HGMPs (NMFS 2012e). Through the following evaluation, NOAA Fisheries is revisiting its previous 4(d) Rule determination for the HGMPs, as proposed for implementation during the preservation and recolonization phases for Elwha River watershed fish restoration.

The HGMPs guide the co-managers' proposed use of supportive breeding techniques to preserve and then assist in the recolonization of remaining native-origin populations of anadromous salmon and steelhead in the Elwha River watershed during and following the periods when the Elwha and Glines Canyon dams are removed. The programs would first function during the preservation phase, encompassing the period during dam removal when elevated suspended sediment concentrations from the release of store sediments behind the dams are expected, at times, to be lethal to all fish in the river, resulting in a high probability for complete loss of native fish populations and their associated genetic and life history diversity, if no protective measures are taken (Ward et al. 2008; Peters et. al. 2014). The goal of the programs during this initial phase is to protect the existing genetic and life history diversity of native salmonid populations until fish passage is restored and water turbidity is determined to be non-lethal to fish in the river.

The programs would extend operations into the recolonization phase of watershed restoration. This second phase includes the period after the dams are removed, fish passage is restored, and fish have access to refugia from lethal suspended sediment concentrations, or suspended sediment concentrations no longer reach lethal levels expected to negatively impact fish populations. The hatchery program goal during the recolonization phase is to ensure that salmonids are continually

accessing habitats above the old dam sites with some fish spawning naturally and producing smolts. Included as proposed actions for operation of the hatchery programs over these two phases of fish restoration are monitoring and evaluation activities. Through implementation of these actions, the co-managers would assess the effects of the supportive breeding programs on listed fish, and their performance in meeting population viability parameter performance indicators (hereafter, "triggers") for the preservation and recolonization phases of fish restoration established for listed Chinook salmon and steelhead (Ward et al. 2008; Peters et al. 2014).

In implementing the hatchery programs over the two initial phases of Elwha River fish restoration, the co-managers would incorporate stock status monitoring actions and recovery phase population viability triggers included in the Elwha monitoring and adaptive management (EMAM) plan developed by the Elwha Monitoring Group (EMG) (Peters et al. 2014). The EMAM plan would initially be used to reflect the pace of natural-origin Chinook salmon and steelhead population recovery resulting from fish restoration actions, based on limited historical data. Performance indicator triggers derived based on EMAM plan recovery projections for each restoration phase would be revised as monitoring information regarding population viability status and response accumulates to assess actual population recovery potentials, and abundance, productivity, diversity, and distribution status and potentials for Chinook salmon and steelhead (Peters et al. 2014).

Transition between the preservation and recolonization phases of fish population restoration in the Elwha River, and responsive changes in supportive breeding strategies to meet listed Chinook salmon and steelhead fish restoration objectives, would be guided by achievement of the EMAM plan population viability parameter triggers defined for the phases (Peters et al. 2014). All of the population viability triggers for a given phase would have to be achieved to transition to the next fish restoration phase. Because all population viability parameters may not exhibit a constant positive trend, if indicators fall below phase triggers, hatchery management actions may revert to the appropriate phase of recovery with associated objectives, protocols, and strategies. Achievement of Chinook salmon and steelhead population viability parameter triggers developed for the third phase of restoration – the local adaptation phase – would signify the need to transition to markedly different hatchery management approaches than proposed in the HGMPs. Progression of the Chinook salmon and steelhead programs into the local adaptation phase of restoration is not part of the proposed joint HGMP actions considered by NOAA Fisheries in this evaluation, and would be subject to reinitiation of ESA consultation.

Proposed actions described in the HGMPs are summarized in NOAA Fisheries' section 7 biological opinion evaluating the effects of the proposed programs on ESA-listed fish (NMFS 2012a). All LEKT and WDFW supportive breeding, and associated monitoring and evaluation actions currently proposed by the co-managers for Elwha River watershed salmon and steelhead populations are included in the HGMPs, and in NOAA Fisheries' evaluation of the HGMPs for listed fish effects. Descriptions presented in these documents of supportive breeding actions and the facilities where the actions occur that are in-common for all programs are further summarized below.

In general, each hatchery program proposes operation of supportive breeding programs based at either WDFW's Elwha Channel Hatchery facility located at Elwha River Mile (RM) 3.5 (Chinook salmon) or the LEKT's Lower Elwha Fish Hatchery facility at RM 1.3 (steelhead, coho, fall chum, and pink salmon) during the preservation and recolonization phases of restoration. The effects on listed fish of withdrawal of surface water used to rear fish in the facilities were previously evaluated and approved under separate NOAA Fisheries ESA consultations (NMFS 2006; 2010; 2012b).

The hatchery facilities use groundwater withdrawn from wells to augment or (if needed) replace surface water sources for fish rearing. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through federal NPDES permits issued to each facility. All of the programs would use broodstock collected and spawned from adult fish representing the remaining native salmon and steelhead populations in the Elwha River. The effects of collection of Chinook salmon and steelhead for use as broodstock were evaluated and authorized through previous ESA consultations (NMFS 2006; 2012b). Juvenile progeny of these native stock-origin fish would be artificially propagated at the hatchery facilities for several months (subyearling Chinook, fall chum, and pink salmon), one year (yearling Chinook and coho salmon), or two years (steelhead). All juvenile fish would be released as seawater-ready migrating smolts directly from the hatcheries, and no off-station releases of juvenile fish are included as proposed actions. Consistent with previous NMFS ESA requirements (NMFS 2006; NMFS 2012b), adult fish recruiting to the hatcheries or collected as broodstock that are surplus to hatchery broodstock needs would be transported upstream above the dam sites and released to spawn naturally. The survival advantage conferred to the species by using supportive breeding to circumvent perturbed natural migration, spawning, incubation, and rearing conditions resulting from dam removal, or placing adult fish upstream to spawn naturally in undisturbed areas in the Elwha River, would substantially benefit the status of listed and non-listed anadromous fish populations over the proposed phase of operation, relative to reliance on natural production alone (NMFS 2006; 2012a; 2012b).

Monitoring and evaluation actions associated with implementation of the proposed programs would include measures designed to assess supportive breeding program performance and effects. Spawning ground surveys would be used to determine annual escapement abundances and distribution of each species by origin (hatchery and wild) in mainstem and tributary areas throughout the watershed. Biological sampling of carcasses would be conducted to determine age class, sex ratios, and mark/tag presence. All fish reared in the hatchery would be monitored and sampled to identify mortality rates by life stage, fish health, and abundance of the propagated populations. 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 allow for differentiation of hatchery- from natural-origin fish upon adult return and during the juvenile fish emigration periods.

The HGMP action area includes the Elwha River and its tributaries, extending from the upper river above the upper-most dam in the process of removal (Glines Canyon Dam at RM 13.4), downstream to the river mouth, including the Elwha River estuary (Figure 1). The action area encompasses the Elwha Channel Hatchery and Lower Elwha Fish Hatchery sites, the Elwha 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 will pass as they enter the river as adults or exit the river as newly released juveniles. The action area includes all freshwater, estuary and immediately adjacent nearshore marine areas used by the extant total populations of listed Chinook salmon and steelhead, originating from the Elwha River watershed.

3.2 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 Elwha River watershed hatchery and associated monitoring and evaluation actions are described in sections 1.7, 1.9, and 1.10, respectively of each HGMP (WDFW 2012; LEKT 2012a; 2012b; 2102c; LEKT and WDFW

2012). This information is also summarized for each of the five proposed supportive breeding programs in section 1.3 of the NOAA Fisheries biological opinion evaluating their effects on listed fish (NMFS 2012a).

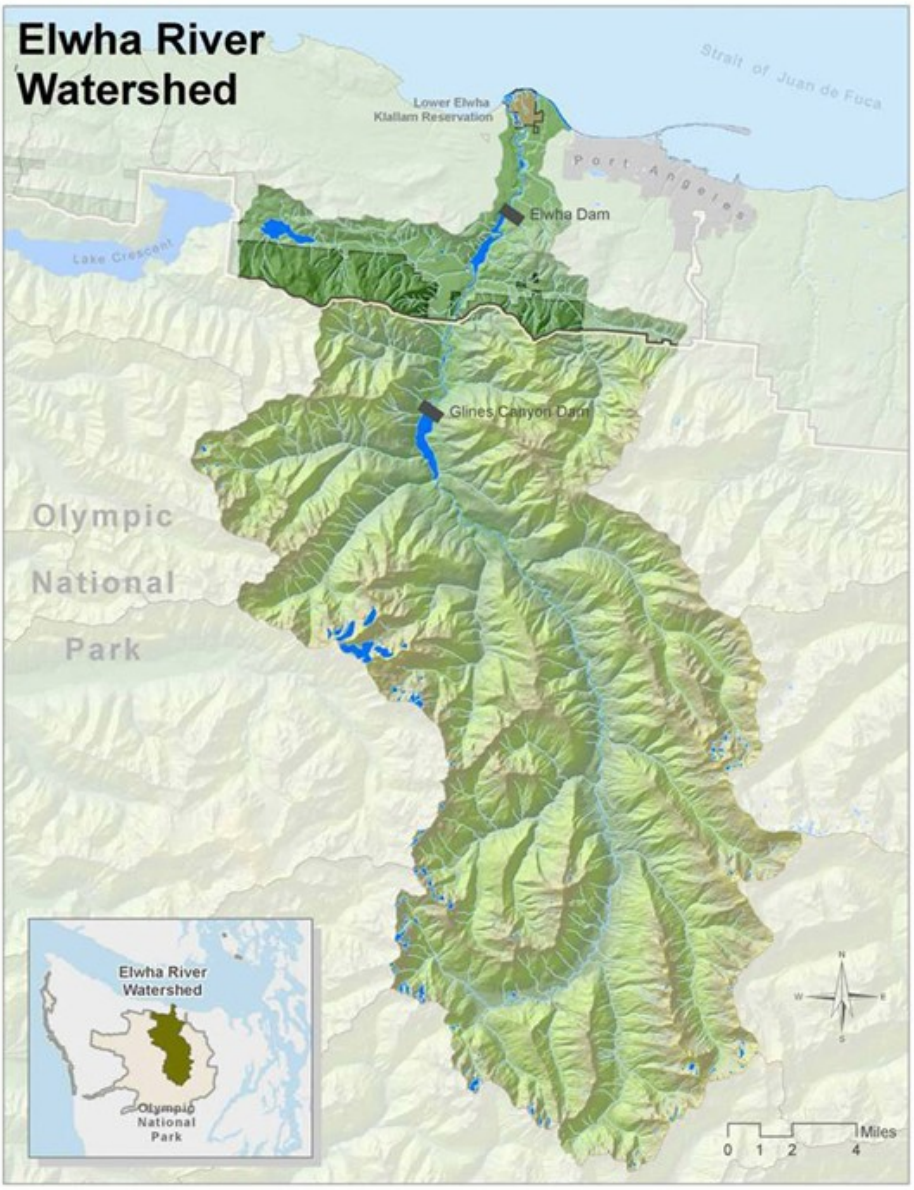

Figure 1. Elwha River watershed, estuary and nearshore marine waters included within the action area for the NOAA Fisheries evaluation of proposed supportive breeding plans for salmon and steelhead (map source: National Park Service, Olympic National Park - http://www.video-monitoring.com/construction/olympic/img/elwhawatershed.jpg.

The general goals of the programs described in section 1.7 of each HGMP are: to preserve the extant native Elwha River salmon and steelhead populations during dam removal and as the river and estuary recover from removal effects; and to help initiate natural recolonization of the watershed by the native fish populations by bolstering abundance above current critically depressed abundance and productivity levels through supportive breeding. Specifically, the supportive breeding programs are proposed to preserve, and enhance the survival of, native Elwha River salmon and steelhead during and for a period following the dam removal phase, when river and estuary habitat will become inhospitable for natural-origin fish survival and productivity. All of the

anadromous fish populations proposed for artificial propagation have already been driven to critically low abundance levels due to the long term degradation and blockage at RM 4.9 of historical natural migration, spawning and rearing habitat primarily as a result of hydropower dam construction and operation (Ward et al. 2008; Pess et al. 2008). The starting points for the preservation efforts, when natural fish production will be severely threatened by the release of sediment stored behind the dams as they are removed, are native salmon and steelhead populations that are all sharing poor viability statuses, with natural-origin population abundances below 200 fish. After dam removal (initiated in September 2011) and as river habitat begins to recover from dam removal effects, the hatchery programs would continue to provide a source of salmon and steelhead to assist in recolonization of the species throughout the watershed, including upstream areas rendered inaccessible to anadromous fish spawning for 100 years. Increases in adult fish returns above levels needed to meet population viability criteria resulting from implementation of the steelhead and coho salmon programs would also potentially support fishing opportunities in the river during the recolonization phase of the recovery effort (LEKT 2012a; 2012b).

Program performance objectives or standards and performance indicators for each of the proposed programs are included in sections 1.9 and/or 1.10 of the HGMPs.

Performance standards, and performance indicators that would be used to gauge compliance with each of the standards, are described for the WDFW Elwha Channel Hatchery Chinook salmon in HGMP section 1.10 (WDFW 2012). Monitoring and evaluation actions that would be implemented to collect information relevant to each indicator are also described. Separate performance standards, indicators, and monitoring and evaluation actions are presented to track achievement of program benefits, and monitor program risks. In general, the WDFW performance standard and indicator approach would determine program consistency with proposed hatchery actions, enumerate intended results (e.g. juvenile fish release levels), measure the program's success or failure in attaining results, and render determinations regarding the effects of the program on natural-origin fish populations.

Performance standards and performance indicators for LEKT Elwha River native winter-run steelhead, coho salmon, fall chum salmon, and pink salmon program operation during the preservation and recolonization phases are presented in HGMP section 1.9, Tables 1.2 and 1.3, respectively (LEKT 2012a; 2012b; 2012c; LEKT and WDFW 2012). Species-specific standards and indicators are proposed to address the four population viability parameters for the target native steelhead and salmon populations. For the preservation phase of restoration, performance standards and indicators addressing abundance would track achievement of captive broodstock production goals (for steelhead and pink salmon), maintenance of on-station juvenile fish release objectives (all species), and the status of total adult return levels and natural smolt production success. Performance standards and indicators addressing productivity would track hatchery smolt to adult survival rates and natural-origin population growth and recruitment. Population spatial structure standards and indicators would address fish migration dispersal in the watershed and the need to augment natural fish spawning in upstream areas through transport and release of hatchery-origin adult fish. Program standards and indicators for diversity during the preservation phase would track hatchery program success in maintaining hatchery populations that would retain the genetic traits of the target, native steelhead and salmon populations. Proposed marking of all hatchery-origin fish would allow monitoring of program effects on diversity. For the recolonization phase, the focus of performance standards and indicators would be adjusted to include to a greater extent monitoring and achievement of population viability status triggers for natural-origin fish. Standards and indicators addressing population abundance would track adult natural-origin fish abundance rather

than only total fish abundance. In addition to monitoring hatchery-origin fish performance, LEKT HGMP productivity standards and indicators would include natural-origin population growth rate and smolt production levels per naturally spawning female. Spatial structure metrics monitored would include natural-origin spawner distribution in the watershed. Performance standards and indicators for diversity would address broodstock and spawner composition by origin.

For all proposed programs, annual natural and hatchery-origin salmon and steelhead population abundances would be assessed by monitoring adult return abundances in the Elwha River mainstem (via Duel Frequency Indicator Sonar (DIDSON) census programs – Denton et al. 2013), the hatchery racks and traps, and natural spawning areas below the dam sites. Beginning in 2012 commensurate with removal of Elwha Dam, and in late summer, 2014, when Glines Canyon Dam will have been completely deconstructed, fish population monitoring will encompass accessible reaches in areas upstream of the dam sites. Abundance estimates derived through these methods would be evaluated to determine status of the listed Chinook salmon and steelhead populations relative to population abundance triggers identified in Peters et al. (2014) for each restoration phase. The estimated contribution of hatchery-origin Chinook salmon and steelhead to the hatcheries, and to natural spawning areas would be monitored by marking and/or tagging all hatchery-origin fish prior to their release from the hatcheries as juveniles to allow for their distinction from natural-origin fish upon return as adults. Estimates of fish-origin would be based on mark or tag observation and recovery data, and age class composition through scale sampling analysis. Using mark recovery information, the number of natural and hatchery-origin fish contributing to annual escapement would be estimated.

Assessments of natural-origin salmon and steelhead productivity would be enabled by monitoring natural origin recruit adult abundances and abundance trends through DIDSON program monitoring, weir counts, hatchery escapement levels, and spawning ground surveys. Achievement of performance standards and indicators for hatchery-origin fish productivity would be determined through assessment of: broodstock collection, holding, and spawning results relative to standards; performance of the hatchery program in producing healthy fish; and, post-release survival rates and contribution of hatchery-origin fish to natural-origin fish production.

The degree to which the Chinook salmon and steelhead programs, and programs propagating non-listed salmon, meet performance standards and indicators for spatial structure would be determined through spawning ground surveys conducted upstream and downstream of the Elwha dam sites.

Compliance with diversity-related performance standards and indicators would be indicated through completion of genetic analyses of the total Chinook salmon and steelhead populations escaping to the Elwha River, genetic surveys and analysis of fish returning to the hatcheries and to natural spawning areas, and annual tracking of population morphometric, meristic, and life history characteristics. Monitoring of the number and proportion of hatchery origin and natural-origin fish in natural spawning areas would be additional diversity indicators.

3.3 5(i)(B) The HGMP utilizes the concepts of viable and critical salmonid population threshold, 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 NOAA Fisheries Viable Salmonid Population (VSP) document (McElhany et al. 2000). Application of these VSP concepts is needed to adequately limit the take of

listed salmonids as broodstock to specified population thresholds or circumstances for the protection of the species. Listed salmonids may be purposefully taken for broodstock purposes only if: the donor population is currently at or above the viable threshold and the collection will not impair its function; the donor population is not currently viable but the sole objective is to enhance the propagation or survival of the listed ESU; or the donor population is shown with a high degree of confidence to be above the critical threshold although not yet functioning at viable levels, and the collection will not appreciably slow attainment of viable status for that population.

Population viability triggers defining the abundance, diversity, spatial structure, and productivity status of Chinook salmon and steelhead for each phase of the fish restoration in the Elwha River have been developed (EMG 2012, finalized as Peters et al. 2014 - Tables 1 and 2). These VSP triggers for the species were applied by the co-managers in implementing the proposed supportive breeding programs for the two species (WDFW 2012; LEKT 2012a). The triggers are the population viability parameter levels that will be used for gauging program performance in achieving recovery objectives for each restoration phase. The viability status of the Chinook salmon and steelhead populations relative to the VSP trigger levels will also be used to consider the need for adjustment of supportive breeding actions, as needed, to help achieve trigger levels.

The following sections identify the current status of the listed Chinook salmon and steelhead populations relative to population viability parameter triggers for the preservation and recolonization phases. General descriptions of how the proposed supportive breeding programs for the species would be implemented to not impair, and benefit, VSP parameters for the two species are provided. More detailed information regarding the effects of the proposed programs on listed fish species can be found in the NOAA Fisheries biological opinion for the five Elwha River salmon and steelhead supportive breeding programs (NMFS 2012a).

Elwha Chinook salmon

Abundance

Abundance of Elwha Chinook salmon is substantially reduced from historical levels, and abundance of the current population is further threatened on the short term by excessive sediment and turbidity levels resulting from dam removal (Ward et al. 2008; Pess et al. 2008; Curran et al. 2013). Elwha Chinook salmon escapement over the last 37 years (1975-2012) averaged 2,392 fish and ranged from 849 to 7,873 fish (data from Puget Sound Run Reconstruction, June 4, 2014 - Figure 2). Total Chinook salmon escapement to the Elwha River in the most recent 14 years (1999-2012) averaged 2,054 fish, and ranged between 1,146 and 3,439 fish (Table 3). The total adult Chinook salmon escapement goal of 2,900 fish established by the co-managers for the population (WDFW 2012) has been met in only one year over this recent 14 year period. Of the total recent year return between 1999 and 2010, an average of 910 fish (44 percent) have escaped to spawn naturally in the lower five miles of river that has been accessible to anadromous fish, and an average of 1,120 fish have been removed for use as broodstock for the supportive breeding program at Elwha Channel Hatchery (Table 3).

To identify adult Elwha Chinook salmon origin and natural production levels, from 2007 through 2010, WDFW field staff sampled fish returning to the Elwha Channel Hatchery trap and adults collected from the run-at-large in the Elwha River for coded-wire tags and otolith marks. From these sampling efforts, WDFW estimates that approximately 95% of the total Chinook salmon adult returns to the river in 2008, 2009, and 2010 originated from Elwha River basin hatchery programs, and just 4% were of natural-origin (WDFW 2012). The estimated total numbers of natural-origin

three and four-year old Chinook salmon (the predominant ages at adult return for Puget Sound fall-run populations) escaping to the Elwha River in 2008 and 2009 were 63 and 62 fish, respectively

Table 1. Population viability parameter triggers for the four phases of Elwha River fish restoration guiding implementation of the proposed Elwha Channel Hatchery Chinook salmon program during the preservation and recolonization phases (Peters et al. 2014).

Restoration Phase	**Abundance**			**Productivity** [3/]			**Spatial Structure**	**Diversity**	
	Natural-origin adult escapement [1/]	Proportion Natural-Origin Spawner	Proportion Hatchery-Origin Spawner	Juvenile Migrants /Female	R/S (spawner to	R/S (pre-fishing R/S)	Distribution of Adult Fish Natural Spawning (Extent/Barriers)	Stream-Type Proportion	Entry Timing Variance
Preservation	950	No goal set	No goal set	200	>1.0 (hatchery+ natural fish)	>1.56 (hatchery+ natural fish)	A portion of adults accessing above Elwha Dam AND no migration barriers exist below Elwha Dam	No goal set	No goal set
Recolonization	4,340	0.95 [2/]	0.05 [2/]	200	>1.0 (for natural fish only)	>1.56 (for natural fish only)	Above Elwha Dam: 43% of Intrinsic Potential AND no artificial barriers in Aldwell reach	No goal set	No goal set
Local Adaptation	10,000	1.0	0	200	>1.0 (for natural fish only)	>1.56 (for natural fish only)	Above Glines Canyon Dam: 86% of Intrinsic Potential AND no artificial barriers in Mills reach	Positive Trend	Stable, > Preservation Phase
Viable Natural Population	>10,000	1.0	0	200	~1.0 (natural fish only)	>1.85 (natural fish only)	100% Intrinsic Potential AND no artificial barriers within Intrinsic Potential	Positive Trend	Stable, > Preservation Phase

1/ Natural-origin spawner escapement abundance levels need to be achieved for four consecutive years to denote progression into the next restoration phase.
2/ In an independent scientific review of the Elwha Channel Hatchery HGMP, the HSRG (2012) made no recommendation for managing for the proportion of hatchery-origin Chinook salmon spawning naturally for the recolonization phase of restoration.
3/ Productivity metrics reflecting population productivity trend need to be achieved for four consecutive years to denote progression into the next restoration phase.

Table 2. Population viability parameter triggers for the four phases of Elwha River fish restoration guiding implementation of the proposed Lower Elwha Fish Hatchery steelhead program during the preservation and recolonization phases (Peters et al. 2014).

Restoration Phase	**Abundance**			**Productivity** [3/]			**Spatial Structure**	**Diversity**	
	Natural-origin adult escapement [1/]	Proportion Natural-Origin Spawner	Proportion Hatchery-Origin Spawner	Juvenile Migrants /Female	R/S (spawner to spawner)	R/S (pre-fishing R/S)	Distribution of Adult Fish Natural Spawning (Extent/Barriers)	Entry Timing Variance	Entry Timing
Preservation	196	No goal set	No goal set	75	>1.0 (hatchery+ natural fish)	>1.0 (hatchery+ natural fish)	Above Elwha Dam; 9% Intrinsic Potential AND no migration barriers below Elwha Dam	No goal set/data collection	Fish returning in February
Recolonization	969	0.90 [2/]	0.10 [2/]	75	>1.0 (hatchery+ natural fish) AND >1.0 (natural fish)	>1.0 (hatchery+ natural fish)	Above Elwha Dam: 37% of Intrinsic Potential AND no artificial barriers in Aldwell reach	0.5 days/year	Fish returning in January
Local Adaptation	2,619	1.0	0	75	>1.0 (hatchery+ natural fish) AND >1.0 (natural fish)	>1.0 (hatchery+ natural fish)	Above Glines Canyon Dam: 74% of Intrinsic Potential AND no artificial barriers in Mills reach	0.5 days/year	Fish returning in December
Viable Natural Population	>2,619	1.0	0	75	>1.0 (hatchery+ natural fish) AND >1.0 (natural fish)	>1.0 (hatchery+ natural fish)	100% of Intrinsic potential AND no artificial barriers within Intrinsic Potential	0.5 days/year	No change from previous

1/ Natural-origin spawner escapement abundance levels need to be achieved for four consecutive years to denote progression into the next restoration phase.
2/ In an independent scientific review of the Lower Elwha Hatchery Steelhead HGMP, the HSRG (2012) made no recommendation for managing for the proportion of hatchery-origin steelhead spawning naturally for the recolonization phase of restoration.
3/ Productivity metrics reflecting population productivity trend need to be achieved for four consecutive years to denote progression into the next restoration phase.

