LOWER ELWHA KLALLAM TRIBE

ʔəʔɬx̣ʷə nəxʷsƛ̓ay̓əm "Strong People"

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Via email to ElwhaHatcheries.nwr@noaa.gov;
Followed by First Class U.S. Mail

November 15, 2012

Will Stelle, Administrator
National Marine Fisheries Service Northwest Region
Salmon Management Division
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

Re: Lower Elwha Klallam Tribe's Comments on NMFS's Draft Environmental Assessment (EA) and Proposed Evaluation and Proposed Determination (PEPD) for Elwha River Hatchery and Genetic Management Plans (HGMPs)

Dear Mr. Stelle:

As Chairperson of the Lower Elwha Klallam Tribe ("the Tribe"), I submit these comments on behalf of the Tribe regarding NMFS's Draft EA and PEPD for Elwha River HGMPs in accordance with the notice at 77 Fed.Reg. 63294 (Oct. 16, 2012). As you know, the Tribe is the proponent of four of the five HGMPs addressed in the notice (for ESA-listed steelhead and for non-listed fall chum, pink, and coho salmon); the State of Washington is the proponent of a fifth HGMP (for ESA-listed
1 Puget Sound Chinook).

From a technical standpoint, our HGMPs speak for themselves, and accordingly these comments will not be technical in nature. We believe the HGMPs demonstrate that our four hatchery programs (and WDFW's single Chinook program) can and will be operated in a manner that will not appreciably reduce the likelihood of survival and recovery of any ESA-listed species. In fact, the Tribe's hatchery is intended to prevent what would otherwise be the very real possibility of loss of species that could result from the sedimentation impacts of the ongoing removal of the Elwha River dams, as well as to aid in recovery and restoration of listed species. The Tribe has always operated each of its hatchery programs in accordance with an HGMP and is currently operating each program in accordance with the plans as submitted. We have the ability to continue to do so.

[redacted] The Elwha River hatchery programs have a vital role to play in preservation, restoration, and recovery. Congress recognized that hatcheries would serve this vital role when it enacted the Elwha River Ecosystem and Fisheries Restoration Act of 1992 ("EREFRA"), and considered restoration of the fisheries as part of a broader settlement of tribal claims. It was a unique settlement at that because it was the
1 product of consensus among a diverse—and frequently adversarial—array of stakeholders and interests.

The 1855 Treaty of Point No Point, 12 Stat. 933, is the foundation for the Tribe's rights in the Elwha River fishery. The Tribe is the modern-day successor to several traditional Klallam villages on the Elwha River that signed the Treaty. In that treaty the Tribe reserved its right to harvest fish at all of its usual and accustomed grounds and stations, including the Elwha River and Strait of Juan de Fuca. *U.S. v Washington*, 626 F. Supp. 1405, 1443 (W.D. Wash. 1985), and 459 F. Supp. 1020, 1049, 1066 (W.D. Wash. 1978).

The two Elwha River dams largely frustrated the fulfillment of that treaty promise for most of the twentieth century. In fact, construction of the Elwha Dam in 1912 contributed significantly to driving Lower Elwha Indians from the traditional village site at the mouth of the river, when the dam burst before it was completed and flooded out tribal homesteads. Removal of the dams in 2011-13 and restoration of native salmonid fisheries, as provided in the Elwha River Ecosystem and Fisheries Restoration Act of 1992 ("EREFRA"), will further the goal of restored and harvestable salmonid populations. [redacted]

Finally, while Elwha River dam removal and fisheries restoration is indeed the product of a unique consensus, it is also correct, as recently noted by Sen. Bill Bradley, that it would not have happened at all but for the persistence of the Tribe:

> Each of us owes the Lower Elwha Klallam Tribe the greatest possible
> gratitude for their unceasing efforts over decades to bring back the River's
> 1 life. To tell us all what the River needed. And we owe the Tribe the greatest
> deference and respect for the burdens its people and society have borne
> because of what was done to the River 100 years ago…

Sen. Bill Bradley, Keynote Address, at 5 (Sept. 16, 2011) (copy attached). It is in the spirit of that observation, by the chief Senate architect of the Elwha Act, that the Tribe submits its HGMPs to preserve and restore the fisheries and to provide at last for the fulfillment of the treaty promise.

Sincerely,

Frances G. Charles

Frances G. Charles, Chairperson
Lower Elwha Klallam Tribal Council
Lower Elwha Klallam Tribe

cc: Robert Turner, NMFS
Allyson Purcell, NMFS
Tim Tynan, NMFS
Doug Morrill, Lower Elwha Natural Resources Director
Larry Ward, Lower Elwha Hatchery Manager
Steve Suagee, Lower Elwha General Counsel

NMFS Response to Lower Elwha Klallam Tribe Comment

1. Comment noted.

Northwest Indian Fisheries Commission
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November 15, 2012

Will Stelle, Administrator
National Marine Fisheries Service Northwest Region
Salmon Management Division
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Portland, OR 97232

Re: Comments on the NMFS's Draft Environmental Assessment and Proposed Evaluation and Proposed Determination for Elwha River Hatchery and Genetic Management Plans

Dear Mr. Stelle:

On behalf of its member tribes the Northwest Indian Fisheries Commission provides the following comments on the NMFS's draft Environmental Assessment (EA) and Proposed Evaluation and Proposed Determination (PEPD) regarding Elwha River salmon and steelhead hatchery management plans.

1 [redacted] (EA at 5), but the EA and PEPD should more clearly acknowledge settled federal law that the treaty fishing rights of the Lower Elwha Klallam Tribe (Lower Elwha), and other tribes, include access to state and tribal hatchery production. *United States v. Washington*, 506 F. Supp. 187, 198 (W.D. Wash. 1980); *United States v. Washington*, 759 F.2d 1353, 1360 (9th Cir. 1985). The EA recognizes that "hatcheries in Puget Sound provide salmon and steelhead for [the treaty] fisheries. Without many of these hatcheries, there would be few, if any, fish for the tribes to harvest." (EA at 11). [redacted] Therefore, we concur with the NMFS conclusion in the EA that Alternatives 3 and 4 do not meet the purpose and need.

2 The NMFS should recognize the likelihood that the recovery trajectories of Elwha River salmon and steelhead stocks will vary. So it is likely that hatchery programs will operate longer for some species to achieve recovery.

3 We appreciate and support the NMFS's explicit consideration of effects on tribal cultural resources in the EA, distinct from its consideration of socioeconomic and environmental justice effects. However, the draft EA does not consider the Lower Elwha Tribe's participation in, and

3 the importance of, marine salmon and shellfish fisheries. Recovery of production in the Elwha River could substantially benefit salmon fisheries, which might occur outside of the Elwha River.

4 The Environmental Justice analysis (Alts 3 & 4) in the EA considers the effects on employment of closing hatcheries, but this understates its proportionately more significant effect on the Lower Elwha tribal community should those hatchery jobs be terminated.

In describing and evaluating genetic risks associated with hatchery programs, the PEPD accurately represents the uncertainty about fitness effects (domestication), and rightly focuses on how hatcheries must operate during the preservation phase to reduce the very real risk of extinction of native populations/stocks. However, the NMFS should embrace its responsibility as cognizant agency for determining the best science to inform this assessment, rather than citing the advice offered in the HSRG review of Elwha programs. For instance, realistic parameters of strength of selection on fitness traits and heritability of adaptive traits have been estimated in the past (see e.g. Mousseau & Roff 1987 and references therein) but the literature of quantitative genetics containing estimates of parameters has been essentially ignored in recent attempts to model genetic risk in hatchery-natural interactions, using selection and fitness parameters selected purely for heuristic purposes.

The science informing management of the genetic risks associated with hatchery production continues to improve. The PEPD should summarize and cite recent research that has demonstrated successful hatchery supplementation of natural Chinook and steelhead production, where native stocks have been extirpated or reduced to critically low abundance (Hess et al 2012).

Studies have cited the contributions that hatchery programs make to recovery and conservation hatchery programs. For instance, in Washington's Cedar River hatchery Chinook salmon have been estimated to increase abundance of Chinook salmon in newly available habitat without producing significant changes in reproductive success of fish in the habitat (Anderson et al. 2012). Berejikian et al. (2008) demonstrated an increase in abundance of steelhead redds in the Hamma Hamma River on Washington's Olympic peninsula, relative to control populations that did not receive hatchery supplementation. These studies demonstrated increased abundance but did not follow fitness effects through generations. Columbia River basin studies have followed the genetic effects of hatchery-origin Chinook salmon through generation and found a demographic boost from hatchery contribution and no heritable genetic effect on subsequent fish naturally-produced by hatchery-origin spawners (Hess et al. 2012, Ford et al. 2012). On the east coast, decades of Atlantic salmon hatchery supplementation, while insufficient to restore salmon abundance after centuries of habitat degradation, has also been insufficient to displace Maine Atlantic salmon with the out-of-basin populations they were supplemented with (NRC 2002).

Several studies indicate the performance of hatchery-origin Chinook is not substantially different from that of natural-origin Chinook, particularly where native broodstock are utilized (Anderson et al 2012; Schroder et al 2010). We believe these studies further support the use of hatchery programs in the Elwha River to both reduce extinction risk in the short term and expedite recovery.

Recent studies are also shedding new light on the extent to which phenotypic variation between hatchery- and naturally-produced Chinook may result from plastic expression of identical genetic backgrounds in different environments rather than changes in the underlying genetic backgrounds of hatchery and naturally-produced fish (Ford et al 2012, Williamson et al 2010; Chittenden et al 2010).

A list of the cited and other relevant studies is attached, with copies of the papers.

5 We support the conclusions of the draft EA in its comparison of Alternatives and discussion of implementation of the proposed hatchery management plans as the preferred alternative. In general the PEPD provides a sound technical basis for its conclusion that implementation of the hatchery programs as proposed, through the recolonization phase of recovery, will achieve the conservation criteria of the 4(d) Rule.

Sincerely,

Billy Frank, Jr.
Chairman

cc: Robert Turner, Allyson Purcell, NMFS
Frances Charles, Chair, Lower Elwha Klallam Tribe

NMFS Response to Northwest Indian Fisheries Commission Comment

1. Comment noted.

2. The environmental assessment has been modified to recognize that the recovery trajectories of Elwha River salmon and steelhead will vary by species reflect this comment (Subsection 2.2, Alternative 2 (Proposed Action) and Subsection 2.3, Alternative 3 (Proposed Hatchery Programs with a Sunset Term).

3. The environmental assessment has been modified to recognize the importance of marine salmon and shellfish fisheries to the Lower Elwha Klallam Tribe (Subsection 3.10, Environmental Justice).

4. The environmental assessment has been modified to recognize the effects that job loss would have on the Lower Elwha tribal community (Subsection 3.10, Environmental Justice).

5. Comment noted.

POINT NO POINT TREATY COUNCIL

Port Gamble S'Klallam * Jamestown S'Klallam

November 19, 2012

Will Stelle, Administrator
National Marine Fisheries Service Northwest Region
Salmon Management Division
1201 NE. Lloyd Boulevard, Suite 1100
Portland, OR 97232

Re: Comments on the NMFS's Draft Environmental Assessment and Proposed Evaluation and Pending Determination for Elwha River Joint Hatchery and Genetic Management Plans

Dear Mr. Stelle:

The Point No Point Treaty Council (PNPTC) is a tribal organization that provides natural resources support services to the Port Gamble S'Klallam Tribe and Jamestown S'Klallam Tribe. We appreciate receiving notice that the NMFS was planning to release for tribal government/program review NMFS's Draft Environmental Assessment (EA) and Proposed Evaluation and Pending Determination (PEPD) for Elwha River Joint Hatchery and Genetic Management Plans (HGMPs).

The four alternatives evaluated in the draft EA address the full range of potential options and meet the purpose and need for the EA. [redacted] We concur with the assessment in the EA that, compared to the No Action Alternative, there would be no change in risks to the Chinook or steelhead populations associated with genetic effects, competition, facility effects, and other factors evaluated in the HGMPs and that there would be no additional risk to Chinook and steelhead population viability.

The EA appropriately describes one of the purposes of the proposed action as to "fulfill treaty-reserved fishing rights as the populations recover", but the EA and PEPD should more clearly acknowledge settled federal law that the treaty fishing rights of the Lower Elwha Klallam Tribe, and other tribes, include access to state and tribal hatchery production. *United States v. Washington*, 506 F. Supp. 187, 198 (W.D. Wash. 1980); *United States v. Washington*, 759 F.2d 1353, 1360 (9th Cir. 1985). The EA recognizes that "hatcheries in Puget Sound provide salmon and steelhead for [the treaty] fisheries. Without many of these hatcheries, there would be few, if any, fish for the tribes to harvest." In the case of Lower Elwha Klallam Tribe, and other tribes, the exercise of treaty rights in the future is inextricably linked to hatchery programs that will both protect against the very real risk of extinction of salmon and steelhead populations following dam removal and expedite their recovery to harvestable levels.

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We appreciate and support the NMFS's explicit consideration of effects on tribal cultural resources in the EA, distinct from its consideration of socioeconomic and environmental justice effects. However, the draft EA does not consider the Lower Elwha Klallam Tribe's, and other tribes with U&A in the Strait of Juan de Fuca, participation in, and the importance of, marine salmon and shellfish fisheries. Recovery of production in the Elwha River could substantially benefit salmon fisheries which occur outside of the Elwha River. Similarly, it should be made clear in the environmental justice section that all tribes with U&A in the Strait of Juan de Fuca are disproportionately impacted and would benefit from improved salmon fisheries.

The PEPD does a good job of identifying the current status of the ESA-listed Chinook salmon and steelhead populations relative to population viability triggers for the preservation and restoration phases and how the proposed hatchery programs would be implemented and enforced to benefit population viability.

[redacted] In addition, the science informing management of the genetic risks associated with hatchery production continues to improve and the PEPD should summarize and utilize the available literature. [redacted]

We appreciate the opportunity to comment on the EA and PEPD. We urge the NMFS to make a determination that implementing and enforcing the joint HGMPs will not appreciably reduce the likelihood of survival and recovery of the ESA-listed Chinook or steelhead populations, and that the plans address the criteria specified in Limit 5 of the 4(d) Rule.

Sincerely,

Randy Harder

Randy Harder
Executive Director

cc: Robert Turner, Allyson Purcell, NMFS
Frances Charles, Doug Morrill, Lower Elwha Klallam Tribe
W. Ron Allen, Scott Chitwood, Jamestown S'Klallam Tribe
Jeromy Sullivan, Paul McCollum, Port Gamble S'Klallam Tribe

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NMFS Response to Point No Point Treaty Council Comments

1. Comment noted.

2. Subsection 1.5.12, U.S. v. Washington, addresses this Federal law.

3. The environmental assessment has been modified to recognize the importance of marine salmon and shellfish fisheries to tribes with usual and accustomed fishing areas in the Strait of Juan de Fuca (Subsection 3.10, Environmental Justice)

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November 15, 2012

Via Email
NMFS Salmon Management Division
1201 N.E. Lloyd Blvd., Suite 1100
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Email: ElwhaHatcheries.nwr@noaa.gov

Re: Proposed Decision to Approve Joint State/Tribal Resource Management Plan for Elwha River Hatchery Programs

Dear Honorable Civil Servants:

Please accept these comments submitted on behalf of the Wild Fish Conservancy, the Wild Steelhead Coalition, the Federation of Fly Fishers Steelhead Committee, and Wild Salmon Rivers d/b/a the Conservation Angler (collectively, "Commenters") on the Draft Environmental Assessment to Analyze NOAA's National Marine Fisheries Service ("NMFS") Determination that Five Hatchery Programs for Elwha River Salmon and Steelhead as Described in the Joint State-Tribal Hatchery and Genetic Management Plans and one Tribal Harvest Plan Satisfy the Endangered Species Act Section 4(d) Rule ("Draft EA"), and the associated Proposed Evaluation and Pending Determination ("Pending Determination").

I. Introduction.

The removal of the Elwha River dams constitutes the largest dam removal and salmonid restoration project in United States history, opening up over seventy miles of river habitat to salmonids. These efforts have been mandated by an act of Congress directing the full restoration of the Elwha River ecosystem and native anadromous fisheries, and are expected to cost taxpayers approximately $325 million. This project, as envisioned by Congress, affords a unique opportunity for wild salmonids to quickly re-colonize large expanses of pristine habitat.

The Elwha River Restoration Project offers unprecedented opportunities to study how a major river system, its ecosystem, and fish populations heal after a century of degradation caused by dams. The Pending Determination to approve large-scale hatchery programs destroys these opportunities and ignores the lessons learned during the last half-century about
1 the harm hatcheries cause to wild salmonid populations and their ability to recover from a depressed state. As stated by Jim Lichatowich, special-consultant to the congressionally-chartered Hatchery Scientific Review Group in its evaluation of the Elwha River hatchery programs:

> The evidence has been accumulating and today the weight of that evidence is clear: hatcheries are part of the salmon's problem. The myth that hatcheries are the solution to the problem of the salmon's declining abundance is still strong and it is a formidable impediment to the incorporation of our current scientific understandings of the effects of hatcheries into salmon management and recovery programs. A situation clearly exemplified by the Elwha recovery program.

First Declaration of Jams Lichatowich, ¶ 18 (a copy of which is attached hereto).

[redacted]

[redacted]

II. Failure to Provide Sufficient Information During Comment Period.

NMFS delayed and refused to provide information requested that is necessary to fully comment on the Pending Determination and Draft EA. Accordingly, such information should be made available to the public and an additional comment period should be provided.

NMFS' regulations require that, before approving a Joint Resource Management Plan under 50 C.F.R. § 223.203(b)(6) ("Limit 6"), NMFS must take comment on how any fishery management plan addresses the criteria in 50 C.F.R. § 223.203(b) ("Limit 4") and how any hatchery and genetic management plan ("HGMP") addresses the criteria in 50 C.F.R. §
2 223.203(b)(5) ("Limit 5"). 50 C.F.R. § 223.203(b)(5)(iii). NMFS published notice in the Federal Register on October 16, 2012, stating: "Notice; availability of joint state/tribal plan and request for comment." 77 Fed. Reg. 63,294 (Oct. 16, 2012).

[redacted] After being unable to locate any relevant information on NMFS' website, an additional request was made as to the location of relevant documents on NMFS' website. [redacted] *Id.*

[redacted] Counsel for the Lower Elwha Klallam Tribe eventually confirmed that certain HGMPs that had been provided were those under consideration by NMFS. [redacted] This document is a critical part of the joint plan under consideration and essential to evaluating whether the HGMPs meet the criteria of Limit 5 and whether the joint plan meets the standard

2 of Limit 6.

This obstructionist conduct of delaying and refusing to provide information has defeated the spirit of the public comment process and NMFS' regulations. These efforts to avoid meaningful public input continue the pattern followed in the development of the 2008 Elwha River Fish Restoration Plan, in which the public was excluded altogether (other than being provided a very early draft as an appendix to a 1996 environmental impact statement).

The restoration of the Elwha River is an enormous federal project projected to cost tax payers nearly $ 325 million. Federal tax dollars are paying not only for dam removal, but for the construction and operations of the Elwha River hatchery. The public should be allowed and encourage to participate in the processes that will decide how salmonids will be restored to the Elwha River watershed. This has not occurred.

Commenters requests that NMFS make publically available all the documents being consideration as part of the plan and provide a new public comment period of at least sixty

days. The HGMPs and any incorporated documents should be made available—especially the
2 MAMP—so that the public can comment on whether these documents meet the Limit 5
criteria. Further, to the extent the MAMP, NMFS should defer any public comment process
and evaluation until this document is finalized.

III. The HGMPs do not Meet the Criteria of Limit 5.

NMFS' regulations require that public comment be taken as to whether HGMPs submitted as part of a joint plan under Limit 6 of the 4(d) Rule meet the criteria of Limit 5. NMFS' 4(d) Implementation Guidance indicates that NMFS will evaluate HGMPs submitted under Limit 6 in the same manner as it evaluates HGMPs submitted under Limit 5. NMFS should decline to approve the joint plan because the HGMPs do meet the criteria of Limit 5 of the 4(d) Rule. In addition to the brief comments provided below, the deficiencies with the joint plan and associated HGMPs are identified in the declarations, reports, and comments attached hereto.

A.

The first criterion of Limit 5 of the 4(d) Rule requires that:

> 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 shall address whether the program is intended to meet conservation objectives, contribute to the ultimate sustainability of the natural population, and/or intended to augment tribal, recreational, or commercial fisheries. Objectives should enumerate the results desired from the program that will be used to measure the program's success or failure.