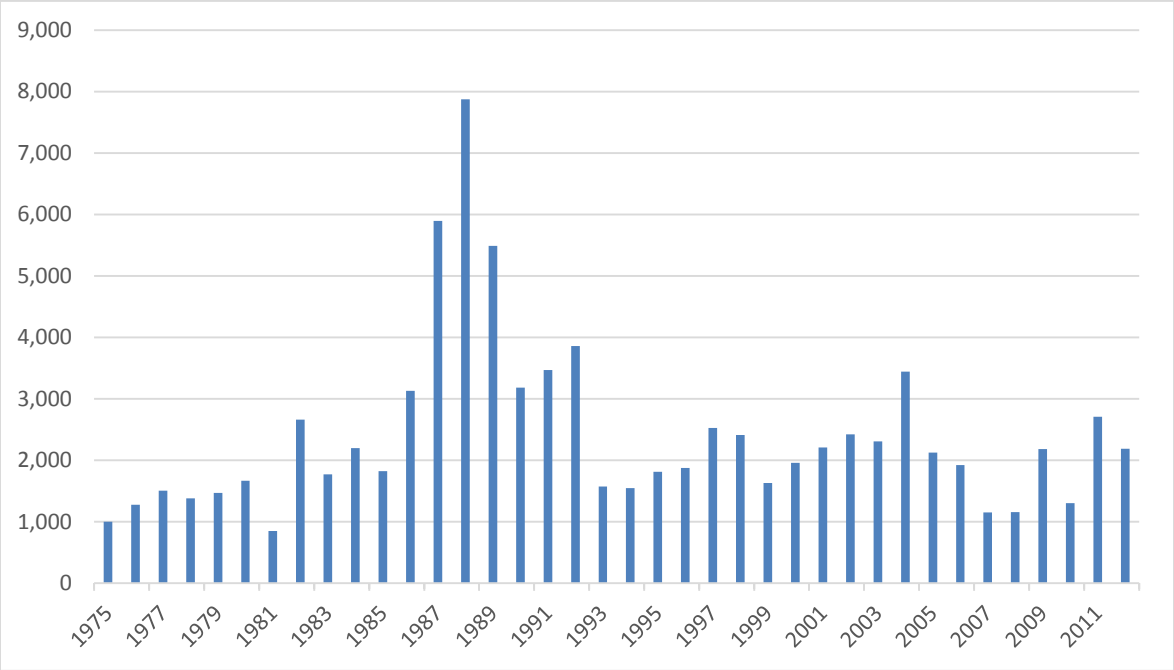

Figure 2. Total number of Chinook salmon returning to spawn in the Elwha River – 1975 through 2012. Source: Puget Sound Chinook Salmon Run Reconstruction – June 4, 2014.

Table 3. Elwha Chinook salmon escapement estimates – 1999- 2012.

Return Year	Broodstock collected / trapped	Total Naturally Spawning Fish	Pre-Spawn Mortality	Total Escapement
1999	699	903	23	1,625
2000	1,136	715	62	1,913
2001	1,553	655	38	2,246
2002	1,505	863	40	2,408
2003	1,182	1045	78	2,305
2004	1,325	2075	39	3,439
2005	1,396	835	7	2,238
2006	1,229	693	11	1,933
2007	757	380	9	1,146
2008	667	470	16	1,153
2009	1,514	651	16	2,181
2010	709	564	5	1,278
2011	844	1863	unk.	2,707
2012	1,158	1028	unk.	2,186
Average	**1,120**	**910**	**29**	**2,054**

Source: WDFW Elwha Channel Hatchery Chinook salmon HGMP (WDFW 2012) and Puget Sound Chinook Salmon Run Reconstruction, June 4, 2014.

(WDFW 2012). Based on these results, the abundance status of the natural-origin component of the Elwha Chinook salmon population for the brood years studied was the poorest of any of the 22 populations composing the listed Puget Sound Chinook salmon ESU, with the exception of South Fork Nooksack in 2009 (PSIT and WDFW 2010; NMFS 2010b - PS Harvest RMP ERD, Table 6).

It is likely that the majority of the Chinook salmon observed in Elwha River natural spawning areas have been hatchery-origin fish for many decades. This is a sensible conclusion, as estimates of the proportion of natural-origin fish spawning in the watershed prior to the mass otolith marking of hatchery-origin fish have been speculative, and failed to fully account for confinement of the species to just 5 miles of natural freshwater and estuary habitat that had become degraded for 100 years by dam-caused starvation of gravel and large woody debris recruitment. A higher level of natural-origin Chinook salmon production was wrongly assumed, based on observations of total spawner use of areas thought to allow natural-origin Chinook salmon segregation and sustainability (i.e. Hunt's Road side-channel). Mark recovery analysis now enabled by mass marking of hatchery-origin fish indicates otherwise (Stenberg et al. 2010; WDFW 2012).

Long term confinement of naturally spawning fish to 5 miles of habitat downstream of Elwha Dam, and the static, degraded condition of that habitat (impaired sediment recruitment and routing caused by the dams) combined with the lack of an adequate estuary (ocean-type Chinook salmon are highly dependent on a functioning estuary), diminish the likelihood that natural-origin Chinook salmon production and returns have been substantial relative to hatchery-origin returns. All juvenile hatchery Chinook salmon release groups in the basin would continue to be mass marked with thermally induced otolith marks and/or blank coded wire tags without adipose fin clips. This hatchery fish identification approach would be applied on the short term to minimize, and allow for assessment of, mark selective fisheries impacts on returning adult fish. The marking approach would allow continued estimation of hatchery-origin versus natural-origin fish contributions to total returns and natural spawning abundances as the dams are removed, and as the river and estuary recover. WDFW began marking a subset of Elwha Channel Hatchery Chinook salmon with an adipose fin clip beginning with the release of 250,000 subyearlings in 2013. If relevant terms and conditions in the NMFS biological opinion for Elwha River hatchery programs are met (NMFS 2012a), all sub-yearling and yearlings released through the Elwha Channel Hatchery program would be marked with an adipose fin clip beginning with the 2016 release year.

Current Chinook salmon abundances are substantially below the EMAM plan trigger natural-origin fish abundance levels proposed for use in implementing the HGMP, and gauging progress in meeting the plan's fish restoration objectives. Of the recent year average total Chinook salmon run size to the Elwha River of 2,054 fish, the majority are likely first generation hatchery-origin fish. The natural spawning abundance triggers for natural-origin adult Chinook salmon are 950 and 4,340 fish for the preservation and recolonization phases, respectively (Table 1). The current annual abundance of natural-origin Chinook salmon escaping to the river is estimated to number under 100 adult fish (NMFS 2012a).

The proposed supportive breeding program is proposed for implementation to benefit the abundance of the total Elwha Chinook salmon population, and the abundance of naturally spawning fish (WDFW 2012; NMFS 2012a). Because the program would propagate the natural-origin Elwha Chinook stock, and a substantial proportion of total returns would escape to spawn naturally, the program would benefit natural-origin population abundance by preserving the population when natural productivity conditions in watershed areas used by natural Chinook salmon for spawning, rearing, and migration are degraded and inhospitable as a result of dam removal. During both the

preservation and recolonization phases, the proposed program would substantially increase, relative to estimated current natural-origin adult return levels, the total number of Elwha River native stock adult fish returning to spawn naturally in the watershed, increasing the number of natural-origin Chinook salmon progeny produced annually. Effects of the program on Chinook salmon abundance would be monitored through DIDSON program estimates of total returns (with associated species composition sampling) (Denton et al. 2013), hatchery rack counts, spawning ground surveys, and biological sampling and mark/tag recovery data from Chinook salmon in natural spawning areas and at the hatcheries.

Diversity

Genetic diversity of the Elwha Chinook salmon has been adversely affected by anthropogenic activities, primarily dam placement and operation over the last century, and is likely reduced relative to historical levels. Because if these activities, only a fraction of the original diversity of the species currently remains (Pess et al. 2008). Fish that would be considered part of the spring-run Chinook race, historically an important genetic component of the Elwha return (as expressed by early river entry, large adult body size, and spawning typically high in the watershed) have been largely extirpated from the Elwha River (Brannon and Hershberger 1984; Wunderlich et al. 1993). Loss of access to upriver habitat, coupled with possible interbreeding with other races of Chinook salmon in the lower river where all fish were confined, are thought to be the primary causes of the significant decline of spring-run fish. Diversity of the extant summer/fall run Chinook salmon population has been reduced as a result of confinement to 10% of historically available habitat, and degradation and loss of habitat within the confined area where the population spawns. The current remaining population of summer/fall stock were found to be genetically intermediate between Puget Sound and Washington coastal populations and considered to be a transitional population between the Puget Sound and Washington Coastal Chinook salmon ESUs (Myers et al. 1999). NMFS found in its initial ESA status review of the species in Puget Sound that some allozyme markers suggested an affinity of the Elwha River population with the Washington coastal stocks, while others suggested an affinity with Puget Sound stocks (Myers et al. 1999).

Release of stored sediments behind Elwha and Glines Canyon dams threatens the remaining diversity of the naturally spawning Chinook salmon population. Inhospitable sediment and water quality conditions during and for a few years following the dam removal period will adversely affect survival of fish spawning in lower river and side channel habitat available for Chinook salmon (Ward et al. 2008). The duration of years that habitat conditions will remain inhospitable after dam removal is complete is unknown, but may be estimated to extend from 2011 when the dams began to be removed, until the advent of sufficient, high flows that will flush sediment stored behind the dams downstream. Threatened with loss are at least three of the four brood cycles of Chinook salmon reproducing naturally in remaining habitat downstream of Elwha Dam. Loss of these brood lines would substantially reduce the diversity of Elwha Chinook salmon. As measures to offset risks to Elwha Chinook diversity as a result of dam removal and resultant creation of inhospitable conditions, NMFS required that adult Chinook salmon be removed from the river at levels sufficient to fully meet hatchery broodstock needs for WDFW's Elwha Channel Hatchery program. NMFS also required that fish surplus to hatchery broodstock needs be collected and transported by truck upstream for release into Elwha River tributary areas unaffected by dam removal effects. These measures were required as a means to minimize take resulting from dam deconstruction, and to preserve the Elwha Chinook salmon population (NMFS 2006).

The target interim goal for restoration of Chinook salmon population diversity in the ERFRP is the recovery of historically extant natural-origin spring and summer/fall races (Ward et al. 2008).

Although no goals were set for natural-origin Chinook salmon diversity for the preservation and recolonization phases by the EMG (Table 1), the objective for this viability parameter is no change from the current diversity condition of the current Elwha population. Achievement of the desired diversity condition is dependent on the condition and pace of recovery of lower river and estuary habitat to support natural-origin and hatchery-origin Chinook salmon survival and productivity, and the success of the supportive breeding effort in preserving remaining diversity of the population.

In an independent scientific review of the Elwha Channel Hatchery program, the Hatchery Scientific Review Group (HSRG 2002) concluded that the program had succeeded in preserving the Elwha Chinook salmon stock over a long period of time, under challenging conditions. In view of the management history of the Chinook salmon population (e.g., hatchery-origin fish have likely composed the majority of Chinook salmon spawning naturally in the river for decades; mainstem river broodstock collection practices have led to the collection of fish representative of the total returning run), hatchery intervention as described in the HGMP is not likely to lead to large further hatchery-induced selection risk during the preservation and recolonization phases (HSRG 2012), which cover the duration of the proposed action. The group also concluded that the off-site hatchery Chinook salmon program, located on Morse Creek, would reduce the risk of losing remaining genetic resources during the preservation and recolonization phases, when habitat is unstable (HSRG 2012).

With the assistance of the supportive breeding program described in the HGMP, during the initial two phases of restoration, the remaining genetic diversity of the Elwha Chinook salmon population should be retained. The genetic diversity status of the Elwha Chinook population should improve substantially after anadromous fish access is restored to the upper Elwha River watershed, and as the population spontaneously recolonizes the newly available habitat upstream of Glines Canyon Dam in 2014 and beyond. The proposed Chinook salmon program would be implemented using management strategies that adequately minimize the risk of adverse hatchery-related genetic effects on the Elwha Chinook population (NMFS 2012a). The program would benefit the diversity of the native Elwha Chinook population by preserving and assisting in the recolonization of the unique stock during and for a period following dam removal when natural productivity conditions will be poor. Supportive breeding of the population at Elwha Channel Hatchery, and creation of a genetic reserve for the stock at Morse Creek Hatchery (WDFW 2012), would circumvent deleterious conditions threatening the Elwha stock during the natural fish spawning, incubation, and rearing life stages, improving prospects that the population would be preserved.

Without this supportive breeding effort, the genetically unique Elwha Chinook salmon population would be at high risk of extinction due to current critically low natural-origin fish abundance levels (under 100 adult fish per year) and threats to the remaining population posed by dam removal effects (NMFS 2012a). As a “Tier 1” population for recovery (NMFS PRA 2010), the loss of the Elwha Chinook genome, representing one of the two extant populations of the species remaining in the Strait of Juan de Fuca biogeographical region, would be an important threat to recovery of the Puget Sound Chinook salmon ESU in total. Increased smolt emigration and adult fish returns afforded by the program over levels achievable under current natural conditions would help ensure that the unique population was retained to the point where local adaptation and creation of a self-sustaining exploitable population without the need for supportive breeding could eventually be achieved. Effects of the program on Chinook salmon population diversity would be managed and monitored through maintenance of program production at proposed levels, and monitoring of natural- and hatchery-origin fish escapement proportions.

Spatial Structure

Spatial structure of the Elwha Chinook population has been adversely affected by dam construction and operation in the watershed, and spatial structure will be further affected as a result of dam removal activities. The construction of the Elwha Dam in 1911 blocked access for Elwha Chinook salmon to 90 percent of their historical range of spawning and rearing habitat (Pess et al. 2008). Further, access to all areas previously utilized by the extirpated spring-run Chinook salmon race (upper reaches of the watershed) was eliminated. Natural salmon production habitat remaining below the Elwha Dam site is of generally poor quality. The only relatively high quality below Elwha Dam remaining prior to dam removal was confined to about two dozen main-stem and side-channel areas (e.g., Hunt's Road side-channel) (NMFS 2012b). This remnant set of areas provided a small, but confined amount of suitable natural spawning habitat for Chinook salmon returning to the Elwha River. However, recent otolith mark recovery analysis showed that natural-origin Chinook salmon production in these remaining areas was unsubstantial (WDFW 2012). Further, rather than persisting as potential refugia for natural-origin fish, with release and mobilization of stored sediments behind the dams, Elwha River floodplain channel areas downstream of the dam sites have instead become sediment repositories that are inhospitable to fish survival (George Pess, NMFS, personal communication, March, 2014).

Release of stored sediments behind Elwha and Glines Canyon dams as they are removed threatens the spatial structure of the remaining naturally spawning Chinook population. Changes in the condition of existing lower river and estuary Chinook salmon habitat are occurring due to unstable channel features such as stream bed aggradation and movement. The substantial increase in sediment supply occurring after the beginning of dam deconstruction in 2011, and extending for an indeterminate number of years after dam removal, is resulting in detrimental effects on salmon habitat capacity and survival, as predicted by Beechie et al. (1996). Inhospitable sediment and water quality conditions during and following dam removal is adversely affecting use of lower river and side channel habitat available for Chinook salmon spawning, incubation, rearing and migration. Elwha Chinook population spatial structure will remain impaired in the lower river for an unknown number of years, and until upstream anadromous fish access above the Glines Dam site is fully restored. Spatial structure of the Elwha population is threatened over the short term.

The trigger spatial structure viability parameters for the preservation and recolonization phases are a portion of adult fish spawning above the Elwha Dam site, and adult fish spawning above the Elwha Dam with spawning distributed over 43% of the intrinsic potential identified for the population, respectively (Peters et al. 2014). Under the ERFRP (Ward et al. 2008), the interim spatial structure target for Chinook salmon restoration is re-establishment of habitat use up to RM 42.9 in the Elwha River mainstem. The current spatial structure for the population is below desired levels. As of 2014, natural spawning distribution remains confined to the portion of the watershed downstream of Glines Canyon dam. Removal of the remaining dam structure in summer, 2014 should allow access for migrating anadromous fish to watershed areas above the Glines Canyon Dam site beginning in late summer or fall 2014.

The Elwha Chinook population currently persists in remaining confined lower river habitat. The spatial structure of the Elwha population should improve substantially after anadromous fish connectivity between the lower and upper reaches of the Elwha River watershed is restored, and as the population recolonizes the newly available upper river habitat beginning in late summer or fall, 2014 and beyond. As a secondary supportive breeding strategy during the preservation phase, and a tertiary restoration approach in the recolonization phase, adult hatchery-origin Chinook salmon surplus to hatchery broodstock needs would be transported and released upstream of the dam sites to

spawn naturally (WDFW 2012, as per Peters et al. 2014). Also, beginning in late summer or fall, 2014, after anadromous fish access above the dam sites is restored, fish released through the hatchery program will return to the river as adults to spontaneously recolonize natural spawning areas throughout the accessible portions of the Elwha River watershed. For these reasons, the proposed Chinook salmon program would benefit Elwha Chinook population spatial structure through production of adult fish that would escape to spawn in the areas unused by the species for 100 years.

Productivity

The productivity of the Elwha natural-origin Chinook salmon population is suppressed, with the species recruiting at below replacement levels. Ford (2011) provided estimates of short-term median population growth rates (lambda) assuming hatchery-origin fish productivity of "0" and equal to natural-origin fish for Elwha Chinook salmon. They reported short-term (1995-2009) and long-term (1986-2009) trends of 0.94 and 0.90, respectively, assuming hatchery-origin fish productivity of "0", and 0.78 and 0.76 assuming hatchery-origin fish productivity of 1.0. The population growth rate estimate for Elwha Chinook represents hatchery-origin and natural-origin spawners, as estimates of the fraction of hatchery fish in time series were not available for use in calculating productivity. The trend estimates assume that the productivity of naturally spawning hatchery fish is equivalent to that of natural-origin fish.

WDFW monitoring of natural-origin Chinook salmon productivity in the lower river portion of the Elwha River, where all natural production has been confined, began with assessment of the progeny to adult return rate for the 2004 brood year (WDFW 2012). Inclusion of recent adult return data has also allowed assessment of productivity for the 2005 brood year. For the two brood years, juvenile to adult survival rates were low: 0.044% for the 2004 brood year and 0.096% for the 2005 brood year. By comparison, the ESU-wide progeny to adult survival rate for naturally spawning Chinook salmon in Puget Sound is 0.39%, assuming a recent year (1999-2005) average total juvenile out-migrant estimate of 9.42 million fish and an average natural-origin adult escapement for the same period of 36,533 fish (NMFS 2014). The survival estimates for Elwha Chinook salmon are based on assessments of adult returns to the river and do not include fish taken in fisheries. These low survival estimates indicate that natural-origin spawner productivity for Elwha Chinook salmon is substantially impaired in the lower Elwha River habitat available for natural fish spawning.

Elwha River hatchery-origin Chinook salmon survival smolt-to-adult survival data are available for comparison with progeny to adult survival estimate for natural-origin fish. Hatchery subyearling fish survival rates are similarly low, with survival rates to returning adult spawner for 1999-2008 ranging from 0.02% to 0.14% and averaging 0.07% (R. Cooper, WDFW, unpublished data, cited in PSIT and WDFW 2010).

The pre-fishing impact naturally spawning Chinook salmon productivity triggers carried forth in the proposed HGMP from Peters et al. (2014) are >1.0 spawner recruits per spawner regardless of origin during the preservation phase, and >1.0 natural-origin spawner recruits per spawner during the recolonization phase. Current natural fish productivity is well below these targets. Achievement of the target productivity levels is dependent on the condition and pace of recovery of lower river and estuary habitat and Chinook productivity in those areas, and the pace of natural fish recolonization and restoration of productivity in newly accessible up-river freshwater environment.

The Elwha Channel Hatchery program's potential effects on the productivity of the Elwha Chinook salmon population are unknown. The critically low abundance and productivity status of the

naturally produced component of the population in available habitat suggests that decades of contribution of hatchery-origin Chinook salmon to natural spawning in the lower five miles of the Elwha River where the population has until recently been confined has not resulted in improved natural fish productivity. The proposed Chinook salmon program would be implemented using management strategies that adequately minimize the risk of survival fitness loss effects on the Elwha Chinook population (NMFS 2012a). Productivity of the species in previously vacant habitat upstream of the dam sites may be accelerated by adult fish production, escapement, and spawning by hatchery-origin Chinook salmon over the short term relative to reliance on natural-origin production only, as indicated by evaluations of hatchery-origin Chinook spawning effects in the Cedar River, Puget Sound (Anderson et al. 2012). The natural-origin component of the Elwha Chinook population is at critically depressed levels, and its productivity is further threatened by dam removal effects. Adult fish produced through the proposed Elwha Channel Hatchery Chinook salmon program that bolster the number of fish that spawn naturally in healthy habitat should help improve the productivity status of the Elwha Chinook population, relative to reliance on spawning by the few remaining natural-origin fish.

Elwha River Native Steelhead

Abundance

As indicated in the LEKT HGMP (LEKT 2012a), abundance of the late-returning, native, winter-run Elwha River steelhead population is very low, and substantially reduced from historical levels. Abundance of the remaining population is further threatened on the short term by excessive sediment and turbidity levels resulting from dam removal (NMFS 2006; Ward et al. 2008; Currans et al. 2013). The historical population size for the native Elwha River steelhead population is unknown (Ward et al. 2008). However, using the parr production potential approach to estimate basin carrying capacity, Gibbons et al (1985) estimated that the Elwha River could produce 10,100 adult recruits. Using an intrinsic productivity model, PSTRT (2012) estimated that historical steelhead abundance in the Elwha River was 7,116 - 14,231 fish, assuming unrestricted anadromous fish access to presently blocked upper river areas.

From 1985 through 1997, WDFW estimated that spawning escapements for native Elwha River winter-run steelhead ranged from 47 to 834 fish, with an average return of 323 fish over the 12 year period (LEKT 2012a). Limited spawner escapement surveys conducted since 2002 have documented an average of 50–100 late returning steelhead redds per year (LEKT 2012a). In 2005 61 discrete redds were identified in the lower river (Ward et al. 2008). Estimated total steelhead abundance in recent years for which data are available, and prior to the first returns of supportive breeding program adults produced by LEKT hatchery, averaged 141 fish and ranged from 45 to 246 fish (Table 4). These estimates are based on redd counts in the accessible lower river spawning areas, which are expanded by 2.62 adults/redd (Table 4 from LEKT 2012a). The escapement estimates are uncertain, because replicated spawning surveys throughout the late winter steelhead return period are often prevented by high flow and turbidity (LEKT 2012a).

Prior to release of the Peters et al (2014) EMAM document, a natural spawning escapement goal for the Elwha River steelhead population had not been established. As a means to manage incidental fisheries impacts, the co-managers' draft harvest plan for Puget Sound steelhead set the critical abundance threshold for Elwha River steelhead at 100 fish and the viable population threshold range at 500 to 750 fish (PSIT and WDFW 2010). These thresholds were developed to inform harvest management in the short term, but lack a technical basis in current or future potential productivity in the Elwha River (LEKT 2012a). The Elwha River watershed also supports resident *Oncorhynchus*

mykiss (rainbow trout) above the dams (Brenkman et al. 2008). Genetic analyses indicate these resident rainbow trout are a mixture of native and introduced populations (Winans et al 2008). Other studies indicate that these resident fish produce out-migrating smolts (Brenkman et al. 2008). Resident *O. mykiss* are expected to contribute to recolonization of steelhead throughout the watershed (Brenkman et al. 2008), but the resident form of the species is not included as part of the listed Puget Sound steelhead DPS (72 FR 26722).

Table 4. Estimated number of late-returning steelhead escaping to spawn in the Elwha River.

Year	Number of Steelhead Adults
2005	100
2006	123
2007	-
2008	-
2009	45
2010	193
2011	246

Source: Estimated number of spawning adult fish for 2005-2011 from LEKT (2012a).

Release of stored sediments behind Elwha and Glines Canyon dams threatens the already low abundance of the naturally spawning steelhead over the period of dam removal (2011 through summer, 2014), and for an unknown period following removal until lower river habitat conditions stabilize. Inhospitable sediment and water quality conditions during and for at least several years following the dam removal period will adversely affect survival of fish spawning in remaining lower river and side channel habitat available for natural-origin steelhead production. Threatened with loss are at least two to three of the four predominately 4-year-old fish brood cycles of steelhead reproducing naturally in the remaining habitat downstream of the Elwha Dam site. Loss of these brood lines would substantially reduce the abundance of natural-origin Elwha River steelhead from already critically depressed levels. As measures to off-set risks to steelhead abundance during the dam removal period, and as a means to preserve the population, NMFS required that unmarked adult steelhead collected through co-manager artificial propagation and research programs in the lower river be removed for use as hatchery broodstock for LEKT's native winter-run steelhead supportive breeding effort, or transported and released upstream into unaffected habitat areas so the fish can spawn naturally (NMFS 2012b). Steelhead transported and released into two tributaries upstream of the Elwha Dam site are spawning successfully, but resultant smolts must still emigrate seaward through inhospitable areas in the lower river and in the estuary to reach seawater.

The interim abundance target identified in the ERFRP for recovering the native Elwha River steelhead population at 10 years is 1,500 fish spawning naturally (regardless of origin) and 5,757 natural-origin fish spawning naturally at 25 years (Ward et al. 2008). The recent year (2005-06; 2009-2011) average escapement of 141 fish (all natural-origin) is 9.4% of the 10-year interim recovery goal of 1,500 naturally spawning fish. Updated population viability triggers developed by the EMG (Peters et al. 2014) will be used guide Elwha native steelhead supportive breeding actions. The EMAM plan natural spawning abundance objective, delineating transition from the preservation to the recolonization phase of restoration, is 196 natural-origin and/or hatchery-origin spawners observed over four consecutive years. The natural spawning abundance trigger ending the recolonization phase and beginning the local adaptation phase is 969 predominantly natural-origin fish observed over four years (Peters et al. 2014).

Prior to 2005, there were no associated native Elwha River stock hatchery-origin fish that would contribute to the abundance of the late-returning winter-run steelhead population. As part of an effort to preserve and restore the depleted natural-origin population, in winter/spring 2006, the LEKT initiated collection of eyed eggs and fry from steelhead redds to create a captively reared population. As described in the HGMP for the program (LEKT 2012a), seven brood years of captive broodstock were produced and maintained in the hatchery. The first progeny of captive broodstock adult steelhead reared through the tribal program were released as two-year-old smolts into the Elwha River in 2011. Because the fish are direct progeny of native stock Elwha River steelhead, all smolts produced by the hatchery program and returning as adults are included with natural-origin Elwha River steelhead as part of the Puget Sound steelhead DPS. The hatchery-origin and natural-origin steelhead are both listed and protected under the ESA (79 FR 20802, April 14, 2014).

Assuming annual on-station hatchery production of 175,000 2+ smolts, and a smolt to adult return survival rate of 0.75% (from LEKT 2012a), the proposed program would lead to the return of about 1,300 native stock adult hatchery-origin steelhead each year. Of that total, up to 500 fish would be required as broodstock to sustain the program, given sex ratio at return, factorial mating practices, and survival rates at the LEKT hatchery (LEKT 2012a). Therefore, at least 800 adult steelhead would return to spawn naturally in reaches upstream and downstream of the Elwha dam sites each year, beginning in 2013. This compares with the potential returning abundance of 45 to 246 adult steelhead resulting from natural-origin production, assuming continuation of recent-year return abundances (Table 4). However, potential natural-origin steelhead adult return levels may be much lower than the recent year range, and perhaps 0, during and for a period following dam removal as a result of inhospitable and potentially lethal turbidity and sedimentation levels in lower river steelhead spawning and rearing areas (Ward et al. 2008). Preliminary sonar-based census data indicate that the total steelhead adult return to the Elwha River in 2013, the first year when four-year-old steelhead produced by the supportive breeding program returned, may have reached 385 fish (LEKT 2013). The return abundance in 2013 represents a 173% increase above the pre-supportive breeding program average adult return of 141 native Elwha River steelhead. The proportions of natural-origin and hatchery-origin fish composing the adult return in 2013 have not yet been estimated, and are pending co-manager analysis of mark presence/absence in fish sampled.

Because the LEKT supportive breeding program would propagate the native, natural-origin winter-run stock, and a substantial proportion of total returns would escape to spawn naturally, the program would benefit natural-origin steelhead population abundance by preserving the Elwha River steelhead population when natural productivity conditions in watershed areas used by natural steelhead are degraded and inhospitable as a result of dam removal. During both the preservation and recolonization phases, the proposed program would substantially increase, relative to current and near-term future natural-origin adult return levels, the total number of Elwha River native stock adult steelhead returning to spawn naturally in the Elwha River, increasing the number of natural-origin progeny produced annually.

Hatchery-origin late-returning steelhead produced by this program are initially intended for conservation and recovery purposes only, and adult returns from the supplementation program beginning in 2013 and likely extending through the preservation phase of restoration would not be subject to directed harvest. As steelhead population viability parameter monitoring indicates transition toward the recolonization phase of restoration, the LEKT proposes that the population would support some directed terminal-area fisheries harvest, consistent with rebuilding towards achievement of population viability parameters for the phase (LEKT 2012a).

Diversity

As a consequence of dam construction and resultant long term blockage and degradation of habitat, diversity of Elwha River steelhead is substantially reduced from historical levels. Occurrence, distribution, and connectivity of anadromous and resident *O. mykiss* life history forms have been severely affected, to the detriment of within and among native steelhead population genetic diversity in the watershed. For example, loss of access to upper watershed areas caused by dam construction has led to decreased life-history diversity (Beechie et al. 2006). Historically, the majority of summer steelhead migrated upstream above Elwha dam in the late spring and early summer to access river habitats that have more suitable temperatures for holding and spawning (Pess et al. 2008). For 100 years, up-river habitat was not accessible to anadromous fish because of upstream migration blockage by Elwha Dam. Summer steelhead were confined to the lower 5 miles of the Elwha River, where peak summer temperatures during the adult migrating and in-river holding periods typically reach 18-21 °C, and this race is now believed by the Puget Sound Steelhead TRT to be extirpated (PSSTRT 2012). Genetic diversity of remaining winter-run forms of the species is further threatened on the short term by excessive sediment and turbidity levels resulting from the release of stored sediment with dam removal (Beechie et al. 2006; Ward et al. 2008).

Elwha river steelhead restoration efforts focus on the native, natural-origin, late-timed, winter-run steelhead component, which is thought to remain genetically representative of the historical native winter-run population (Ward et al. 2008; Winans et al. 2008). Genetic analysis indicates that the formerly present early timed portion of the steelhead run (hatchery releases sustaining early steelhead returns were terminated in 2011) was largely derived from the transplanted Chambers Creek Hatchery stock (Winans et al. 2008). The analysis also showed the late-returning component is significantly different from the early, hatchery-origin component, but also different from some collections of resident *O. mykiss* from the upper Elwha River above the dams. Further analysis of DNA samples collected from four consecutive brood years of late-returning Elwha River steelhead indicates that the non-native early and native late steelhead populations were distinct, with no apparent introgression by the Chambers Creek stock (G. Winans, unpublished data, December, 2011). The same analysis showed that the extant Elwha River late-returning steelhead population may be largely supported by straying of wild steelhead into the river from other Puget Sound steelhead populations (e.g., Dungeness River). Phelps et al. (2001) suggested that some residualized populations of *O. mykiss* upstream of Elwha Dams were similar to the remnant late-returning anadromous aggregation of the species below the dam. Although not included as part of the listed Puget Sound steelhead DPS, the extant resident *O. mykiss* population apparently retains an anadromous legacy, as indicated by DNA results showing that resident fish contributed to the return of several adult fish in recent years (G. Winans, unpublished data, December, 2011). It may take several years following the removal of the Elwha River dams for the resident populations to reestablish themselves as anadromous, contribute substantially to adult steelhead returns, and reach some equilibrium with the extant natural-origin steelhead population (Phelps et al. 2001).

The proposed HGMP is designed to benefit the diversity of the native Elwha River winter-run steelhead population by preserving and assisting in the recolonization of the unique stock during and for a period following dam removal when natural steelhead population productivity conditions will be poor. As described in the LEKT steelhead HGMP (LEKT 2012a), captive breeding of the population at Lower Elwha Fish Hatchery would reduce the risk of extinction through creation of a genetic reserve for the stock, circumventing deleterious habitat conditions threatening the native stock in the natural environment during the natural fish migration, spawning, incubation, and rearing life stages. The program would improve prospects that the population would be prevented

from extinction during the preservation phase of restoration. The smolt release portion of the program would assist in the preservation and recolonization of the Elwha River native steelhead genetic lineage by supporting the population as habitat in the watershed recovers and natural-origin steelhead production is re-established and increases.

Without the proposed supportive breeding effort, the genetically unique Elwha River native steelhead population would be at high risk of extinction due to current critically low natural-origin fish abundance levels (43 to 246 adult fish per year), and threats to the remaining population posed by dam removal effects. The loss of the native steelhead genome, representing one of the two extant populations of the species remaining in the Strait of Juan de Fuca biogeographical region (PSTRT 2012), would be an important threat to recovery of the Puget Sound steelhead DPS. Increased smolt emigration and adult fish returns provided by the supportive breeding program over levels and rates achievable by the remaining natural-origin component of the population under current degraded natural conditions would help ensure that the unique Elwha River population was retained to the point where local adaptation and creation of a self-sustaining exploitable population without the need for supportive breeding could eventually be achieved. The HSRG concluded that the proposed LEKT program would benefit native Elwha River steelhead population diversity, as the hatchery program may serve as a genetic reserve for the population, assuming appropriate hatchery practices that minimize divergence between the hatchery-origin and natural-origin populations are applied (HSRG 2012).

Spatial Structure

Spatial structure of the Elwha River steelhead population has been adversely affected by dam construction and operation in the watershed, and spatial structure will be further affected as a result of dam removal activities. The construction of the Elwha Dam in 1911 blocked access of steelhead to 90 percent of their historical range of spawning and rearing habitat, and steelhead have been confined for 100 years to the lowest 5 miles of the watershed (Pess et al. 2008; Ward et al. 2008). Further, access to upper reaches of the watershed previously utilized by the likely extirpated summer-run steelhead race was eliminated. Suitable habitat in the lower river has been reduced because the construction of the Elwha River dams truncated the alluvial transport of sediment, resulting in the coarsening of river bed, and leading to the loss of spawning habitat below the dams (Pess et al. 2008). From 1939 to 2002, the lower Elwha River lost over 75% of the available spawning habitat for all salmonids due to disrupted sediment transport (Pess et al. 2008). Between 1991 and 2002 the decline in spawning area was reversed, as the river shifted course into the Hunt's Road side-channel, exposing a relatively large area of newly created spawning habitat, increasing available lower river habitat by 56% over 1991 levels (Pess et al. 2008). However, as noted above, side channel areas downstream of the dams are no longer suitable as natural-origin fish production areas. Current steelhead habitat below the Elwha Dam site is of poor quality.

Release of stored sediments behind Elwha and Glines Canyon dams further threatens the spatial structure of the naturally spawning native winter-run steelhead population remaining in the river. Change in the condition of existing lower river steelhead habitat has occurred as a result of unstable channel features such as stream bed aggradation and movement due to an increase in sediment supply, resulting in detrimental effects on salmon habitat capacity and survival as predicted by Beechie et al. 1996. Inhospitable sediment and water quality conditions during the dam removal period (from 2011 through summer, 2014), and for a period after removal until advent of sufficient high flows flush accumulated sediment from the river, will adversely affect use of lower river and side channel habitat available for steelhead spawning, incubation, rearing and migration. These areas are the sole natural spawning and production habitats remaining for the Elwha River native

steelhead population prior to restoration of upstream anadromous fish access. The spatial structure of the Elwha River steelhead population remains threatened over the short term.

The steelhead HGMP addresses the spatial structure of the native Elwha River steelhead population. As a secondary supportive breeding strategy during the preservation phase, and a tertiary approach in the recolonization phase, adult natural- and hatchery-origin steelhead collected that are surplus to hatchery broodstock needs would be transported and released upstream of the dam sites to spawn naturally. Also, beginning in late summer or early fall, 2014, as anadromous fish access above the dam sites is fully restored, adult fish produced through the program would spontaneously colonize natural spawning areas throughout the accessible portions of the Elwha River watershed. For these reasons, the proposed steelhead program would benefit population spatial structure by substantially bolstering the number of returning adult fish that would escape to spawn in the areas unused by the anadromous form of the species for 100 years.

Productivity –
The productivity of the Elwha River late-returning steelhead population is suppressed, with the species recruiting at levels well below replacement. Ford et al. (2011) reported sharply declining short (1995-2009) and long (1986-2009) term population growth rate trends for the late-returning Elwha River steelhead population of 0.75 and 0.84, respectively. Of the Puget Sound steelhead populations analyzed in the Ford et al. (2011) species status review, only Lake Washington had lower long- and short-term growth rates than Elwha. NMFS estimated that the probability that the Elwha River steelhead population would decline to 10% of its current estimated abundance (i.e., to 10 fish) is fairly high: ~ 90% within 40 years (Ford et al. 2011). They were highly confident ($P < 0.05$) that a 90% decline in the population will not occur within the next 8-10 years (but will occur within 70 years), and that a 99% decline will not occur within 25-30 years (but might occur within 120-150 years). However, for intermediate years and other values of decline they were highly uncertain about the precise level of risk.

Under the ERFRP (Ward et al. 2008), the interim restoration target for natural-origin steelhead productivity is > 1.0 recruits per spawner, and 1.8 recruits per spawner at maximum sustainable yield conditions for the population. Further, productivity triggers for Elwha River steelhead defined by the EMG (Peters et al. 2014) are > 1.0 (spawner to spawner, hatchery plus natural-origin fish) for the preservation phase and > 1.0 (spawner to spawner, all natural-origin fish) for the recolonization phase (Table). Current productivity estimated by Ford et al (2010) is well below these viability targets and triggers, and below the population replacement level on the short and long terms.

Achievement of desired steelhead productivity levels is dependent on the condition and pace of recovery of lower river habitat and natural steelhead productivity in available habitat, and the pace of natural fish recolonization and restoration of productivity in newly accessible up-river freshwater environment after the dams are removed. For the short term, the already depressed productivity of the native steelhead population is further threatened by the effects of dam removal, with excessive sediment and turbidity levels forming conditions that are inhospitable for steelhead migration and spawning, and egg and juvenile fish survival in available lower river habitat.

The proposed HGMP (LEKT 2012a) addresses potential effects on the productivity of the Elwha River native winter-run steelhead population. Specific effects of the program on productivity are as yet unknown. However, productivity of the species in previously vacant habitat upstream of the dam sites may be accelerated by adult fish production, escapement, and spawning by hatchery-

origin native steelhead over the short term relative to reliance on natural-origin production only. Natural-origin steelhead production is currently at critically depressed levels because of critically low spawner abundance, and is further threatened by dam removal effects. Genetic risk reduction measures would be implemented to reduce the risks of hatchery-related fitness loss in the population that would adversely affect productivity (NMFS 2012a).

In summary, the primary purposes of the proposed Chinook salmon and steelhead supportive breeding programs evaluated in this document are native stock preservation, and assistance in recolonization of natural habitat by the remnant critically depressed populations during the periods when natural habitat for the species will be inhospitable for natural-origin fish survival and productivity. The Elwha River Chinook salmon and steelhead populations that are the focus of the proposed supportive breeding programs are at risk and not viable, and well below population viability triggers identified for the preservation and recolonization phases of fish restoration - the term of operation for the proposed hatchery programs. The future existence of both populations is further threatened by the effects of dam removal (Ward et al. 2008; NMFS 2012a: NMFS 2012b). Because the sole objectives of the programs are to enhance the propagation or survival of populations included in the listed Puget Sound Chinook salmon ESU and Puget Sound steelhead DPS, and the proposed HGMPs apply VSP criteria as recovery goals and monitoring objectives, it is consistent with this 4(d) rule criterion that listed fish may be purposefully taken for use as broodstock. Listed fish takes associated with collection of Chinook salmon and steelhead from the Elwha River as broodstock for the proposed programs were evaluated and authorized through separate NOAA Fisheries ESA section 7 consultations (2006; 2012b).

5(i)(C) Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities.

The proposed supportive breeding programs account for the health, abundances, and trends in the listed Chinook salmon and steelhead populations affected by broodstock collection actions, and reflect appropriate priorities, consistent with the population preservation and recolonization intent of the HGMPs. Under this 4(d) Rule criterion, a prioritized purpose of a broodstock collection program using listed fish is to reestablish an indigenous salmonid population for conservation purposes, including restoration of similar at-risk populations within the same ESU, and reintroduction of at-risk populations to under-seeded habitat. All of the proposed HGMPs would be implemented specifically for this prioritized purpose. The HGMPs propose to preserve native-origin populations of salmon and steelhead during the period when dam removal activities have caused the natural habitat sustaining the populations to become inhospitable for survival and productivity. The programs also propose to assist in the recolonization of the populations into newly accessible habitat upstream of the Elwha dam sites after their removal. All of the programs are operated for conservation purposes, with a primary goal of creating viable, natural-origin salmon and steelhead populations in the river that will eventually reach self-sustaining fishable levels, using native-origin spawners as hatchery broodstock, while minimizing risks to listed Chinook salmon and steelhead (WDFW 2012; LEKT 2012a; LEKT 2012b; LEKT 2012c: LEKT and WDFW 2012)).

Broodstock collection actions and effects on listed Chinook salmon and steelhead associated with implementation of the HGMPs were previously evaluated and authorized through NOAA Fisheries consultations (NMFS 2006; 2012b). Under these previous consultations, takes associated with the collection of Chinook salmon adults for use as broodstock for the Elwha Channel Hatchery Chinook salmon program were authorized through an incidental take statement (ITS) provided with the ESA section 7 biological opinion issued to the National Park Service (NPS) (NMFS 2006).

NMFS issuance of the ITS to the NPS concluded a formal consultation for the "Elwha River Ecosystem and Fisheries Restoration Project". In its opinion, NMFS determined that, as a term and condition, to be exempt from section 9 take prohibitions, the NPS must rescue and remove adult Chinook salmon from the Elwha River and move the fish to the WDFW rearing channel, the Lower Elwha Klallam Tribe's fish hatchery, or to unaffected river habitat above Lake Mills (upstream of the Glines Canyon dam site) to reduce the level of take from sediment releases (NMFS 2006). Through a reinitiated consultation regarding dam removal effects on listed fish, NMFS completed a second biological opinion in 2012 to address takes of listed steelhead, which had been listed as threatened in 2007 after completion of the initial NMFS opinion (NMFS 2012b). Take associated with the collection of steelhead adults for use as hatchery broodstock was authorized by NMFS in this second biological opinion through inclusion of a term and condition requiring removal of steelhead from the river to minimize take associated with dam removal effects from sediment and turbidity.

3.4 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.

All of the proposed HGMPs include protocols for their implementation regarding fish health, broodstock collection, broodstock spawning, rearing and release of juveniles, deposition of hatchery adults, and catastrophic risk management. The protocols include actions that would be taken to minimize risks to listed fish,

Fish Health
Protocols addressing fish health, including fish health maintenance and hatchery sanitation procedures applied during broodstock collection, mating, fish incubation, rearing, and release, are detailed in each of the HGMPs in the sections addressing those activities. Fish health monitoring and evaluation measures are also included in the HGMPs.

The LEKT and WDFW would operate the programs in compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" protocols (NWIFC and WDFW 1998). This 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 pathogens between and within watersheds (NWIFC and WDFW and 1998). They would also comply with standard fish health diagnosis, maintenance and hatchery sanitation practices referenced in the policy (as per PNFHPC (1989) and AFS (1994) guidelines). For fish propagated at Lower Elwha Fish Hatchery, Northwest Indian Fisheries Commission (NWIFC) fish health specialists and pathologists would provide fish health management support and diagnostic fish health services (LEKT 2012a: 2012b; 2102c; LEKT and WDFW 2012). Staff with the WDFW Fish Health Section would provide the same services for the Elwha Channel Hatchery Chinook salmon program (WDFW 2012).

As described in the HGMPs, adult fish collected as broodstock for the program would be held at the hatcheries for a relatively short period before they are spawned, so minimally invasive fish health maintenance procedures would be conducted during the pre-spawn holding period. Behavior and external condition of the fish would be routinely observed, in addition to occasional non-lethal sampling to detect external parasites in conjunction with other handling. Any fresh pre-spawning mortalities would be removed and examined. If necropsy is warranted, the carcass would be either

examined immediately by fish health staff or frozen and examined during the next monitoring visit. In general, at spawning, lots of 60 adult fish would be sampled and analyzed for pathogens and parasites at the tribal and state fish health labs. For the captive rearing program for native steelhead at Lower Elwha Fish Hatchery, all female broodstock would be monitored for regulated viral pathogens and pathogenic bacteria (LEKT 2012a). Kidney, spleen and ovarian fluid samples would be collected from each female at spawning. Fish health would be monitored throughout the juvenile fish rearing periods at the hatcheries. Fish health professional staff would visit the hatchery sites monthly, or as needed, to perform routine monitoring of juvenile fish, advise hatchery staff on disease findings, and recommend remedial or preventative disease treatments with administration of therapeutic and prophylactic treatments when appropriate. Vaccinations of rearing fish populations to reduce the incidence of specific fish diseases would also be provided, as needed. Consistent with the co-manager fish health policy (NWIFC and WDFW 1998), all fish scheduled for release from the hatcheries would be certified as disease-free prior to release through collection and diagnostic analysis of representative samples of pre-smolts. WDFW would maintain a fish health database to identify trends in fish health and disease and implement fish health management plans based on findings (WDFW 2012).

Protocols for monitoring the health of fish in hatcheries specified in the co-managers' fish health policy (NWIFC and WDFW 1998) help reduce the likelihood of disease transmission from hatchery salmonids to naturally produced fish. When implemented, the protocols would help contain any fish disease outbreaks in the hatcheries, minimizing the potential for release of diseased fish from hatcheries, and reducing the risks of disease transfer and amplification to natural-origin fish populations (NMFS 2012c). In addition to routine testing of salmonids in the hatcheries, extant salmonids in the lower, middle, and upper Elwha River watershed have been tested for bacteria and viruses, and screened for the parasite *Myxobolus cerebralis* (Brenkman et al. 2008). These test and screening data provide a baseline for monitoring increasing disease incidence among the natural-origin salmon and steelhead populations in the Elwha River watershed. Protocols applied to minimize risks of adverse effects on listed Chinook salmon and steelhead associated with fish disease pathogen transfer and amplification for the five proposed Elwha River HGMPs are sufficiently protective of listed fish populations (NMFS 2012a).

Broodstock Collection

Sections 6 and 7 of the HGMPs describe protocols for broodstock selection and collection, including objectives, holding and handling practices, and methods. Detailed evaluations of the effects of salmon and steelhead broodstock collection and selection on listed Chinook salmon and steelhead are presented in the NMFS biological opinions for Elwha River restoration actions (NMFS 2006; 2012a; 2012b).

Native Elwha River stock adult salmon and steelhead returning to the Elwha River (and Morse Creek for Chinook salmon) are the brood sources for the proposed hatchery programs. In addition, for steelhead and pink salmon, adult fish grown in captivity from eggs or fry produced by natural-origin fish would augment broodstock collected from adult returns to the river (LEKT 2012a; LEKT and WDFW 2012). Broodstock from adult fish returns to the river for the programs would be collected using a variety of methods in the natural environment and in the hatcheries. For all species, opportunistic netting or hook and line capture of adult fish from the river would be among the methods used to collect broodstock. Adult fish recruiting to the hatchery release sites at Elwha Channel Hatchery and Lower Elwha Fish Hatchery, where they would be collected using weirs and traps, would provide substantial proportions of broodstock required each year to implement the programs. Broodstock collected through these methods, or produced through captive broodstock

rearing, would be selected for spawning at the hatcheries to be representative of the migration timing, sex ratio, age class, and morphological traits of the extant native Elwha River populations of the species. Protocols applied to minimize risks of adverse effects on listed Chinook salmon and steelhead for broodstock collection and selection occurring through the five proposed Elwha River HGMPs are sufficiently protective and would not jeopardize the listed ESU or DPS (NMFS 2006; NMFS 2012a; 2012b). Broodstock collection and selection protocols for the two supportive breeding programs propagating listed Chinook salmon and steelhead (WDFW 2012 and LEKT 2012a) are summarized below.

The Elwha Channel Hatchery Chinook salmon program has been sustained for decades only through the collection of broodstock from the adult salmon population returning to the Elwha River (WDFW 2012). The ESA-listed hatchery- and natural-origin components of the Elwha population are genetically indistinguishable and are thought to represent what remains of the historical, genetically unique, and independent Elwha Chinook salmon population. Recent natural-origin Chinook salmon productivity data (WDFW 2012) suggests that Elwha Chinook salmon would be extinct but for supportive breeding provided through annual operation of the Elwha Channel hatchery program over the past 30-40 years (NMFS 2012a). Under the proposed program, collection and spawning of up to 1,700 adult fish would be required to attain the proposed annual egg-take goal of 3.5 million unfertilized eggs. Broodstock collection in the mainstem river and at the hatchery facility for the past 20-30 years have likely incorporated a mix of predominately first generation hatchery-origin fish, with natural-origin fish. However, natural-origin fish have composed a low proportion of total collections, considering recent otolith mark recovery data showing that the total run is dominated by first generation hatchery-origin fish (WDFW 2012). The program would continue to collect the required number of adult fish from the run-at-large, representative of the current annual total return in run timing, age class, and sex ratio. Chinook broodstock are collected from adult fish volunteering to the Elwha Channel Hatchery trap, and through in-river gaffing, gill netting, and seining operations. In-river collection of broodstock using these methods would occur seven days per week for the duration of the annual adult Chinook salmon migration period (WDFW 2012).