50 C.F.R. § 223.203(b)(5)(i)(A). The HGMPs submitted as part of the joint plan do not meet these requirements.

The statements of program goals, performance objectives, and performance indicators in each of the HGMPs is inappropriately general and vague at best. The HGMPs state a primary goal of conservation motivated by the belief that high levels of suspended sediments in the Elwha River downstream of Elwha Dam resulting from the removal of the two dams will threaten the continued existence of the remaining populations of native salmon and steelhead. Yet, no detailed argument and evidence are provided to support this fundamental claim. This claim is highly controversial and uncertain, yet none of the HGMPs nor the Pending Determination acknowledge this controversy and attempt to provide reasoned support for the claim.

All HGMPs state objectives in vague, general terms and phrases that ignore relevant and substantive biological issues that arise in conservation contexts. For example, Table 1.1 of the steelhead HGMP states "Conserve abundance" as a goal of the "Preservation" phase. In light of the considerable concerns regarding the effectiveness of hatchery supplementation of steelhead due to negative effects on the fitness and adaptive potential of the target wild population, vaguely stated "conservation of abundance" is an inappropriately vague goal statement. The HGMP should instead state unambiguous target levels of numbers of returning adult by origin (captive brood, hatchery-origin adult, natural-origin (wild) adults), target adult age composition and sex ratio.

The statement of "objectives" associated with the general goal statement ("conserve abundance") is also inappropriately vague: "prevent extinction", "retain genetic identity and diversity", "hatchery returns increase adult abundance", "successful natural production in mid- and upper basin MS & tribs", "supplement spawning (maintain upstream migration passage as well as move returning adults into areas of watershed unaffected by dam removal). Of these five objectives, only the last is stated in language specific enough to clearly understand what is required to verify whether or not the objective is being achieved. No text in the HGMP related to table 1.1 remedies this lack of specificity. Regarding the preservation of genetic diversity, which is a fundamental and critical performance and monitoring variable, none of the HGMPs provide specifics regarding the kind(s) of genetic markers to be measured, how many loci for each marker are to be measured, what genetic parameters are to be monitored using the markers (expected and observed levels of heterozygozity, allelic richness, etc.), and what target levels of genetic parameters are to be achieved. As a result, none of the HGMPs can state what corrective actions will be taken when target levels of genetic diversity are not attained.

Moreover, none of the HGMPs provide any substantive text that explains the relationship of listed performance indicators to associated performance standards and goals. No proper justification is provided for the indicators and standards. Rather, goals, standards, and indicators are largely simply asserted.

B. The HGMPs do not Utilize the Concepts of Viable Salmonid Populations.

The second criterion of Limit 5 of the 4(d) Rule requires that:

> 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" (NMFS, 2000b). 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; if the donor population is not currently viable but the sole objective of the current collection program is to enhance the propagation or survival of the listed EUS; or if the donor population is shown with a high degree of confidence to be above critical threshold although not yet functioning at viable levels, and the collection will not appreciably slow the attainment of viable status for that population.

50 C.F.R. § 223.203(b)(5)(i)(B). The HGMPs submitted as part of the joint plan do not adequately utilize the Viable Salmonid Population ("VSP") concepts and do not meet these requirements.

The Chinook salmon HGMP (section 2.2.2) does not state either the critical or the viable population size identified by NMFS for the Elwha Chinook population, nor does the HGMP relate the proposed size of the program and the program goals for adult abundance to these or related target levels of abundance. The winter-run steelhead HGMP (section 2.3.2) does state the preliminary critical and viable abundance thresholds identified by the Puget Sound Steelhead Technical Recovery Team for the Elwha population. However, the HGMP fails to note that these thresholds apply to a recovered population with unobstructed access to the entire Elwha River baisn, and does not discuss how these abundance levels should be related to the current condition of the population. The HGMP also states that the "co-managers' harvest plan for Puget sound steelhead sets the critical threshold for Elwha steelhead at 100" (HGMP page 10) but neither explains the significance or justification for this number, nor how this threshold level is to be related to the current condition of the population or to the proposed hatchery program.

C. The HGMPs' Broodstock Programs do not Reflect Appropriate Priorities.

The third criterion of Limit 5 of the 4(d) Rule requires that:

> Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities. The primary purpose of broodstock collection programs of listed species is to reestablish indigenous salmonid populations for conservation purposes. Such programs include restoration of similar, at-risk populations within the same ESU, and reintroduction of at-risk populations to underseeded habitat. After the species' conservation needs are met and when consistent with survival and recovery of the ESU, broodstock collection programs may be authorized by NMFS such for secondary purposes, as to sustain tribal, recreational, and commercial fisheries.

50 C.F.R. § 223.203(b)(5)(i)(C). The broodstock programs described in the HGMPs submitted as part of the joint plan do not reflect appropriate priorities.

The primary motivation for and justification of the proposed programs is the alleged threat posed by suspended sediment levels in the Elwha River mainstem below Elwha Dam that are expected to occur intermittently for a period of one or more years following the initiation of the removal of the two dams. This corresponds to the vaguely characterized "Preservation Phase" of the Elwha native fish restoration process. As noted above, there is no small scientific controversy regarding this alleged threat, which NMFS and the authors of the HGMP seem intent not to acknowledge. A truly adaptive approach to the uncertainty attending this risk factor would be to treat the threat as a hypothesis to be evaluated and consequently to shape the conservation hatchery actions in light of the hypothetical nature of the threat. This would require an explicit research and monitoring program to evaluate suspended sediment levels at time throughout the year and using metrics that are biologically relevant to the fish species of concern that are potentially affected by the suspended sediment.

Consistent with such an adaptive approach, but independent of it, even if the alleged short-term (one to two steelhead generations) threat from the dam removal process were accepted at face value, an appropriate conservation hatchery program for each species should be much smaller than proposed by the HGMPs. This is especially true for the programs for the two listed species. In view of the considerable genetic risks imposed on wild populations by captive brood and supplementation hatchery programs (cite to the Declarations) the duration of the programs should be strictly limited to the Preservation Phase itself, and to the level of risk from suspended sediment levels that is actually revealed by monitoring the sediment threat hypothesis. For this reason, NMFS should only consider granting any approval of any of the HGMPs for a period of no more than five years.

In this regard, it is also relevant that the June 1, 2012 draft of the MAMP has not secured funding for regular monitoring of the concentration of suspended sediment in the Elwha River mainstem and side-channels below Elwha Dam (Draft MAMP Table 20). The USGS is currently monitoring turbidity remotely using infrared reflectance (FNUs) and plans to continue this monitoring, pending funding. However, the draft MAMP admits that measurement of turbidity does not translate readily to suspended sediment concentration (mg-per-liter), which is the metric that can be directly related to impacts on fish health.

Consequently, direct field-based measurements of suspended sediment concentration need to be made regularly in addition to the remote turbidity measures. But the MAMP does not indicate the frequency that such measurements should be made, and Table 20 shows that those measurements that are planned are not fully funded. Yet, this is the single environmental parameter on which the entire motivation for the conservation hatchery programs rests.

1. The Winter-Run Steelhead HGMP Broodstock Program.

The broodstock program described in the winter-run steelhead HGMP does not reflect appropriate priorities. The Elwha River winter-run steelhead population is part of the Puget Sound steelhead DPS listed as threatened under the Endangered Species Act ("ESA"). Accordingly, the primary purpose of any broodstock collection program should be conservation. The broodstock program proposed is far in excess of what is appropriate for a conservation program, and is instead designed to expedite harvests. Such a program is not appropriate until the species' conservation needs are met.

2. The Chinook Salmon HGMP Broodstock Program.

The broodstock program described in the Chinook salmon HGMP does not reflect appropriate priorities. The Elwha River Chinook salmon population is part of the Puget Sound Chinook salmon ESU listed as threatened under the Endangered Species Act ("ESA"). Accordingly, the primary purpose of any broodstock collection program should be conservation. The broodstock program proposed is far in excess of what is appropriate for a conservation program, and is instead designed to expedite harvests. Such a program is not appropriate until the species' conservation needs are met. Moreover, the proposed program is an extension of the program that has existed for several decades and for which data exists regarding the performance of the program since 1999. The smolts-to-adult return data for both sub-yearlings and yearlings is extremely low, and is among the poorest performing

Chinook salmon hatchery programs in all of Puget Sound. This data indicates that the fitness of the hatchery Chinook population has been driven very low by hatchery domestication selection. Continuation of the hatchery program on the large scale on which the program has operated in the past will most likely only further erode natural spawning fitness and compromise the ability of the native Elwha Chinook salmon population to rebuild and recolonize the newly accessible upper watershed. A much smaller program is required and would be more appropriate to serve a short-term, risk-averse conservation purpose.

D. The HGMPs do not Minimize Harm to Wild Populations.

The fifth criterion of Limit 5 of the 4(d) Rule requires that:

> The HGMP evaluates, minimizes, and accounts for the propagation program's genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by the straying of hatchery fish.

50 C.F.R. § 223.203(b)(5)(i)(E). The HGMPs submitted as part of the joint plan do not meet these requirements.

The hatchery programs proposed in the Chinook, Coho, and Steelhead HGMPs impose significant threats of harm to Elwha Chinook salmon and winter-run steelhead populations. Genetic and ecological effects are not appropriately evaluated and accounted for, or minimized. Specifically, the steelhead and Chinook programs pose significant genetic risks of reduced fitness to the wild populations that will impair the survival and recovery of these populations. The steelhead program does not adequately acknowledge the risk of fitness loss that is likely to be caused by the steelhead program and, therefore, does not consider appropriate monitoring and measures to detect and avoid such impacts. For example, there is no explicit monitoring or research to evaluate the relative reproductive success of hatchery-origin steelhead and of crosses between hatchery-origin and natural origin adults. Explicit geneotyping of all hatchery parents, with full details regarding what kind of genetic markers will be used, how many markers will be used, what genetic parameters will be monitored and what the threshold levels of those parameters will be should be provided in the HGMP. The Chinook HGMP fails to consider the evidence from the past hatchery program indicating that the fitness of the remaining Elwha Chinook has been driven extremely low by hatchery domestication selection. This is clearly evidenced by the extremely low levels of smolt-to-adult survival of yearling and sub-yearling smolts over the past 20 years.

The coho salmon HGMP does not minimize risks to wild salmonid populations. The HGMP proposed to release 425,000 smolts that will be approximately 140 millimeters (5.5 inches) of more in length. This is generally larger than the size of the average wild coho salmon smolt. The number and size of the smolts released impose a non-negligible risk of competition for food and rearing space of wild Elwha coho smolts, wild steelhead smolts, rearing steelhead parr, and rearing and outmigrating Chinook smolts in the lower Elwha River and estuary. A short-term, risk-averse conservation hatchery program for coho that would support the recolonization of the upper Elwha by native Elwha coho salmon does not require the large scale proposed in the HGMP. An appropriate program one-quarter or smaller than the size proposed in the HGMP would both meet any legitimate conservation concern while greatly reducing the risks posed to the listed species.

E. The Adequacies of the Hatchery Facilities.

The seventh criterion of Limit 5 of the 4(d) Rule requires that:

> 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 or domestication.

50 C.F.R. § 223.203(b)(5)(i)(G). The HGMPs do not meet this requirement.

The Chinook salmon and winter-steelhead HGMPs propose to incorporate large numbers and high percentages of hatchery-origin adults into the annual hatchery broodstocks.

Such practice will significantly increase the probability of domestication selection that will reduce the fitness of hatchery progeny in the wild. *See First Declaration of Gordon Luikart* (a copy of which is provided herewith). To the extent that such practice may be unavoidable in the near-term given the depressed state of wild population that the conservation hatchery programs are intended to aid, the high risk of domestication further argues for as small a program as possible to meet the conservation risk and sustained for as short a term as possible. This is further reason to limit any approval of any of the HGMPs to a period of no longer than five years, and to require specific monitoring with secure funding to evaluate domestication risks to the wild populations.

F. The HGMPs Lack Adequate Monitoring and Evaluation.

The eighth criterion of Limit 5 of the 4(d) Rule requires that:

> 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.

50 C.F.R. § 223.203(b)(5)(i)(H). There is not adequate monitoring and evaluation of the hatchery programs' success and risks to listed species. This fact alone violates this criterion. Further, as evidenced in the draft MAMP dated June 1, 2012 (Table 20, section 7), adequate funding does not exist to conduct even the minimally necessary monitoring and evaluation ($725,000 to $1,000,000 per year for 10 years). It is worth noting, by contrast, that according to the Chinook salmon and winter-run steelhead HGMPs, the minimum total annual operating cost of the proposed hatchery programs exceeds $1,200,000. The scarce funds required for monitoring the recolonization of the Elwha River basin by native salmonids have been re-directed to hatchery programs of questionable scale and need. Without adequate monitoring, there are likely to be severe adverse impacts to listed Chinook salmon and steelhead.

G. The HGMPs do not Include Adequate Adaptive Measures.

The ninth criterion of Limit 5 of the 4(d) Rule requires that:

> The HGMP provides for evaluating monitoring data and making any revisions of assumptions, management strategies, or objectives that data show are needed. The failure of the HGMPs to identify relevant measureable genetic and life history parameters and to specify corresponding quantitative threshold or target levels to avoid risks to listed populations means that no adaptive measures exist for altering program practices in the light of data. Even were some adaptive measures provided, the absence of adequate and/or assured funding of the essential monitoring activities means that the data necessary to implement adaptive measures will not be obtained in an appropriately timely manner, which is tantamount to having no adaptive management at all. However, in general the HGMPs provide no explicit set of decision procedures or protocols by which monitoring data will be acquired, analyzed, and by which program practices are to be changed based on the results of those analyses.

50 C.F.R. § 223.203(b)(5)(i)(I). The HGMPs submitted as part of the joint plan do not meet these requirements.

IV. Lack of Adequate Monitoring and Adaptive Management.

In addition to the MAMP not being finalized and available for public review, the latest draft of the MAMP, titled "Guidelines for Monitoring and Adaptively Managing Chinook (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) Restoration in the Elwha River, Final Draft" dated June 1, 2012 admits that funding to undertake even the minimally necessary annual monitoring is inadequate and adequate funding necessary to determine whether or not restoration is succeeding and why it is or is not succeeding has not been secured. Absent an ability to undertake the minimally necessary monitoring of the likely adverse impacts of the conservation hatchery programs on the Elwha Chinook salmon and winter-run steelhead populations, NMFS cannot approve the HGMPs because it cannot be assured (and cannot assure the public) that likely adverse impacts that are likely to result in take of the listed species will not occur nor will be detected in a timely enough manner to identify and undertake corrective actions.

V. The Joint Plan Does not Meet the "No Jeopardy" Standard.

Joint Resource Management Plans submitted under Limit 6 of the 4(d) Rule may be approved only if the implementation and enforcement of the plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs. 50 C.F.R. § 223.203(b)(6)(i). The submitted plan and the Pending Determination do not meet this requirement. In addition to the brief comments provided below, the threats to ESA-listed species and their ability to recover are described in the declarations, reports and comments attached hereto.

Recovery of the native Elwha River winter-run steelhead population and the native Elwha River Chinook salmon population is essential to the recovery of the Puget Sound steelhead distinct population segment and the Puget Sound Chinook salmon ESU. The size and pristine condition of the Elwha River watershed provide an enormous potential population sizes for these species. This watershed constitutes a unique component of the geographic and evolutionary diversity of the Puget Sound steelhead DPS and the Chinook salmon ESU. Threats to the recovery of native Elwha River winter steelhead and native Elwha River Chinook salmon therefore pose a significant threat to the recovery and de-listing of the Puget Sound steelhead DPS and the Puget Sound Chinook salmon ESU.

As discussed herein and in the attached documents, the proposed plan and Pending Determination pose severe risks and will impede the recovery of threatened salmonids.

VI.

The purpose of the National Environmental Policy Act ("NEPA") is, *inter alia*, to
3 declare a national policy that will encourage productive and enjoyable harmony between man and his environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man, and to enrich the

understanding of the ecological systems and natural resources important to the Nation. 42 U.S.C. § 4321. NEPA requires federal agencies undertake processes to "insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken" and that are "intended to help public officials make decisions that are based on understanding of environmental consequences." 40 C.F.R. §§ 1500.1(b) and (c).

To accomplish these purposes, NEPA requires federal agencies to prepare a "detailed statement" regarding all "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). The "detailed statement," commonly known as an environmental impact statement ("EIS"), is to describe the environmental impact of the proposed action, any adverse environmental effects which cannot be avoided should the 3 proposal be implemented, alternatives to the proposed action, the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. The requirement to prepare an EIS serves two important purposes: 1) it ensures the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts, and 2) it guarantees that the relevant information will be made available to the larger audience that may also play a role in both the decision making process and the implementation of that decision. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989).

Before preparing an EIS, an agency may prepare an Environmental Assessment ("EA") if it is uncertain whether a proposed action may have a significant effect on the environment. 40 C.F.R. § 1508.9. The purpose of an EA is to provide the agency with

3 sufficient evidence and analysis for determining whether to prepare an EIS or to issue a FONSI. *Metcalf v. Daley*, 214 F.3d 1135, 1143 (9th Cir. 2000) (citing 40 C.F.R. § 1508.9).

NMFS' Draft EA does not satisfy the intent or requirements of NEPA because it fails to take a hard look at the effects of the proposed hatchery programs, which present an abundance of known and potentially significant adverse effects on the environment, and in
4 particular, on threatened fish species. [redacted]

5 [redacted]
Without a meaningful evaluation of the effects of the proposed hatchery programs, NMFS' Draft EA fails to meet the requirements of NEPA. As these comments explain, and the Draft EA recognizes, scientific literature has documented and raised substantial questions about the
6 significant adverse effects that the proposed hatchery programs will have on the environment, thereby warranting a full evaluation in an EIS.

A. The Pending Determination Will Have Significant Effects on the Environment.

7 [redacted]

In addition to the brief comments provided below, the need to prepare an EIS is supported by the declarations, reports, and comments attached hereto.

If an agency decides not to prepare an EIS, it must supply a "convincing statement of reasons" to explain why a project's impacts are insignificant. *Blue Mts. Biodiversity Project*
7 *v. Blackwood*, 161 F.3d 1208, 1212 (9th Cir. 1998) "The statement of reasons is crucial to determining whether the agency took a 'hard look' at the potential environmental impact of a project." *Id*. NMFS has failed to provide a sufficient explanation of why the proposed hatchery programs are insignificant and therefore do not warrant preparation of an EIS. Indeed, NMFS does not even attempt to state that the proposed actions will be insignificant in the Draft EA.

An EIS is required where substantial questions are raised as to whether the proposed agency action *may* have a significant effect on the environment. *Klamath Siskiyou Wildlands Ctr. v. Boody*, 468 F.3d 549, 562 (9th Cir. 2006); *Nat'l Parks & Conservation Ass'n v. Babbitt*, 241 F.3d 722, 730 (9th Cir. 2001). This is a low standard. *Klamath Siskiyou Wildlands Ctr.*, 468 F.3d at 562.

The hatchery programs proposed in the draft EA meet the threshold for preparation of an EIS because of the programs' significant adverse effects. Various scientific studies, technical memoranda, and agency documents highlight the serious ecological risks that hatchery fish pose to native salmonids. *See, e.g., First Declaration of Gordon Luikart*, ¶ 7
8 (discussing Araki et al., 2007a,b, Araki et al. 2009, Christie et al. 2011, Christie et al. 2012, Normandeau et al. 2009; Theriault et al. 2011; Grant 2011; Lorenz et al. 2012). The artificial propagation programs will harm ESA-listed species and impede their ability to recover through genetic interactions (lowering reproductive fitness), ecological interactions (competition for resources), predation, and facility effects (migration impediments). The

hatchery programs also pose significant risks associated with diseases and pathogens. Native salmonids will be even more vulnerable to the risks posed by hatchery practices due to the
8 degraded environmental conditions caused by the dam removal process in the Elwha River, such as large sediment loads.

These are not just general problems with hatcheries—specific aspects of the hatchery programs proposed in the Draft EA are likely to have significant adverse effects on wild fish species. The attached expert declarations highlight some of the specific problems that the activities and programs in NMFS' Pending Determination pose for threatened fish species. NMFS' failure to acknowledge these significant effects and analyze them in an EIS would violate NEPA requirements.