The captive broodstock component of the native steelhead supportive breeding program was developed to provide sufficient adult broodstock for a subsequent conventional smolt release program that would have minimal effect on natural fish production (LEKT 2012a). The native steelhead program began in 2005 with collection of eyed eggs and/or emergent fry from redds created by naturally spawning late-returning steelhead in the Elwha River. Egg/fry collection continued annually through 2011, when collections from redds were terminated. The annual number of native steelhead eggs, fry, and adults collected for captive rearing of broodstock ranged from 431 to 2,731 during the years 2005 – 2011. The first spawning of captive-reared adults occurred in 2009; their age 2+ smolt progeny were released in 2011. Dependent on the abundance of adults returning as a result of initial fish releases in 2011 and subsequent smolt releases, the last releases of progeny of captive reared native stock Elwha River steelhead adults would occur in 2017 or 2018.

During the preservation phase, the LEKT (2012a) program will have the option to utilize natural-origin steelhead adults collected from the weir and by other means to supplement captive-reared adults. Starting in 2013, initial native stock steelhead adult returns to LEKT hatchery resulting from fish releases in 2011 were also available for use as broodstock in the LEKT program. During the preservation phase, the benefits of using natural-origin broodstock for the hatchery program will be assessed against the benefits of outplanting them as adults in the mid and upper river to promote recolonization (LEKT 2012a).

A maximum of 500 adult steelhead may be collected/selected as broodstock for spawning in the program each year (LEKT 2012a). During the preservation phase of restoration, the intent is to collect as many returning natural-origin adults as feasible and outplant these fish to upper mainstem and tributary areas to promote recolonization. Additionally during both the preservation and recolonization phases, captive-reared (through 2015 or 2016), and returning hatchery- and natural-origin adults will be available for use as broodstock. Steelhead adults required in excess of captive broodstock to meet annual smolt production objectives would be collected from returns to the Lower Elwha Fish Hatchery trap, and through opportunistic capture using hook and line or nets in the mainstem river. Steelhead collection and selection as broodstock would occur randomly from the captive brood population and the run-at-large, representative of the migration timing, sex ratio, age class distribution, and morphological traits of the total native steelhead population. All fish utilized for spawning in the program would be verified to represent the extant, native, late winter-run steelhead population in the Elwha River.

Pending results of genetic testing, all captive brood fish verified as of native Elwha River stock have received a PIT (passive integrated transponder) tag to identify their family origin. Run timing is assumed to be identical for both hatchery- and natural-origin adults, because broodstock are taken throughout the run. Other risk minimization methods to reduce the likelihood of adverse genetic or ecological effects on listed steelhead from broodstock collection and selection are maximization of genetic variability in the hatchery-reared population by verifying the identity of broodstock via genetic analysis of captive reared fish, and efforts to maximize diversity in progeny by utilizing the entire spawn-timing distribution of the captive brood. In-river harvests targeting remaining non-native early-timed, hatchery-origin steelhead returns in 2012-13 and 2013-14 were implemented to remove the fish from the river, and reduce the risk of interbreeding between non-native and native steelhead (LEKT 2013a; LEKT 2013b).

Broodstock Spawning

Broodstock spawning protocols are described in section 8 of each of the five HGMPs. Proposed mating procedures are consistent with NOAA Fisheries guidelines for artificial propagation under the ESA (Hard et al. 1992), and are guided by NWIFC and WDFW geneticists to reduce risks of genetic diversity loss and hatchery-induced selection effects (WDFW 2012; LEKT 2012a; LEKT and WDFW 2012). Summaries of proposed spawning practices, and detailed evaluations of the effects of hatchery salmon and steelhead broodstock spawning on listed Chinook salmon and steelhead are presented in the NMFS biological opinion evaluating listed fish effects of supportive breeding actions in the Elwha River (NMFS 2012a). In general, all broodstock are spawned as they become mature across the entire maturation period for each species. Fish are selected for spawning on any given day randomly from the mature populations. Fertilization of eggs would occur using factorial mating protocols to help ensure that all fish have an equal opportunity to contribute to spawning. Broodstock spawning protocols for the two supportive breeding programs propagating listed Chinook salmon and steelhead (WDFW 2012 and LEKT 2012a) are summarized below.

Spawning protocols applied in the Elwha Channel Hatchery program would ensure that all broodstock are spawned as the Chinook salmon ripen across the entire maturation period for population held in the hatchery (WDFW 2012). Females collected from the river by gaffing would be spawned where they are captured and crossed on-site with any males collected through that method. If not enough males were collected by gaffing, males held at the hatchery tap would be used for spawning. For fish held at the hatchery, all ripe females collected from the river, plus females recruiting voluntarily to the hatchery trap, would be spawned, primarily with males in the pond, and with a few males gaffed from the river. All males collected, including any jacks, would

be selected randomly and used for spawning from the entire maturing population. Eggs would not be fertilized at the Elwha River egg-take sites, although some fertilization may take place at Elwha Channel Hatchery for eggs that cannot be transferred. Egg fertilization would occur primarily at WDFW's Hurd Creek Hatchery. Eggs would be collected from spawned females at the Elwha River sites in three- or four-fish pools, depending upon the volume of the eggs. Milt would be collected in one-fish units (no pooling) in plastic bags with oxygen. Eggs and milt would then be iced and transported to Hurd Creek Hatchery, where eggs would be fertilized using a 'modified factorial design, where each bucket of pooled eggs would be split into three to four aliquots, depending upon the number of females, and each aliquot of eggs would be fertilized with sperm from one male. After a few moments, the eggs would be recombined and placed into isolation incubation units for water hardening in iodophor and incubated until virus-free certification was completed.

Under the WDFW (2012) HGMP, risk aversion measures would be applied to minimize the likelihood for adverse genetic or ecological effects on listed Chinook salmon resulting from broodstock spawning (fully described in NMFS 2012a). Chinook salmon adults to be spawned would be chosen at random from the available gene pool. Out-of-basin stray Chinook salmon would not be knowingly spawned or incorporated into the gene pool. Every attempt would be made to ensure that the egg-take is representative of the entire Chinook run in the Elwha River. In an effort to minimize directed, artificial selection of traits that could negatively affect the listed Elwha Chinook salmon population, proper spawning protocols would be implemented to maximize the representation of each individual adult fish into the entire brood.

Broodstock pairs spawned through the Lower Elwha Fish Hatchery native steelhead program would be selected from the captive-reared population held at the hatchery through 2015 or 2016, when the last captive brood fish maintained at the hatchery would mature as four and five year old fish, respectively (LEKT 2012a). Subsequently, hatchery-origin adults returning to the hatchery or the river from on-station smolt releases would also be available for use as broodstock. Natural-origin adults may be incorporated into broodstock as part of the proposed action, and the priority for natural-origin returns would be to allow the fish to spawn naturally in areas unaffected by dam removal activities. Natural-origin steelhead would be collected and spawned, if necessary, to meet native steelhead restoration objectives during the local adaptation phase of fish restoration (LEKT 2012a). Captive brood and hatchery-origin adults recruiting to the hatchery would be selected randomly for spawning from ripe fish on a given day. Mating guidelines and spawning matrices that would be applied were developed in partnership with geneticists at the NMFS Northwest Fisheries Science Center (NWFSC) to avoid half-and full-sibling crosses may include the following practices (LEKT 2012a). Ovulating females would be scanned to determine PIT tag identity and to identify appropriate mates. Each female would be mated with three males, and females would not be mated with half- or full-sibling males. Males would be mated only with females from different families. Females would be spawned individually. Eggs from each female would be divided into three aliquots. Eggs would be rinsed with a buffered sodium bicarbonate solution to remove debris and promote sperm motility. Each egg aliquot would receive sperm from one of the three males. Water would be added to initiate sperm motility and eggs would be recombined into a single incubation lot. Eggs would be loaded into vertical tray incubators and allowed to water-harden. Following water-hardening, incubation flows would be supplied at 3.0 gallons per minute. These spawning protocols described in LEKT (2012a) would reduce inbreeding risks by avoiding sibling pair matings, and act to maximize diversity of progeny.

Protocols applied to minimize risks of adverse effects on listed Chinook salmon and steelhead from broodstock spawning proposed through Elwha Channel Hatchery and Lower Elwha Fish Hatchery HGMPs are adequate to reduce the risk of genetic diversity reduction and hatchery-induced selection risks and are sufficiently protective of listed fish (NMFS 2012a).

Rearing and Release of Juveniles

Salmon and steelhead rearing and release protocols proposed under the five Elwha River HGMPs are described in plan sections 9 and 10 of the plans. These protocols were developed consistent with standard fish cultural practices proven to ensure the propagation and release of healthy juvenile fish that meet fish abundance and fish size at release, and smolt survival to adult return objectives. The rearing and release protocols are also designed to minimize the risk of adverse effects on natural-origin fish populations downstream of the hatchery locations.

Summaries of proposed rearing and release practices described in the proposed HGMPs, and detailed evaluations of the genetic and/or ecological effects of hatchery salmon and steelhead broodstock spawning on listed Chinook salmon and steelhead, are presented in the NMFS biological opinion for supportive breeding actions in the Elwha River (NMFS 2012a). In general, the progeny of all fish spawned through the programs would be incubated and reared using water sources, water quantities, facilities, and fish cultural practices proven in the past at the hatchery facilities to be effective in rearing healthy fish and meeting annual fish production goals. In particular, fish rearing densities and feeding amounts and methods would be consistent with fish growth and health maintenance protocols generally applied in successful Pacific Northwest anadromous fish rearing operations. Releases of juvenile fish through the programs would be limited to on-station releases of smolts only, to reduce risks of adverse ecological interactions with natural-origin fish that may be produced in upstream areas. All on-station releases of juvenile fish would be made at fish sizes and times that would reduce or avoid spatial and temporal interactions with natural-origin salmon and steelhead that might lead to resource competition and hatchery fish predation. Off-station release of fish through the programs would occur through upstream transport and release of adult fish only that would spawn naturally and produce juveniles similar in life stage, size, and behavior to juvenile fish produced by natural-origin spawners. This adult fish only upstream planting practice would reduce supportive breeding-related ecological risks to rearing and migrating fish in newly accessible areas upstream of the dam locations. Rearing and release protocols for the two supportive breeding programs propagating listed Chinook salmon and steelhead (WDFW 2012; LEKT 2012a) are summarized below. Full details regarding the protocols that would be applied are provided in the HGMPs for the programs.

Fish rearing and release protocols for the Elwha Channel Hatchery program are described in HGMP sections 9 and 10 (WDFW 2012). During the preservation and recolonization phases of fish restoration, adult Chinook salmon collected from the river and at the hatcheries that are surplus to hatchery broodstock needs would be transported and released above the Elwha dam sites to spawn naturally, as required by NMFS (NMFS 2006; 2102a; 2012b). All eggs collected from females retained for spawning for the Elwha Channel Hatchery Chinook salmon program would be incubated to the eyed egg life stage at WDFW's Hurd Creek Hatchery. Once eyed, and after virus-free certification by fish health staff, the majority of the eggs would be transported by truck to WDFW's Sol Due Hatchery for incubation through the time of hatching and for initial rearing through the fry or fingerling life stage. Fry would be transported from Sol Duc Hatchery back to Elwha Channel Hatchery at an average fish size of 400-600 fish per pound (fpp) by April each year for rearing and imprinting on Elwha River water prior to release into the river from the facility.

The annual on-station release goals for the proposed program are 2.5 million sub-yearling smolts released in June at an average fish size of 80 fpp. Approximately 200,000 of the Chinook salmon would be retained at Sol Duc Hatchery each year for continued rearing to a size of 20 fpp for transfer in October for continued rearing at WDFW's Morse Creek Hatchery. The fish would be reared to an average size of 8 fpp for release as yearlings into Morse Creek in early April. A portion of the eyed eggs produced at Hurd Creek Hatchery each year would be retained at the site for hatching and rearing of fish to yearling size. Fish reaching an average size of 20-60 fpp in October would be transferred to Elwha Channel Hatchery for continued rearing, where the on-station release goal would be 200,000 yearling smolts in March at an average size of 10 fpp. For all phases of rearing, as a measure to produce healthy fish, maximum fish rearing densities would be maintained at 3 pounds of fish per gallon per minute of water inflow or less, and under 0.35 pounds of fish per cubic foot of rearing space. All Chinook salmon would be fed a high quality commercial diet at amounts and frequencies that would meet fish growth rate objectives and maintain fish health. Daily fish mortality levels and fish health would be monitored daily by hatchery staff. All facilities would be staffed on-station, or on a daily basis, by trained hatchery personnel to ensure that fish under propagation are safeguarded. Prior to their release, all juvenile fish produced through the program would receive a thermally induced otolith mark to allow for identification of the fish as hatchery-origin. Beginning in 2013, a subset of subyearlings released from Elwha Channel Hatchery were also marked with an adipose fin clip/coded wire tag combination. Proposed fish release sizes, life stages, timings and locations would minimize the magnitude and duration of any interactions with listed natural-origin fish populations that would lead to adverse effects from competition or predation (NMFS 2102a).

Protocols for fish rearing and release for the Lower Elwha Fish Hatchery native steelhead program are described in HGMP sections 9 and 10 (LEKT 2012a). As proposed in the HGMP, and required by NMFS as a measure to reduce takes resulting from dam deconstruction, during the preservation and recolonization phases of fish restoration, adult native steelhead collected from the river and at the hatcheries that are surplus to hatchery broodstock needs would be transported and released above the Elwha dam sites to spawn naturally (NMFS 2006; 2102a; 2012b). Specific outplanting sites for adults thus far have included Little River and Indian Creek, two tributaries above the Elwha Dam site. Adult steelhead would be transported upstream for release by tank truck. Fertilized eggs taken from captive brood and returning adult native stock steelhead would be incubated in individual Heath trays identifiable by broodstock source, capture location, and spawn date. Eggs would be incubated in a facility supplied by constant temperature (silt-free) ground water. Eggs reaching the eyed stage would be shocked, sorted to remove non-viable eggs, inventoried, and retrayed prior to hatching. Eggs would be retrayed in Heath trays with triple-layer of Vexar screening to inhibit excessive movement by alevins which may cause coagulated yolk condition. Alevins in egg trays would be transferred to early rearing troughs when the majority are buttoned up. When fry to be retained for rearing as captive broodstock reach a length of 100 mm (fl) they are PIT tagged and a tissue sample is collected for genetic analysis to verify parental lineage. The PIT tag identifier would be used to identify the fish for the duration of residence at the hatchery, and for reference in applying mating protocols. Rearing fish would be maintained in fiberglass troughs and, when reaching a large enough size, concrete raceways during residence at the hatchery. Flow-based and volume-based fish rearing density criteria to safeguard fish health developed by NWIFC are maintained throughout the rearing period. Optimal fish rearing densities would be 1.20 pounds fish per gallon per minute inflow per inch fish length and 0.30 pounds fish per cubic foot rearing space per inch fish length. Water temperature and flows would be constantly monitored in troughs and raceways to safeguard rearing fish.

Steelhead are reared to age-2 smolts, mimicking the predominant age at emigration for the natural-origin Elwha River steelhead population. Growth curves developed by NMFS NWFSC staff for the Hood Canal wild steelhead supplementation study (Berejikian et al. 2005) were used to guide production for the Elwha steelhead program until sufficient data regarding on-station growth trajectories are obtained. Fish size, behavior and morphology are monitored to assess readiness of fish for on-station release as smolts. Annual juvenile fish production goals would be 175,000 2+ smolts released from the hatchery at RM 1.3 at an average size of 5-8 fpp. Captive reared steelhead would be reared an additional one to two years in the hatchery, typically reaching sexual maturity at ages 3 and 4. Beginning in March on the year of their expected maturation, female ovulatory status (and maturity of males) would be assessed weekly. Ripe females and males would then be segregated for subsequent mate selection and spawning.

The HGMP describes a steelhead smolt release date of mid-May as the applied release date in recent years (HGMP section 10.3). A mid-May release date was pursued as a means to further reduce predation risks that may be associated with hatchery steelhead smolt encounters with emigrating natural-origin and hatchery-origin salmon. In practice, and as a proposed action in the current HGMP, the steelhead smolts would be released from the LEKT hatchery when physiologically optimal, typically in March or April (LEKT 2012a, section 10.2), because the fish generally become smolts during those months. As described in the HGMP, this release date range was selected based upon smolt readiness (as indicated by pre-smolt behavior changes, scale loss, and feed response) and consideration of outmigration timing of natural-origin salmon emigrants (LEKT 2012a). It is detrimental to fish health to retain the smolts in hatchery ponds when they have attained that physiological condition, and their release from the hatchery has been required. Achievement of a mid-May release goal is therefore subject to the onset of smoltification in the population, and the need to maintain the health of these listed hatchery-origin steelhead by releasing the fish when they become smolts.

Even taking into account the release of smolts in March or April, protocols included in the HGMPs and proposed for fish rearing and release through the Elwha Channel Hatchery and Lower Elwha Fish Hatchery programs – in particular, the release of all fish as smolts in the very lowest portion of the Elwha River – are adequate to reduce the risk of adverse ecological interaction effects (competition and predation) on listed natural-origin fish populations. The protocols would minimize the duration of interaction with listed fish, and substantially reduce the likelihood for competition and predation in freshwater areas (NMFS 2012a).

Disposition of Hatchery Adults

Protocols for the disposition of adult salmon and steelhead are included in the proposed HGMPs. As noted previously, a condition of previous NMFS consultations regarding dam deconstruction effects (NMFS 2006; 2012b) and the effects of proposed hatchery programs on listed fish (NMFS 2012a) is that Chinook salmon and steelhead surplus to hatchery broodstock needs would be transported and released into upstream areas above the dam sites to allow the fish to spawn naturally. This strategy would be applied as the secondary supportive breeding strategy (behind on-station releases of juvenile fish) for all of the proposed Elwha River hatchery salmon and steelhead programs during the preservation phase of restoration (NMFS 2012a; Peters et al. 2014). During the recolonization phase of fish restoration, upstream transport and release of surplus adult fish would become the tertiary fish restoration strategy, behind spontaneous natural recolonization by upstream migrating salmon and steelhead adults (NMFS 2012a; Peters et al 2014). Further, as described in the HGMPs, LEKT and WDFW would disperse carcasses from spawned hatchery-origin fish into watershed

areas for nutrient enrichment purposes. Marine-derived nutrients provided by decaying hatchery adult carcasses would benefit natural productivity in the watershed, improving growth and survival conditions for rearing and migrating natural-origin salmon and steelhead. Protocols for the disposition of hatchery-origin adults for the two supportive breeding programs propagating listed Chinook salmon and steelhead are summarized below. Full details regarding the protocols that would be applied are provided in the HGMPs for the five proposed hatchery programs (WDFW 2012; LEKT 2012a).

Through past operation of the Elwha Channel Hatchery Chinook salmon program, there have been very few if any live adult fish captured through the broodstock collection program in excess of program needs (section 7.2, WDFW 2012). In years when large numbers of Chinook salmon adults have entered the Elwha Channel Hatchery trap as volunteers, gaffing to collect fish as broodstock has been reduced accordingly to prevent surplus adult removals. Consistent with NMFS (2006; 2012a; 2102b) consultation requirements, Chinook salmon collected at the hatcheries and from the river that are surplus to hatchery needs will be transported live upstream above the dam sites for release into areas unaffected by dam deconstruction to allow the fish to spawn naturally. WDFW may distribute carcasses of spawned adult Chinook salmon from the program into the watershed to contribute marine derived nutrients that would increase natural-origin fish productivity in the watershed. These carcass seeding efforts may result in distribution of up to 2,900 adult Chinook salmon carcasses assuming program goal fish production and broodstock collection levels. Assuming an average size of adult Chinook salmon of 18 pounds, approximately 52,200 pounds of marine derived nutrients could be deposited in the river through the program if goal adult broodstock collection levels are met.

The Lower Elwha Fish Hatchery native steelhead program would also not likely result in the production or collection of adult fish surplus to annual broodstock needs. Under the proposed program, carcasses of steelhead spawned at the hatchery would be dispersed into natural watershed areas through nutrient enhancement programs, provided to tribal wildlife programs as bait for trapping efforts, or donated to regional raptor rescue centers (LEKT 2012a). The tribal plan notes that increased abundance and distribution of salmon carcasses would provide transport of marine derived nutrients into the watershed, potentially increasing primary and secondary productivity, and increasing the abundance of prey species required by juvenile steelhead and other salmonids (LEKT 2012a). The program could result in the annual dispersal of 1,313 steelhead carcasses or (assuming an average adult fish size of 8 pounds) 10,500 pounds of marine-derived nutrients into the Elwha River watershed each year.

Protocols included in the HGMPs for the disposition of hatchery adult fish through the proposed hatchery programs, including the programs producing listed fish (the Elwha Channel Hatchery and Lower Elwha Fish Hatchery) would benefit listed fish populations in the Elwha River watershed. The protocols would likely benefit abundance and productivity of the natural-origin components of the listed populations through the transport and upstream release for natural spawning of Chinook salmon and steelhead surplus to hatchery broodstock needs (NMFS 2012a). Protocols in the five HGMPs would also benefit listed fish through dispersion of marine derived nutrients from hatchery salmon and steelhead carcasses, and from spontaneous escapement of hatchery-origin adults originating from the programs into natural spawning areas (NMFS 2012a).

Catastrophic Risk Management
The HGMPs that would rear listed Chinook salmon and steelhead include catastrophic risk management protocols designed to reduce the risk of injury and mortality of listed fish while under propagation in the hatcheries. Inclusion of these protocols in the proposed plans addresses the need for the programs to operate in a manner that adequately safeguards listed fish while under propagation. Chinook salmon and steelhead propagated through the Elwha Channel Hatchery (WDFW 2012) and Lower Elwha Fish Hatchery (LEKT 2012a) programs are included as part of the listed Puget Sound Chinook salmon ESU and Puget Sound steelhead DPS, respectively. To protect these listed fish while under propagation, catastrophic risk management protocols are included in the HGMPs for the programs in all appropriate plan sections.

The Elwha Channel Hatchery HGMP describes available back-up water supply systems, and risk aversion measures, that would be applied at each of the facilities rearing Chinook salmon as part of the program, that minimize the likelihood for listed Chinook salmon mortalities resulting from equipment failure, water loss from power failure, and flooding. The HGMP for Elwha Channel Hatchery indicates that gravity feed river water can be used as a backup water supply for rearing fish in the event of loss of power to well pumps. At Sol Duc Hatchery, all rearing water is gravity fed to fish rearing ponds, which reduced the risk of water supply loss to Chinook salmon. At Hurd Creek Hatchery, a generator would supply back-up power in the event of power loss. Morse Creek Hatchery maintains a generator which would supply back-up power in the event of power loss and two gas powered pumps supply water in the event of pump failure. Chinook salmon eggs for the program are incubated on well water at Hurd Creek Hatchery, and clear, spring water at Sol Duc Hatchery, to avoid egg losses due to siltation and from fish disease pathogens. The hatchery sites are attended full time by qualified fish culture staff, and water supply systems at the hatcheries are alarmed with 24-hr/day monitoring to indicate, and allow rapid responses to, water supply failures. The HGMP describes emergency fish release procedures that would be applied to respond to irresolvable water system failures. Emergency fish release measures would include removal of screens and stop logs on rearing ponds to provide fish access to the Elwha River, providing a temporary water supply to fish held in the ponds through gravity-fed sources, and allowing fish to migrate from the ponds into the river. Emergency water loss responses at Sol Duc Hatchery would include use of an alternative water supply source, and immediate transport of Chinook salmon juveniles to Elwha Channel Hatchery. During a flood or drought events that would threaten rearing fish and water supplies at Elwha Channel Hatchery, fish would be released early directly into the Elwha River to prevent possible fish losses if the Chinook salmon were retained in the hatchery.

Catastrophic risk management protocols for operation of the Lower Elwha Fish Hatchery native steelhead program are described in the LEKT HGMP (LEKT 2012a). Proposed measures include implementation of back-up water supply systems and risk aversion measures that would minimize the risk of hatchery steelhead mortalities resulting from equipment failure, water loss from power failure, and flooding. To reduce risks to listed fish resulting from facility failure, the facility where the steelhead would be reared is monitored full time by on-site hatchery staff. Hatchery operations would continue to be maintained in compliance with state and federal water withdrawal, effluent discharge and screening criteria to reduce the risk of catastrophic losses of listed fish in the hatchery and in the natural environment. Protocols are included in HGMP section 5.7 to address facility operational problems which pose risks of substantial fish mortality in the hatchery. Flooding of the Elwha River that could inundate the facility's fish ladder and harm listed fish present in the ladder would be addressed by diverting water from the ladder and pumping the water out of the facility. The risk of loss of electrical power that could result in pump failure and loss of surface and/or

groundwater supplies to fish in the hatchery would be mitigated through use of an emergency stand-by generator. The generator is capable of supplying facility electrical needs in the event of such power outages.

The risk of loss of the hatchery surface water supply caused by failure of the Elwha Surface Water Treatment Plant, or flooding in the Elwha River causing erosion and damage to the buried pipeline feeding the hatchery would be addressed through the use of recirculation pumps or groundwater sources at the hatchery to maintain flows to fish under propagation. Other backup systems and /risk aversion measures proposed to reduce the risk of catastrophic fish loss at the hatchery are described in HGMP section 5.8. A flood reduction levee has been constructed by the U.S. Army Corps of Engineers to reduce the risk of inundation of the hatchery and loss of fish. During flood events, a gate on the hatchery fish ladder can be closed to prevent entrance of flood waters into the hatchery facility. The local Public Utility District has upgraded the electrical service entrance and transmission lines leading to the hatchery facility, reducing power loss risks.

The risk of pump failure and hatchery water supply loss is further addressed through regular monitoring of pump production and operation. All pumps at the hatchery receive regular servicing and inspections. The loss of adult steelhead theft and risk of vandalism at the hatchery that could cause fish losses is reduced through installation and operation of a video security and alarm system monitored 24 hours/day, and seven days/week. The risk of substantial fish losses due to avian predation would be reduced by installation and upgrading of pond netting systems to exclude birds. The tribal HGMP also includes emergency fish release protocols that would be applied to rescue fish in the event of an emergency posing risks to fish held in the hatchery (LEKT 2012a). As described in the HGMP, if an emergency occurs prior to the scheduled release date for steelhead smolts, the circumstances regarding the emergency would be evaluated and causes addressed if possible. If the emergency cannot be resolved, feeding of the fish would be stopped, and fish releases would begin at a pace based on the nature of the emergency. Although the facility is protected by a flood control levee, and the facility has been free of flooding impacts since its construction, during a flood event, any on-going releases of steelhead from the hatchery would be halted until the end of the event. In the event of a water supply system failure, the hatchery water distribution pattern would be evaluated and adjusted to ensure even distribution of remaining water sources to rearing ponds.

Catastrophic risk management protocols included in the Elwha Channel Hatchery Chinook salmon HGMP (WDFW 2012) and the Lower Elwha Fish Hatchery native steelhead HGMP (LEKT 2012a) would adequately safeguard listed Chinook salmon and steelhead while maintained in the hatcheries.

3.5 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 five Elwha River salmon and steelhead HGMPs submitted to NOAA Fisheries provide evaluations of potential genetic and ecological effects on listed salmon in section 2.0 of each proposed plan. Each HGMP includes risk minimization measures in plan sections describing actions that may affect listed fish (sections 6-10) that would be implemented to reduce disease transfer, competition, predation, and genetic diversity effects. The plans account for potential effects on listed Chinook salmon and steelhead in sections 2.0 and in the take tables appended to each HGMP. In general, the HGMPs would apply a risk management approach designed to allow

for the adaptive management of supportive breeding actions based on the performance of the programs in meeting preservation and recolonization objectives, and effects on listed fish, as determined by monitoring and evaluation. The Elwha Monitoring Group monitoring and adaptive management document (EMG 2012, now finalized as Peters et al. 2014) referenced in the Chinook salmon and steelhead HGMPs identifies triggers and thresholds for each of the four restoration phases. These triggers and thresholds would serve as reference points to gauge population viability status. They would also generally guide responsive actions implemented through each hatchery plan that are necessary to meet population viability triggers for each restoration phase.

The NMFS biological opinion for the five Elwha River HGMPs summarizes genetic and ecological risk minimization actions and take levels described in the proposed hatchery plans, and evaluates the potential effects of plan actions on listed fish (NMFS 2012a). This information from the NMFS biological opinion, germane to how the HGMPs comply with 4(d) Rule limit criterion 5(i)(E), is presented below. Further details regarding each issue and the basis for NMFS's effects determinations are provided in the biological opinion (NMFS 2012a).

Genetic Effects

The proposed HGMPs for Chinook salmon (WDFW 2012) and steelhead (LEKT 2012a) would be the only plans that have the potential to affect the listed populations of the same species genetically. The other HGMPs would propagate species that cannot interbreed with Chinook salmon or steelhead, and would have no genetic effects on listed fish. The following description of HGMP compliance under this criterion will therefore only address the potential genetic effects of the proposed Chinook salmon and steelhead plans on the listed Chinook salmon and steelhead populations, respectively. The genetic effects that artificial propagation of these species may pose to the associated listed Elwha River populations can be separated into reductions or changes in the genetic variability (diversity) among and within populations. From information provided in the proposed HGMPs, NMFS (2012a) evaluated three types of genetic risks that may result from implementation of the Chinook salmon and steelhead HGMPs: loss of within-population diversity, outbreeding effects, and hatchery-induced selection (aka "domestication") (NMFS 2012c).

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).

Elwha Channel Hatchery Chinook salmon program

The proposed supportive breeding program for Chinook salmon may pose risks of within-population genetic diversity loss for Elwha River Chinook salmon. A subset of the total run-at-large - 57% of the total estimated return (1999-2010 average WDFW 2012) – would be collected from the river for use as broodstock each year. There is a potential risk that collections would not include a representative sample of remaining genetic diversity for the species. For the reasons presented previously, it is highly likely that supportive breeding provided through hatchery propagation over the past 40- 50 years has preserved the extent Elwha Chinook salmon population.

Existing genetic diversity expressed by the total population has resulted from, and has been substantially supported by, the hatchery program. Extant within-population diversity for Elwha Chinook salmon is largely an artifact of any artificial selection that has likely occurred over the long term of operation of the hatchery program in a much degraded freshwater environment. Under this baseline, it has not been possible for natural production to contribute substantially to total population diversity because natural production of adult fish that may spawn naturally and levels of natural-origin broodstock incorporated into the hatchery population through adult collections from the river have been very low. The HSRG concluded that the off-site hatchery Chinook salmon program located on Morse Creek would help reduce the risk of losing remaining genetic resources during the preservation and recolonization phases, when habitat is unstable (HSRG 2012). For these and other reasons described in NMFS (2012a), it is unlikely that the proposed Elwha Channel Chinook salmon program, operating over the term of the preservation and recolonization phases of restoration, and implemented as proposed with incorporation of mitigative measures, would pose substantial risks to the remaining within-population diversity of the Elwha Chinook salmon population.

To mitigate risks under this category, broodstock collection, mating and artificial propagation measures are proposed in WDFW (2012) that would minimize the risk of within-population diversity loss of the remaining aggregate, predominately hatchery-origin population. These measures would be implemented to minimize the risk of this hazard over the term of program operation during the stock preservation and recolonization phases of restoration, when demographic risks to the population resulting from dam deconstruction would be greatest. The risk of loss of within-population genetic diversity in the hatchery and total populations resulting from implementation of the Elwha Channel Hatchery program would be minimized through the following proposed measures (WDFW 2012):

- Over the most recent 14 years (1999-2012) the number of broodstock randomly collected from adult returns to the river has averaged 1,120 adult fish per year (Table 3), with the goal of meeting the annual broodstock collection objective of 1,700 fish (WDFW 2012). Nearly all fish collected over this period were spawned, and a high effective breeding population size (Ne) was maintained. Assuming a ratio of 4 spawners per effective spawner in the hatchery (Table 3), the Ne for the most recent generation span (2009-2012) was 1,223 fish, and 1,472 fish for the previous 4 brood year generational group (2003-2007)1. The Ne maintained through the program is sufficient to minimize the risk of loss of within-population diversity and rare alleles. Allendorf and Ryman (1987) report that less than 1% of the genetic variation would be lost each generation if Ne is maintained at a level greater than 50 breeding individuals. They recommended that at least 100 fish of each sex (200 individuals) be used to maintain a hatchery strain sufficient to retain genetic variability of the population while under artificial propagation. Further, several other researchers concluded that the long-term adaptive potential of an isolated population (without migration into it) is conserved when Ne is on the order of 500 individuals (FAO - UN 1981; Nelson

[1] To determine the total number of fish needed to achieve a 500 fish per generation effective size, divide 500 by the generation time of the fish species. For Chinook salmon, the generation time is 4 years, so 125 effective spawners are needed each year. Because an average of one in four of the Chinook spawned in the hatchery contribute to the subsequent generation of fish (assuming a ratio of 4 spawners per effective spawners in the hatchery (pers. comm. between M. Ford and C. Busack; June 3, 2014), multiply the number of effective spawners times four to calculate the number of annual broodstock needed to achieve a 500 fish per generation effective size. For a Chinook salmon hatchery program, 500 broodstock should be collected annually to maintain a 500 fish per generation effective size.

and Soule 1987). The proposed Elwha Channel Hatchery program would maintain a Ne much larger than these levels suggested to maintain propagated populations – 2,125 if the goal collection level of 1,700 fish per year is met for five consecutive brood years. For this reason, the program averts the risk of loss of genetic diversity for what remains of the extant Chinook salmon population in the river.

- The sex ratio of the Chinook salmon population collected each year would be reflective of the run-at-large, and would include sufficient ratios of male and female fish.

- All fish collected through netting or gaffing in the river or as volunteers to the hatcheries would be used in the annual spawning operation, thereby reducing sources of bias that could lead to a non-representative sample of the broodstock of the Chinook population collected and spawned.

- Broodstock would be collected randomly from the mainstem river (seines, gill nets, and hook and line) over the breadth of the total annual August through October Chinook salmon spawner return period (WDFW 2012; HGMP Section 1.3.1). Because, based on historical averages, approximately 80% of all Chinook salmon collected as broodstock would be obtained through gaffing and netting operations directed at the population at large in the mainstem Elwha River (NMFS 2003), there would be a high probability that any natural-origin adults present would be collected and incorporated into the broodstock due to non-selective mainstem collection methods applied. These measures minimize the risk of selection for traits in broodstock that are not reflective of the run-at-large and that pose a risk of within-population diversity loss.

- Factorial mating strategies applied through the program help ensure that all fish collected have an equal opportunity to contribute to the production of progeny, and the retention of diversity.

- When the total Chinook return abundances exceeds a certain level, fish surplus to hatchery needs will be transported live upstream above the dam sites for release to allow the fish to spawn naturally, bolstering the number of adult fish of the total population that would not be exposed to hatchery-related selection effects that would potentially increase the risk of within-population diversity loss.

- Implementation of a genetic reserve program at Morse Creek Hatchery would act as a safety net for preserving remaining genetic diversity of the Elwha Chinook salmon population, providing an additional or alternate broodstock collection source in the event of catastrophic loss of the population in the Elwha River watershed, for example, as a result of lethal turbidity and sediment levels from the release of stored materials as the dams are removed.

<u>Lower Elwha Fish Hatchery Native Steelhead program</u>

Implementation of the proposed native winter-run steelhead supportive breeding program may pose risks of within-population genetic diversity loss to the anadromous form of the species persisting in the lower Elwha River. Although the precise abundance of the spawning population in the river is unknown (perhaps 60 to 200 fish according to LEKT 2012a), it is possible that the now-terminated hydraulic redd sampling methods used to collect eggs and fry to initiate captive broodstock did not lead to collection of a population for artificial propagation that was fully representative of the

annual run-at-large nor the total genetic diversity of the remaining native steelhead population. If this is true, it is likely that the effective size of the population would be reduced through broodstock collection practices, and through supportive breeding that promotes improved hatchery fish survival to adult return relative to naturally spawned fish, risking loss of diversity of what remained of the species in the lower river. A subset of the total run-at-large returning as adults may be collected from the river for use as broodstock each year, and there is a risk that collections would inadvertently not include a representative sample of remaining genetic diversity for the species in the propagated steelhead population that would be expected to have a higher survival rate to adult return than fish produced naturally. Additionally, as an artifact of retention of fish for their entire life spans in the hatchery, and if proper mating procedures are not followed, the captive broodstock strategy initially used as the primary supportive breeding method for the species could pose substantial within-population diversity loss risks to the Elwha steelhead population. Although no further brood years of steelhead are proposed for creation under the proposed action (the 2011 brood year was the last created), on-going production of adult fish and their progeny through 2015 or 2016 may be of concern. However, it is highly likely that supportive breeding for the species as proposed, including captive broodstock production, is needed to preserve remaining diversity of the native winter-run population.

Because of inhospitable habitat conditions created by the dams for natural-origin steelhead production over the long term, the native population has been driven to critically low abundance levels, with substantial reductions in the diversity of the population relative to its historical baseline. The remaining abundance and diversity of the population are further threatened by dam deconstruction activities and effects on remaining lower river habitat. Existing genetic diversity expressed by the total population would be substantially supported by the proposed hatchery program for at least two brood years, and pending the rate of recovery of critical habitat, all brood years for the species. For these reasons, the proposed Lower Elwha Fish Hatchery native steelhead program, operating over the term of the preservation and recolonization phases of restoration and implemented as proposed with incorporation of mitigative measures, would support rather than adversely affect the remaining within-population diversity of the Elwha native winter-run steelhead population (NMFS 2012a).

To address risks under this category, broodstock collection, mating and artificial propagation measures are proposed that would minimize hatchery-related within-population diversity loss of the captive broodstock aggregation under propagation, and for the remaining native steelhead population. These mitigative measures would be implemented to reduce the risk of this hazard over the term of program operation during the stock preservation and recolonization phases of restoration, when demographic risks to the population resulting from dam deconstruction would be greatest. The HSRG found that the strategies described for using hatchery production to preserve the genetic lineage of the native Elwha River steelhead population are generally accepted as being appropriate for that purpose (HSRG 2012).

The risk of loss of within-population genetic diversity in the hatchery population would be minimized through the following actions and proposed measures implemented through the Lower Elwha Fish Hatchery native steelhead program (LEKT 2012a):

- The original donor source for the captive broodstock producing progeny for rearing and release through the proposed program in 2005 – 2011 was eggs and/or fry collected from redds created by naturally spawning native winter-run steelhead. Redds identified for hydraulic sampling and egg/fry removal were randomly selected from the total number of

observed redds created during the March-April period when native winter-run fish spawn. Eggs and emergent fry were taken from multiple redd sites throughout the available watershed (LEKT 2012a).

- Captive broodstock adults produced for spawning may be augmented with hatchery-origin adult returns resulting from releases of the smolt progeny of captive brood fish previously released.

- The proposed program would have an annual broodstock collection objective of up to 500 fish (LEKT 2012a). Assuming a ratio of 4 spawners per effective spawner in the hatchery (Table 3), and a generation time of four years for steelhead, the effective breeding population size (Ne) maintained through the hatchery program would be 500 fish.[2]. This Ne is sufficient to minimize the risk of loss of within-population diversity and rare alleles. Allendorf and Ryman (1987) report that less than 1% of the genetic variation would be lost each generation if Ne is maintained at a level greater than 50 breeding individuals. They recommended that at least 100 fish of each sex (200 individuals) be used to maintain a hatchery strain sufficient to retain genetic variability of the population while under artificial propagation. Further, several other researchers concluded that the long-term adaptive potential of an isolated population (without migration into it) is conserved when Ne is on the order of 500 individuals (FAO - UN 1981; Nelson and Soule 1987). The proposed LEKT steelhead program would maintain a Ne within the range of these spawning abundance levels suggested to maintain propagated populations. For this reason, the program would help avert risk of loss of genetic diversity for what remains of the extant Elwha River steelhead population.

- After the preservation phase of restoration, and as river habitat stabilizes, the genetic diversity maintenance benefits of incorporating natural-origin adult fish as broodstock would be evaluated in light of their role in re-colonization through natural spawning. Guidelines would be developed for the program, considering ranges in the abundance and the likely availability of natural-origin steelhead in the short and long term phases of recovery.

- All steelhead broodstock utilized by the program would undergo genetic testing to verify that the fish represent the extant, native, late winter-run steelhead return to the Elwha River to ensure that fish spawned are genetically part of the native steelhead population that spawn naturally. Through this action the genetic origin of the steelhead population propagated through the program relative to the donor natural-origin population would be maintained.

[2] To determine the total number of fish needed to achieve a 500 fish per generation effective size, divide 500 by the generation time of the fish species. For steelhead, the generation time is 4 years, so 125 effective spawners are needed each. Because an average of one in four of the steelhead spawned in the hatchery contribute to the subsequent generation of fish (assuming a ratio of 4 spawners per effective spawners in the hatchery (pers. comm. between M. Ford and C. Busack; June 3, 2014), multiply the number of effective spawners times four to calculate the number of annual broodstock needed to achieve a 500 fish per generation effective size. For a steelhead hatchery program, 500 broodstock should be collected annually to maintain a 500 fish per generation effective size.

- Run timing for hatchery-origin fish would remain identical to the natural-origin population, because broodstock collected from adult returns to the river would be representative of the breadth of the total annual native steelhead return.

- There would be no selection effects for sex ratio or age, as the primary source for fish reared to broodstock size for spawning through the proposed program would be progeny of naturally spawning native steelhead secured from redds as eyed eggs or fry.

- Appropriate mating practices would be applied in the captive broodstock program to minimize the risk of selection effects resulting in diversity loss. As described in section 8 of the HGMP (LEKT 2012a), fish spawned at Lower Elwha Fish Hatchery would be selected randomly from ripe fish on a given day. All gravid females would scanned to determine identity (all captive broodstock fish are individually PIT tagged to identify brood year and family origin) and to identify appropriate mates.

- Mating guidelines and spawning matrices developed in partnership with geneticists from the NMFS NWFSC would be applied to conduct crosses with the goal of minimizing the risk of inbreeding and the loss of genetic diversity in the propagated population, which may include:
    - each female would be crossed with three males;
    - each female must be genetically unique from each of the three males;
    - each male spawned must be genetically unique from other males in a given mating;
    - each male may be used up to three times during the spawning season; and,
    - each female must be spawned individually, with each egg aliquot receiving milt from one of the three males.

Outbreeding depression

As reviewed in NMFS (2012a), outbreeding depression is a loss of fitness of a population in the first or subsequent generations after interbreeding with another population. Outbreeding depression can be a simple loss of adaptation caused by changes in allele frequency or by the introduction of new alleles. It can also result in the disruption of co-adapted gene complexes, sets of alleles at different genes that work well together. The greater the geographic separation between the source and recipient population, the greater is likely to be the genetic difference between the two populations. Therefore a hatchery-origin fish whose origins are geographically distant likely will genetically differ from a local natural population, regardless of additional differences that might develop due to the impact of the hatchery rearing environment (hatchery-influenced selection- see below) resulting in outbreeding depression. Such distant-origin hatchery fish therefore may pose a greater risk to the genetic character of a local natural-origin population than hatchery-origin fish originating from the same local natural-origin population.

Elwha Channel Hatchery Chinook salmon program

The Elwha Channel Hatchery program has been sustained for decades only through the collection of broodstock from the adult salmon population returning to the Elwha River (NMFS 2003; WDFW 2012). Broodstock would continue to be collected only from the Elwha River, and from Morse Creek, where a reserve population has been established through out-plants of Elwha Chinook salmon stock. The risk of outbreeding depression associated with implementation of the program to the naturally spawning Chinook salmon population in the Elwha River action area would therefore

be unsubstantial. There are no data indicating that Elwha Chinook stray into the Dungeness River (the location of the closest adjacent independent Chinook salmon population) and spawn with Dungeness Chinook salmon, so any outbreeding depression risks that would be posed through the proposed program are unknown and speculative. Measures would be implemented through the Elwha Channel Hatchery program to reduce the risk of outbreeding depression and straying resulting from adult hatchery-origin fish returning to the Elwha River and Morse Creek release sites:

- The proposed program would propagate and release only fish from the local indigenous Elwha River population, and any straying into adjacent watersheds where other natural-origin Chinook salmon populations exist would not be expected to result in among population genetic diversity reduction risks that are substantially different in magnitude and effects that would result from natural-origin Elwha Chinook straying into those areas.

- Juvenile fish reared through the program would be adequately acclimated to their sites of release in the Elwha River and Morse Creek watersheds to ensure that the hatchery fish retain a high fidelity to their release sites as returning adults.

- Returning spawners, localized to their release sites, rather than transferred fish would be used as broodstock to further foster local adaptation, and limit straying potential.

- All juvenile fish released through the program would be marked with wire tags and/or otolith marks to allow for monitoring and evaluation of straying and contribution of Elwha River hatchery-origin Chinook salmon to natural production in watersheds where adult fish may potentially stray.

- The primary proposed off-station supportive breeding fish release strategy of trucking and releasing adult fish for natural spawning above the dam sites over the term of the preservation and recolonization phases would foster greater fidelity of adult salmon returns to the Elwha River when compared to adult fish returns resulting from other hatchery release strategies (e.g., truck-planted smolts). Stray rates for adult fish resulting from this release strategy would be expected to mimic rates exhibited naturally by the species and any outbreeding depression risks to adjacent natural-origin Chinook salmon populations would not be elevated above baseline natural levels.

<u>Lower Elwha Fish Hatchery Native Steelhead Program</u>

Germane to considerations regarding expected outbreeding effects on adjacent listed steelhead populations with the ESU/DPS would be the probability of Elwha hatchery-origin steelhead straying and the proportion of spawners in the receiving watershed composed of strays. The proposed native winter-run steelhead hatchery program propagates the native Elwha River stock, and outbreeding depression effects on the remnant wild population in the Elwha River would therefore not be a risk factor. Adjacent watersheds harboring natural-origin distinct independent populations of steelhead where Elwha River hatchery-origin steelhead might stray and spawn include Morse Creek, Dungeness River, and miscellaneous tributaries to Sequim and Discovery bays (WDF et al. 1994; PSSTRT 2012).

Until recently, production of winter-run steelhead in the Elwha River basin included releases of out-of-basin origin Chambers Creek hatchery-lineage winter-run steelhead. This early-returning stock

was propagated by LEKT at Lower Elwha Hatchery beginning in 1976 for segregated fisheries harvest augmentation purposes. Prior to that time, and continuing through the mid- 2000s, WDFW also released Chambers stock steelhead into the Elwha River through truck plants. All Chambers Creek-lineage steelhead have been marked with an adipose fin-clip beginning with releases in the mid-1990s to allow for their directed harvest, and to control and minimize incidental takes of native stock Elwha River steelhead. Considering the need to reduce the risk of among population diversity loss to the native winter-run steelhead population, the LEKT terminated the Chambers steelhead release program in 2012. The last smolt releases of the stock occurred in spring, 2011, and the final adult returns of Chambers Creek-lineage steelhead to the Elwha River returned in winter, 2013-2014. Genetic analyses by the NMFS NWFSC of four brood years of native Elwha steelhead stock collected from redds in 2005, 2006, 2007 and 2008 showed no trace of Chambers Creek steelhead genetic introgression (G. Winans, unpublished data, December, 2011).

Outbreeding depression effects on the native Elwha River steelhead population of the now-terminated LEKT early winter steelhead program appear to have been unsubstantial. As a measure to reduce genetic diversity risks, the LEKT opened fisheries in 2012-2013 and 2013-2014 to remove adipose-finned clipped steelhead (all early winter steelhead produced by LEKT received an adipose fin clip) escaping into lower Elwha River spawning areas during the late fall-early winter Chambers Creek steelhead return period (LEKT 2012a). The tribal fishery operating in 2012 through 2013 harvested and removed 99 adipose fin-clipped steelhead from the Elwha River (LEKT 2013b). The co-managers also maintained hatchery weirs and traps open to collect and cull any adipose fin-clipped steelhead encountered (LEKT 2012a). No adipose fin clipped steelhead escaped to the LEKT hatchery in the 2012-2013 period because the tribal fishery for Chambers steelhead operated directly adjacent to the hatchery, and removed fish returning there (LEKT 2013b). In 2013-2014, a total of 8 adipose fin clipped steelhead were culled upon return to LEKT Hatchery, and 12 adipose fin-clipped steelhead that volunteered to the Elwha Channel Hatchery trap were destroyed (LEKT 2013a).

The first hatchery releases of native Elwha River winter-run steelhead smolts occurred in 2011, and the first adults from the releases returned in 2013. There are no data indicating that native Elwha River stock hatchery-origin steelhead strayed into neighboring watersheds where they could potentially pose outbreeding depression risks to neighboring steelhead populations. Any outbreeding depression risks to other populations that would be posed by the proposed program are unknown and assessment of the degree of risk would be speculative. However, genetic analyses of four years of broodstock propagated through the program indicates that Dungeness River-origin wild steelhead have contributed substantially to the genetic structure of the Elwha River population (Gary Winans, NMFS, unpublished data, 2011). These analyses showed that other natural-origin Puget Sound steelhead populations have also contributed to the current genetic character of Elwha River native steelhead, suggesting that natural straying and spawning by non-native, but natural-origin stocks from adjacent Puget Sound watersheds have contributed to the extant diversity of the Elwha River population. A distinct genetic signature for Elwha River steelhead persists, however.

Measures that would be implemented through the Lower Elwha Fish Hatchery program to reduce the risk of straying and outbreeding depression to other populations from the Elwha River native winter-run steelhead program:

- The proposed program would propagate and release only fish from the native Elwha River population that are genetically related to the natural-origin steelhead population in the major adjacent watershed (the Dungeness River) where the hatchery fish would have the

highest probability of straying. Any effects on the Dungeness population would be unsubstantial, as the steelhead population in the Dungeness River has been shown to be a primary contributor to natural spawning by late winter-run steelhead in the Elwha River. Any straying by Elwha hatchery-origin steelhead back into the Dungeness River would not be expected to have substantial effects on the diversity of the Dungeness population.

- Fisheries targeting early-timed, hatchery-origin steelhead in 2012-13 and 2013-14 occurred to remove the last returning Chambers Creek-lineage steelhead adults returning to the Elwha River. The steelhead removed through the fisheries reduced the risk that the last remaining adult returns of early-timed Chambers lineage stock would escape into natural spawning areas and interbreed with native late-retuning winter-run steelhead.

- Weirs and traps at Lower Elwha Fish Hatchery, the old Lower Elwha Hatchery, and Elwha Channel Hatchery were operated to collect and cull the last returning marked, early-returning Chambers lineage adult steelhead in 2012-13 and 2013-14 to reduce among diversity reduction loss risks to the listed native steelhead population.