NMFS recognized in the Draft EA that "hatchery programs can adversely affect natural-origin salmon and steelhead and their habitat through genetic risks, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer." Despite acknowledging these adverse effects, the Draft EA failed to
9 provide a detailed discussion of the effects of hatchery programs on salmon, steelhead, and their habitat, deferring instead to the outdated and unrelated draft EIS for the Columbia River Basin. The failure to provide a more robust discussion in the Draft EA about the effects of hatchery operations on wild fish results in a NEPA document that fails to provide the analysis required.

Regulations promulgated by the Council on Environmental Quality ("CEQ") direct agencies to consider both the context and intensity of a proposed action when considering
10 whether an EIS is required. 50 C.F.R. § 1508.27. Context refers to the setting in which the proposed action takes place. *Id.* at § 1508.27(a). Intensity means "the severity of the impact." *Id*. at 1508.27(b). CEQ regulations provide several factors to consider in determining whether

a significant effect may result. These factors are non-exclusive, and the potential presence of 10 even one significant factor is sufficient to require the preparation of an EIS. *Ocean Advocates v. U.S. Army Corps of Eng'rs*, 402 F.3d 846, 865-66 (9th Cir. 2005).

NMFS is proposing to authorize under the ESA hatchery programs in the Elwha River on the Olympia Peninsula in Washington. The Elwha and Glines Canyon dams have blocked approximately ninety percent of the salmonid spawning habitat in the Elwha River basin and resulted in a massive drop in the size of the populations. Despite the critically small population sizes that exist from the blockage of the river by the dams, several species of salmonids remain in the Elwha River. These include three species that are listed as threatened under the ESA—Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout. After the removal of these dams, wild fish species will again be able to reach the upstream passage in the Elwha River Basin, providing an invaluable opportunity to restore legendary fish runs in the river. This is the largest dam removal project in U.S. history, which provides an unparalleled opportunity to restore wild fish populations in a pristine wilderness environment.
11 NMFS' proposed actions have and will continue to frustrate this historic restoration opportunity through the harm that the hatchery programs cause to wild fish species. NMFS must prepare an EIS to take a hard look at the effects of the proposed action in this historic context.

The restoration of these fish populations is a not just a matter of local or regional concern: in the Elwha Act of 1992, Congress mandated the full restoration of the Elwha River ecosystem and native anadromous fisheries. At an expected cost to taxpayers of approximately $324.7 million, this fish restoration project is a project of national importance. The proposed action threatens to prevent the full recovery of these wild fish stocks throughout the Elwha River through the infusion of 7.4 million hatchery fish each year. To protect these

11 national interests and ensure that the purpose of the Elwha Act is upheld, NMFS must analyze the effects of the proposed action in an EIS.

The intensity of NMFS' proposed action implicates several of the CEQ significance factors, thereby warranting the preparation of an EIS. One of the most important of these factors in determining whether a federal action may have a significant impact on the environment is whether the proposed action *may* adversely affect species listed as endangered or threatened under the ESA or their critical habitat. 40 C.F.R. § 1508.27(b)(9); *see also Klamath-Siskiyou Wildlands Ctr. v. United States Forest Serv.*, 373 F.Supp.2d 1069, 1080-81 (E.D.Cal. 2004). As these comments have already explained, the proposed hatchery programs will seriously frustrate the preservation and restoration of native fish species that are protected
12 under the ESA: Puget-Sound steelhead, Puget-Sound Chinook salmon, and bull trout. Studies on both spring Chinook and winter and summer-run steelhead show that there is a non-negligible risk of reduced fitness for returning adults. Indeed, recent studies involving winter-run and summer-run steelhead have shown that the reproductive success of naturally spawning progeny of supplementation hatchery fish whose parents were wild is significantly lower than wild fish. Additionally, the hatchery programs include proposals to transplant adult and/or juvenile hatchery offspring to the upper Elwha basin for release while also releasing hatchery juveniles into the lower river. Releasing hatchery juveniles into the lower river will create severe competition for food and rearing space for the migrants from the upper basin, resulting in take of ESA protected fish. Because the hatchery fish are and will continue to increase competition, reduce fitness, and disrupt the feeding and breeding of the native salmonids, the hatchery operations will cause take of Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout. These are the types of adverse effects that must be analyzed in an EIS.

Some of the risks that the HGMPs pose to threatened and endangered fish species were raised in the Review of the Elwha River Fish Restoration Plan and Accompanying HGMPs prepared by the Hatchery Scientific Review Group in January 2012, a copy of which
12 is attached hereto. Additionally, the attached declarations explain many of the specific threats that the hatchery programs pose to threatened and endangered fish species. These examples provide substantial information that the proposed actions will have significant effects on ESA-listed species, warranting the preparation of an EIS.

NMFS' Draft EA completely failed to provide a meaningful evaluation of the effects of the proposed action on other ESA-protected species: bull trout, eulachon, and the Southern Resident Killer Whale. The draft EA lumps bull trout and eulachon into the "other fish" category and does not consider the negative effects that hatchery fish could have on these species through ecological interactions and predation. Without considering all of the potential and known significant effects on these ESA-protected species, the Draft EA provides an unsupported conclusion that the proposed action "would not be expected to change the Federal or State listing status" of these species. Similarly, the only consideration that the
13 Draft EA provides to the effects on the Southern Resident Killer Whale is an unsupported conclusion that the proposed action "would not be expected to change the Federal listing status of" the Southern Resident Killer Whale. A true evaluation of the effects on the Southern Resident Killer Whale should have included an analysis of the potential for reduced fish populations over time due to negative influence of hatchery fish. NEPA requires a more detailed analysis of the significant effects of the proposed action on the size, health, and survival of these ESA-listed species, not just on whether there will be a change to their listing status.

Most egregiously, the Draft EA fails to mention or consider the effects of the proposed action on the critical habitat designated for Puget Sound Chinook salmon and bull trout.
14 These proposed actions are likely to adversely modify these areas of designated critical habitat by flooding them with hatchery fish. The Draft EA's silence on these issues should be evaluated in an EIS.

As the largest dam project in U.S. history, the success of the corresponding Elwha River fish restoration will set important precedent for future dam removal and fish restoration projects. Without taking a closer look at the resulting environmental effects of the hatchery projects now, NMFS risks not only impeding the success of this restoration project, but also future projects that may rely on this NEPA analysis as an example of the effects of hatchery programs as a tool to restore fish populations after dam removal. Further, the lack of similarly sized fish restoration projects following a dam removal project presents a novel factual situation about which NMFS has no data or experience. Therefore, NMFS must complete a robust evaluation of the novel questions presented by the proposed actions due to the lack of similar NEPA evaluations or information regarding the significant effects of
15 hatchery programs in a similar context.

NMFS has approved few HGMPs for a hatchery programs since promulgating the ESA 4(d) regulations. Without sufficient prior NEPA evaluations for approved HGMPs, NMFS is heading into unchartered waters, which warrants a "hard look" at the effects of hatchery programs on the environment. This NEPA process and these hatchery programs will set important precedent about the level of analysis that NMFS provides to hatchery programs and the types of hatchery programs that meet the ESA's requirements. Accordingly, heightened scrutiny of the proposed action is necessary to ensure that NMFS recognizes all of the potential effects and does not make irreversible commitments of resources before

15 weighing the serious risks posed by these programs. The presence of these precedent-setting factors warrants the preparation of an EIS.

16 NMFS also must prepare an EIS if a proposed action is highly controversial. A proposal is highly controversial when there is "a substantial dispute [about] the size, nature, or effect of the major Federal action rather than the existence of opposition to a use." *Blue Mountains*, 161 F.3d at 1212. Here, NMFS' hatchery proposals have generated significant local and national controversy due the serious potential that the programs will frustrate the restoration of wild fish populations as they are able finally able to reach the free-flowing waters of the Elwha River basin. Indeed, the hatchery programs are currently the subject of ongoing litigation. Moreover, the proposed hatchery programs are based upon a highly controversial assumption: that the resulting sediment levels from the removal of the dams on the Elwha threaten the continued existence of the remaining populations of native salmon and steelhead, thereby warranting supplementation and assistance from hatchery programs. The controversy surrounding this assumption and the resulting hatchery programs is based not only on the use of hatcheries in this process, but also on the massive scope and particular details of the hatchery programs, thereby warranting additional analysis through an EIS.

17 Another factor that warrants an EIS is the unique characteristics of the geographic area of the proposed action, which includes its proximity to park lands and other ecologically critical areas. *See* 50 C.F.R. § 1508(b)(3). The hatchery programs proposed to be approved will flood the newly-opened Elwha River with hatchery fish. The vast majority of the Elwha River watershed is within the Olympic National Park and the Olympic Wilderness Area. Indeed, the river's watershed encompasses approximately 321 square miles, of which approximately 267 square miles are within the boundaries of the Olympic National Park. These park lands provide extensive pristine habitat for threatened fish species to reach once

the dams on the Elwha River no longer provide an impediment to fish passage. The characteristics of this area are unmatched and this habitat provides an unparalleled opportunity to restore fish runs that were decimated by the Elwha Dams and to study the effects of dam removal on fish populations in optimal conditions.

17 Along the same lines, the proposed hatchery programs threaten to contaminate wilderness areas unspoiled by the footprint of industry and commerce. [redacted]

NMFS cannot avoid the preparation of an EIS by relying on purported beneficial effects of the proposed hatchery programs because actions that an agency believes will be beneficial on balance still require an EIS if there will be a significant effect on the
18 environment. 50 C.F.R. § 1508.27(b)(1). Therefore, NMFS cannot fast track the proposed hatchery programs without preparing an EIS by claiming that the actions will preserve fish populations during dam removal process or strengthen habitat conditions after the dam removal. The actual benefits of these actions are questionable and are outweighed by the serious adverse effects of the proposed actions.

B. The Draft EA Inappropriately Includes Illegal Hatchery Programs in the Baseline.

The Draft EA states that the environmental baseline includes a continuation of hatchery programs. These programs have been conducted illegally without approval under the ESA 4(d) Rule and are the subject of litigation challenging their continuation. That the
19 proposed hatchery programs have been and are currently being operated in violation of the ESA triggers yet another factor warranting the preparation of an EIS. 40 C.F.R. § 1508.27(b)(10). Further, these programs are funded by the United States government.

To fully assess the effects of the hatchery programs, NMFS should have compared the proposed action to a baseline without any continued hatchery influence. In the absence of any differences between the proposed action and the baseline conditions, NMFS cannot meaningful understand or evaluate the effects these hatchery programs have on the

19 environment. For example, NMFS acknowledges that "the operation of the Elwha River hatchery programs would be the same as under Alternative 1 [], so the hatchery programs would have identical impacts on natural-origin Chinook salmon and their habitat as under Alternative 1. There would not be any change in risks associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer relative to Alternative 1." Draft EA at 59. This statement demonstrates that NMFS' inclusion of the proposed hatchery programs in the baseline has foreclosed an actual evaluation of the effects of the proposed action.

C. The "No Action" Alternative Inappropriately Assumes a Continuation of Illegal Hatchery Programs.

Agencies must include a no action alternative in their NEPA analyses and give the no action alternative "meaningful consideration" in order to avoid violating NEPA's mandates. *See Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1230 (9th Cir. 1988). "The no action alternative is meant to provide a baseline against which the action alternative . . . is

20 evaluated." *Ctr. for Biological Diversity v. U.S. Dep't. of Interior*, 623 F.3d 633, 642 (9th Cir. 2010). A no action alternative is supposed to "facilitate comparison of the environmental impacts of the proposal and the alternatives." *Valley County v. United States Dep't of Agric.*, 2012 U.S. Dist. LEXIS 106667 (D. Idaho July 27, 2012) (citing 40 CFR § 1502.14) (internal quotation omitted). NEPA's required no action alternative "is meaningless if it assumes the

existence of the very plan being proposed." *Friends of Yosemite Valley v. Scarlett*, 439 F. Supp. 2d 1074, 1105 (E.D. Cal. 2006) (finding that a no-action alternative could not properly include elements of an illegal plan).

The Draft EA defines the "no action" alternative as NMFS taking no action on the submitted joint plan. The Draft EA assumes that, under such circumstances, the illegal hatchery operations would continue under baseline conditions, including the Chambers Creek steelhead program (the Draft BA contradicts this assertion elsewhere by falsely stating that the Chambers Creek program was discontinued in 2011). These programs have been conducted illegally without approval under the ESA 4(d) Rule and are the subject of litigation challenging their continuation. Further, these programs are funded by the United States government. Accordingly, the "no action" alternative cannot assume that the illegal conduct will continue and be funded with federal tax dollars. The "no action" alternative should
20 assume the programs and funding therefor will be discontinued. By failing to include a true "no action alternative," NMFS did not compare the effects of the proposed action against the effects of taking no action, thereby rendering NMFS' analysis virtually meaningless. As a result, the Draft EA fails to meet the NEPA's purpose and mandate regarding the no action alternative.

In the Final EA approving HGMPs for hatchery programs on the Sandy River in Oregon, NMFS took a very different stance on the no-action alternative—that the failure to approve the HGMPs would result in "termination of all hatchery programs as described in the HGMPs." Final Environmental Assessment: Determination that the Hatchery and Genetic Management Plans for Sandy River Programs Submitted by the Oregon Department of Fish and Wildlife Satisfy the Endangered Species Act Section 4 (d) Rule under Limit 5 (September 2012) at 17. Yet NMFS has taken the opposite position in the Draft EA—that the no action alternative would result in the continuation of these hatchery programs. NMFS' differing approaches for similar situations is arbitrary.

NMFS' assumption that the hatchery programs will continue regardless of the agency's NEPA decision ignores the fact that the federal government has the ability to affect
20 the size and scope of these hatchery programs through its funding and/or Rule 4(d) approval. Indeed, the federal government has been and plans to continue providing significant funding for these hatchery programs. NMFS should have incorporated into the no-action alternative an evaluation of the hatchery programs in the absence of federal funding or support, which could have resulted in an analysis of a no-action alternative that included substantially smaller hatchery activities.

D. NMFS Has Prepared an Unreasonable Range of Alternatives

NEPA requires that an agency "[r]igorously explore and objectively evaluate all reasonable alternatives." 40 C.F.R. § 1502.14(a). The requirement that alternatives be given full and meaningful consideration applies to EAs as well as to EISs. *Native Ecosystems Council v. U.S. Forest Serv*., 428 F.3d 1233, 1245-46 (9th Cir. 2005). NMFS has failed to consider a reasonable range of alternatives in the EA that would substantially reduce or eliminate the adverse effects to threatened and endangered species.

21 The purpose and need statement is a crucial part of crafting a reasonable range of alternatives because only a sufficiently broad statement will allow full development of an adequate range of alternatives. *See, e.g., Simmons v. U.S. Army Corps*, 120 F.3d 664 (7th Cir. 1997); *Davis v. Mineta*, 302 F.3d 1104, 1118 (10th Cir. 2002). Agencies cannot unnecessarily limit or interpret their purpose and thereby place unnecessary limits on the range of alternatives. *Id.*; *see also Van Abbema v. Fornell*, 807 F.2d 633, 638 (7th Cir. 1986), *see also 'Ilio'ulaokalani Coalition v. Rumsfeld*, 464 F.3d 1083 (9th Cir. 2006).

NMFS' range of alternatives is insufficient because the purpose and need of the
proposed actions are drawn too narrowly. Draft EA at 5. In the explanation of NMFS'
rejection of alternative four, NMFS clarifies that the purpose and need are based upon the
assumption that hatchery programs are necessary for fish restoration in the Elwha River in a
21 20 to 30 year time frame. Draft EA at 17. This assumption is flawed because it ignores the
evidence that the hatchery programs will frustrate and impede the fish restoration in the
Elwha River, both during the stated time frame and the long-term. A full restoration of native
fish stocks is not only possible, but more probable, without the influence of hatchery
programs.

[redacted]
22 A
smaller alternative such as this would likely reduce the adverse effects on the environment, in
particular the fish species listed under the ESA.

NMFS' proposed action area is drawn too narrowly because it ignores the effects that
hatchery fish will have outside of the area where "Elwha River fish would be spawned,
incubated, reared, acclimated, released, or harvested." EA at 6; EA at 20. The hatchery fish
23 will travel beyond these areas and harm wild fish far outside of the action area. Such areas
include the entire Elwha River watershed and other rivers where hatchery fish may stray.
[redacted]

E. NMFS Has Relied Upon Faulty Assumptions

24 NEPA requires that agencies provide high quality information before making
decisions and taking actions. *W. Watersheds Project v. Kraayenbrink*, 632 F.3d 472, 492 (9th

Cir. 2011). Yet the Draft EA relies upon a series of false assumptions and questionable scientific conclusions to analyze and eliminate alternatives from consideration. Notably, the Draft EA relies on monitoring, evaluation, and adaptive management that are not funded and not reasonably likely to occur.

Further, Alternative 3's critique was based upon a highly controversial and baseless assumption—that the lack of hatchery programs after 2019 may increase the risk of extirpation and delay attainment of a viable abundance level for fish species. Draft EA at 60. To the extent that there is a question about how long it will take for conditions in the Elwha River to support abundant populations, NMFS should not rely upon the more risky answer to provide carte blanche for the hatcheries to continue past 2019. Additionally, the Draft EA also relies upon the false assumption that under Alternative 3, after hatchery programs are terminated, the total number of salmon and steelhead would decrease. Draft EA at 78.

24 NMFS' assumption is highly questionable and does not acknowledge that wild fish could thrive after discontinuation of the hatchery programs.

[redacted] EA at 61 and 65. [redacted] The Draft EA also falsely assumes that genetic diversity will be improved through the introduction of hatchery fish—indeed, the risks that hatchery fish will produce genetically inferior populations is must greater than any purported gains in genetic diversity that will result from the hatchery operations. Draft EA at 65.

F. NMFS Cumulative Impacts Analysis is Insufficient.

In addition to the proposed action, agencies must consider other actions, "which when viewed with other proposed actions have cumulatively significant impacts." 40 C.F.R. § 1508.25(a)(2). A cumulative impact is defined as "the impact on the environment which results from the incremental impact of the actions when added to other past, present, and
25 reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions." 40 C.F.R. § 1508.7. Cumulative impacts include direct as well as indirect effects, "which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8(a).

The Draft EA ignores the long-term foreseeable cumulative impacts of the proposed actions on fish species. In particular, the Draft EA ignores the compounding adverse genetic effects and the reduced fitness levels that will become more pronounced overtime as the
26 hatchery programs continue. Rather than acknowledging that these genetic problems could get worse over time when combined with the negative potential effects from climate change, the Draft EA suggests that the proposed hatchery programs will actually have positive genetic effects through a genetic "safety net."

The cumulative impacts discussion admits some of the significant adverse effects that climate change will pose to the environment and ESA-listed fish species. Draft EA at 97-98. Some of these effects, such as increased incidence of disease breakouts and virulence in juveniles, will be exacerbated by the increased effects of disease and pathogens introduced by
27 the hatchery programs. The Draft EA's cumulative impacts conclusion is based upon the false assumption that the monitoring and adaptive management program would protect ESA-listed species and mitigate potential adverse cumulative impacts. EA at 96. As these comments have explained, the adaptive management and monitoring programs are insufficient

and unfunded. Therefore, the Draft EA has wrongly relied on these programs to ignore the
27 significant impact of cumulative impacts.   As a result, the EA fails to propose any limitations
on the proposed actions or less harmful alternatives.

Finally, the Draft EA fails to account for the cumulative impacts resulting from other
28 hatchery programs in the Puget Sound region. Many of these programs have been operating
without 4(d) approval and are currently under review by NMFS.

VII. Incorporation of Documents.

In addition to the comments provided herein, Commenters hereby incorporate with
29 this reference the reports, comments and declarations attached hereto. These documents
provide further details regarding the issues addressed by Commenters.

SMITH & LOWNEY, P.L.L.C.

By: _s/ *Brian A. Knutsen*_
Brian A. Knutsen

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- **Appendix B: Review of the Draft Elwha Summer/Fall Chinook Hatchery and Genetic Management Plan (HGMP), Hatchery Scientific Review Group (July 27, 2012);**
- **Appendix C: First Declaration of James A. Lichatowich**
- **Appendix D: First Declaration of Jack A. Stanford;**
- **Appendix E: First Declaration of Gordon Luikart;**
- **Appendix F: Comments on WDFW Elwha Summer/Fall Chinook Hatchery Program, Nick Gayeski, Wild Fish Conservancy (July 20, 2012).**

APPENDIX A

Review of the Elwha River Fish Restoration Plan and Accompanying HGMPs

January 2012

Prepared by

Hatchery Scientific Review Group

Review of the Elwha River Fish Restoration Plan and Accompanying Hatchery and Genetic Management Plans

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Acronyms and Abbreviations

ad-clip	adipose clip
cfs	cubic feet per second
DPS	Distinct Population Segment
Elwha Plan	Elwha River Fish Restoration Plan
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
HGMP	Hatchery and Genetic Management Plan
HOR	hatchery-origin recruit (the number of HORs equals the sum of HOS + hatchery-origin broodstock + hatchery-origin fish intercepted in fisheries)
HOS	hatchery-origin spawners
HSRG	Hatchery Scientific Review Group
LCFRB	Lower Columbia Fish Recovery Board
LEKT	Lower Elwha Klallam Tribe
M&E	monitoring and evaluation
mSAT	microsatellite
MSY	maximum sustainable yield
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	natural-origin recruit (the number of NORs equals the sum of natural-origin broodstock + NOS + natural-origin fish intercepted in fisheries)
NOS	natural-origin spawner
NPDES	National Pollutant Discharge Elimination System
NWIFC	Northwest Indian Fisheries Commission
pHOS	proportion of effective hatchery-origin spawner
Plan	Elwha River Fish Restoration Plan
PNI	proportionate natural influence
pNOB	proportion of hatchery broodstock comprised of natural-origin fish

PNPTC	Point No Point Treaty Council
PSIT	Puget Sound Indian Tribes
PSSMP	Puget Sound Salmon Management Plan
PSTT	Puget Sound Treat Tribes
RM	river mile
SAR	smolt to adult survival rate
SASSI	Salmon and Steelhead Stock Inventory
Tribe	Lower Elwha Klallam Tribe
USGS	United States Geological Survey
VSP	viable salmonid populations
WDFW	Washington Department of Fish and Wildlife

Review of the Elwha River Fish Restoration Plan and Accompanying Hatchery and Genetic Management Plans

Key Findings and Recommendations

In response to a request from the Lower Elwha Klallam Tribe (Tribe or LEKT) and Washington Department of Fish and Wildlife (WDFW), the Hatchery Scientific Review Group (HSRG) has reviewed the Elwha River Fish Restoration Plan (Elwha Plan, Restoration Plan, or Plan)(Ward et al. 2008) and associated Hatchery and Genetic Management Plans (HGMPs) to assess the benefits and risks of the proposed programs for re-establishing self-sustaining populations of five species of anadromous fish (Chinook, coho, chum, and pink salmon and steelhead) in the Elwha River Basin. Detailed discussion of the approach to analysis is provided in Chapter 1 of this report. The conclusions the HSRG reached for each of the five fish species are presented in Chapters 2 through 6, with Chapter 7 focusing on the importance of monitoring, evaluation, and adaptive management. The following discussion summarizes the HSRG's key findings and highlights program modifications the HSRG believes are critical to program success.

Key Findings

The restoration of salmon and steelhead populations to their historic distribution in the Elwha River is cause for celebration. Salmon populations are likely to effectively recolonize the watershed as access to quality habitat above the Elwha and Glines Canyon dams is reestablished and habitat at the dam sites and below is improved. The HSRG believes there is every reason to be optimistic about the future of salmon and steelhead populations and the value they provide to the community. The main concern the HSRG has with the Elwha Plan is the potential for unintended negative consequences of excessive and prolonged hatchery influence. This issue should be addressed through a strengthened adaptive management component, including detailed monitoring procedures and protocols, to ensure that the benefits of hatchery intervention outweigh the risks. Revised adaptive management and monitoring plans should be developed as soon as possible and subjected to peer review before implementation.

Benefits of the Proposed Plan

In general, hatcheries can play a significant role in the conservation, recovery, and rebuilding of natural populations of salmon and steelhead and have the potential to provide opportunities for sustainable harvest. The HSRG identified the following specific benefits that may result from implementation of the Restoration Plan:

- Adding viable natural populations that provide support for the broader Evolutionarily Significant Units (ESUs) as a whole.
- The strategy is likely to be successful at preserving the existing genetic resources of salmon and steelhead throughout the period of adverse habitat conditions during and immediately following dam removal in the Elwha Basin.
- Nutrification resulting from increased natural spawning will benefit ecological processes in the Elwha Basin (Appendix A).
- Larger spawner abundance may help improve spawning habitat through bioturbation.
- The project as currently planned could provide harvest opportunities through selective harvest of hatchery fish.

Risks/Unintended Negative Consequences of the Plan

The risks associated with hatchery programs are well-documented; they include adverse genetic, ecological, and behavioral changes; increased potential for overharvest; and transmission of disease from hatchery fish to native stocks. The HSRG identified the following as specific risks associated with implementation of the Elwha Plan, as proposed:

- Prolonged hatchery influence may lead to loss of fitness of natural populations, potentially resulting in reduced or delayed restoration and loss of long-term sustainable harvest opportunities.
- Ecological interactions of hatchery fish may reduce or delay recovery of native species, especially at the juvenile life stages during the recolonization phase, before ecological functions within the Elwha Basin have been restored.
- Inadequate program monitoring may lead to management decisions that reduce or delay recovery, rather than promoting it, and prevent managers from identifying and testing alternatives that could be more effective.
- Inadequate monitoring may lead to poorly-informed management responses to external events and conditions (e.g., changing climate conditions) that affect program outcomes.
- Inadequate monitoring and evaluation represents a lost opportunity to gain knowledge that could lead to more effective restoration and long-term fisheries management in the Elwha Basin and elsewhere.
- Prolonged influence of hatchery fish may lead to loss of fitness of natural populations, potentially resulting in reduced or delayed restoration and loss of long-term sustainable harvest opportunities.

Likelihood of Success of the Plan

The greatest concern the HSRG has about the likelihood of success of the restoration program is the use of an extensive hatchery program combined with the lack of a structured adaptive management process driven by an effective monitoring and evaluation program. The monitoring program should be designed to focus on those key assumptions that: a) directly affect decisions that move the project toward success, b) involve uncertainty about the “true” value, and c) can be measured with sufficient accuracy and precision to be useful.

Based on extensive analysis of hatchery programs and salmon and steelhead populations throughout the Pacific Northwest, the HSRG has identified three fundamental principles that must be followed for hatchery programs to be effective tools in management. These are:

1) Clear and explicit goals

2) Scientific defensibility

3) Monitoring and evaluation that drives adaptive decision-making

When hatchery programs do not adhere to these principles, the likelihood of success is reduced and the risk of unintended negative consequences increases. The Elwha Plan must be improved in all three of these areas.

Issues related to goal setting are addressed in the species-specific chapters that follow (Chapters 2 through 6), as is the scientific defensibility principle. Clear and explicit goals are needed to define a program’s path, while the scientific defensibility principle simply means that the scientific method should be applied (Platt 1964), where a working hypothesis is developed under which the proposed strategy will contribute to achieving the program goals, while avoiding negative consequences.

The third principle requires two things that are missing in the Elwha Plan: 1) a structured annual decision-making process with explicit, predefined decision rules, and 2) a decision-focused monitoring and evaluation plan. Without a structured adaptive management process supported by an effective monitoring and evaluation plan, the restoration program may fail in several ways:

1) Wrong decisions may be made, leading to delay or failure to meet the full restoration goal. For example, the longer the termination of hatchery intervention is delayed, the slower the recovery of fitness. For example, it is possible that if the abundance trigger for ending hatchery outplants is too high or poorly measured, recovery may be delayed for decades. Hence, monitoring performance indicators that drive decisions are critical to project success.

2) If uncertainties affecting the decision rules are not effectively addressed, not only may achievement of goals be delayed, but explanations for failure will be lacking. In other words, we failed because we were not looking. If we don't know why specific strategies fail, there is little hope that effective remedial action will be undertaken.

3) Removal of the Elwha and Glines Canyon dams offers a unique opportunity to learn about watershed restoration processes. Suppose, for example, that spontaneous colonization is very rapid and efficient (which some scientists argue to be the case). If we fail to recognize and understand this, not only will we delay success by employing ineffective strategies, we also will have wasted valuable financial resources in the process. In other words, when we fail and learn nothing from it, there is a double loss to society.

Recommendations

The following discussion illustrates the approach we recommend to strengthen the adaptive management component of the Elwha Plan and to fill the monitoring and evaluation gaps.

Rather than being tied to specific actions and dates (pre-, during, and post-dam removal), we recommend that Elwha River fish restoration proceed through four biologically defined phases. These are: preservation, recolonization, local adaptation, and full restoration, as defined in Table 1.

Table 1 Definitions of biological phases of restoration, in terms of restoration objectives.

Biological Phases	Objective
PRESERVATION	Secure the genetic identity and diversity of the native population until fish passage is restored and habitat can support survival at all life stages
RECOLONIZATION	Re-populate suitable habitat from pre-spawning to smolt outmigration (all life stages)
LOCAL ADAPTATION	Meet and exceed minimum viable spawner abundance for natural origin spawners. Increase fitness, reproductive success and life history diversity through local adaptation.
FULL RESTORATION	Long-term adaptive management to maintain viable population, in terms of all VSP parameters

The hatchery programs may have a purpose in any of these phases. The phases are generally sequential, but there may be some overlap between several of the phases (e.g., between the preservation and recolonization phases and/or between the recolonization and local adaptation phases). A set of **objectives** should be defined for each phase, and each phase should be terminated and the next one initiated when a set of predefined **indicators** reach specified **trigger values**. The indicators should reflect progress toward the objectives for each phase. These terms are defined as follows:

- **Objectives** refer to parameters that are estimated from observations over time—for some parameters it may take a decade or more to obtain estimates that meet NOAA guidelines for precision.
- **Indicators** are annual outcomes that are indicative of population parameters.
- **Triggers** are critical values for indicators that signal a change in management according to predefined decision rules. Indicators are measured annually, and when trigger values are met, management changes immediately.

We use Elwha Chinook salmon as an example to illustrate these concepts (Table 2). While the specific numbers in the example are hypothetical, they are perhaps not unrealistic.

Table 2 Example of objectives, indicators, and triggers associated with each phase of restoration (Elwha Chinook salmon).

Phase	Objectives	Indicators	Triggers (annual)
Preservation Develop and maintain a hatchery population at Morse Creek	Prevent extinction Retain genetic diversity and identity of existing population.	Adult abundance Life history diversity Genetic profile (e.g., allelic diversity, Ne, metrics of genetic distance from other populations)	Initiate Recolonization Phase when natural spawning produces outmigrant smolts. For example, when 100 unmarked Chinook smolts are trapped in the lower river. Assumes all hatchery juveniles released are marked.
Recolonization Allow 2,000 adults to spawn naturally (HOR+NOR) annually for 5 years	NOR spawner abundance consistently above minimum viable population level (500), with productivity greater than 2 and spawning distributed over 50% of suitable spawning habitat.	NOR abundance, # of stream reaches with redds	Initiate the Local Adaptation Phase the first year when 600 NORs return and redds have been observed in 20 mile segments of Chinook spawning habitat.
Local Adaptation Withdraw hatchery influence. Achieve HSRG broodstock standards (PNI>0.67), i.e., remove HORs from escapement. Reduce hatchery program to an on-station safety net (200 brood, including 100 NORs).	Increasing abundance, diversity and distribution.	NOR abundance, pHOS, and # of reaches with redds	Local Adaptation Phase continues until all HORs returning are from the safety net program. If the NOR run falls below the 600 level, Recolonization Phase is reinitiated until the next time the 600 NOR level is again observed.
Full Restoration Hatchery program eliminated.	Abundance, productivity, diversity, and spatial distribution achieve full potential of the restored habitat. Expressed in terms of VSP parameters, including, e.g., Beverton-Holt productivity of 10 and capacity of 20,000.	NOR recruitment and spawning escapement, pHOS	Eliminate the hatchery safety net the first year the NOR abundance returning to the Elwha exceeds 4,000 adults.

As generally defined, colonization is considered to occur when adults reproduce successfully in the wild. During recolonization of the Elwha, the hatchery adults allowed to spawn during the Recolonization Phase may come from either juveniles released on-station or juveniles outplanted in the habitat at various life stages. Returning adults produced from on-station juvenile releases may either be allowed to distribute themselves volitionally (Strategy 1) or be transported to selected spawning areas (Strategy 2). Hatchery adults may also originate from outplanted hatchery-origin juveniles (Strategy 3).

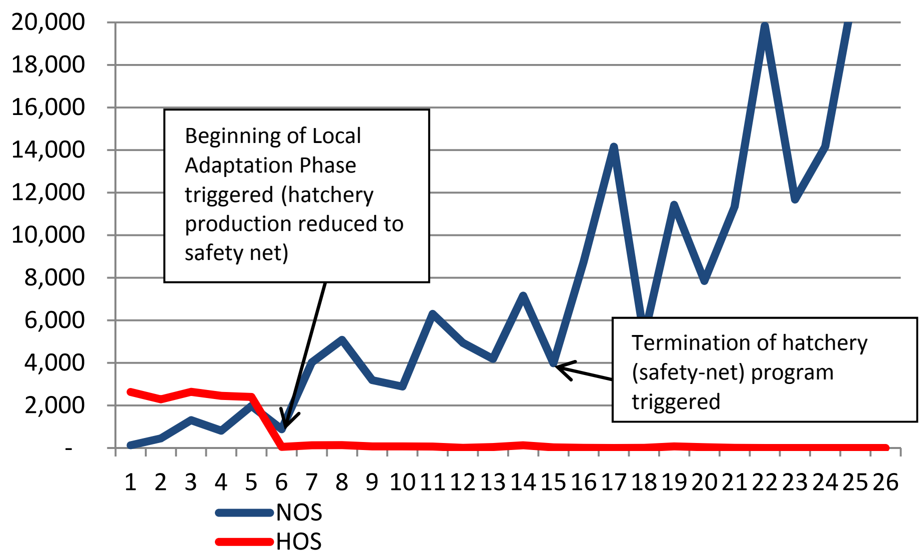
There are significantly different benefits and risks associated with the three hatchery-aided colonization strategies and a fourth spontaneous colonization strategy (Strategy 4). These strategies, risks and benefits are outlined in Table 3. Strategy 4, spontaneous colonization, should be the first priority and Strategy 3, outplanted juveniles, the last. In other words, strategies 1, 2, and/or 3 should be used only to the extent that the benefit-risk picture for Strategy 4 alone is less favorable. The HSRG favors minimal use of hatchery intervention during colonization, with a small-scale, safety net hatchery program maintained through the Local Adaptation Phase, in case population abundance falls below a predefined, minimum viable abundance level.

Table 3 Benefits and risks associated with various colonization strategies.

Colonization Strategy		Benefits	Risks
1	Volitionally distributed HOR adults from on-station releases	Available immediately—resulting NORs return within a generation Less opportunity for negative ecological interactions[1]	Potentially less optimal spatial distribution of natural spawning
2	Outplanted HOR adults from on-station releases	Available immediately—resulting NORs return within a generation Less opportunity for negative ecological interactions	Transported/volitionally distributed adults may "fall back" or fail to distribute themselves as effectively as those from outplanted juveniles
3	HOR adults from outplanted juveniles	Better spatial distribution of HOR spawners	NORs will return at least one generation later (i.e., the colonization will occur about 5 years later) Ecological interactions during rearing and outmigration
4	No further hatchery releases. (Spontaneous colonization)	Reduced fitness loss due to domestication effects resulting in potentially rapid gain in abundance and productivity No adverse ecological interactions	If initial population abundance is very low or repeatedly impacted by adverse habitat conditions, colonization may be delayed or hatchery outplants (from the safety net program) may need to be initiated.

[1] Intra-species competition may be particularly significant due to lack of nutrients until ecological functions have been restored.

The decision rules and triggers outlined in Table 2 are illustrated in a hypothetic example, again using Elwha Chinook salmon, in Figure 1. The example is based on a Beverton-Holt production function with productivity of 10 recruits/spawners and capacity of 20,000 adults (these numbers are half of the corresponding values inferred by the Federal Energy Regulatory Commission (FERC) in its 1993 analysis of alternatives for hydropower project operation, including a decommissioning and dam removal option (FERC 1993). It is further assumed that productivity initially is half again that of the eventual habitat potential (i.e., approximately 5) and a capacity of 10,000. The example also assumes that the fitness of the natural population is half that of a fully locally adapted one (i.e., initial productivity and capacity are 2.5 and 5,000, respectively). The increase in NOR spawners (NOS) is due to habitat improving over time and fitness increasing due to reduced hatchery influence (Ford 2002). A pre-terminal harvest rate of 24% is applied. Log normal survival creates the annual variability in abundance. This example suggests that a short period (5 years) of hatchery contribution to natural spawning is sufficient to assure that the population remains above the minimum viable population level (e.g., 500 spawners) and continues to increase.



In the Preservation Phase and Recolonization Phase, the population relies on hatchery-origin spawners (HOS). In the Local Adaptation Phase, hatchery influences are withdrawn with the hatchery serving as a safety net. As the NOS establish themselves, the hatchery program is eliminated in the Full Restoration Phase.

Figure 1 Hypothetical Elwha Chinook restoration pattern.

Summary of Recommendations

In summary, the HSRG recommends the following key modifications to the proposed Plan. These modifications might be best achieved by updating the HGMPs, and including an adaptive management addendum.

1) Develop a detailed description of a structured adaptive management process (see Chapter 7) with predefined decision rules and the recommended biologically phased approach. This expanded adaptive management plan should be species-specific and based on a set of **objectives** defined for each phase. Measurable **indicators** should be identified that reflect progress toward the objectives. The end of one phase and the beginning of the next should be based on predetermined **trigger** points. As mentioned earlier, the HSRG defines these terms as follows:

    - **Objectives** refer to parameters that are estimated from observations over time—for some parameters it may take a decade or more to obtain estimates that meet NOAA guidelines for precision.

- **Indicators** are measurable annual outcomes (variables) that are sensitive to the population parameters used to define objectives.

- **Triggers** are critical values for indicators that signal a change in management according to predefined decision rules. Indicators are measured annually, and when trigger values are met, management changes immediately.

Within each phase, the decision rules should also specify how natural escapement and hatchery broodstock should be managed to achieve appropriate standards for hatchery influence (pHOS and PNI), as well as the overall size of the hatchery program. Change should be the norm, not the exception.

The adaptive management plan should also define roles and responsibilities and a scheduled set of steps leading to an annual action plan. These steps should include an annual workshop, where new information is brought forward and opportunity for peer review is provided. Decisions for the coming season should be captured in an annual action plan. The adaptive management framework and the decision rules would be incorporated in the HGMPs. The action plan would formalize the Co-managers' annual agreement on how to implement the Plan.

2) Develop a detailed description of a focused, effective and peer-reviewed monitoring and evaluation plan tailored to address the decision rules and key uncertainties (see Chapter 7).

3) Finally, the HSRG recommends that the recolonization efforts focus more on adults (volunteers or outplanted) and less on juvenile outplants, especially for Chinook, coho, and steelhead.

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1 Introduction

1.1 Purpose of the Review

The Lower Elwha Klallam Tribe (Tribe or LEKT) and Washington Department of Fish and Wildlife (WDFW) collaborated with their federal partners to develop the Elwha River Fish Restoration Plan (Elwha Plan, Restoration Plan, or Plan)(Ward et al. 2008). The Plan identifies strategies required to preserve and restore Elwha River fish populations before, during, and after removal of the Elwha and Glines Canyon dams. In addition to habitat restoration methods, it includes descriptions of fish stock restoration, artificial propagation, population recovery objectives, and monitoring and adaptive management needs. The Tribe and WDFW are Co-managers for the restoration of fish stocks (several of which are federally listed or candidates for listing under the Endangered Species Act [ESA]) and management of hatcheries in the Elwha Basin (respectively), and have prepared Hatchery and Genetic Management Plans (HGMPs) that provide additional details regarding implementation of the Plan for each of the five anadromous fish species addressed in the Plan.

In a letter dated December 6, 2011, the Co-managers requested the Hatchery Scientific Review Group (HSRG) to review "*Chinook, steelhead, coho, chum, and pink salmon hatchery programs in the Elwha River*." The letter further states "*we are asking the HSRG to assess the risks and benefits of the programs, evaluate the likelihood that the programs will achieve the stated goals, and identify any potential program modifications that would improve the likelihood of achieving our goals*." In a response letter dated December 8, 2011, the HSRG agreed to the Co-managers' request and outlined a schedule and approach for the review.