- Juvenile fish reared through the program would be adequately acclimated at the Lower Elwha River Hatchery in the lower Elwha River to ensure that the fish retain a high fidelity to their release lower river release site as returning adults. Returning spawners, localized to their hatchery release site, rather than transferred fish, would be used as broodstock to further foster local adaptation, and limit straying potential.

- All juvenile fish released through the program would be marked and/or tagged to allow for monitoring and evaluation of straying and contribution of Elwha River hatchery-origin steelhead to natural production in watersheds outside of the Elwha River where adult fish may potentially stray.

- The primary proposed off-station supportive breeding fish release strategy of trucking and releasing adult fish for natural spawning above the dam sites over the term of the preservation and recolonization phases would foster greater fidelity of adult salmon returns to the Elwha River when compared to adult fish returns resulting from other hatchery release strategies (e.g., truck-planted smolts). Stray rates for adult steelhead resulting from this release strategy would be expected to mimic rates exhibited naturally by the species and any outbreeding depression risks to adjacent natural-origin steelhead populations would not be elevated above baseline natural levels.

Hatchery-Influenced Selection ("Domestication")

Hatchery-influenced selection (commonly called "domestication") pertains to 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. Hatchery-influenced selection may lead to changes in quantity, variety and 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 2012c).

Hatchery-influenced selection can result from rearing fish in an artificial environment that imposes different selection pressures than what they would encounter in the wild for the spawning, incubation and juvenile rearing portions of their life history. The concern is that hatchery-influenced selection effects will decrease the performance of hatchery fish and their descendants when exposed to natural selection conditions in the wild. Busack and Currens (1995) identified three types of hatchery-influenced selection: intentional or artificial selection, representing purposeful attempts to change the population to meet management needs, such as time of adult return or spawning time; biased sampling during some stage of culture leading to hatchery-influenced selection caused by errors during any stage of hatchery operation; and, unintentional or relaxed selection that may cause genetic changes to occur because salmon in hatcheries usually have (by design) much higher survival rates during the incubation and juvenile rearing periods than they would have in the wild.

Elwha Channel Hatchery Chinook salmon program

Based on currently available scientific information, the proposed program would likely result in some hatchery-influenced selection risks to the Chinook salmon population remaining in the Elwha River. Some degree of effects associated with this hazard would likely be unavoidable for the program, given that not all adult fish of aggregate hatchery- and wild-origin returning to the Elwha River each year are collected and retained as broodstock. Rearing of fish to sub-yearling or yearling size would confer further selection risks as the fish are propagated in an artificial, rather than a natural, setting. In an independent scientific review of the Elwha Channel Hatchery program, the HSRG concluded that the program had succeeded in preserving the Elwha Chinook stock over a long period of time, under challenging conditions (HSRG 2002). In view of the management history of the Chinook population (e.g., hatchery-origin fish have likely composed the majority of Chinook salmon spawning naturally in the river for decades; mainstem river broodstock collection practices have led to the collection of fish representative of the total returning run), the HSRG group concluded that hatchery intervention as proposed is not likely to lead to significant further "domestication" risk during the preservation and recolonization phases (HSRG 2012), which cover the duration of proposed action operation.

Considering the severely depressed abundance status of natural-origin Chinook returns, very low productivity for fish spawning naturally in conditions prior to dam removal, and expected elevated threat to fish survival and productivity during and for a period after dam removal, NMFS determined the demographic risk faced by the natural population outweighs any hatchery-influenced selection risks that would result from hatchery intervention as proposed in the Elwha Channel Hatchery HGMP (NMFS 2012a). Hatchery-origin fish derived from the local extant Chinook salmon population would be encouraged to spawn naturally during the earliest phases of fish restoration, as a means to preserve and rebuild the total abundance, and retain what remains of the diversity, of the Chinook population. These perspectives regarding the acceptability of genetic effects associated with the proposed program take into account the compromised demographic strength of the remaining natural Chinook salmon population, the proportion of total genetic diversity retained in the current hatchery program over the long and short term, the existing impaired, and further threatened condition of critical Chinook habitat over the short term, and expectations for improved productivity of habitat in the watershed as the lower river heals and a functioning estuary reforms.

Genetic risk management measures are proposed in the HGMP to reduce the risk of intentional or unintentional hatchery-influenced selection, and biased sampling, effects on Elwha Chinook salmon

population diversity over the preservation and recolonization phases of restoration (from WDFW 2012):

- Broodstock used to sustain the program each year would be Elwha Chinook salmon collected from the run-at-large adult return to the Elwha River and Morse Creek. Out-of-basin strays from other Chinook salmon populations will not be knowingly spawned or incorporated into the gene pool.

- Broodstock would collected randomly across the breadth of the adult return timing, and representative of the age class distribution and sex ratio for the species, from the combined number of fish collected at the Elwha Channel Hatchery weir, Lower Elwha Fish Hatchery, and from the lower mainstem river (through seining, gillnetting, or hook and line capture).

- In collecting adult Chinook salmon randomly from the total run-at-large in the mainstem river, natural-origin adults would be included annually as hatchery broodstock, which should assist in maintaining genetic similarity between first generation hatchery and naturally produced fish, reducing the risks of hatchery-influenced selection effects.

- In-river activities implemented to collect broodstock that would harm naturally spawning Chinook salmon productivity, and potentially population diversity, would be minimized to reduce negative impacts on actively spawning fish and redds.

- The survival and diversity of the population collected from the mainstem river through netting or gaffing and maintained for spawning until maturity would be enhanced by holding the fish in well water. Typically, surface water from the Elwha River would not be used to hold adult, due to the high water temperatures and the historical presence of the fish parasite *Dermocystidium* that has caused substantial mortalities in past years.

- Mating protocols would be applied to reduce the risk of directed or unintentional selection of traits that could negatively affect the diversity of the listed population, and that would maximize the representation of each individual adult in the propagated population through: use of all males, including jacks, collected randomly from broodstock retained for spawning; spawning of eggs in three- or four-fish pools; spawning of each male in one-fish units (no pooling); and fertilization using a "modified factorial" mating design, where each bucket of pooled eggs is split into three to four aliquots, and each aliquot of eggs is fertilized with sperm from one male.

<u>Lower Elwha Fish Hatchery Native Steelhead Program</u>

Based on currently available scientific information, the proposed program would likely result in some hatchery-influenced selection risks to the native steelhead population remaining in the Elwha River (NMFS 2012a). Some degree of effects associated with this hazard would likely be unavoidable for the program, given that not all adult fish and families of aggregate hatchery- and wild-origin returning to the Elwha River each year were used to found the captive broodstock propagated in the program, nor would they be collected and retained as broodstock when returning as adults. Hatchery-influenced selection effects would also likely result as a consequence of the relatively high degree of hatchery intervention associated with the proposed supportive breeding actions (i.e., captive broodstock rearing). Rearing of fish for two years in the hatchery prior to their release would confer further selection risks as the fish are propagated for an extended period, and

for a substantial proportion of their total life spans, in an artificial rather than a natural setting. Hatchery-origin steelhead adult transported and released to spawn naturally as the secondary supportive breeding action would have a low risk of further hatchery-influenced selection risks because the spawning fish and their progeny would be exposed to selective pressures entirely in the natural, rather than hatchery, environment. In its most recent review of draft Elwha River basin HGMPs, the HSRG accentuated the opinion that prolonged hatchery influence may lead to loss of fitness of natural populations, potentially resulting in reduced or delayed restoration (HSRG 2012). The HSRG also found that the strategies described in LEKT (2012a) for using hatchery production to preserve the genetic lineage of the native steelhead population are generally accepted as being appropriate for this purpose (HSRG 2012).

HSRG recommendations regarding PHOS and PNI requirements for managing hatchery-origin steelhead contribution to spawning were not included in their most recent review of the program for operation during the preservation and restoration phases. Rather, these metrics were included for program operation only for the local adaptation and "full restoration" phases for fish restoration in the Elwha River for steelhead. The need to manage for hatchery-origin steelhead proportions in naturally spawning areas was therefore not included in the proposed LEKT (2012a) HGMP approved by NMFS (2012a). Given current and near term future steelhead stock status and habitat productivity conditions, the supportive breeding program as proposed would not lead to substantial, further domestication risk during the preservation and recolonization phases (NMFS 2012a).

Genetic risk management measures, consistent with measures described in NMFS (2012c), are proposed in the LEKT steelhead HGMP to reduce the risk of intentional or unintentional hatchery-influenced selection and biased sampling effects on Elwha native steelhead population diversity over the preservation and recolonization phases of restoration (from LEKT 2012a):

- All broodstock used to sustain the proposed steelhead program would be genotyped to help ensure the fish represent the extant, native, late winter-run steelhead return to the Elwha River.

- Broodstock would be grown to adult size from eggs/fry originally collected from native steelhead redds (2005-2011), and from the run-at-large adult steelhead return to the Elwha River (post 2013). Out-of-basin strays from other steelhead populations will not be knowingly spawned or incorporated into the gene pool.

- Hatchery selection and biased sampling risks would be reduced thorough cessation of further redd sampling to collect broodstock for captive rearing after the 2011 collection year, and final spawning of the last brood year of captive broodstock steelhead in 2015 or 2016. The highest level of hatchery intervention (captive broodstock rearing and spawning) would be terminated and replaced by a smolt release-based supplementation effort, resulting in reduced genetic diversity and fitness loss risks to the target steelhead population.

- Subsequent to 2012, hatchery-origin adult steelhead returning as a result of smolt releases may contribute to broodstock. The inclusion as broodstock of progeny of captive broodstock fish that were exposed to natural selective pressures and survived in the wild to return as adults would reduce hatchery-influenced selection risks relative to previous, all captive brood-origin groups.

- Broodstock would be collected randomly across the breadth of the adult native steelhead return timing, and representative of the age class distribution and sex ratio for the species, from the combined number of fish collected from the mainstem river (seines, gill nets, hood and line), at Lower Elwha Fish Hatchery, and the Elwha Channel Hatchery weir and trap. These measures would reduce risks of hatchery-influenced selection effects on the propagated population.

- In-river activities implemented to collect broodstock that would harm naturally spawning steelhead productivity, and potentially natural population diversity, would be minimized to reduce negative impacts on actively spawning fish and redds. The collection of eggs and/or fry from redds created by naturally spawning steelhead ended after the 2011 collection year and further redd disturbance is not part of the proposed action.

- The cessation of egg collections from redds as part of broodstock collection after 2011 for the proposed program would substantially reduce the risk of biased sampling that might lead to hatchery-influenced selection. The risk that only a subset of the total number of families would be included in the propagated population, and therefore unnaturally amplified in subsequent adult return abundances and proportions, would be reduced.

- During the recolonization phase, the proportion of hatchery-origin adult fish used for spawning and escaping to spawn naturally may begin to be managed through selective harvest of hatchery-origin recruits, reducing the risk that fish derived from hatchery production would drive diversity of the propagated and naturally spawning populations.

- During the preservation and recolonization phases, captive-reared adult fish, returning adult native stock hatchery-origin steelhead, and returning adult native stock natural-origin steelhead may be collected from the run-at-large for spawning at the LEKT hatchery. Incorporation of naturally produced steelhead would help reduce the risk of genetic divergence between the propagated and natural-origin components of the native steelhead population, and reduce the risk of hatchery-influenced selection effects.

- Potential loss of genetic diversity in the native steelhead population under propagation would be reduced by applying mating protocols developed by NMFS NWFSC scientists. Implementation of those protocols will ensure that relatives are not crossed, diversity of each year's gene pool is maximized, and hatchery-influenced selection risks are reduced.

- Mating protocols developed in partnership with NWIFC geneticists would be applied to reduce the risk of directed or unintentional selection of traits that could negatively affect the diversity of the listed steelhead population (e.g., full- or half-sibling matings), and that would maximize the representation of each individual adult in the propagated population. These protocols may include:

    - use in spawning of all mature fish collected randomly from broodstock on any given day;
    - for captive broodstock-origin fish, scanning of all ovulating females to determine PIT tag identity and to identify appropriate mates;
    - mating of each female with three males;

- prevention of matings between half- or full-siblings;
- mating of males to females that are from different families; and,
- individual spawning of each female and male in one-fish units (no pooling) and fertilization using a "modified factorial" mating design, where each females eggs is split into three aliquots, and each aliquot of eggs is fertilized with sperm from one of the three males.

- As natural-origin steelhead spawn in the restored river, their progeny as returning adult fish, would be integrated into the hatchery program at appropriate levels while ensuring that the naturally produced component of the population continues to expand into available habitat. Appropriate tagging and monitoring techniques would help ensure the success of this effort.

Ecological Effects

The ecological effects resulting from implementation of the HGMPs are also evaluated, minimized (through application of operational practices in appropriate plan sections), and accounted for in the five proposed HGMPs. Ecological effects of concern include fish disease pathogen transfer, resource competition, and predation effects on listed Chinook salmon and steelhead that may result from implementation of the five salmon and steelhead HGMPs. From information provided in the proposed HGMPs, NMFS (2012a) evaluated these ecological risks that may result from implementation of the salmon and steelhead HGMPs.

Disease
HGMP sections addressing listed fish take effects (section 2.0), broodstock selection and collection (sections 6.0 and 7.0), incubation and rearing (sections 9.0), and fish release (section 10.0) describe fish disease pathogen issues of concern and actions that would be implemented to minimize risks of disease transfer and amplification. An objective of programs operating under the ERFRP (Ward et al. 2008) as the overarching scientific framework is that fish diseases are not introduced, transferred, or amplified in the watershed as a result of the actions. To meet this objective, the proposed programs would be managed in accordance with the “Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State (NWIFC and WDFW 2008) to reduce risks of fish disease to propagated and natural fish populations through regular fish health monitoring and reporting, and application of measures to reduce fish health risks. The health of salmon and steelhead reared at the hatchery would be monitored and managed throughout the rearing period consistent with fish health policy practices. Under the fish health plan, professional fish pathologists from the NWIFC Tribal Fish Health Center or WDFW Fish Health Section would visit the hatcheries 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.

Fish health staff would also provide fish disease pathogen vaccinations for use in Tribal fish production programs. All fish monitored for fish health assessment purposes would be sampled consistent with 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 tribal and WDFW hatchery personnel are trained in standard fish propagation and fish health maintenance methods to help ensure that salmon and steelhead 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 quantity.

Protocols for monitoring the health of fish in hatcheries, specified in the co-managers co-manager fish health policy have proven successful in containing disease outbreaks in the Elwha River hatchery programs, minimizing the release of fish carrying disease pathogens, and reducing the risk of transfer to wild fish populations. In addition to routine testing of salmon in the hatcheries, extant salmonids in the lower, middle, and upper Elwha River watershed have been tested for bacteria and viruses, and screened for the parasite Myxobolus cerebralis (Brenkman et al 2008). These data provide a baseline for monitoring increasing disease incidence among natural-origin salmonids in the watershed. For these reasons, fish disease pathogen transmittal and amplification associated with HGMP implementation are not considered substantial risks to listed fish populations in the Elwha River. In its biological opinion (NMFS 2012a), NMFS determined that the proposed hatchery programs are unlikely to substantially affect listed fish through fish disease pathogen amplification and transfer.

Competition

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). Release of non-indigenous, artificially propagated 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). 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 2012c).

For competition between species to occur, substantial levels of spatial and temporal overlap and limited resources shared by the species must exist. With respect to spatial overlap, the current distribution of anadromous Elwha River salmonid species is constrained to the lower 5 miles of the Elwha River watershed. This area is presently the only location where spawning, incubation, rearing and migration of listed Chinook salmon and steelhead occurs. The available area, including spawning and rearing areas, and potential food sources supporting these salmonid life history segments will be expanded to include up to 70 miles of habitat after the Glines Canyon Dam site becomes passable to anadromous fish in summer/fall, 2014. The two hatchery sites where all juvenile salmon and steelhead releases will occur are located in the lowest portion of the Elwha River watershed at RM 3.5 and RM 1.25. Prior to dam removal and restoration of upstream fish access, all natural-origin fish have been confined to the lowest 5 mile of the Elwha River, and hatchery fish releases at RM 3.5 and 1.25 may lead to interactions between the two groups, and potentially competition. Post-dam removal, natural-origin fish rearing or migrating in the lowest portion of the river may still interact with newly released hatchery fish. However, natural-origin fish produced and rearing in the approximately 65 miles of fish habitat above the dam sites will have a low likelihood for interacting with hatchery-origin juvenile salmon and steelhead, because all juvenile hatchery-origin fish would be released into the lowest portion of the Elwha River. No juvenile hatchery fish out-planting would occur into upstream areas where most natural-origin fish production in the watershed will occur.

The degree to which natural- and hatchery-origin juvenile salmon and steelhead that share the same river areas interact, potentially leading to competition effects, also depends on the opportunity for temporal overlap between the two groups. Table 5 compares the relative occurrence timings by life stage of natural-origin juvenile Chinook salmon and steelhead, and hatchery-origin juveniles by species proposed for release through the HGMPs. The majority of hatchery-origin Chinook salmon produced through the Elwha Channel Hatchery program (WDFW 2012) would be released as sub-yearling smolts in June, after the majority of juvenile natural-origin ocean-type Chinook salmon have emigrated seaward. Temporal overlap and the opportunity for substantial competition effects from this hatchery release type with natural-origin Chinook salmon would therefore not be expected. Yearling Chinook salmon from the Elwha Channel Hatchery program would be released in April, and temporal overlap with emigrating natural-origin Chinook salmon present in the lowest portion of the river and in the estuary would potentially occur. The disparity in individual size between the hatchery yearlings and "0" age natural-origin Chinook means that the two groups would select different prey types, making diet overlap and food resource competition unlikely (SIWG 1984).

As indicated in the section 10.2 of the HGMPs (LEKT 2012a; 2012b), hatchery-origin 2+ steelhead and yearling coho are proposed for release into the lower river in March or April, as dictated by their smoltification timing and the need to preserve fish health by releasing the fish when they reach that physiological condition. Hatchery-origin steelhead and coho salmon smolts released at RM 1.25 from the Elwha Channel Hatchery program would interact with emigrating natural-origin Chinook salmon present in the lowest portion of the river and in the estuary. Like yearling Chinook salmon, differences in individual fish size between the hatchery steelhead and coho smolts and underyearling natural-origin Chinook would lead to selection for different prey types, making diet overlap and food resource competition unlikely (SIWG 1984). However, if feasible considering hatchery fish smoltification timing, as a measure to reduce interactions and competition with seaward migrating natural-origin Chinook salmon, 2+ steelhead and yearling coho salmon releases from Lower Elwha Fish Hatchery would be delayed until mid-May each year.

Fall chum and pink salmon fry would be released during the natural-origin Chinook salmon and steelhead juvenile emigration periods in late February through April and March through April, respectively. Because of their release timing, fall chum and pink salmon fry from Lower Elwha Fish Hatchery would have the potential to interact with co-occurring natural-origin Chinook juveniles, but competition between the species would be unlikely due to food preference differences (SIWG 1984). Also, the one gram hatchery-origin fall chum and pink salmon would emigrate quickly seaward from their site of release at RM 1.25, and temporal overlap with Chinook salmon in the river where competitive interactions could occur would be of very short duration.

Table 5. Comparative individual sizes and freshwater occurrence timings for rearing and/or emigrating natural-origin salmon and steelhead juveniles by species and life stage, and hatchery-origin smolts proposed for release from Elwha River hatchery programs (from NMFS 2012a).

Species/Origin	***Life Stage***	***Individual Size (mm fl avg. and range)***	***Occurrence or Release Timing***
Chinook salmon	Fry	*40 (34-59)*	*December-April*
Chinook salmon	Parr	*75 (57-92)*	*late May-July*
Chinook salmon	Yearling	*120 (92-154)*	*late March-May*
Chinook salmon	Sub-yearling	*80 (57-86)*	*June*
Chinook salmon	Yearling	*155 (155-196)*	*April*
Steelhead (wild)	Fry	*60 (23-100)*	*June-Oct.*
Steelhead (wild)	Parr	*96 (65-131)*	*Oct.- mid May*
Steelhead (wild)	Smolt	*165 (109-215)*	*late April-June*
Steelhead (hatchery)	2+ year-old	*185 (170-202)*	*March-April*
Coho (wild)	Fry	*30 (29-36)*	*March*
Coho (wild)	Parr	*37-74*	*April-April*
Coho (wild)	Yearling	*107 (74-190)*	*Late April-May*
Coho (hatchery)	Yearling	*140 (131-156)*	*March-April*
Chum (wild)	Fry	*38 (33-50)*	*February-May*
Chum (hatchery)	Fed fry	*50 (42-52)*	*late-February-*
Pink (wild)	Fry	*34 (32-43)*	*March-April*
Pink (hatchery)	Fed fry	*50 (40-52)*	*March-April*
Sockeye (wild)	Fry	*28 (25-31)*	*April-May*
Sockeye (wild)	Lake phase	*32-119*	*June-March*
Sockeye (wild)	Smolt	*125 (120-129)*	*March-April*

- Wild Chinook salmon data from WDFW juvenile out-migrant trapping reports (Seiler et al 2003; 2003; 2004; Volkhardt et al., 2005, 2006a; Kinsel et al., 2007).
- Wild steelhead individual size data and occurrence estimates from Shapovalov and Taft (1954) and WDFW juvenile out-migrant trapping reports (Volkhardt et al., 2005b, 2006, Kinsel et al., 2007).
- Wild coho data for Green River from Topping et al. 2008 (smolts); Shapovalov and Taft (1954) (fry); parr size range extrapolated from smolt and fry data considering year-round residence.
- Wild chum data from Volkhardt et al. 2006 (Green River fall-run), and Tynan 2007 (summer-run).
- Wild pink salmon data from Topping et.al 2008 (Dungeness Pink salmon).
- Wild sockeye salmon data from Burgner (1991) for Lake Washington sockeye (predominantly 3-1 fish). Parr size range extrapolated from smolt and fry data considering year-round residence.
- Hatchery-origin fish release size and timing data are average individual fish size and standard release timing targets applied for hatchery salmon and steelhead production in Puget Sound from Elwha River Basin salmon and steelhead HGMPs and from WDFW and PNPTT 2000.
- As a goal, hatchery steelhead and coho smolt releases would be delayed until mid-May, however, delays beyond the practiced March-April release timing must consider smoltification status and associated fish health maintenance needs.

Although as a species more likely to inhabit upstream areas in the Elwha River watershed for most of its freshwater life history, natural-origin steelhead juveniles may be present in the lower 3.5 miles of the Elwha River during the hatchery fish release periods as rearing parr and as rearing and emigrating smolts (2+ or 3+ fish). Steelhead of these life stages may be vulnerable to competition with co-occurring hatchery-origin Chinook salmon, steelhead, and coho salmon for food and space in waters adjacent to, and downstream of, the hatchery release sites. Young-of-the-year steelhead fry produced naturally in the lower river would emerge too late in the season to interact with newly released hatchery-origin fish, so competition risks for this steelhead life stage would be unsubstantial. The hatchery yearling Chinook salmon may compete with natural-origin steelhead smolts as the species emigrate seaward in the lower 3.5 miles of the Elwha River. Any competitive interactions would be limited in duration, perhaps hours or a few days, and substantial adverse competitive effects on wild steelhead are therefore unlikely. Competition risks to natural-origin steelhead posed by hatchery releases posed by of hatchery-origin fall chum and pink salmon fry released at RM 1.25 would not be of concern. Chum and pink salmon have different prey requirements than steelhead, and competition between these species for food resources in freshwater is a very low risk (SIWG 1984).

For the above reasons, NMFS does not expect that competition from hatchery-origin salmon and steelhead juveniles would pose a substantial risk to listed natural-origin fish populations in the lower Elwha River. Further, any competition risks to Chinook salmon and steelhead are outweighed by demographic or short-term extinction risks to the populations, which NMFS believes are substantially greater threats to the viability of the listed populations than competition and predation risks during the initial phases of fish restoration (NMFS 2012a). Demographic or short-term extinction risks for Chinook salmon and steelhead would be substantially abated by the supportive breeding actions. The co-managers have included hatchery management measures in the proposed HGMPs that would reduce the potential for competition risks posed by hatchery-origin salmon and steelhead to listed Chinook salmon and steelhead in the Elwha River action area:

- As the primary supportive breeding strategy, all hatchery-origin juveniles would be released on-station into the lowest portion of the Elwha River (RM 1.3 or 3.5). The lower river release locations limit the duration of hatchery fish presence in freshwater, reducing the duration of interaction with any natural-origin fish rearing or migrating adjacent to or downstream of the hatcheries. The secondary artificial production strategy proposed during the preservation and recolonization phases would be the upstream transport and release of adult fish above the dam sites. The HSRG concluded that best strategy to avoid negative ecological interactions among juveniles, including competition, would be to outplant adults upstream, and release all juveniles directly from the lower river hatchery locations (HSRG 2012);

- All chum and pink salmon fry, sub-yearling Chinook salmon, 2+ steelhead, and yearling Chinook and coho salmon would be released from the hatcheries in a physiological condition ready for transition to a seawater existence. The practice of releasing only actively migrating smolts that would exit freshwater rapidly would reduce the duration of interaction, and competition with any natural-origin Chinook salmon, steelhead, or eulachon in the lowest portion of the Elwha River;

- Steelhead 2+ and coho salmon yearling smolts that do not volitionally leave the hatchery at the times of their release will be removed from rearing units and disposed of to limit residualism and enhanced risks of competition associated with residualizing hatchery fish.