1.2 Premise and Framework for Review

Our approach to the review of the Elwha Plan is guided by a basic premise that has two parts: first, that hatcheries are a compromise – a balance between benefits (desired increase in abundance and/or harvest) and risks (unintended genetic and ecological interactions); and second, that when fisheries managers have selected hatchery production as a tool to meet conservation and/or harvest goals, certain principles must be incorporated into hatchery programs to minimize the risks and maximize the benefits. This premise and both its underlying concepts are described in detail in previously published HSRG documents (HSRG 2009, Paquet et al. 2011).

Hatcheries are tools used to achieve goals; but should not be confused with the goals themselves. For example, hatchery production numbers may be an effective means of contributing to harvest and conservation goals, but hatchery production numbers do not represent the end-point. The hatchery tool can provide benefits, but may also entail risks; the use of the hatchery tool requires explicit recognition and management of the trade-offs between those risks and benefits.

As a result of its comprehensive review of salmon and steelhead hatchery programs in the Pacific Northwest (HSRG 2004, HSRG 2009), the HSRG concluded that three fundamental principles must be followed in order for hatchery programs to serve as effective tools in fisheries management. The principles are:

1) Conservation and harvest goals for natural and hatchery populations must be clear, specific and quantifiable.

2) When hatcheries are used as a tool to meet conservation and harvest goals, they must be designed and operated in a scientifically defensible manner.

3) Hatchery programs must be part of an adaptive management strategy that is based on effective monitoring and evaluation and responsive decision-making.

The HSRG developed 17 recommendations (Paquet et al. 2011) to guide the implementation of the three principles outlined above. These are:

1) Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity).

2) Express harvest goals in terms of a population's contribution to specific fisheries.

3) Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin.

4) Identify the purpose of the hatchery program (i.e., conservation, harvest or both).

5) Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals.

6) Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose.

7) Size hatchery programs based on population goals and as part of an "all H" strategy.

8) Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation. Standards used by the HSRG for broodstock management are as follows:

   HSRG criteria for hatchery influence on Primary populations

   - The proportion of effective hatchery-origin spawners (pHOS) should be less than 5% of the naturally-spawning population, unless the hatchery population is integrated with the natural population.
   - For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater (with pNOB>10%), and pHOS should be less than 0.30.

   HSRG criteria for hatchery influence on Contributing populations

   - The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population. For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB ≥10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

  In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. It is possible to accomplish this by either reducing or totally eliminating hatchery fish. These options, however, would severely reduce most fisheries and the associated economic and cultural benefits, as well as reduce the demographic benefits provided by hatchery programs.

  The HSRG's analysis showed that both conservation goals and harvest goals could be met with an appropriate combination of reduced hatchery production, selective harvest of hatchery fish, and/or selective removal of hatchery adults with tributary traps or weirs.

  Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, proportion of hatchery broodstock comprised of natural-origin fish (pNOB) and PNI.

9) Manage the harvest to achieve full use of hatchery-origin fish.
10) Ensure all hatchery programs have self-sustaining broodstocks.
11) Coordinate hatchery programs within the Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations.
12) Assure that facilities are constructed and operated in compliance with environmental laws and regulations.
13) Maximize survival of hatchery fish consistent with conservation goals.
14) Regularly review goals and performance of hatchery programs in a transparent, regional, "all-H" context.
15) Place a priority on research that develops solutions to potential problems and quantifies factors affecting relative reproductive success and long-term fitness of populations influenced by hatcheries.
16) Design and operate hatcheries and hatchery programs with the flexibility to respond to changing conditions.
17) Discontinue or modify programs if risks outweigh the benefits.

Consistency with the principles and recommendations is a critical part of our review of the Restoration Plan, because the HSRG believes that implementing these principles and recommendations will give the Restoration Plan the best chance for success.

1.3 Analytical Approach

The Elwha was part of the very first hatchery review conducted by the HSRG 10 years ago. Since then, the HSRG has reviewed all salmon and steelhead hatchery programs in the state of Washington and the Columbia Basin (including Oregon and Idaho). The present review incorporates the experience gained in those subsequent reviews, as well as more recent research findings regarding the risks and benefits of hatchery programs.

To begin the present review process, the HSRG considered information included in the Elwha Plan, the HGMPs, and summary information provided by the Co-managers and invited speakers during an HSRG meeting in Port Angeles on December 19-22, 2011. The HSRG then compared the restoration approach proposed for each species to the three principles and 17 recommendations described above, identifying – for each species – areas where the approach is consistent, partially consistent, or not consistent. Finally, the HSRG developed specific recommendations for hatchery program modifications that it believes will assist the Co-managers in reaching their restoration goals.

In conducting this evaluation, the HSRG recognized that the role of hatchery programs in the restoration of the Elwha River ecosystem will change as the river and its salmon and steelhead populations respond to the removal of the Elwha and Glines Canyon dams. Although the Elwha River Fish Restoration Plan structures those changes around three discrete physical/temporal stages of the dam removal process (Table 1-1), the HSRG concluded that the river and its fish populations will move through four more or less distinct biological phases (Table 1-2). We believe the hatchery component of the restoration plan should be driven by the biological responses associated with the physical changes to the environment. For this reason, we recommend that the decision rules for adapting the hatchery strategy to each phase should be based on specified, measurable biological triggers.

Table 1-1 Existing phase structure.

BEFORE DAM REMOVAL
Duration All years prior to beginning of the dam removal. *Activity* Hatchery-based fish production will maintain ongoing enhancement or will be increased to boost total adult returns. *Transition Trigger* Initiation of dam removal.
DAM REMOVAL PERIOD
Duration Initiated and completed during the approximately 3-year removal period. *Activity* Elwha sport and commercial fisheries will be curtailed for all stocks. Because of expected turbidity levels, hatchery production limited to capacity of water treatment facility. Upstream and downstream passage is re-established. *Transition Trigger* Dam removal is completed.
POST DAM REMOVAL PERIOD
Duration Over a 10-year period, turbidity in the Basin is stabilized and water quality approaches natural background levels. *Activity* Hatchery programs increased to full restoration production levels. Adult capture weir phased out and greater emphasis on natural recolonization. Monitoring will assess recovery efforts. *Transition Trigger* Complete the 10-year period.

Table 1-2 Recommended biologically-based phase structure.

PRESERVATION PHASE

Objective

Secure the genetic identity and diversity of the native population until fish passage is restored and habitat can support survival at all life stages

Requirements for success

Key assumptions that must be assessed:

1. Natural production potential and SAR
2. Low harvest rates (if any)
3. Hatchery facilities and operations that ensure abundance and genetic diversity of the sequestered population.
4. Adult weir efficiency
5. Fish health
6. Evidence that habitat can support life stage-specific survival
7. Upstream and downstream passage

Transition Triggers/Decision Rules

This phase is currently in progress. Decision rules with measurable triggers for each species must be identified to determine when the colonization phase will begin. There will be overlap between the preservation and the colonization phases. Decision rules and triggers should be chosen that provide evidence that up and downstream passage is restored at each dam site and that habitat supports survival at all freshwater life stages. Test releases into the habitat may provide some of the information needed to apply decision rules for transition to the next phase. Decision rules must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision.

RECOLONIZATION PHASE

Objective

Recolonize suitable habitat from pre-spawning to smolt outmigration (all life stages)

Requirements for success

Key assumptions that must be assessed include those listed above and the following:

1. Ecological interactions between artificially- and naturally-produced juveniles
2. Genetic interactions
3. Natural production potential
4. Habitat suitability and life stage survivals

Transition Triggers/Decision Rules

This phase will begin when predefined decision rules indicate that habitat can sustain natural production. It will transition to the next phase when another set of decision rules and triggers provide evidence that (for example) distribution is increasing and abundance of naturally-produced fish is above a minimum population threshold level. In years of lower than minimum numbers of NORs returning, additional hatchery-origin recruits (HORs) would be placed in the watershed to spawn.

LOCAL ADAPTATION PHASE

Objective

Achieve local adaptation and life history diversity

Requirements for success

Key assumptions that must be assessed include those listed above and the following:

1. Decision rules for hatcheries, i.e., which programs continue and which ones are terminated?)
2. Emergence of alternative life histories
3. Decision rules for the harvest of naturally-produced fish.

Transition Triggers/Decision Rules

This phase will begin when threshold abundance has been reached on a consistent basis. This phase is characterized by removing the hatchery influence from the population (i.e., manage for pHOS and any continuing hatchery programs for PNI). It will transition to the next phase when another set of decision rules and triggers provide evidence that, for example, a hatchery program is no longer needed as a demographic safety net to prevent extinction.

FULL RESTORATION PHASE

Objective

Long-term adaptive management to maintain viable population, in terms of all VSP parameters.

Requirements for success

Conditions at this point will dictate which of the above key assumptions still need to be assessed. New uncertainties include:

1. Establishing triggers that would, for a given species, revert to an earlier phase (including reinitiating a hatchery program)
2. Establish long-term monitoring

Transition Triggers/Decision Rules

This phase begins when decision rules end the Local Adaptation Phase and continues in perpetuity as productivity increases over time due to local adaptation of the naturally-spawning population to the dynamic conditions (including climate change) of the watershed.

1.4 Organization of the Document

As mentioned above, the HSRG evaluated the proposed restoration approach for each of the five species for consistency with the three principles and 17 recommendations, and summarized our findings for each species for each of the four restorations phases. The results for each species are presented in chapters 2-6, according to the outline below:

Species (Chinook, coho, chum, pink salmon, and steelhead)

- Description of current status and recovery goals
- Assessment of consistency with Principle 1
    - Summary of observations and findings regarding Principle 1, by recovery phase
- Assessment of consistency with Principle 2
    - Summary of observations and findings regarding Principle 2, by recovery phase
- Overall observations, conclusions, and recommendations for the species, by recovery phase

Chapter 7 provides a discussion of Principle 3 and its recommendations. It addresses the need for monitoring, evaluation, and adaptive management of hatchery programs, within the context of conservation and harvest goals. This discussion pertains to hatchery programs for all five fish species.

In addition to Chapter 8 (Citations), the document also includes three appendices. Two of the appendices address topics related to potential uses of surplus hatchery production: nutrification (Appendix A), and selective harvest fishing gear (Appendix B). Examples of an approach to adaptive management (Appendix C) could serve as a template for similar plans needed to support Elwha River fisheries restoration efforts.

2 Chinook Salmon Population Report

Chinook salmon populations in the Elwha River historically displayed a wide range of life history strategies that took advantage of diverse natural habitat conditions present in the river in its pristine state. Remaining components of the historic populations have been retained through natural spawning and hatchery enhancement activities in what is now believed to be a single population. The current population exists in a reduced form: principal entry and spawning dates have been altered over time (shifted to later summer/fall dates) and reduced in duration.

Elwha Chinook salmon are genetically distinct from other Chinook salmon in the Strait of Juan de Fuca and Puget Sound (Ruckelshaus et al. 2006). Spring Chinook salmon, as expressed by early river entry and large adult body size, 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 co-temporal spawning with other populations of Chinook salmon in the lower river are thought to be the primary factors responsible for their demise (Ward et al. 2008).

Maintenance of a Chinook salmon hatchery program using broodstock collected from natural- and hatchery-origin adult returns is expected to provide a composite population on which to base stock restoration (WDFW 2002). Intentional capture and segregation of a discrete spring Chinook salmon component from the greater population was rejected as a restoration strategy, due to reduced population size and the potential for selection biases (Ward et al. 2008).

<u>Population Definition:</u> Elwha Summer/Fall Chinook were identified as a distinct population based on their distinct spawning distribution. Allozyme analysis has shown that Elwha Chinook are genetically distinct from all other Washington Chinook stocks examined (Marshall et al. 1995). Spawning is currently limited to the lower 4.8 miles of the river below the Elwha Dam site.

<u>Population Designation:</u> Assumed to be Primary, though this is not explicitly stated in the Plan (on page 15, the Plan refers to all Elwha populations as primary, as opposed to secondary; it is not clear that this refers to the Primary, Contributing or Stabilizing categories defined by the HSRG and others).

<u>Population Origin:</u> Population components in the wild and in the hatchery originate from native Elwha stock. The WDFW Elwha Hatchery collects broodstock from the Elwha River annually. The wild and hatchery components are intermingled.

<u>ESA Status:</u> The Elwha River Chinook salmon population is included as part of the ESA-listed threatened Puget Sound Chinook salmon Evolutionarily Significant Unit (ESU) (NMFS 2005a). As one of only two Chinook salmon populations delineated for the entire Strait of Juan de Fuca biographical region, recovery of the Elwha River Chinook salmon stock to a viable status is considered a requirement for the recovery and delisting of the Puget Sound Chinook salmon ESU (NMFS 2005b).

<u>Recent Status and Trends:</u> Population status is now rated Depressed due to a long-term negative trend and chronically low escapements since 1992. Spawner abundance has fallen to levels below the current natural escapement goal of 2,900 adults, and the hatchery program is essential for maintenance of the stock at its current abundance level (Table 2-1) (WDFW 2012a).

Table 2-1 Recent natural spawning escapement.

Return Year	Total return to the river (does not include pre-spawning mortality) (1)	Natural Spawning Escapement (NOR + HOR) (2)	pHOS	Hatchery Broodstock (3)	pNOB
	Actual	Actual	Actual	Actual	Actual
2005	2,245	835	unk	1,396	unk
2006	1,924	693	unk	1,227	unk
2007	1,137	380	unk	757	unk
2008	1,155	470	unk	667	unk
2009	2,197	651	96%	1,514	unk
2010	1,283	564	96%	709	unk

1) Recent Total Return to the River target has been 2,900
2) Recent Natural Spawning Escapement target (NOR + HOR) has been a minimum of 500
3) Recent hatchery broodstock target has been 1,700 adults

Recent Hatchery Production: The past proportion of natural-origin fish incorporated as broodstock is unknown. Recent data from mass-marked hatchery-origin adult returns indicate that hatchery-origin fish comprise the majority of the current returning Elwha Chinook salmon population. Considering the long-standing blockage of the mainstem river limiting natural production, and operation of the hatchery program consistent with proposed production levels since 1976 broodstock collection, operations in the mainstem river and at the hatchery facility for the past 20-30 years have likely incorporated a mix of predominantly first generation hatchery fish, with natural-origin fish accounting for a low proportion of totals. The plan is to continue to collect the required number of adult fish from the run-at-large, representative of the current annual total return (WDFW 2011). A coded wire tag (CWT) analysis of the 2002-2005 brood years indicate an average smolt to adult survival rate (SAR) of 0.03% for zero-age smolts and a SAR of 0.02% for yearling smolts (Regional Mark Processing Center 2012).

Table 2-2 Recent hatchery release numbers.

Release Year	Number Released	
	(zero-age smolts) (1)	(Yearling smolts) (2)
2005	2,750,000	424,250
2006	2,957,000	355,900
2007	2,609,000	347,400
2008	1,868,400	484,950
2009	926,000	340,946
2010	3,266,130	402,017

(1) Recent hatchery production targets have been 2,500,000 zero-age smolts
(2) Recent hatchery production targets have been 400,000 yearling smolts (includes Morse Ck releases)

Recent Harvest: For years, the naturally spawning stocks of salmon in the Elwha River were managed as secondary populations, with the hatchery stocks on the river accorded primary status. However, to be consistent with risk-averse harvest management approaches applied to other natural-origin populations in the Strait of Juan de Fuca region, the Tribe and WDFW agreed, beginning in the 1990s, to manage all naturally spawning salmon populations in the Elwha River as primary populations (again, it is not clear that this implies the Primary classification as defined more recently by HSRG and others).

This change helped ensure that all fisheries in U.S. waters south of the Canadian border would be managed to meet natural spawner escapement goals and objectives established for Elwha River salmon populations. In addition, the Tribe and WDFW have agreed to curtail all in-river fisheries for a period of 5 years, beginning in 2012. Following this time, the opportunity to recommence limited fisheries in-river will be evaluated, based on stock status. However, all agencies recognize the objective is recovery of healthy, self-sustaining natural spawning populations to the watershed, and in-river harvest activities will be scheduled to avoid interfering with recovery (Ward et al. 2008).

During the early 1990s, exploitation rates on zero-age smolts from the Elwha were documented to be 35%, with 70% of that occurring outside U.S. waters (1993 brood year CWT analysis presented in FERC 1993). During the 2005 harvest season, the anticipated incidental total exploitation rate was 24%, of which 4.3% was attributable to southern U.S. fisheries directed at other salmon species and populations (Ward et al. 2008).

Further, in the restoration strategy for Puget Sound Chinook salmon, it has been agreed that no directed harvest shall be permitted for Elwha Chinook salmon, and that the total incidental exploitation rate shall not exceed 10% (PSIT and WDFW 2004). It is anticipated that 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.

Presently, no harvest is directed on this stock. Terminal Chinook fisheries (and terminal fisheries for other species, as well) have been curtailed in the Elwha River and marine areas in the proximity of the Elwha River to minimize impacts to listed Chinook. Adult fish are harvested in mixed stock marine waters, particularly the ocean and the Strait of Juan de Fuca, as well as Canadian waters (Ward et al. 2008).

Specific exploitation rates are unknown, due to the lack of an adipose clip (ad-clip) on fish receiving a CWT. While the presence of an adipose fin allows fish to escape the mark-selective fisheries for Chinook in U.S. waters, it also prevents detection in other fisheries (non-U.S.) that use the missing adipose fin as an indicator of a CWT.

Table 2-3 Recent catch estimates.

Year	Total Catch (US only) [1]
2004	0
2005	4
2006	4
2007	4
2008	4

[1] Catches represent non-directed catch in the Chinook fishery (Data from Randy Cooper, WDFW).

Table 2-4 presents a summary of status, trends and restoration goals for Chinook.

Table 2-4 Summer/fall Chinook summary.

Population Designation[1]		Primary
Program Type [2]		Integrated Recovery
Historical Abundance [3]		1,284 - 17,493
Current Escapement [4]		5 year average: Return = 2,200
Restoration Goals	Plan	After 10 years: Returns = 2,000; After 25 years: Escapement = 6,900, Recruitment = 17,000
	HGMP	Adult Escapement: Low Productivity = 17,000 High Productivity = 6,900

1) HSRG assumed designation
2) Source HGMP
3) Range of several estimates
4) Source Ward et al. (2008)

2.1 Principle 1: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

Goals for fish populations must be explicitly communicated and fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (e.g., harvest, conservation, education, research). Hatchery production numbers may be the means of contributing to harvest and/or conservation values, but they are not end-points. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when benefits significantly outweigh the risks, and when the benefit/risk mix resulting from the program is more favorable than the benefit/risk mix associated with non-hatchery strategies for meeting the same goals.

The HSRG has developed three general recommendations as guidelines for defining goals for natural and hatchery populations. The HSRG review of the Elwha Plan in terms of its consistency with Principle 1 is presented with reference to these recommendations.

General Comments on Principle 1

The Elwha Plan does not state the restoration goal for Chinook salmon in terms that conform to the HSRG's recommendations. However, pieces of information are scattered throughout the text of the Plan which, taken in total, can be used to construct a goal. For example, Table 25 (page 97) gives interim restoration targets for abundance after 10 and 25 years, productivity after 10 years and at maximum sustainable yield (MSY), and spatial distribution and harvest goals for Puget Sound and the coasts Washington, Oregon and California. These targets could be part of the restoration goal.

The interim targets are quantitative, but they do not separate natural and hatchery populations, nor are they placed in an "all H" context. Four goals on page 95 are described as central to the implementation of the Elwha Act. They are:

1) Reestablish self-sustaining anadromous salmonid populations and habitats throughout the Elwha River watershed and its near shore as quickly as possible, using the most appropriate methods.

2) Maintain the integrity of the existing salmonid genetic and life history diversity before, during, and after dam removal and the subsequent periods of elevated sediment levels.

3) Maintain the health of fish populations before, during, and after dam removal.

4) Restore the physical and biological processes of the overall ecosystem through dam removal, including the return of viable salmonid populations (VSPs).

Additionally, a parallel goal is found in the NOAA Fisheries guidance documents (NMFS 2010) for recovering ESA-listed salmon species: restoration efforts shall be targeted at achieving VSPs. These goals are not species-specific, nor are they quantitative. They are broad descriptions of things that will be done (tasks), not things that will be achieved (goals). The Plan needs to present a comprehensive, species-specific goal statement near the beginning of the Plan's narrative. The goal statement should comply with HSRG's Principle 1.

2.1.1 Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity).