- There will be few natural-origin fish of any species in the lower Elwha River that would serve as prey during the preservation and recolonization phases when and where the hatchery programs are proposed for juvenile fish release due to the effects of the release of stored sediments behind the dams; and,

- If naturally-produced smolt outmigration timing, determined by monitoring in the mainstem or tributaries, suggests that proposed release timings for Chinook salmon, steelhead, and coho salmon from the hatcheries would result in significantly harmful ecological interactions with listed natural-origin fish, alternate release timings or other mitigation measures will be developed to minimize such interactions.

Predation

Risks to naturally produced salmonids 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 2012c). Hatchery-origin fish may prey upon juvenile naturally produced salmonids at several stages of their life history. Newly released hatchery smolts have the potential to prey on 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 stream-rearing juveniles over a more prolonged period. Hatchery salmonids planted as non-migrant fry or fingerlings, also have the potential to prey upon natural-origin salmonids in the freshwater where they co-occur. 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 2012c).

The risk of hatchery-origin 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. Table 5 compares the relative individual sizes and occurrence timings of natural-origin juvenile Chinook salmon and steelhead, and hatchery-origin juveniles by species proposed for release through the HGMPs. Considering natural fish occurrence and hatchery-origin fish release timings into the lower Elwha River where predator-prey interactions would potentially occur, the hatchery-origin species and life stages with spatial and temporal overlap with juvenile listed Chinook salmon and steelhead in the lower Elwha River release locations would be sub-yearling and yearling Chinook salmon, 2+ steelhead, coho yearlings and fall chum and pink salmon fry.

Although the diet of hatchery-origin Chinook salmon yearling smolts produced by Elwha River Channel Hatchery has not typically been found to include a substantial proportion of sub-yearling Chinook or juvenile steelhead, their size differential indicates the potential for predation (Peters 1996). Considering monthly relative five sizes indicated in Table 5, Chinook salmon yearlings released in April through the proposed Elwha Channel Hatchery programs would be of large enough size to prey on juvenile Chinook salmon less than approximately 50 mm (fl) present in the lower Elwha River when the hatchery fish would be released. Hatchery yearling Chinook salmon would

not encounter juvenile natural-origin steelhead in April that would be of a size vulnerable to predation.

As noted in the HGMPs (LEKT 2012a; 2012b), hatchery-origin 2+ steelhead and coho yearlings are proposed for released in March or April. The release of the fish into the very lowest portion of the Elwha River (downstream of RM 1.25) in March or April may lead to encounters with rearing or emigrating listed Chinook salmon. To minimize interactions with emigrating Chinook salmon juveniles, the hatchery-origin steelhead and coho salmon smolts would be released "voluntarily" after exhibiting physiological conditions and behavior indicating they are ready to migrate the 1.25 miles to the river mouth. Where released, these actively migrating smolts would quickly emigrate seaward over a short span of river and have little opportunity to residualize in the river and interact with fish of a size vulnerable to predation. After release, the hatchery-origin steelhead and coho salmon smolts would have just 1.25 miles to transit downstream prior to reaching seawater, where the fish would disperse into open water. Juvenile outmigrant trapping data has shown that steelhead and coho smolts released from Lower Elwha Hatchery reach the estuary in a few hours (M. McHenry, LEKT, pers. comm. April, 2012). Coho salmon smolts released from Lower Elwha Fish Hatchery have been shown to move quickly downstream to the mouth of the Elwha River, where they directly enter the Strait of Juan de Fuca, or reside in estuarine beach lakes (RM 0.1) for a brief period prior entering the Strait (LEKT 2012b). Surveys on the Elwha River during the hatchery coho salmon release period indicate that following entry into the Elwha River, smolts do not move back upstream (Peters 1996). Stomach content analyses, including hatchery-origin steelhead and coho salmon, sampled near the mouth of the Elwha River in 1996, 2006, and 2007 showed no sign of piscivorous behavior (Peters 1996; Duda et al., 2011). Further monitoring near the mouth, side channel areas, and estuary ponds would assist in verifying these findings (LEKT 2012b).

LEKT hatchery-origin steelhead and coho salmon released in March or April into the lower Elwha River may interact with large steelhead yearling parr and migrating two-year old smolts, and would not encounter juvenile natural-origin steelhead of a size vulnerable to predation. As an additional risk aversion measure, if feasible considering state of smoltification and the need to release the fish earlier to maintain their health, hatchery-origin 2+ steelhead and coho yearlings would be released in mid-May, when any co-occurring natural-origin Chinook salmon and steelhead are generally large enough size to not be vulnerable to predation. Subyearling Chinook salmon, fall chum salmon, and pink salmon that would be released through the proposed programs are too small to consume any natural-origin Chinook salmon and steelhead at the time the hatchery-origin fish are released, and are not a risk regarding predation.

In summary, the potential for predation by hatchery-origin yearling Chinook salmon, 2+ steelhead, and yearling coho salmon on listed juvenile fish would be minimized by releasing all hatchery fish as migration-ready smolts directly from the hatcheries, which are located in the lower portion of the river (RM 3.5 and 1.25). These newly released hatchery fish would typically be present very briefly in the lower Elwha River where they may interact with any natural-origin fish vulnerable to predation before emigrating into marine waters.

For the above reasons, NMFS does not expect that predation by newly released hatchery-origin salmon and steelhead juveniles would pose a substantial risk to listed natural-origin fish populations in the lower Elwha River downstream from the hatchery releases sites. Predation risks to Chinook salmon and steelhead are outweighed by demographic or short-term extinction risks to the populations, which NMFS believes are substantially greater threats to the viability of the listed populations than predation risks during the initial phases of fish restoration (NMFS 2012a).

Demographic or short-term extinction risks for Chinook salmon and steelhead would be substantially alleviated by the supportive breeding actions (NMFS 2012a). Predation risks to listed juvenile fish would be minimized through application of the following risk minimization measures described by LEKT and WDFW in the HGMPs (LEKT 2012a; WDFW 2012):

- As the primary supportive breeding strategy, all hatchery-origin juveniles would be released on-station into the lower Elwha River (RM 1.3 or 3.5). The lower river release locations confine presence of the hatchery juveniles to only the very lowest portion of the Elwha River. These release sites limit presence of seaward emigration hatchery fish in freshwater, reducing the duration of interaction with any natural-origin fish of a size vulnerable to predation in the small area downstream. The secondary artificial production strategy proposed during the preservation and recolonization phases would be the upstream transport and release of adult fish above the dam sites. In its recent review of Elwha HGMPs, the HSRG found that the best strategy to avoid negative ecological interactions among juveniles, including predation, would be to outplant adults, and release all juvenile salmon and steelhead directly from the hatchery locations in the lowest portion of the Elwha River(HSRG 2012);

- All yearling fish would be released from the hatcheries as actively migrating smolts that would exit freshwater rapidly. This smolt release practice would reduce the duration of interaction with any natural-origin fish of a size vulnerable to predation in the lower river;

- Steelhead 2+ and coho salmon yearling smolts that do not volitionally leave the hatchery at the times of their release will be removed from rearing units and disposed of to limit residualism and enhanced risks of predation associated with residualizing hatchery fish.

- There will be few natural-origin fish of any species in the lower Elwha River that would serve as prey during the preservation and recolonization phases when and where proposed juvenile fish releases would occur, due to the adverse effects on natural-origin fish survival and productivity from the release of stored sediments behind the dams;

- Diet studies conducted in the Elwha River have indicated that newly released hatchery-origin yearling fish (Chinook, coho and steelhead) do not prey on fish; and,

- If naturally-produced smolt outmigration timing, determined by monitoring in the Elwha River mainstem or tributaries, suggests that proposed release timings for juvenile Chinook salmon, steelhead, and coho salmon from the hatcheries would result in significantly harmful ecological interactions with listed natural-origin fish, alternate release timings or other mitigation measures will be developed to minimize such interactions.

3.6 5(i)(F) The HGMP describes interrelationships and interdependencies with fisheries management.

The HGMPs describe the relationship of the proposed actions with fisheries management in section 3 of each plan. The LEKT native steelhead HGMP expands from this general discussion of harvest integration associated with the proposed supportive breeding actions for the species in section 3 through inclusion of an appended harvest plan (LEKT 2012a). Of concern are the effects of

incidental and directed fisheries harvests of hatchery-origin salmon and steelhead produced by the programs on listed Chinook salmon and steelhead.

Under the co-managers' Puget Sound Chinook Salmon Harvest Resource Management Plan (Harvest RMP - PSIT and WDFW 2011), there will continue to be no directed fisheries harvest of Elwha Chinook salmon. Under the RMP, the total incidental fisheries exploitation rate for Elwha Chinook shall not exceed 10% of the total annual adult return. This harvest management strategy shall remain in effect until either the Elwha Chinook salmon population recovers or the harvest rate proves to be in excess of the level that will lead to restoration (PSTT and WDFW 2011). Additionally, a five-year harvest moratorium on fisheries in the Elwha River watershed was implemented by the co-managers after the 2011-12 fishing season. The fisheries moratorium provides further protection, and assists in the preservation and rebuilding of native Elwha River salmon and steelhead populations during and immediately after the dam removal phase. The lone harvest action that was allowed during this moratorium period was a LEKT fisheries management-sanctioned effort to remove the remaining brood year adult returns of non-native stock Chambers Creek-lineage steelhead originating from the now-terminated tribal early winter steelhead hatchery program (LEKT 2012a). This focused fishing activity to remove escaping adipose fin-clipped, non-native steelhead occurred in the 2012-2013 and 2013-2014 steelhead return years as a genetic risk reduction measure to further reduce threats to the native winter-run steelhead population. Annual reports submitted by LEKT indicate that the tribal fisheries were successful in removing returning Chambers Creek steelhead (LEKT 2013a; LEKT 2013b).

After the conclusion of the voluntary five-year harvest moratorium, basin population recovery objectives would include the need to accommodate sustainable fisheries harvest. The HGMPs are proposed for implementation to eventually resurrect self-sustaining, natural-origin fish populations that would be harvestable at sustainable levels in LEKT and all-citizens fisheries over the long term.

As described in the WDFW Elwha Channel Hatchery Chinook salmon HGMP (WDFW 2012), there are currently no U.S. fisheries directing harvests at the Elwha Chinook salmon population, and none are planned until the population is recovered. In fact, all Washington State salmon fisheries in the Elwha River and adjacent marine areas have been curtailed to minimize impacts on listed Elwha Chinook salmon. Elwha River origin Chinook salmon may be harvested incidentally by salmon fisheries directed at other Chinook salmon populations or salmon species in Washington mixed stock marine waters, particularly in the ocean and the Strait of Juan de Fuca, as well as in Canadian waters. Specific exploitation rates are unknown, but NMFS estimates that current rates for Elwha Chinook salmon based on harvest levels observed for adjacent indicator stocks and considering current fisheries regimes are approximately 25% (L. LaVoy, NMFS, pers. comm.). Under the proposed HGMP, direct and incidental harvests of Elwha Chinook salmon are objectives after the naturally spawning component of the species has been restored to a healthy, harvestable status (WDFW 2012).

Harvest impacts on listed Chinook salmon associated with the production of Elwha River hatchery-origin Chinook salmon (WDFW 2012) and coho salmon (LEKT 2012b), and fisheries harvesting hatchery-origin fish, were previously evaluated and authorized by NMFS through a separate ESA consultation (Table 9 in NMFS 2011a). This separate consultation evaluated the effects of the co-managers' harvest management RMP (PSIT and WDFW 2010) for all Puget Sound salmon fisheries potentially affecting listed Puget Sound Chinook salmon, pursuant to 50 CFR 223.209 (Tribal Rule) and the government-to government processes therein. NMFS determined under 50 CFR

223.203(b)(6) that implementing and enforcing the RMP would not appreciably reduce the likelihood of survival and recovery of the Puget Sound Chinook Salmon ESU (NMFS 2011a).

Until recently, Elwha Channel Hatchery Chinook salmon have been released without marks or tags. Beginning in 2003, some fish were adipose fin-clipped and coded-wire tagged (CWT), or adipose-fin clipped, ventral fin clipped, and CWT. Beginning with the 2010 brood year releases and continuing through the present, all Chinook salmon released through the program were otolith marked (sub-yearlings) or otolith marked and blank wire tagged (yearlings). All Chinook salmon released from Elwha Channel Hatchery are currently marked or tagged to differentiate hatchery- from natural-origin Chinook salmon and allow for assessments of hatchery program performance and effects.

Under the HGMP, beginning with brood year 2012 (release year 2013), 250,000 of the 2,500,000 subyearlings released through the Elwha Channel Hatchery program would be adipose-clipped and CWT-tagged each year (WDFW 2012). The purpose for this marking approach is to determine where and how many Elwha Chinook salmon (hatchery and natural-origin alike) are caught in ocean fisheries, including the potential reduction in escapement resulting from mark-selective fisheries. Under the 4(d) rule for listed Puget Sound Chinook salmon (70 FR 37160. June 28, 2005), hatchery-origin fish marked with an adipose fin clip are excluded from ESA section 9 take prohibitions and would not receive 4(d) rule protection. Under the rule, fish marked with an adipose fin clip are not protected to allow for the harvest of fish not necessary for the conservation of the ESU.

Beginning no earlier than brood year 2015, WDFW proposes to mass mark all Elwha River hatchery-origin subyearlings released each year with an adipose fin clip, and discontinue otolith marking (WDFW 2012). However, adipose clipping of all subyearlings may be delayed if sediment levels in the river remain high, natural production is low, it is judged unlikely that broodstock management will be initiated with the adult return of the 2015 brood of subyearling Chinook salmon, and analysis of CWT recoveries indicates a substantially higher mortality rate of clipped Chinook salmon in mark-selective fisheries than projected by the Fisheries Resource Assessment Model (FRAM). Assuming that 100%adipose fin clipping is initiated beginning with the 2015 brood of subyearling Chinook salmon, adult returns of adipose fin clipped fish will begin in 2018 with the return of 3 year old fish, and by 2020 essentially all hatchery-origin adult returns will be clipped and visually identifiable. This timing is intended to correspond to the period when turbidity in the river has decreased, estimated at up to 5 years post dam removal (WDFW 2012).

Beginning no earlier than brood year 2014, all Elwha River Chinook salmon yearlings would be adipose clipped at a 100% rate, while otolith marking would be discontinued (WDFW 2012). As with the subyearling mass-mark proposal, adipose clipping of all yearlings may be delayed if sediment levels in the river remain high, natural production is low, it is judged unlikely that broodstock management will be initiated with the adult return of the 2015 brood of subyearling Chinook, and analysis of CWT recoveries indicates a substantially higher mortality rate of clipped Chinook salmon in mark-selective fisheries than projected by FRAM.

WDFW proposes to apply an adipose fin clip to juvenile Chinook salmon to begin to efficiently identify the hatchery or natural origin of fish. The purpose of an adipose fin clip would be to aid in eventually begin implementing broodstock management principals intended to reduce hatchery influence in the naturally spawning population, with the goal of developing a self-sustaining locally adapted stock (WDFW 2012), commencing during the local adaptation phase of restoration. WDFW also proposes that fisheries harvest impacts on the total abundance of Elwha Chinook

salmon escaping to spawn would not be substantial as a consequence of marking all hatchery fish with an adipose fin clip, and that any added low abundance risk to the Elwha Chinook salmon population created by a reduction in returning hatchery-origin adults form fisheries harvest would decrease as natural Chinook salmon production in recovering habitat increases. Under the HGMP, as proposed for implementation during the preservation and recolonization phases of restoration, there is no proposal to use the adipose fin clip mark as a means to manage the proportion of hatchery-origin Chinook salmon spawning naturally or the proportion of hatchery and natural-origin fish incorporated as hatchery broodstock (WDFW 2012).

NMFS is concerned about any increase in demographic risk to the total Elwha Chinook population that may be posed by increased harvest impacts that may occur in association with mark-selective fisheries. Current average escapement level for the population is already at low abundance relative to abundance triggers, and is further threatened with additional reduction over the short term by dam removal effects. To address this concern, NMFS has included terms and conditions in its section 7 biological opinion directed at the effects and timing of adipose fin clip marking of hatchery-origin Chinook salmon (NMFS 2012a – Terms and Conditions 2d – 2g). If available prior to 2016, WDFW will be required to analyze fisheries harvest impacts on the adipose fin clipped/marked subyearling subgroups released from Elwha Channel Hatchery Chinook salmon. Mark recovery results will be used as one basis for adjusting the type and timing of proposed marking/tagging strategies for all juvenile fish released through the Elwha Channel Hatchery program. In particular, if observed fisheries impact levels resulting from mark selective fisheries differ substantially from modeled levels. WDFW will also be required to take into account the status of the total Elwha Chinook salmon population relative to abundance triggers for the preservation and recolonization periods to guide fish marking decision, commensurate with evaluations of actual harvest rate impacts associated with adipose fin clip marking (NMFS 2012a).

Through these terms and conditions, added demographic risk to the total population that may result from application of an adipose fin clip will be balanced with the need for and timing of application of an adipose fin clip mark. NMFS believes these terms and conditions addressing the proposed Chinook salmon marking actions are appropriate considering that no “real time” genetic risk management actions are proposed, or identified as necessary, to reduce any diversity or fitness reduction effects posed by hatchery-origin fish during the preservation and recolonization phases of restoration.

Harvest impacts resulting from the production of fall chum salmon (LEKT 2012c) and pink salmon (LEKT and WDFW 2012) through the proposed HGMPs would not be expected to result in any substantial harvest effects on listed fish species. Because of the extremely depressed abundance status of the natural-origin populations of the species used as donor broodstock, the proposed programs would produce modest number of adult fish, with all resultant returns to the river needed for spawning in the natural or hatchery environments during the preservation and recolonization phases (NMFS 2012a). No fisheries targeting fall chum and pink salmon would therefore be planned that could potentially affect listed Chinook salmon and steelhead.

The Puget Sound Steelhead Harvest Management Plan (PSIT and WDFW 2010) establishes specific objectives for direct or incidental harvest of listed steelhead in Puget Sound watersheds. Under the plan, annual harvest management plans are developed for each watershed or group of watersheds prior to the start of the steelhead fisheries. The “Elwha Steelhead Harvest Management Plan” appended to the LEKT (2012a) steelhead HGMP describes objectives and guidelines relevant to managing harvest of steelhead in the Elwha River from the present through the preservation and

recolonization phases of recovery. The proposed harvest plan specifies that hatchery-origin native steelhead produced by the tribal program would be used principally for stock conservation and recovery purposes. As stock recovery and natural recolonization throughout the Elwha River watershed progresses (as per achievement of population viability triggers), ceremonial, subsistence, commercial, and recreational fisheries targeting steelhead would be developed, initially targeting hatchery production (LEKT 2012a). The tribal steelhead harvest plan would set limits on the annual number of fish harvested and the terminal harvest rate for naturally-produced steelhead. Any steelhead harvests in the Elwha River would be implemented consistent with ESA conservation standards to avoid impeding the recovery of the native Elwha River steelhead population.

3.7 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.

The issue under this criterion is the adequacy of hatchery facilities in safeguarding listed Chinook salmon and steelhead from harm while the fish are under propagation. The programs of concern would be the Elwha Channel Hatchery Chinook salmon program (WDFW 2012) and the Lower Elwha Fish Hatchery native steelhead program (LEKT 2012a). The hatchery-origin Chinook salmon and steelhead populations propagated through the programs are no more than moderately diverged from their associated natural-origin populations (70 FR 37204, June 28, 2005) and are therefore included with natural-origin Chinook salmon and steelhead in the Elwha River that are part of the listed ESU and DPS (70 FR 37160; 76 FR 157, August 15, 2011; NMFS 2011b; Jones 2011). The three other HGMPs proposed for implementation (LEKT 2012b; 2012c; and LEKT and WDFW 2012) would not lead to the propagation of listed fish species and are not of concern for compliance with this criterion.

Water sources and facilities that would be used to collect and hold listed Chinook salmon and steelhead broodstock, incubate eggs, and rear and release juvenile fish are described in the HGMPs (sections 4 and 5 of WDFW (2012) and LEKT (2012a)). Included in these sections are assessments of ecological and genetic risks and descriptions of measures that would be applied at the facilities to minimize the likelihood for adverse effects on listed fish under propagation.

Under the Elwha Channel Hatchery Chinook salmon HGMP, four separate hatchery locations are proposed to effectuate various portions of the supportive breeding effort – Elwha Channel Hatchery, Hurd Creek Hatchery, Sol Duc Hatchery, and Morse Creek Hatchery. The water sources and facilities that would be used to propagate listed Elwha Chinook salmon are located at WDFW hatchery sites that have successfully operated for the purposes of salmon and steelhead hatchery production for decades, with the exception of Morse Creek Hatchery which is a new facility. As described in the WDFW HGMP (sections 4 and 5 of WDFW (2012)) and summarized in the NMFS biological opinion for the program (NMFS 2012a), together, the hatcheries have the necessary surface and groundwater sources, fish trapping and holding facilities, egg incubation and fish rearing vessels, and fish release facilities that would ensure proper rearing of the progeny of natural- and hatchery-origin Chinook salmon broodstock collected from watershed areas. The water sources and WDFW facilities are state-of-the-art for the artificial propagation of anadromous fish species and adequate for their purpose as proposed for the hatchery production of Chinook salmon. NMFS determined that substantial demographic risks to listed Chinook salmon are unlikely from propagation of the listed fish in the WDFW facilities as proposed (section 2.8.1 in NMFS 2012a). The WDFW HGMP also describes how the fish would be reared to maintain fish health through implementation of co-manager fish health policy protocols (NWIFC and WDFW 1998). Those

protocols have proven adequate to protect salmon and steelhead from fish disease transfer and amplification effects in practice in Puget Sound hatcheries (WDFW and PSTT 2004).

In its biological opinion, NMFS determined that the operation of the proposed Chinook salmon program consistent with the co-manager fish health protocols would adequately protect fish under propagation from fish disease-influenced effects (section 2.8.1, Table 9 in NMFS (2012)). As indicated in sections 8 and 9 of the WDFW HGMP (WDFW 2012a), the program has a demonstrated record of maintaining high survival rates for each Chinook salmon life stage under propagation (i.e., green to eyed egg; eyed egg to fry; and fry to smolt release), and consistent with goal levels for well-run artificial propagation programs (Fuss and Ashbrook, 1995). Measures that would be implemented to protect the genetic diversity of the propagated listed Chinook salmon population are proposed in the WDFW (2012) HGMP (sections 6-10). NMFS evaluated the genetic diversity effects of the Elwha Channel Hatchery Chinook salmon program on listed Elwha Chinook salmon, including loss of within-population diversity, outbreeding depression, and hatchery-influenced selection (section 2.4.2.1.2 in NMFS (2012a)). For the reasons provided in the opinion, NMFS determined that the risk of adverse genetic diversity effects on listed Elwha Chinook salmon associated with implementation of the proposed program was unsubstantial (NMFS 2012a). Hatchery management measures that are proposed for implementation in the WDFW HGMP are consistent with NMFS (2012a) measures that would further reduce within-population diversity, outbreeding depression, and hatchery-influenced selection risks to listed Chinook salmon propagated through the program.

Facilities proposed for the artificial propagation of native Elwha River winter-run steelhead through the Lower Elwha Fish Hatchery program would be adequately protective of the health and diversity of the listed species. The hatchery location where all supportive breeding activities would occur was constructed in 2010 and stands as the newest hatchery facility in the state of Washington. The facility includes best available, state-of-the-art power sources and back-ups, surface and groundwater supply systems, and fish rearing systems and structures designed and operated to promote production of healthy steelhead and salmon. As described in LEKT (2012a) HGMP sections 4 and 5, and summarized in the NMFS biological opinion for the program (NMFS 2012a), the hatchery has the necessary surface and groundwater sources, fish trapping and holding facilities, egg incubation and fish rearing vessels, and fish release facilities that would ensure proper rearing of the progeny of listed natural- and hatchery-origin native stock steelhead collected as broodstock. Although water quality conditions in the river during the dam removal period may impair full use of surface water supplied to the hatchery, groundwater supplied by wells at LEKT hatchery is sufficient for rearing fish at proposed abundances. The water sources and facilities are adequate for their purpose as proposed for the hatchery production of steelhead. NMFS determined that substantial demographic risks to listed steelhead are unlikely from propagation of the listed fish at Lower Elwha Fish Hatchery as proposed (section 2.8.1 in NMFS 2012a).

The HGMP describes how the fish would be reared at the tribal facility to maintain fish health through implementation of co-manager fish health policy protocols (NWIFC and WDFW 1998). In its biological opinion, NMFS determined that the operation of the proposed steelhead program consistent with the co-manager fish health protocols would adequately protect fish while under propagation from fish disease-influenced effects (section 2.8.1, Table 9 in NMFS (2012a)). The hatchery has operated for 2 years and, in practice, has demonstrated the capability of maintaining high survival rates, reflective of a well-run program, for each steelhead life stage under propagation, and to the point of fish release (sections 9 and 10 in LEKT 2012a). Measures that would be implemented to protect the genetic diversity of the propagated listed Chinook salmon population are

proposed in the LEKT (2012a) HGMP (sections 6-10). NMFS evaluated the genetic diversity effects of the proposed Lower Elwha Fish Hatchery steelhead program on listed Elwha River steelhead, including loss of within-population diversity, outbreeding depression, and hatchery-influenced selection (section 2.4.2.1.2 in NMFS (2012a)). For the reasons provided in the opinion, NMFS determined that the risk of adverse genetic diversity effects on listed Elwha River steelhead associated with implementation of the proposed program was unsubstantial (NMFS 2012a). Hatchery management measures that are proposed for implementation in the LEKT (2012a) HGMP are consistent with NMFS (2012a) terms and conditions that would further reduce within-population diversity, outbreeding depression, and hatchery-influenced selection risks to listed steelhead propagated through the program.