The Primary, Contributing and Stabilizing population designations refer to the biological significance of the population in the context of its ESU. The following general viability criteria apply (see Recommendation 7):

- Primary: populations must achieve at least high viability
- Contributing: populations must achieve at least medium viability
- Stabilizing: populations must maintain at least current viability
- Viability goals should be expressed in terms of population productivity and abundance
- Viability goals should also take into account spatial structure and diversity (Paquet et al. 2011)

Different definitions of biological significance are used by managers throughout the Northwest. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board in 2004, under which all distinct salmon and steelhead populations are classified as either *Primary,* which are targeted for restoration to high productivity and abundance; *Contributing,* where small to medium improvements are needed; or *Stabilizing,* populations that may be maintained at current levels. Viability goals are expressed in terms of population productivity and abundance and also take into account spatial structure and diversity.

The following applies to all restoration phases:
Decision rules with measurable triggers for the Chinook population must be identified to determine when to transition to the next restoration phase. For the fourth phase (full recovery), the decision rules and triggers should determine if/when it is necessary to revert to an earlier phase. Decision rules must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision. All key assumptions (see Chapter 1.2, Table 1-2) must

be monitored until they are either resolved or it is determined that they are not relevant to the recovery of the Elwha ecosystem. See Chapter 7 for specifics.

- ***Preservation Phase***

  Plan Description. All naturally spawning salmon in the Elwha River are managed as primary populations (Ward et al. 2008, page 15). This should apply to Chinook salmon in the Elwha.

  Presumably, the current Chinook escapement goal (of 2,900 fish and a natural spawning level of at least 500 fish, page 32 of the Plan) would remain the same through at least part of the Preservation Phase. Natural production may be impaired by high sediment levels during dam removal (page 8 of the Plan). The role of the hatchery program, throughout the restoration effort, is to preserve extant populations during dam removal and to help initiate recolonization of the watershed through selective outplanting of Chinook salmon (adults and/or juveniles) in the Basin (WDFW 2002, page 2).

  Observations. The productivity of the naturally spawning element of the Chinook population is not given. Hatcheries will be used as a refuge during dam removal so the Chinook population will be in a position to take advantage of passage to and from the upper river after dam removal.

- ***Recolonization Phase***

  Plan Description. All naturally spawning salmon in the Elwha River are managed as primary populations (page 15 of the Plan). Predicted rebuilding curves for Chinook salmon given on pages 88 and 89 of the Plan could be used to develop specific abundance goals during this phase. Tables 7 and 8 of the Plan (page 36) give the restoration strategies (hatchery releases). Those tables would cover the duration of the Recolonization Phase.

  Observations. As indicated in the general comments on Principle 1, there is no goal statement for the Chinook population that is consistent with Principle 1 and Recommendation 1.

- ***Local Adaptation Phase***

  Plan Description. All naturally spawning salmon in the Elwha River are managed as primary populations (page 15 of the Plan). The naturally produced Chinook population should be rapidly rebuilding during this phase. Page 97, Table 25, of the Plan states that after 10 years of recovery, the expected abundance of adult Chinook salmon spawning naturally regardless of origin should be 2,000 per year; the productivity of natural-origin recruits per spawner should be >1; the expected distribution is up to river mile (RM) 42.9; and the population is expressing the spring and summer/fall life histories.

  Observations. The information given generally satisfies Recommendation 1. However, it should be included in a single goal statement for Chinook salmon close to the beginning of the Plan's narrative.

- ***Full Restoration Phase***

  Plan Description. All naturally spawning salmon in the Elwha River are managed as primary populations (page 15 of the Plan). The Chinook populations in this phase should have reached the full recovery as described on page 97, Table 25. The expected annual abundance of adult

Chinook salmon of natural origin spawning naturally at MSY is 6,900; the productivity of natural-origin recruits per spawner at MSY is 4.6; the expected distribution is up to river mile 42.9; and the population is expressing the spring and summer/fall life histories. It is expected that these targets will be achieved 25 years after dam removal.

Observations. The information given generally satisfies Recommendation 1. However, it should be included in a single goal statement for Chinook salmon close to the beginning of the Plan's narrative.

2.1.2 Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively, where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

- ***Preservation Phase***

  Plan Description. Page 34 of the Plan states that no directed commercial or recreational fisheries on Elwha Chinook salmon will occur during this phase. This same statement is repeated for the original three temporal phases, which would probably cover the first three of the four biological phases used in this review.

  Page 32 of the Plan explains that "*During the 2005 harvest season, the anticipated incidental total exploitation rate was 24%, of which 4.3% was attributable to southern U.S. fisheries directed at other salmon species and populations. Further, in the restoration strategy for Puget Sound Chinook salmon, it has been agreed that no directed harvest shall be permitted for Elwha Chinook salmon, and that the total incidental exploitation rate shall not exceed 10% (PSIT and WDFW 2004). It is anticipated 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.*" Page 89 of the Plan states "*Chinook harvest restrictions in the Elwha River would probably be in place for at least the first two complete cycles (8–10 years). Additional harvest restrictions in localized marine fisheries (e.g., area closures in the Freshwater Bay vicinity) might be necessary during the same period.*"

  Observations. Since Elwha Chinook are not ad-clipped, current reliable estimates of exploitation rates are not available.

- ***Recolonization Phase***

  Plan Description. See Preservation Phase above.

  Observations. Since Elwha Chinook are not ad-clipped, current reliable estimates of exploitation rates are not available.

- ***Local Adaptation Phase***

  Plan Description. See Preservation Phase above.

  Observations. Since Elwha Chinook are not ad-clipped, current reliable estimates of exploitation rates are not available.

- ***Full Restoration Phase***

  Plan Description. Page 86 of the Plan states: "*True productivity, escapement, and harvest goals will be developed at a later date, when specific information is available for the Elwha Basin. More importantly, initial goals for total production and rates of recovery will be updated as the recolonization process proceeds and information is gathered regarding the inherent productivity of the Elwha watershed.*"

  Observations. When the recovery of Chinook salmon reaches the Full Restoration Phase, we expect the long-term sustainable harvest goals will be established and the moratorium directed harvest will be lifted. At that time, the harvest goals must be consistent with Recommendation 2. It is unclear how long the moratorium will be extended relative to the conservation objectives.

2.1.3 Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin

Efforts to harvest abundant hatchery fish from one population can impact natural fish in another population; hatchery strays can and do interact with natural populations from different locations within the region. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

- ***Preservation Phase***

  Plan Description. Page 34 of the Plan states that no directed commercial or recreational fisheries on Chinook salmon will occur during this phase. All the HGMPs state that the timing of releases of propagated salmon and steelhead are selected to reduce the possibility of ecological interactions with other species or naturally produced juveniles of the same species. To view the hatchery release numbers and times by species, please see Table 2-7 under Recommendation 11, below.

  Observations. Since there is no directed fishery on Chinook salmon during this phase, there will be no incidental catch of other species. The habitat below the dam sites, which is already degraded, will become more impaired with the expected release of large amounts of sediment following dam removal. Natural production will be very small. We do not expect that the proposed Chinook salmon releases during the Preservation Phase to cause negative ecological interactions with other species or with naturally produced Chinook salmon.

- ***Recolonization Phase***

  Plan Description. We understand that the moratorium on directed commercial and recreational fisheries continues through this phase. All the HGMPs state that release times are selected to reduce the possibility of ecological interactions with other species or naturally produced juveniles of the same species. To view the hatchery release numbers and times by species, please see Table 2-7 under Recommendation 11.

  Observations. Since there is no directed fishery on Chinook salmon during this phase, there will be no incidental catch of other species. During this phase, sediment is expected to return to natural background levels. Passage in the middle river and above the dam sites will be restored and natural production will be occurring. With the onset of natural production above the dam sites, the numbers and timing of hatchery releases must take into consideration the effects of ecological interactions. As a result, the possibility of ecological interactions between artificially and naturally produced juveniles is a key assumption that must be addressed (Table 1.2). For a detailed explanation, please see comments under Recommendation 11.

- ***Local Adaptation Phase***

  Plan Description. The moratorium on directed commercial and recreational fisheries continues through this phase. All the HGMPs state that the timing of releases of propagated salmon and steelhead are selected to reduce the possibility of ecological interactions with other species or naturally produced juveniles of the same species. To view the hatchery release numbers and times by species, please see Table 2-7 under Recommendation 11.

  Observations. It is reasonable to expect that a rapid recovery of naturally produced Chinook salmon will create interest to lift the moratorium on directed harvest on Elwha Chinook. This is precisely why it is important to have predetermined decision rules (e.g., escapement goals for natural origin adults) for harvest of naturally produced fish (Table 1.2). During this phase, passage in the middle river and above the dam sites will have been restored and the numbers of naturally produced fish will be building. As the natural production of Chinook salmon builds through this phase, decision rules and triggers for Chinook hatchery programs should be modified (Table 1.2). Page 30 of the Plan discusses the phase-out of hatchery programs as natural production increases. To avoid confusion, this needs to be reconciled with the Chinook hatchery production numbers given in Table A-7 on page 135 of the Plan. The table does not show that hatchery production is phased out as adult returns increase; it shows just the opposite, i.e., an increase in total hatchery production up to a total of 3.35 million when adult returns reach more than 4,000 adults.

  To the extent that hatchery releases continue, monitoring to detect ecological interactions among naturally and artificially produced fish must continue. This is particularly important if the large increases in hatchery production are realized. For a detailed explanation of this concern, please see comments under Recommendation 11.

- ***Full Restoration Phase***

  Plan Description. The Plan is structured around three phases, the last of which is the post dam removal period. There is no equivalent full restoration phase.

  Observations. If a fully functioning monitoring and adaptive management plan is in place (See Chapter 7) by the time the Elwha restoration reaches full recovery, negative interactions between species and between hatchery produced and naturally produced Chinook salmon should have been identified and resolved.

2.1.4 Summary of Observations and Conclusions for Principle 1—Chinook Salmon

Table 2-5 summarizes our findings regarding the consistency of the Chinook component of the Plan with HSRG Principle 1 and specifically, with the three recommendations that address harvest and conservation goals. Table 2-6 summarizes our observations and conclusions, by restoration phase.

Table 2-5 Principle 1: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 1: Are conservation goals expressed in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)?	Partially
Recommendation 2: Are harvest goals expressed in terms of a population's contribution to specific fisheries?	No directed harvest
Recommendation 3: Are goals for individual populations coordinated and compatible with those for other populations in the Elwha Basin?	No

Table 2-6 Observations and conclusions regarding Principle 1—population goals.

<u>All Phases</u> The Plan lacks a clear statement of goals. Goal statements that comply with Principle 1 and Recommendations 1 – 3 should be developed.
<u>Preservation Phase</u> Biologically- based, measurable criteria for preservation of the genetic resource are needed.
<u>Recolonization Phase</u> Biologically-based, measurable objectives for natural production during the Recolonization Phase are needed. These objectives should address abundance and spatial distribution of naturally spawning fish. Observable indicators for these objectives should be identified (e.g., the number of natural origin adult returns for abundance and the number of stream miles with one or more redds for distribution). Trigger values for the indicators should be defined to signal the end of this phase and the beginning of the next one (e.g., the return of 500 NORs and 20 stream mile segments with at least one Chinook redd).
<u>Local Adaptation Phase</u> Biologically-based, measurable objectives for natural production during the Local Adaptation Phase are needed. These objectives should address abundance, productivity, diversity and spatial distribution of naturally spawning fish. Observable indicators for these objectives should be identified. Trigger values for the indicators should be defined that signal the end of this phase and the beginning of the next one.
<u>Full Restoration Phase</u> Long-term goals for harvest and natural production appear to be based on a premise that is questionable. The goals appear to be based on an earlier analysis (FERC 1993) that is no longer supported by the best available science. More clarity is needed regarding the long-term goals for Chinook in the Elwha Basin.

2.2 Principle 2: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program in terms of benefits and risks must be formulated, explaining how the program expects to achieve its goals. The purpose, operation, and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated. In general, scientific defensibility will occur at three stages:

1) During the deliberation stage, to determine whether a hatchery should be built and/or a specific hatchery program initiated;

2) During the planning and design stage for a hatchery or hatchery program; and

3) During the operations stage.

This approach ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied by citations from the scientific literature.

HSRG recommendations 4 through 13 are aimed at ensuring scientifically defensible hatchery programs. The HSRG review of the Elwha Plan is presented with reference to these recommendations.

2.2.1 Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. A conservation program is one that is compatible with goals for biological significance (Primary or Contributing) and viability (productivity, abundance, diversity and spatial structure) of a population. A harvest program is one that contributes to specific fisheries at specified rates or harvest numbers, and is compatible with identified conservation objectives for all populations. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program. It is important to note that the purpose of the hatchery program will vary by phase of the restoration project.

The Plan and the HGMP identify the purpose of the proposed hatchery programs as conservation. With reference to the biological phases we suggested above (Chapter 1.2), the purpose of the Chinook hatchery program, by phase, would be as follows:

Preservation Phase	Conservation
Recolonization Phase	Conservation
Local Adaptation Phase	Conservation
Full Restoration Phase	No hatchery program

2.2.2 Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program (harvest, conservation, or both) have been established, the scientific rationale for the program must be documented. The scientific rationale explains, in terms of benefits and risks, how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions must be documented, so those assumptions can be evaluated and modified as new information becomes available. This approach ensures a scientific foundation for hatchery programs, a means to address uncertainty, and demonstrates accountability. Documentation should include citations from the scientific literature and analytical tools that take into account the various factors that will affect the success of the program (predation assumptions, cumulative effects, etc.).

The following applies to all phases:
The Plan states (page xiv): "*Using a spawner-recruit model, production estimates for Chinook salmon start at 200 natural spawners in the first year following dam removal, with growth to nearly 6,000 within 25 years. The model utilized assumes a very high fisheries harvest rate for Chinook, which does not represent the current understanding of Chinook productivity. However, the current fishing regime does not attempt to sustain such high harvest rates, so it is believed that the estimates of recovery time and spawner abundances provided by the model are still reasonable*."

Observations

- ***All Phases***

  The Ricker model cited (FERC 1993) is based on an MSY rate of 78%. If this "*does not represent the current understanding of the Chinook productivity*" (page xiv of the Plan), then there is no basis for the projected rate of population growth (from 200 to 6000 in 25 years). If, indeed, the 78% MSY rate cited in FERC (1993) reflects the assumed productivity, and if the harvest rate during the recovery period remains at 24%, then the population would recover within a generation (10,000 spawners within 10 years). At this rate of productivity, the hatchery program would be needed only for a very short colonization period. If, on the other hand, the habitat productivity for Chinook is considerably less, then the colonization period would be longer. Natural production potential is clearly a critical assumption affecting the Chinook recovery strategy and the decision rules for broodstock management of the hatchery program.

  The estimated MSY harvest rate was based on a comparative analysis of Puget Sound and Washington coastal fall Chinook populations (FERC 1993). If this analysis is no longer valid, some rationale should be provided and an alternative set of assumptions (perhaps a range) stated in the Plan.

  The number 17,493 appears in several places in the documents, variously referred to as spawner capacity and expected natural spawning escapement. This number is also not consistent with or even related to the spawner-recruit model. This number also dates back to FERC (1993). It is not clear how this number is to be viewed relative to goal-setting and restoration strategies.

  Assumptions about survival by life stage should also be explicitly stated, especially in light of the poor survival observed for Chinook in recent years.

We note that assumptions about natural production potential are critical both to define success and to the choice of hatchery strategies to meet those goals. These key assumptions are not explicitly stated.

The key assumptions vary by project phase and while many of the assumptions are contained in either the Plan or the HGMP, the information about critical assumptions, under which the chosen strategy will succeed, should be explicitly stated and summarized by project phase (e.g., preservation, recolonization, local adaptation and full restoration). They should be clearly linked to decision rules and monitoring and evaluation priorities for each phase.

Predefined triggers for modifying hatchery programs, including shifting between project phases, should be based on a set of initial assumptions. They should also be explicitly stated.

In summary, the Elwha Plan falls short of meeting this recommendation. The Plan lacks a set of clearly articulated assumptions under which the proposed hatchery strategy will meet Chinook goals over time.

- ***Preservation Phase***

  The key assumptions during this phase relate to the conditions of the habitat during and immediately following the dam removal. They also relate to the “safety” of the alternative strategies to preserve the remaining genetic resources during this phase. This part of the Plan is well thought out and clearly explained.

- ***Recolonization Phase***

  A key assumption for this phase is the number of natural origin spawners required to assure that the population will persist and grow. This number might be defined also as the minimum viable population size. It has been suggested, for example, that for Chinook generically, this number might be around 500 (HSRG 2005). Assumptions leading to the identification of the natural-origin recruit spawner (NOS) abundance at which the population no longer benefits from hatchery contributions to natural spawning have not been stated. Missing assumptions include estimates of the productivity potential of the habitat.

- ***Local Adaptation Phase***

  During this phase and perhaps during part of the Full Restoration Phase, a safety net hatchery program may be advisable as insurance that the genetic resources will not be lost in case of unforeseen failure of the habitat to sustain the natural population until habitat is fully functional. Such a program would presumably be as small as possible and managed to meet HSRG standards for hatchery influence. A rationale in terms of assumptions and purpose for such a program is not explicitly stated in the Elwha Plan. In fact, the maximum contribution of pHOS is not mentioned anywhere in the Plan. The assumptions and rationale for terminating such a program are also not stated in the Plan.

- ***Full Restoration Phase***

  To establish realistic goals, an evaluation of current habitat conditions and future habitat potential is needed. A working hypothesis must be based on current science and best data available. Uncertainty is not a justification for being vague about expectations. Without an explicitly stated working hypothesis, it is not possible to identify critical uncertainties or design a monitoring and evaluation (M&E) plan to resolve those uncertainties over time (Platt 1964).

2.2.3 Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

One of the most critical needs in hatchery reform is to improve hatchery broodstock management. Hatchery programs should be managed as either genetically integrated with, or segregated from, the natural populations they most directly influence (HSRG 2009, Appendix A, Implementing and Transitioning Hatchery Programs).

A fundamental purpose of most integrated hatchery programs is to increase abundance for harvest, while minimizing the genetic divergence and reproductive fitness differences between the hatchery broodstock and the naturally spawning population. In some cases, integrated programs also serve as a demographic safety net to vulnerable natural populations. An integrated program is intended to maintain the genetic characteristics of a locally adapted natural population and minimize the potential genetic effect of domestication. To achieve this, at a minimum, the pNOB has to be greater than the proportion of the natural spawning population that is made up of pHOS.

For segregated hatchery programs, the intent is to maintain a genetically distinct hatchery population that is isolated from natural populations. Ideally, fish from this type of hatchery program would be propagated solely from hatchery returns and not allowed to spawn with the natural population. The primary intent of a segregated program is to create a hatchery-adapted population to meet goals for harvest.

The biological principle behind the broodstock standards for both integrated and segregated populations is local adaptation, i.e., allowing a population to adapt to the environment it inhabits. Proper integration and segregation of hatchery programs is the HSRG's recommended means for minimizing adverse effects of hatcheries on local adaptation. The typical benefit of reforming broodstock management is that abundance goals for conservation and harvest can be met while at the same time improving the productivity of natural populations. Hatchery fish on the spawning grounds always represent a compromise between the demographic benefits and the genetic risk, even when they come from a well-integrated program. The HSRG concluded that when its broodstock management standards for an integrated or segregated program are met and managers' abundance goals are achieved, the benefits of the hatchery program outweigh the risks.

The following applies to all phases:

Plan Description. The HGMP and information provided at the HSRG's December 19, 2011 meeting indicate that the Chinook hatchery program is intended to be integrated; however the Plan makes no mention of the term "integrated". Since the purpose of the program is strictly conservation, this would be the appropriate broodstock strategy.

The Plan makes only vague references to broodstock composition, e.g., on page 31: *"Maintenance of a Chinook salmon hatchery program using broodstock collected from natural- and hatchery-origin adult returns provides a composite population on which to base stock restoration (WDFW 2002)."*

And on page 32: *"Elwha River–origin adult fish produced at and returning to the Morse Creek facility will be fully incorporated with Elwha River adult returns as broodstock used to implement Elwha River hatchery-based restoration efforts."*

And on page 34: *"Broodstock collection strategies for adult Chinook salmon during this period will include trapping of adult returns to the Elwha Channel and Morse Creek facilities, in-river net capture of adults, and gaffing of adults on the spawning grounds."*

While the HGMP states that the hatchery program is an "integrated recovery" one, its definition of integrated is apparently the SASSI composite. For example, Section 6.3 of the HGMP states that: *"Broodstock selection is totally random from returns to the trap and from fish collected in the river. The hatchery program is totally integrated with the population spawning in the wild."*

Observations. The plan's definition of "integrated" was not provided, but does not appear to be consistent with the HSRG concept with the same name, and therefore, there does not appear to be an explicit commitment to adopt an integrated broodstock strategy as defined by the HSRG and by the Washington Hatchery and Fishery Reform Policy POL-C3619 (WDFW 2009).