3.8 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.

Monitoring and evaluation actions are proposed in the HGMPs to evaluate their performance in meeting Elwha River salmon and steelhead preservation and recolonization phase objectives, and effects on ESA-listed fish. These actions are described in Section 11 of each HGMP ("Monitoring and Evaluation of Performance Indicators"). Included in section 11.0 are descriptions of monitoring and evaluation measures that would be implemented to assess plan benefits and risks addressing HGMP section 1.10 performance indicators.

The scientific framework for research, monitoring, and adaptive management actions included in the five proposed HGMPs is presented in the ERFRP (Ward et al. 2008). Building from the ERFRP, detailed descriptions of core monitoring, evaluation, and adaptive management actions that would guide actions implemented to determine the performance and effects of programs propagating listed Chinook salmon and steelhead (WDFW 2012 and LEKT 2012a) are provided in EMAM document prepared by the Elwha Monitoring Group (Peters et al. 2014). The proposed HGMPs for Chinook salmon and steelhead include actions that address key monitoring and evaluation recommendations described in the EMAM document. Further, several core monitoring and evaluation actions described in Peters et al. (2014) were included by NMFS as required for implementation in its consultation with the NPS to help identify dam deconstruction effects on listed fish (NMFS 2012b). These required monitoring and evaluation actions included spawning ground surveys (boat, foot, and snorkel), juvenile fish outmigrant trap operation, DIDSON-based fish censusing, aerial spawning ground surveys, fish health surveys and sampling, fish relocation, fish tagging and tracking, and habitat and ecosystem status monitoring (NMFS 2012a).

The monitoring and evaluation methods specified in NMFS (2012b) originally included operation of a mainstem Elwha River resistance board weir for the proposed purpose of identifying the number of adult fish migrating above RM 3.7. Initiated in 2010, the operation of the mainstem weir was viewed by researchers as experimental, and dependent on river flow and post-dam removal bedload conditions that would allow for its successful operation. As described in USFWS (2012) in the agency's consultation with NMFS regarding Elwha hatchery effects on USFWS listed species, "the feasibility of continuing to effectively operate the mainstem weir is currently under review. High spring and early summer flows carry high debris loads, limiting its operation and capture efficiency which calls to question its continued operation beyond 2013." Recognizing that flow and sediment conditions in the river had a high potential to prevent successful operation of the weir, in its section biological opinion, NMFS noted that the co-managers will "operate the mainstem Elwha River weir if feasible" (NMFS 2012a). In fact, as recognized by NMFS and USFWS as a potential outcome, river conditions that could potentially make operation of the mainstem weir infeasible were realized.

Release of large amounts of course sediment stored behind the dams, combined with high river flows during salmon and steelhead migration periods, caused operation of the mainstem resistance board weir to become unfeasible.

These conditions, including burial of weir components under large quantities of sediment, prevented the program from meeting its objectives, which included enumerating migrating adult fish populations, and augmenting Chinook salmon broodstock collection actions implemented at the hatcheries and in the mainstem river (Anderson and Ackley 2013). Consistent with the adaptive management intent for adjusting RM&E actions (Peters et al. 2014), the mainstem weir program was terminated after 2013, and replaced with a DIDSON (sonar) salmon and steelhead abundance census program. Salmon and steelhead population abundance monitoring and evaluation objectives originally proposed through mainstem weir operation are now being met through successful implementation of the DIDSON program (Denton et al. 2013). Broodstock collection actions implemented in the river (seines, gill nets, hook and line) and at the hatcheries are providing required numbers of adult salmon to sustain the comanager supportive breeding program without contributions from the mainstem weir (WDFW 2014).

Consistent with the Peters et al. (2014) document, and taking into account previously required actions from the NMFS dam deconstruction consultation (NMFS 2012b), monitoring and evaluation objectives and responsive actions that would be implemented specifically under the HGMPs are summarized below. These proposed HGMP activities would complement, augment, or address the core monitoring and adaptive management actions that were previously identified in NMFS's reinitiated consultation with NPS regarding dam deconstruction effects (NMFS 2012b) to adequately assess listed Chinook salmon and steelhead population viability status and hatchery program performance effects.

As described in the NMFS biological opinion (NMFS 2012a), the primary monitoring and evaluation objectives associated with hatchery fish production in the watershed are to: 1) evaluate recolonization by species (or genotype) and method of reintroduction through the examination of rebuilding rates (production), population size (abundance), spatial distribution, and habitat utilization; 2) document the genetic structure and life history diversity of existing Elwha River fish populations, and identify how genetic structure and life history diversity are affected by dam removal and hatchery practices over time; document how any changes affect the viability of the population; 3) monitor fish health over time, space, and method of reintroduction; and, 4) document recovery of ecosystem processes over time and space, including not only the freshwater ecosystem, but also riparian, nearshore, and terrestrial habitats. Testable hypotheses have been developed for each of the four primary objectives to specify desired or expected outcomes of the recovery plan requiring implementation of monitoring, evaluation, and research actions (Ward et al. 2008, and Table 5 in NMFS 2012a). Development of responses to these hypotheses form the basis for actions proposed in the HGMPs to monitor program performance and effects.

For the plans propagating listed fish (WDFW 2012; LEKT 2012a), the Chinook salmon and steelhead HGMPs identify monitoring, evaluation, and research objectives and actions that would be used to address the primary objectives and hypotheses from Ward et al (2008) and the EMG (Peters et al. 2014). All of the proposed HGMPs identify objectives and actions needed to determine hatchery program performance in meeting stated preservation, restoration, and/or production objectives for the specific species that are the focus of each HGMP (performance standards and indicators in HGMP sections 1.10), and effects on target and non-target, natural-origin fish populations in the Elwha River watershed (section 2.0). Actions would include operation

of weirs (at the Elwha Channel and Lower Elwha Fish hatcheries, and (through 2013) on the Elwha River mainstem at RM 3.7); operation of juvenile outmigrant traps to collect fish for identification of species, origin, and biological characteristics; foot and boat surveys to census salmon and steelhead spawning abundance and sample carcasses to identify fish origin; monitoring and reporting of fish harvests by species and by origin; monitoring of broodstock collection, egg take, and smolt release levels for each program; fish health monitoring and reporting; genetic analysis of naturally produced smolts, and un-marked adults to measure the extent of genetic exchange between hatchery-origin and natural-origin fish; and other activities needed to determine hatchery program effects and performance.

Operation of a juvenile out-migrant monitoring program to assess natural- and hatchery-origin salmon and steelhead abundance and migrational behavior (seasonal timing, migration rate, and migration duration) is an essential component of Elwha River fish restoration research, monitoring, and evaluation. The program is needed to identify listed species survival and productivity during the fish restoration effort, and overlap in timing between natural-origin species and newly released hatchery-origin fish. To meet these objectives, the LEKT would place and operate a rotary screw-trap each year in the mainstem Elwha River at approximately RM 0.6. As described in the EMAM document, rotary screw traps will also be operated in tributaries above the Elwha Dam site to evaluate fish production in areas unaffected by dam removal activities (Peters et al. 2014). The tribal juvenile outmigrant monitoring effort in is assisted by the NMFS NWFSC and the Northwest Indian Fisheries Commission (NWIFC), and funded by NPS as part of its recently completed consultation with NMFS (2012b). Species-specific data collected through annual juvenile outmigrant monitoring includes abundance, emigration timing, individual fish size, and origin (marked/tagged vs. unmarked/untagged). Stomach contents may also be collected from subsamples of captured juveniles to determine fish diets during emigration. The traps operate (pending river flow and water quality conditions) from February to July each year. To ensure proper care and maintenance of trapped fish, and minimize listed fish takes, the traps are sampled frequently to reduce holding duration. Trapping would be suspended during high flow events to reduce the risk of fish injury and mortality. Other risk aversion measures for the mainstem trapping program that are implemented to minimize take are specified in annual NMFS 4(d) Evaluation and Determination documents authorizing tribal research in Puget Sound (NMFS 2009).

The LEKT receives annual authorization for the take of listed fish species for its screw trap operations through a separate consultation process that includes evaluation of the effects of all research, monitoring and evaluation programs operated by the treaty tribes in the Puget Sound region (NMFS 2009). The tribes provide estimates to NMFS each year of the maximum annual number of listed juvenile Chinook salmon and steelhead by origin that would be captured, handled, sampled, and released through the proposed trapping program. Anticipated take levels are evaluated for effects at the population and ESU/DPS levels, and a determination is made under the 4(d) Rule research limit whether the actions are sufficiently conservative to warrant exception from section 9 take prohibitions.

As noted previously, operation of adult salmon and steelhead weirs on the Elwha River Basin to collect data to meet listed salmon and steelhead abundance, distribution, and origin objectives specified as primary monitoring needs in the HGMPs, and resultant listed fish take levels, have been previously evaluated and authorized through separate NMFS ESA consultations (NMFS 2006; 2012b). Takes of listed Chinook salmon and steelhead occurring through operation of a DIDSON system near the river's mouth and in Hunt's Road Side Channel (including tissue sampling for genetic analyses) are also previously authorized (NMFS 2012b). Other hatchery-related monitoring

and evaluation actions proposed in the HGMPs that have not been previously evaluated for listed fish effects, and that would be implemented with the weirs and juvenile out-migrant trapping programs to meet HGMP objectives, would include (WDFW 2012; LEKT 2012a):

- Counting and sampling (scale, mark/tag and/or otolith) and identification of age class distribution and sex ratio of adults returning to the hatcheries and escaping to spawn naturally to assess fish species status and origin;

- Tissue sampling and genotyping of adult Chinook and steelhead returning to the hatchery and of carcasses recovered in natural spawning areas to enable evaluation of hatchery program genetic diversity effects and parentage analysis-based estimation of total escapement;

- Marking and/or tagging of all fish released through the hatchery programs to allow for assessment of hatchery-origin adult contributions to total returns to the river and natural spawning; productivity of naturally spawning salmon and steelhead; post-release migration behavior of hatchery fish in the river; and survival of program-origin fish from smolt release to adult return to the river;

- Documentation of fish cultural techniques used for listed Chinook salmon and steelhead propagation to gauge whether the programs are meeting objectives and to identify the need for adjustment to adequately safeguard the listed fish, including: broodstock collection and handling procedures, fish and egg condition at time of spawning, fertilization procedures, incubation methods/densities, temperature unit records by developmental stage, egg shocking methods, fungus treatment methods for eggs; start feeding methods, rearing/pond loading densities, feeding schedules and rates; fish release locations and methods; and fish mortality levels by life stage;

- Sampling and monitoring of fish health for all species under propagation consistent with co-manager Fish Health Policy procedures; and,

- Monitoring of hatchery- and natural-origin adult fish contributions to in-river fisheries harvest that occurred n 2012-2014 to remove remaining Chambers Creek hatchery-lineage adult steelhead, and after the harvest moratorium has lapsed in 2017.

NMFS does not expect that program performance and effects monitoring and evaluation actions proposed as part of HGMP implementation would pose substantial risks of injury or mortality to listed natural-origin or hatchery-origin fish populations in Elwha River watershed. Risks under this hazard category would be partially ameliorated through application of risk minimization measures proposed in the LEKT and WDFW HGMPs, and summarized in the NMFS opinion evaluating HGMP effects (NMFS 2012a).

For the above reasons, adequate measures for monitoring HGMP performance, and for determining the effects of the programs on recovery of the listed Puget Sound Chinook salmon ESU and Puget Sound steelhead DPS are proposed for implementation, and the plans are consistent with this criterion.

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 provide for evaluating monitoring data, and applying results to adjust supportive breeding actions as needed to improve performance or reduce unanticipated adverse effects on listed fish. As noted above in 5(i)(H), these proposed activities would complement and/or augment the core monitoring and evaluation actions from the EMG document (Peters et al. 2014) that were previously identified as required to adequately assess listed Chinook salmon and steelhead population viability status and supportive breeding program performance effects in NMFS's reinitiated consultation with NPS regarding dam deconstruction effects (NMFS 2012b). All of the proposed HGMPs identify objectives and actions needed to determine hatchery program performance in meeting stated preservation, restoration, and/or production objectives for the specific species that are the focus of each HGMP (HGMP sections 1.10), and effects on target and non-target natural-origin fish populations in the Elwha River watershed. In compliance with this 4(d) Rule criterion, the HGMPs would apply adaptive management and risk management approaches in their implementation of hatchery and research actions. These approaches are applied in response to uncertainties regarding the effects of hatchery actions, the pace of recovery of Elwha River critical habitat needed to sustain the species, and salmon and steelhead preservation and recolonization needs.

Data collected each year relating to hatchery program performance and effects would be evaluated by WDFW and LEKT, and by NMFS consistent with its ESA take limitation requirements, to determine whether the programs were meeting objectives for the preservation and recolonization phases of restoration. Marking and/or tagging of all juvenile hatchery-origin fish released through the programs allows for identification of returning adult origin, which would be a key data source for rendering program performance and effects determinations. Marking/tagging of steelhead, coho salmon fall chum salmon, and pink salmon is adequate to meet this data evaluation need. All Chinook salmon released into the Elwha River through the Elwha Channel Hatchery program have been marked with an otolith band (subyearlings) or an otolith/blank coded wire tag combination (yearlings). All Chinook salmon released from Elwha Channel Hatchery would continue to receive a thermally influenced otolith mark to allow for their differentiation from natural-origin Chinook salmon and to allow for assessment of hatchery program performance and effects. Under the proposed WDFW HGMP, beginning with brood year 2012 releases in 2013, 250,000 subyearling Chinook salmon released from Elwha Channel Hatchery received an adipose fin clip and a coded wire tag. WDFW is applying this visually identifiable mark with a CWT to a subset of the subyearlings released from Elwha Channel Hatchery beginning with brood year 2012 as a means to (among other objectives) collect information regarding fisheries interception rates for Elwha Chinook under current fishing regimes, which include mark selective fisheries. Because Elwha Chinook salmon have not been recently marked or tagged to identify their origin, current impacts in fisheries are unknown. WDFW proposes that the results of CWT recovery analyses to estimate fisheries interception rates would allow adjustments in proposed adipose clipping plans for Elwha Channel Hatchery-origin Chinook salmon if harvest impacts are shown to be unacceptably high.

Initially, 250,000 (10 per cent) of the 2,500,000 subyearling Chinook salmon released through the proposed Elwha Channel Hatchery program would be marked with an adipose fin clip. The majority of juvenile fish released through the proposed program would remain unmarked to reduce the risk that the expected low total abundance of adult fish returning during the preservation period of restoration would be further reduced by interceptions in mixed stock marine area fisheries, including mark-selective fisheries. Beginning no earlier than brood year 2015 (releases in 2016),

WDFW proposes to mass mark all subyearlings prior to release with an adipose fin clip, and discontinue otolith marking. All hatchery subyearlings are proposed to be mass-marked with an adipose fin clip in anticipation that turbidity and sediment transport levels in the lower watershed would be less hospitable to natural Chinook salmon production when three and four year old adult Chinook salmon resulting from brood year 2015 releases would return. Beginning no earlier than brood year 2014, all yearling releases of Elwha River Chinook salmon would be adipose clipped at a 100 per cent rate, while otolith marking would be discontinued. As with the subyearling mass-mark proposal, adipose clipping of all yearlings may be delayed if sediment levels in the river remain high, natural production is low, it is judged unlikely that broodstock management will be initiated with the adult return of the 2015 brood of subyearling Chinook, and analysis of CWT recoveries indicates a substantially higher mortality rate of clipped Chinook salmon in mark-selective fisheries.

The rationale for applying an adipose fin clip at that time is that the ability to visually identify hatchery-origin Chinook adults beginning in 2018 and 2019 would coincide with the expected period when naturally spawning Chinook salmon might be able to begin successfully recolonizing the watershed. WDFW proposes that monitoring the proportion of hatchery origin fish in natural spawning areas would become necessary beginning in 2018 or 2019 to inform decisions regarding hatchery production. The proposal to apply an adipose fin clip is consistent with "a growing need to efficiently identify the hatchery or natural origin of fish to aid in implementing broodstock management principals intended to reduce hatchery influence in the naturally spawning population, with the goal of developing a self-sustaining locally adapted stock" (WDFW 2012). Hatchery fish management in natural spawning areas is proposed to commence during the local adaptation phase of restoration. Under the HGMP that is proposed for implementation only during the preservation and recolonization phases of restoration, use the adipose fin clip mark as a means to manage the proportion of hatchery-origin Chinook salmon spawning naturally or the proportion of hatchery and natural-origin fish incorporated as hatchery broodstock is not part of the proposed action (WDFW 2012).

The concern with the adipose fin clip marking strategy proposed by WDFW is that the exploitation rate on Elwha River hatchery-origin Chinook salmon produced for integrated recovery purposes would be increased above levels previously authorized by NMFS through the retention of now adipose-fin-clipped fish in mark selective fisheries (MSF). It is NMFS's view that the current otolith mark and otolith/blank wire tagging strategy applied for identifying WDFW Elwha Channel Hatchery Chinook salmon program-origin fish would be sufficient for evaluating program performance and effects during the preservation and recolonization phases of restoration (NMFS 2012a). Preserving the abundance of the unique Elwha Chinook population and improving prospects for its recovery in the Elwha River watershed, and not management of naturally spawning hatchery-origin fish proportions, are the over-riding concerns during these initial phases of restoration.
Management of hatchery-origin spawners and natural-origin fish proportions in the hatchery is not recommended by the HSRG (2012) for the preservation and recolonization phases of Chinook salmon population restoration in the Elwha River, and there is no "real time" need to identify the origin of adult fish escaping to the river for these phases.

NMFS believes that when sufficient tagged fish recovery data become available, adipose fin clip marking and coded wire tagging of a subset of Elwha Channel Hatchery subyearlings released through the program that began in 2013 will provide useful information regarding major interceptory fisheries, and resultant harvest management protection actions that may be needed.

When available, this information may also indicate the accuracy of mark selective fishery impact rates estimated by WDFW for adipose fin clip-marked Elwha Chinook salmon (WDFW 2012). Under terms and conditions included in the NMFS biological opinion (NMFS 2012a), these latter data would be considered with assessments of the standing of the total abundance of the Chinook salmon population relative to abundance triggers defined for the preservation and recolonization phases, to determine the appropriate timing for commencement of adipose fin clipping of the subyearling component of Chinook salmon hatchery production under the WDFW plan.

Annual reports for the programs assembled by WDFW and LEKT would be jointly reviewed by the co-managers and NOAA Fisheries to document program results, and to determine if the programs need to be adjusted to meet HGMP performance objectives. As specified in the NMFS opinion (NMFS 2012a), these reports will be completed by January 31st each year, and will be displayed on the NOAA Fisheries Northwest Region website with the HGMPs for public information purposes.

As referenced in the HGMPs, for all proposed programs, monitoring data evaluation and plan revision objectives and processes would be consistent with the adaptive management approach generally described in the ERFRP (Ward et al. 2008) and specified to a greater degree in the EMG document (Peters et al. 2014). In general, each HGMP would implement monitoring and evaluation and plan adjustment actions to meet the following four ERFRP adaptive management objectives (from Ward et al. 2008):

- Evaluate recolonization by species (or genotype) and method of reintroduction through the examination of rebuilding rates (production), population size (abundance), spatial distribution, and habitat utilization;

- Document the genetic structure and life history diversity of existing Elwha River fish populations. Identify how genetic structure and life history diversity are affected by dam removal and hatchery practices over time. Document how any changes affect the viability of the population.

- Monitor fish health over time, space, and method of reintroduction.

- Document recovery of ecosystem processes over time and space. Ecosystem recovery includes not only freshwater, but also riparian, nearshore, and terrestrial habitats.

For the HGMPs proposed for listed fish species propagation, the approach for monitoring data evaluation and plan revision objectives and processes is refined to be consistent with the monitoring and adaptive management actions described for Chinook salmon and steelhead in Peters et al. (2014). Summarized and incorporated by reference in the WDFW (2012) and LEKT (2012a) HGMPs, the approach described in the EWG document addresses uncertainty, incorporates best available scientific methods and management responses, and best ensures the recovery of the native Elwha River stocks of anadromous salmonids, while minimizing the risks to these species from the dam removal and stock preservation efforts (Peters et al. 2014). The adaptive management process defined in the EMG document includes a decision-making process and timeframe, defined decision rules, and a decision focused monitoring and evaluation plan. The EMAM plan approach relies on performance indicators and triggers tied to hatchery performance and effects monitoring to guide associated management actions. The population viability trigger values described for the four fish restoration phases were developed to test the basic assumptions of the fish restoration program. In

general, if certain hatchery rearing and release strategies prove to be unsuccessful in meeting identified population viability triggers, they may be discontinued at any time in favor of options that are more likely to produce healthy, naturally spawning populations. Specific options include discontinuation of the release of yearling fish into Morse Creek through the Chinook salmon HGMP, when abundance triggers for fish escaping to spawn in the Elwha River during the preservation phase were met (Table 1), and when the risk of catastrophic loss of the Elwha Chinook salmon population during and immediately after the dam removal phases had passed (Ward et al. 2008). In its biological opinion for the five proposed Elwha River watershed HGMPs (NMFS 2012a), NMFS specifies that HGMP monitoring and evaluation actions shall concentrate on adequate collection and analyses of data necessary to identify the status of the Elwha River Chinook salmon and steelhead populations relative to population viability parameter triggers defined for each restoration phase in the EMAM plan (Peters et al. 2014). The supportive breeding programs shall be adjusted in response to monitoring and evaluation data indicating achievement of the population viability triggers for each restoration phase described for Elwha River Chinook salmon and steelhead (NMFS 2012a).

3.9 5(i)(J) NOAA Fisheries provides written concurrence of the HGMP which specifies the implementation and reporting requirements.

After completion of the public review and comment period for this evaluation/determination document, NOAA Fisheries will make a determination regarding the adequacy of the five HGMPs composing the RMP. If the determination is made that the plans address all of the criteria specified in Limit 6 of the 4(d) Rule, NOAA Fisheries will issue a letter of concurrence to the co-managers to implement the Elwha River water supportive breeding programs in accordance with the final HGMPs.

3.10 5(i)(K) The HGMP is consistent with plans and conditions set within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

The HGMPs were developed by the co-managers pursuant to the *United States v. Washington* (1974) fisheries and hatchery management framework. The HGMPs are one component of an overall effort to preserve and recover listed Chinook salmon, steelhead, and other non-listed anadromous salmon populations native to the Elwha River watershed, consistent with the Elwha Act (1992), the Strait of Juan de Fuca watershed component of the Shared Strategy Recovery Plan (Ruckelshaus et al. 2005), and the Elwha River Fish Restoration Plan (Ward et al. 2008). Adopted by NMFS on January 19, 2007 (72 FR 2493), the ESU recovery plan has hatchery and habitat components, which include monitoring, research, and habitat protection, assessment, and restoration recommendations to complement artificial production.

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 programs.

4.0 Notice of Pending Recommendation

As required by the 4(d) Rule, the Secretary previously made available for public review his pending determination as to whether the RMP would appreciably reduce the likelihood of survival and recovery of the ESA-listed salmonids. Availability of the initial pending determination for public review was originally announced in the Federal Register on October 16, 2012 (77 FR 63294). The

public comment period closed on November 15, 2012. After evaluating the RMP, and considering public review comments, the Secretary made a final 4(d) rule determination regarding the RMP on December 21, 2012 (77 FR 75611). The Secretary determined pursuant to Limit 6 of the 4(d) rule for salmon and steelhead that implementing and enforcing the RMP will not appreciably reduce the likelihood of survival and recovery of Puget Sound Chinook salmon and Puget Sound steelhead (77 FR 75611).

For this updated version, the Secretary is making available for public review through announcement in the Federal Register a new pending determination as to whether the RMP would appreciably reduce the likelihood of survival and recovery of ESA-listed salmonids.

4.1 Notice of Recommended Determination

As required in (6)(iv) of section 223.203 of the 4(d) Rule for Puget Sound Chinook salmon and Puget Sound steelhead, the Secretary will publish notice of his determination as to whether the RMP appreciably decreases the likelihood for survival and recovery of affected threatened salmon ESUs and steelhead DPS, together with a discussion of the biological analysis underlying that determination.

PENDING RECOMMENDED DETERMINATION

After considering comments received, the Northwest Region Sustainable Fisheries Division recommends a finding that the five co-manager HGMPs composing the hatchery RMP for salmon and steelhead populations in the Elwha River watershed, including listed Chinook salmon and steelhead, address all of the criteria established for a RMP under Limit 6 of the 4(d) Rule.

Reevaluation Criteria

NOAA Fisheries 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 NOAA Fisheries' 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 NOAA Fisheries' evaluation of the HGMPs.

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