According to the HSRG definition of an integrated program, broodstock for the hatchery program should be managed to assure that the natural environment drives the adaptation of the population. This in turn requires that natural origin adults contribute more to the genetic makeup of the hatchery population than hatchery fish contribute to natural production. For a Primary population, this means that the pNOB is twice as large as the pHOS in the wild. In addition, pNOB must be at least 10% (See Recommendation 8 below).

2.2.4 Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve abundance goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions, and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions. The abundance and productivity of the natural population, as well as the ability to fully harvest hatchery-origin fish, determine the effect of hatchery straying on the natural population. This, in turn, determines the proper size of a hatchery program.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. Time, size, age and location of released hatchery fish also affect straying, survival and ecological interactions. When a hatchery program is sized appropriately, the demographic benefits to harvest and/or conservation outweigh the genetic and ecological risks.

The HSRG recommends that managers size their hatchery and harvest programs to reduce these surpluses and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers (see Appendix A).

The following applies to all phases:

Plan Description. The Plan links changes in the habitat to hatchery activities. The moratorium on fisheries targeting Elwha Chinook also brings the hatchery component of the restoration strategy into an "all H" context.

Observations. As indicated in Chapter 1.2 above, the HSRG recommends a stronger biological perspective to the phased restoration process.

The Plan should avoid using the poorly-defined term "supplementation". Describing the hatchery strategies in terms of their purpose is more informative and helps bring focus on the end-points instead of the process. The purposes of hatchery strategies as described in the Plan are 1) gene conservation, the preservation of the genetic identity and diversity of the extant Elwha Chinook population during the dam removal period, when habitat limits or precludes in-river natural production; 2) acceleration of colonization of restored and un-populated habitat, once it can again sustain natural production; and 3) demographic safety net against unforeseen events.

- ***Preservation Phase***

  The Plan addresses the need to maintain genetic identity and diversity of the population as well as is possible under the circumstances, though the rationale for the size of the program from a biological preservation point of view is not clear. The text of the Plan discusses the factors that affect transition from preservation to recolonization, but specific criteria and triggers that drive this transition are not explicitly stated. This is not to suggest that the preservation purpose ends when colonization begins; there will be a need for some hatchery production as part of a demographic safety net through the recolonization and local adaptation phases.

- ***Recolonization Phase***

  On page 26, the Plan summarizes the hatchery colonization phase as follows: *"Outplanting strategies will include multiple life history patterns including adults, juveniles, and eyed eggs. Selection of life history patterns outplanted is based on stock availability and appropriateness of specific life history patterns to meet outplanting goals. The selection of outplanting strategies employed is dynamic, subject to review by managers, and may shift throughout the duration of the restoration project according to fish response."*

  The HSRG recommends a more structured, predefined process based on the scientific method, rather than the ad hoc consensus approach suggested in the quote above.

  The text in the Plan discusses the outplanting of multiple life history stages, including adults (see quote above). Yet, Tables 6, 7, and 8 show only minimal numbers of adults allowed to spawn naturally until total returns exceed 2,000 fish. Tables 6-8 also do not take into account the composition of adult escapement and do not explain why hatchery production increases with adult escapement levels. See also discussion about adaptive management, triggers and decision rules in Key Findings and Recommendations and Chapter 1.3, and under Principle 3 (Chapter 7).

- ***Local Adaptation Phase***

  During this phase, the influence of the hatchery program on the natural population should be reduced and eventually eliminated. The Plan calls for the hatchery program to be integrated, yet makes no mention of pNOB and the PNI index. During this phase, the hatchery broodstock and natural spawning escapement should be managed to meet HSRG standards for a Primary population—PNI greater than 0.67. In this phase, the hatchery should be downsized to a safety net for demographic and genetic preservation, in case re-initiating recolonization becomes necessary. Again, a structured and pre-planned approach is called for, rather than the more ad hoc process described in the statement on page 30 of the Plan: *"Annual review of the status of each population relative to the interim goals will guide decisions regarding continuation of the supplementation program. For example, if at the end of 10 years it is found that the abundance of naturally spawning Chinook salmon is 4,000 fish, productivity is two recruits per spawner, and*

Chinook salmon are spawning throughout their historic range, then the hatchery program would be phased down to a low maintenance level or eliminated entirely. Conversely, if abundance and productivity were to remain as above, but Chinook salmon were only spawning in the lower 10 miles of the river, then it would be necessary to carefully evaluate the program and decide on a course of action most likely to ensure recolonization of the historic range is achieved."

- ***Full Restoration Phase***

  Triggers for the start of this phase should be explicitly stated along with the decision prompted by those triggers.

  The planting of hatchery origin Chinook will now have been terminated; however, the fate of the Chinook rearing channel and associated hatchery facilities is not mentioned. Since this phase will begin before natural productivity has been fully restored, hatchery production should not be reinitiated until other impediments to natural production have been identified, such as overharvest, poor habitat conditions, or lack of nutrification (see Appendix A).

2.2.5 Recommendation 8: Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

Effectively managing harvest, hatchery broodstock and natural spawning escapement is essential to controlling genetic risks due to straying of hatchery adults. Unless the explicit purpose of the hatchery program is either preservation (gene banking) or recolonization, straying can result in fitness loss in natural populations. To limit these risks and meet conservation goals, the HSRG developed quantitative standards for the pHOS, the pNOB, and the PNI on an integrated population that results from the combination of pHOS and pNOB.

The designation of a population as Primary, Contributing or Stabilizing is, in part, a policy decision. However, for this analysis, the HSRG made assumptions based on the status of each population and the Co-managers' objectives. Standards recommended by the HSRG for broodstock management are as follows:

HSRG criteria for hatchery influence on Primary populations

- The pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

The following applies to all phases:

Observations. As noted in 2.2.3 above, the implied definition of an integrated hatchery program is not consistent with the HSRG definition.

There is no reference to standards or guidelines for broodstock composition of an integrated Primary population in either the Plan or the HGMP. Instead, section 6.2.3 states that: *"It will not be possible to determine the exact number of wild origin adults being incorporated into the broodstock as the Elwha Chinook are not scheduled for mass-marking. Until the trapping facility can be made more effective in trapping the required number of adults, it is highly probable that wild origin adults will be collected and incorporated into the broodstock due to the seining, netting and gaffing operations utilized to collect broodstock."* This statement does not suggest any intent to actively manage broodstock, even if effective trapping and mass-marking were available.

To be clear, the purpose of the HSRG standards is to assure that the Chinook population adapts to local environmental conditions over time. For this reason, the standards are particularly important during the Local Adaptation Phase.

2.2.6 Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase harvest and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality.

Plan Description. The Plan and the HGMP indicate that hatchery fish are not externally marked. Since the hatchery program will be terminated, this is not an issue in the long-term (i.e., the Full Restoration Phase), but it would be of concern during the Local Adaptation Phase.

Observations. Part of the purpose of this recommendation is to assure that hatchery fish that return in excess of broodstock and natural spawning escapement needs are fully harvested in a fishery or a weir without over-harvesting natural origin adults. Mass marking of hatchery fish and/or some form of selective harvest is essential both for broodstock management (see above) and to make optimal use of all hatchery fish. It is also important to assure that sufficient numbers of fish are CWT marked to allow estimation of contribution to all fisheries and total survival.

The Plan and the HGMP are unclear about how to assure full harvest (removal) of surplus hatchery fish. See also comments about nutrification in Appendix A.

2.2.7 Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Use of local broodstock and in-Basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations.

Plan Description. The Plan is very clear that there is no intent to import brood from non-native populations, meaning that the program is expected to be self-sustaining.

Implementation of this recommendation would require that survival of hatchery fish is sufficient to return the broodstock needed to maintain the program over time. It also requires a high rate of broodstock capture at the hatchery rack and weir. Low survival has been a problem in the past and it is a major uncertainty in the future.

Observations. We note that the weir must remain in operation as long as hatchery fish return to the river; its purpose is not just for broodstock collection, but also for pHOS control. Means for controlling pHOS include externally marking all hatchery fish and releasing fish from the safety net program from sites that reduce straying, e.g., Morse Creek.

A related issue that was also addressed in the earlier HSRG review (HSRG 2004) is the need for out-of-Basin incubation and rearing. It would be advisable to consider adding incubation space within the Elwha Basin, perhaps at the new Tribal Hatchery.

2.2.8 Recommendation 11: Coordinate hatchery programs within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

- ***Preservation Phase***

  Plan Description. Pages 10 and 11 of the Plan state that three out-of-Basin hatchery facilities operated by WDFW will be used to support the two in-Basin hatcheries as satellite incubation, rearing, and broodstock production locations: Sol Duc Hatchery, Hurd Creek Hatchery, and the Morse Creek rearing and brood stock collection facility. The Hurd Creek Hatchery in the Dungeness watershed will serve as the initial incubation site for fertilized eggs procured from Chinook salmon collected from the Elwha River. Following eyeing, the eggs will be transferred to the WDFW Sol Duc Hatchery. The Sol Duc Hatchery will conduct final incubation and initial early rearing of Elwha River Chinook salmon. From the Sol Duc Hatchery, fry will be transferred to the Elwha rearing channel for additional rearing, acclimation, and release as sub-yearlings and yearlings. Fingerlings will also be transferred to the Morse Creek rearing and brood stock collection facility for volitional release as yearlings into the creek.

Table 2-7 Elwha River hatchery release numbers and times by species.

PROPOSED RELEASES [1]					RELEASE TIME			
Species	Fingerling	Fry	Presmolts	Yearling	March-April	April	May	June
Chinook	2,500,000			200,000		200,000		2,500,000
Coho		300,000 [4]	75,000 [4]	780,000 [2, 3]	750,000			
Chum	650,000 [5]	275,000 [4]			650,000			
Early Steelhead				65,000			65,000	
Late Steelhead		275,000 [4]	20,000 [4]	175,000 (age 2 smolts) 25, 000 smolts	175,000 [6]			
Pink		3,000,000			3,000,000			

1. Source: All information from HGMPs, does not include eyed egg plants
2. Source: HGMP, Section 10, but Section 1.9 gives a release of 650,000 smolts
3. 30,000 smolts out planted
4. Release times not found
5. Drops to 300,000 after dam removal
6. Source: HGMP, Section 11.2 Released March-April, but later in same section release date of mid-May given.

Observations. The use of out-of-Basin facilities for incubation and early rearing raises the possibility that Chinook salmon subjected to this treatment will stray as adults into other nearby watersheds. To reduce this possibility, the Co-managers should try to accommodate the Chinook hatchery program wholly within the Elwha Basin. For example, one option would be upgrading the Tribal Hatchery to accommodate incubation and early rearing of Elwha Chinook prior to transfer to the Elwha rearing channel. This recommendation does not apply to the Morse Creek operation, because it is intended as a short-term refuge protecting the Elwha Chinook stock from total loss in the event of a catastrophic release of sediment during dam removal.

- ***Recolonization Phase***

Plan Description. Page 31 of the Plan states that Chinook salmon populations in the Elwha River historically displayed a wide range of life history strategies that took advantage of diverse natural habitat conditions present in the river in its pristine state. The Plan states that a Chinook salmon restoration strategy that treats the population as a single unit, collecting eggs from across the range of the current spawning spectrum followed by outplanting juveniles throughout the Basin, will best permit diverse life history types to develop and express themselves in the population.

Observations. The Plan correctly concludes that the recolonization of the upper Elwha River is likely to result in the emergence of diverse life history types in the Chinook population. The HSRG recognized this possibility when it concluded that ecological interaction between artificially and naturally produced juveniles is an uncertainty that must be addressed in the Recolonization Phase (Table 1.2). One particular Chinook juvenile life history is of special concern, because it is likely to be impacted by artificially propagated Chinook juveniles as well as propagated juveniles of other species. This life history can be characterized as a slow, downstream rearing migration with the possibility of extended rearing in the lower river and migration to sea as 0-age smolts (Reimers 1973, Schluchter and Lichatowich 1977, Carl and Healey 1984, Johnson et al. 1992). This life history may be the most productive in terms of returning adults (Reimers 1973, Schluchter and Lichatowich 1977). The reason the emergence of this life history has the potential for negative ecological interactions with artificially produced juveniles is complex. The lower river habitat has been degraded by the two dams that blocked the movement of fluvial gravel and large woody debris and by human-caused channel modifications. It may be several years after dam removal before the degraded habitat in the lower river is fully restored. The hatchery programs for all species will release several million juvenile salmon and steelhead into this degraded habitat (Table 2-7). Which Chinook life histories will emerge from natural spawning in the upper river and the timing of their downstream migration is not known, but Chinook juveniles migrating downstream in the spring and summer of their first year will likely encounter large numbers of propagated fish. If the survival of the naturally produced juveniles is impaired, it could have a major negative effect on the rate of recolonization and recovery. It is essential that the Elwha Plan initiate monitoring capable of detecting negative ecological interactions among natural and artificially produced juvenile salmon and steelhead in the lower river. The best strategy to avoid negative ecological interactions among juveniles is to outplant adults and release all juveniles from the hatchery.

- ***Local Adaptation Phase***

  Plan Description. Page 33 of the Plan states that specific options, including the release of fish into Morse Creek, will be discontinued as soon as the risk of catastrophic loss of the Elwha River production has passed. Hatchery production proposed for this period will be phased out over time as the natural-origin Chinook salmon population increases to a healthy, self-sustaining level and as seasonal components of the natural-origin population (spring, summer, and fall) reestablish.

  Page 30 of the Plan states that the objective of using artificial supplementation as a tool in restoring fisheries resources in the Elwha Basin is to maintain existing native fish populations during the period of dam removal, to ensure adequate numbers of fish are available to seed the Basin once conditions allow, and to begin to recolonize the Basin once the dams are removed. It is envisioned these programs will phase out as natural production recovers.

  Observations. The risk of the problem described in the Recolonization Phase will be reduced or eliminated as the hatchery programs are phased out. To implement the planned reduction and termination of hatchery programs, the HSRG identified decision rules for hatcheries, i.e., which programs are continued and which ones are terminated, as a key assumption in this phase (Table 1-2). Currently, the risks are unclear, because the Plan does not contain explicit decision rules that govern the termination of hatchery programs.

  As the Chinook population increases during this phase, it is likely that pressure to resume directed harvest will mount. The HSRG recognizes this and identified decision rules for the harvest of naturally produced fish as a key assumption, as well (Table 1-2). The decision rules should include provisions to avoid negative impacts of a fishery on mixed stocks of hatchery and wild Chinook salmon or incidental harvest of other species.

- ***Full Restoration Phase***

  Plan Description. The 25 year targets described in Table 25, page 97 of the Plan will have been attained or possibly exceeded.

  Observations. As the Elwha fish restoration efforts reach full recovery, the focus of attention will shift to a long-term fish and fishery management program.

2.2.9 Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities as well as structures to remove and discharge water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change in-stream flow, alter riparian habitat and diminish water quality through hatchery discharges. Water for hatchery use is often drawn from an adjacent stream via pumps or gravity. Improperly designed and maintained water intakes can impinge migrant or resident juveniles on hatchery screens or cause fish to be trapped in hatchery facilities. Structures such as adult weirs and water intake dams can also block natural passage of salmonids to spawning or rearing areas. Water diverted from adjacent streams for fish culture purposes is often returned downstream and can reduce the amount of water for juvenile rearing and upstream adult migration between the area of intake and discharge. Hatchery discharge can also diminish water quality below the point of discharge through changes in temperature, settle-able and suspended solids, chemical composition, and presence of therapeutic drugs. The HSRG has noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

The HSRG is not aware of any issues related to environmental compliance of the Chinook spawning channel or the Hurd Creek facility. We assume that all NPDES permits are in place and that the water treatment plant intake is safely screened.

2.2.10 Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. Conservation hatcheries producing juveniles with high survival generate more spawners on the spawning grounds. This, in turn, accelerates the rate at which recovery programs move toward meeting their goals. Production programs may have to reduce release numbers to decrease negative ecological impacts on natural populations. Increasing post-release survival can offset this reduction and enable managers to meet their harvest goals.

There are many approaches to increasing fish survival. The release of fish at the appropriate time, size, age and location can significantly increase their recruitment to fisheries and natural escapement. Releasing rapidly migrating smolts, rather than fry, increases survival and reduces negative ecological interactions in the freshwater environment. Similarly, the release of healthy fish produces more fish for harvest and less opportunity to spread disease to natural populations. Improving water quality and reducing loading and density during rearing are also proven tools used by fish culturists to enhance fish survival. Adoption of volitional release (allowing smolts to outmigrate when they are ready, rather than "forcing" them out at a preset date) with removal of residuals (fish that do not outmigrate) may increase the long-term survival of released fish, while decreasing negative ecological interactions with natural populations. Proper acclimation and imprinting of hatchery juveniles can reduce straying and enhance survival to the desired location for their harvest or artificial spawning.

Developing and adopting these and other culture and release practices that maximize fish survival and minimize negative ecological interactions by reducing production release numbers, can aid conservation programs in rebuilding runs and reducing the conflict between harvest programs and conservation goals for natural populations.

> *To reduce potential harm to natural population through genetic and ecological interactions, hatchery program should be no larger than necessary to meet the recolonization objectives. The higher the survival of hatchery fish, the smaller the program can be to produce the required number of adult offspring. See also Recommendation 11 above.*

2.2.11 Summary of Observations and Conclusions for Principle 2—Chinook Salmon

Table 2-8 summarizes our findings regarding the consistency of the Chinook component of the Plan with HSRG Principle 2 and specifically, with the seven recommendations that address scientific defensibility. Table 2-9 summarizes our observations and conclusions, by restoration phase.

Table 2-8 Principle 2: Are hatchery programs designed and operated in a scientifically defensible manner?

Recommendation 4: Is the purpose of the hatchery program defined (i.e., conservation, harvest or both)?	Yes
Recommendation 5: Are the scientific assumptions, under which a program contributes to meeting the stated goals, explicitly stated?	No
Recommendation 6: Has an integrated or segregated broodstock management strategy been selected, that is based on population goals and hatchery program purpose?	No
Recommendation 7: Is the size of hatchery programs based on population goals and as part of an "all H" strategy?	No
Recommendation 8: Are harvest, hatchery broodstock, and natural spawning escapement managed to meet HSRG standards appropriate to the affected natural population's designation?	No
Recommendation 9: Is the harvest managed to achieve full use of hatchery-origin fish?	No
Recommendation 10: Do all hatchery programs have self-sustaining broodstocks?	Yes
Recommendation 11: Are hatchery programs coordinated within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations?	No
Recommendation 12: Are facilities constructed and operated in compliance with environmental laws and regulations?	Yes
Recommendation 13: Is survival of hatchery fish maximized consistent with conservation goals?	Unknown

Table 2-9 Observations and conclusions regarding Principle 2—scientific defensibility.

<u>Preservation Phase</u> This phase of the project is generally consistent with Principle 2.
<u>Recolonization Phase</u> While the Plan lays out a schedule for sizing the program based on combined returns of natural and hatchery origin adults, the rationale for this schedule is not clearly explained. The Plan incorporates a mixed strategy in terms of life stages to be planted in the habitat, but omits the option of outplanting adult hatchery fish without explanation. Most importantly, the end-points of the Recolonization Phase are not defined in terms of predetermined triggers and responses.
<u>Local Adaptation Phase</u> For Chinook, this would be a relatively short, but very critical phase, where the hatchery program is managed to meet HSRG standards and sized and operated only as a safety net to promote local adaptation. Progress toward local adaptation and increased fitness are balanced against demographic risks due to uncertainty about habitat conditions. During this phase, specific trigger points in terms of numbers of returning natural origin spawners should be identified to signal transition to the next phase. The trigger points, along with clearly identified uncertainties (see also Recommendation 5) and the accuracy and precision requirements of their estimates, should be major drivers for the monitoring and evaluation plan.
<u>Full Restoration Phase</u> Since the hatchery program will be terminated as this phase begins, the main concern here is the determination of when this stage begins. The population may not yet have reached its potential as measured in VSP parameters, but it is now sustainable and increasing over time without the aid of a hatchery program. The conditions that define the onset of this phase, based on biological triggers, need to be made more explicit.

2.3 Summary of Observations, Conclusions and Recommendations for Chinook Salmon

The table below summarizes our assessment of the consistency of the Chinook component of the Elwha Plan with HSRG Principles 1 and 2. It also provides recommendations for improving consistency with these principles.

Table 2-10 Summary of observations, conclusions and recommendations for Chinook salmon.

<u>Benefits</u> • The off-site hatchery program will reduce the risk of losing remaining genetic resources during the preservation and recolonization phases, when habitat is unstable. • Given the management history of the Chinook population, the hatchery intervention is not likely to lead to significant further domestication risk during the preservation and recolonization phase.
<u>Risks</u> • The heavy reliance on outplanting of hatchery juveniles rather than releasing juveniles from the hatchery to produce adult spawners for recolonization poses both genetic and ecological risks to the rebuilding of a diverse and productive natural population of Chinook. • Lack of a clearly defined end-point to the outplanting phase in terms of predefined indicators (triggers) may cause this phase to be prolonged and local adaptation of the natural population to be impeded. • The absence of any specific reference to broodstock and natural escapement composition (e.g., pHOS, PNI) implies unknown domestication risk. • Lack of a plan for future use of hatchery facilities in the Basin appears to leave the long term existence of the hatchery program in question.
<u>Likelihood of meeting goals</u> • Without explicit quantifiable goals, success is not well defined. • Without predefined, measurable performance indicators, we do not know what success "looks like" even with well-defined goals. • Without a structured information-driven decision-making process, it is not possible to determine whether the project is effectively navigating around risks toward goals.

<u>Recommended modifications</u>

- Update the assessment of Chinook production potential.
- Define Chinook production goals in terms of VSP parameters.
- Identify measurable performance indicators of project success that reflect viability (VSP).
- Develop a set of decision rules that incorporate predefined triggers for change for each phase of the project.
- Develop and implement an adaptive management process that describes an annual decision making process and includes, schedule, roles and responsibilities, and decision rules.
- Include an adipose clip on the 200,000 smolts released with full CWT to allow for current harvest analysis Develop a monitoring and evaluation plan to resolve uncertainties (to update decision rules) and estimate performance indicators (to measure progress toward goals), and triggers (to implement decision rules).

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3 Coho Salmon Population Report

Population Definition: Elwha coho were identified as a distinct population based on their spawning distribution. Elwha coho grouped with the Dungeness collection, even though the two collections have statistically different allele frequencies (overall chi-square P=0.000; FST=0.173). As a group, these collections clustered with coho salmon from the northern Washington coast (as opposed to exhibiting a Puget Sound affinity) (Winans et. al 2008). Spawning is currently limited to the lower 4.8 miles of the river below the Elwha Dam site.

Population Designation: Assumed to be Primary, though this is not explicitly stated in the Plan.

Population Origin: This is a mixed stock with composite production. Streams in this area (eastern Strait) have been heavily planted with non-native coho, including Elwha, Dungeness and Soos Creek (Green River) hatchery stocks. Homing of returning adults back to the Elwha Hatchery rack was limited at the old hatchery, and many hatchery-origin fish spawn in the river (WDFW 2012a).

ESA Status: Puget Sound / Georgia Basin Coho ESU (including Elwha coho) are designated as a candidate species for listing under the ESA.

Recent Status and Trends: Table 3-1 presents data regarding recent natural spawning escapement.

Table 3-1 Recent natural spawning escapement.

Return Year	Natural Spawning Escapement (NOR + HOR) (1)	pHOS(2)	Hatchery Broodstock (3)	pNOB
	Actual	Actual	Actual	Actual
2005	unk	unk	2,347	unk
2006	unk	unk	219	unk
2007	unk	unk	401	unk
2008	unk	unk	307	unk
2009	unk	unk	361	unk
2010	unk	unk	3,070	unk

1) Recent Natural Spawning Escapement target (NOR + HOR) has been 250;
2) pHOS is assumed to be 90.5%
3) Recent hatchery broodstock target has been 1,250 adults

Recent Hatchery Production: The current hatchery program for Elwha coho salmon is operated for commercial and recreational fisheries augmentation purposes. The egg-take goal for the program is currently 1.2 million, with an annual release goal of 750,000 yearling smolts (Ward et al. 2008).

The coho program at the Lower Elwha Fish Hatchery began in 1978, utilizing Elwha River broodstock. Since commencing operation, the hatchery has received one importation of eggs from the WDFW Dungeness Hatchery (645,000 eyed eggs, brood year 1988). Selection of the stock was based upon its localized adaptation, unique genetic composition, run timing characteristics, tribal cultural priorities, and stock availability. The number of natural fish incorporated into the hatchery program annually is unknown although scale analyses show no natural-origin fish represented in the hatchery population (L. Ward, LEKT, pers. comm., December 19, 2011).

The goals of this program are to preserve and rebuild natural coho salmon production in the Elwha River by supplementing the abundance of juvenile and returning adult fish. Hatchery production will maintain the genetic characteristics of the native stock. Over the longer term, contingent on coho achieving target abundance levels and distribution in the watershed, hatchery-origin adults will provide enhanced in-river harvest opportunities. The coho program is intended to promote recolonization of suitable coho spawning and rearing habitat (LEKT 2011b).

Coded wire tag analysis of the 2002, 2004, and 2005 brood years indicate an average SAR of 0.20% (Regional Mark Processing Center 2012).

Table 3-2 Recent hatchery release numbers.

Release Year	Number Released (Yearling smolts) [4] Actual
2005	411,745
2006	323,745
2007	365,387
2008	218,468
2009	426,316
2010	pending

[4] Recent hatchery production targets have been 750,000 yearling smolts.
(Data taken from Lower Elwha Klallam Tribe Coho Salmon Hatchery and Genetics Management Plan December 2011)

Recent Harvest: Pre-terminal fisheries targeting Elwha River coho salmon are managed primarily to meet the objectives for wild coho salmon production in other Strait of Juan de Fuca streams. Exploitation was limited to a target rate of 40% and a forecasted exploitation rate of 11.6% for natural stocks in 2005 (PNPTC et al. 2005). The objective of the Lower Elwha Hatchery coho salmon program is to augment harvests of returning adult fish in in-river commercial and recreational fisheries, which are managed to meet hatchery broodstock escapement needs. The 2005 total forecasted exploitation rate for Elwha coho salmon was about 50%, with a forecasted in-river exploitation rate of about 30%.

Elwha coho are caught in pre-terminal marine commercial and recreational fisheries in British Columbia, in Washington coastal waters, and in Puget Sound, and in tribal commercial, subsistence, and ceremonial fisheries, and recreational fisheries in the Elwha River (LEKT 2011b).

A recent analysis of CWT data from brood years 2002, 2004, 2005 indicates an approximately 50% exploitation rate on clipped hatchery coho released from the Elwha Hatchery and a 33% exploitation rate on unclipped hatchery coho (simulating natural origin fish) (Regional Mark Processing Center 2012).

Catch in non-U.S. fisheries accounts for 19% of total harvest on clipped coho. However, a lack of electronic sampling of catch in those fisheries, which would not detect CWT unclipped fish, could also be occurring.

Approximately 50% and 90% of the reported harvest on clipped and unclipped fish occurred in the Puget Sound net fishery, respectively.

Table 3-3 presents a summary of status, trends and restoration goals for coho.

Table 3-3 Coho salmon summary.

Population Designation[1]		Primary -warrants more discussion
Program Type [2]		Integrated recovery evolving toward integrated harvest
Historical Abundance [3]		3,510 - 19,143
Current Escapement [4]		Terminal Run Size = 2,000 - 10,000 In 2005: Escapement = 4,768 Harvest = 5,097 Total Recruit = 9,865
Restoration Goals	Plan	After 10 years: Returns = 3,000 After 25 years: Escapement = 12,100; Recruitment = 4,521
	HGMP	Adult Escapement: After 10 years – 10,000 After 25 years – 96,000

1) HSRG assumed designation
2) Source HGMP
3) Range of several estimates
4) Source Ward et al (2008)

3.1 Principle 1: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

Goals for fish populations must be explicitly communicated and fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (harvest, conservation, education, research, etc.). Hatchery production numbers may be the *means* of contributing to harvest and/or conservation values, but they are not end-points. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when benefits significantly outweigh the risks and when the benefit/risk mix from the program is more favorable than the benefits and risks associated with non-hatchery strategies for meeting the same goals.

The HSRG has developed three general recommendations as guidelines for defining goals for natural and hatchery populations. The HSRG review of the Elwha Plan in terms of its consistency with Principle 1 is presented with reference to these recommendations.

General Comment on Principle 1

The Elwha Plan does not state the restoration goal for coho salmon in terms that conform to the HSRG's recommendations. However, scattered throughout the text of the plan are pieces of information that, taken in total, would provide some the information needed to construct a goal. For example, Table 25 (page 97) gives interim restoration targets for abundance after 10 and 25 years, productivity after 10 years and at MSY, spatial distribution and harvest goals for Puget Sound and the coasts Washington, Oregon and California. These targets could be part of the goal. The interim targets are quantitative, but they do not separate natural and hatchery populations, nor are they placed in an H" context. Four goals on page 95 are called central to the implementation of the Elwha Act. They are:

1) Reestablish self-sustaining anadromous salmonid populations and habitats throughout the Elwha River watershed and its near shore as quickly as possible, using the most appropriate methods.

2) Maintain the integrity of the existing salmonid genetic and life history diversity before, during, and after dam removal and the subsequent periods of elevated sediment levels.

3) Maintain the health of fish populations before, during, and after dam removal.

4) Restore the physical and biological processes of the overall ecosystem through dam removal, including the return of VSPs.

Additionally, a parallel goal is found in the NOAA Fisheries guidance documents (NMFS 2010) for recovering ESA-listed salmon species: restoration efforts shall be targeted at achieving viable salmonid populations. These goals are not species specific, nor are they quantitative. They are broad descriptions of things that will be done (tasks), not things that will be achieved (goals). The Elwha Plan needs a comprehensive, species-specific goal statement near the beginning of the Plan's narrative. The goal statement should conform to HSRG's Principle 1.

3.1.1 Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity).

The Primary, Contributing and Stabilizing population designations refer to the biological significance of the population in the context of its ESU. The following general viability criteria apply:

- Primary: populations must achieve at least high viability
- Contributing: populations must achieve at least medium viability
- Stabilizing: populations must maintain at least current viability
- Viability goals should be expressed in terms of population productivity and abundance
- Viability goals should also take into account spatial structure and diversity (Paquet et.al. 2011)

Different definitions of biological significance are used by managers throughout the Northwest. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board in 2004, under which all distinct salmon and steelhead populations are classified as either *Primary*, which are targeted for restoration to high productivity and abundance; *Contributing*, where small to medium improvements are needed; or *Stabilizing,* populations that may be maintained at current levels. Viability goals are expressed in terms of population productivity and abundance and also take into account spatial structure and diversity.

The following applies to all phases:

Decision rules with measurable triggers for the coho population must be identified to determine when to transition to the next management phase. For the third and fourth phases (Local Adaptation Phase and Full Restoration), decision rules and triggers should also be developed to determine when it may be necessary to revert back to an earlier phase, should the trend toward recovery be significantly reversed.

Decision rules and triggers must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision. All key assumptions and uncertainties (See Chapter 1.2, Table 1-2) must be monitored until they are either resolved or it is determined that they are not relevant to the recovery of the Elwha ecosystem. See Chapter 7 for specifics.

- ***Preservation Phase***

  Plan Description: All naturally spawning salmon in the Elwha are managed as primary populations (Ward et al. 2008). This should apply to coho salmon in the Elwha, since there is a small naturally spawning component in the population. The segregated hatchery population will be used as a refuge population during dam removal, and to help initiate recolonization of the watershed.

  Observations. Natural spawners are in low abundance due to limited spawning habitat below the Elwha Dam site. Most natural spawners are likely hatchery strays from the segregated hatchery broodstock.

- ***Recolonization Phase***

  Plan Description. All naturally spawning salmon in the Elwha are managed as primary populations (Ward et al. 2008). A segregated hatchery program will be used for recolonization. A predicted rebuilding curve for coho salmon is given on page 92 of the Plan. Tables 13 and 14 of the Plan (page 49), provide the restoration strategies (hatchery releases). The information in these tables would cover the duration of the Recolonization Phase.

  Observations. As indicated in the general comment on Principle 1, there is no goal statement for the coho population that is consistent with Principle 1 and Recommendation 1. Also, no decision rules or measurable triggers are provided for moving to the next phase (Local Adaptation Phase) or reversion to the earlier Preservation Phase.

- ***Local Adaptation Phase***

  Plan Description. All naturally spawning salmon in the Elwha are managed as primary populations (Ward et al. 2008). Segregated hatchery program will be used for recolonization. A predicted rebuilding curve for coho salmon is given in the Plan (page 92). Tables 13 and 14 of the Plan (page 49) provide the restoration strategies (hatchery releases). The HGMP and Plan provide two benchmarks for coho recovery: terminal abundance of 3,000 in10 years and 12,100 in 25 years, with productivity exceeding 1.0.

  Observations. As indicated in the general comment on Principle 1, there is no goal statement for the coho population that is consistent with Principle 1 and Recommendation 1. Also, no decision rules or measurable triggers are provided for transition to the next phase (Full Restoration Phase) or reversion to the earlier Recolonization Phase.

- ***Full Restoration Phase***

  Plan Description. All naturally spawning salmon in the Elwha are managed as primary populations (Ward et al. 2008). A segregated hatchery program will be used for recolonization. A predicted rebuilding curve for coho salmon is given in the Plan (page 92). Tables 13 and 14 of the Plan (page 49), provide the restoration strategies (hatchery releases). The HGMP and Plan provide two benchmarks for coho recovery: terminal abundance of 3,000 in 10 years and 12,100 in 25 years, with productivity exceeding 1.0.

Observations. As indicated in the general comment on Principle 1, there is goal statement for the coho population that is consistent with Principle 1 and Recommendation 1. Also, no decision rules or measurable triggers are provided for reversion to the earlier phase (Local Adaptation Phase), should monitoring indicate that the population is not sustaining itself.

3.1.2 Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

- ***Preservation Phase***

  Plan Description. Fishery impacts on the Elwha coho population will be managed under the Co-managers Comprehensive Coho Management Plan (PSIT and WDFW 1998), which imposes stepped harvest rate ceilings keyed to the forecasted abundance of natural-origin coho comprising the Strait of Juan de Fuca management unit. This translates to a pre-terminal harvest rate of approximately 40-50% for hatchery coho and 10% for natural coho (Ward et al. 2008). There will be no in-river fisheries in the Elwha for 5 years, starting in 2012.

  Observations. Harvest management appears appropriate for this phase of recovery. Actual exploitation should be monitored and reviewed annually to ensure consistency with assumptions.

- ***Recolonization Phase***

  Plan Description. Fishery impacts on the Elwha coho population will be managed under the Co-managers Comprehensive Coho Management Plan (PSIT and WDFW 1998), which imposes stepped harvest rate ceilings keyed to the forecasted abundance of natural-origin coho comprising the Strait of Juan de Fuca management unit. This translates to a pre-terminal harvest rate of approximately 40-50% for hatchery coho and 10% for natural coho (Ward et al. 2008). There will be no in-river fisheries in the Elwha for 5 years, starting in 2012. Terminal-area coho fishing regimes will be developed when fishing resumes, to provide opportunity that is consistent with achieving coho recovery objectives.

  Observations. The in-river fishery moratorium may need to continue longer than 5 years to assure recolonization. It is unclear how long the moratorium will be extended relative to conservation objectives. The moratorium could be shortened with development and use of selective fishing gears in the in-river fishery (see Appendix B). Actual exploitation should be monitored and reviewed annually to ensure consistency with assumptions.

- ***Local Adaptation Phase***

  Plan Description. Fishery impacts on the Elwha coho population will be managed under the Co-managers Comprehensive Coho Management Plan (PSIT and WDFW 1998), which imposes stepped harvest rate ceilings keyed to the forecasted natural abundance of coho comprising the Strait of Juan de Fuca management unit. This translates to a pre-terminal harvest rate of approximately 40-50% for hatchery coho and 10% for natural coho. There will be no in-river fisheries in the Elwha for 5 years, starting in 2012. Terminal-area coho fishing regimes will be developed when fishing resumes, to provide opportunity that is consistent with achieving coho recovery objectives.

Observations. It is unclear how long the fishing moratorium will be extended beyond 5 years relative to the conservation goals. The moratorium could be shortened with development and use of selective fishing gears in the in-river fishery. Actual exploitation should be monitored and reviewed annually to ensure consistency with assumptions.

- ***Full Restoration Phase***

  Plan Description. Fishery impacts on the Elwha coho population will be managed under the Co-managers Comprehensive Coho Management Plan (PSIT and WDFW 1998), which imposes stepped harvest rate ceilings keyed to the forecasted natural abundance of coho comprising the Strait of Juan de Fuca management unit. This translates to a pre-terminal harvest rate of approximately 40-50% for hatchery coho and 10% for natural coho (Ward et al. 2008). There will be no in-river fisheries in the Elwha for 5 years, starting in 2012. Terminal-area coho fishing regimes will be developed when fishing resumes, to provide opportunity that is consistent with achieving coho recovery objectives. In-river harvest is assumed to be 30% once the coho population is restored and self-sustaining.

  Observations. In-river harvest rate will need to be subject to achieving the escapement objective for natural-origin coho.

3.1.3 Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin

Efforts to harvest abundant hatchery fish from one population can impact natural fish in another population; hatchery strays can and do interact with natural populations from different locations within the region. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

- ***Preservation Phase***

  Plan Description. The Plan implements fish disease monitoring and control procedures consistent with the Salmon Disease Control Policy of the Fisheries Co-Managers of Washington State (NWIFC 2006). NPDES permit standards are being met. Adults will be collected at hatchery facilities and by using gill nets. There will be no in-river fisheries for 5 years, starting in 2012. Smolt releases from the hatchery are timed to reduce interactions with juvenile chum and pink salmon.

  Observations. Use of selective fishing gear to collect broodstock could reduce mortality to adult coho and other species caught unintentionally (see Appendix B). Since there is no directed fishery on coho salmon during this phase, there will be no incidental catch of other species. The habitat below the dam sites, which is already degraded, will become more impaired with the expected release of large amounts of sediment following dam removal. Natural production will be very small. We do not expect the proposed coho salmon releases during the Preservation Phase to cause negative ecological interactions with other species.

- ***Recolonization Phase***

  Plan Description. The Plan implements fish disease monitoring and control procedures consistent with the Co-managers' Fish Heath Policy (NWIFC 2006). NPDES permit standards are being met. Adults will be collected at hatchery facilities and by using gill nets. There will be no in-river fisheries for 5 years starting 2012. Smolt releases from the hatchery are timed to reduce interactions with juvenile chum and pink salmon.

  Observations. It is unclear whether the in-river fishing moratorium will be extended beyond 5 years relative to conservation goals. During this phase, sediment is expected to return to natural background levels. Passage in the middle river and above the dam sites will be restored and natural production will be occurring. With the onset of natural production above the dam sites, the numbers and timing of hatchery releases must be viewed with a concern for ecological interactions. As a result, the possibility of ecological interactions between artificially and naturally produced juveniles is a critical uncertainty that must be addressed (Table 1.2). For a detailed explanation, see comments under Recommendation 11.

- ***Local Adaptation Phase***

  Plan Description. The Plan implements fish disease monitoring and control procedures consistent with the Co-managers Fish Heath Policy (NWIFC 2006). NPDES permit standards are being met. Adults will be collected at hatchery facilities and by using gill nets. Smolt releases from hatchery are timed to reduce interactions with juvenile chum and pink salmon. Sport and commercial in-river harvest of coho will be implemented as hatchery and natural goals for the Basin are met.

  Observations. It is reasonable to expect that a rapid recovery of naturally produced coho salmon will create interest to lift the moratorium on directed harvest on Elwha coho. The HSRG recognized this when it stated that there is a need for decision rules for harvest of naturally produced fish (Table 1.2). During this phase, passage in the middle river and above the dam sites will have been restored and the numbers of naturally produced fish will be building. As the natural production of coho salmon builds through this phase, decision rules and triggers for how the coho hatchery programs should be modified (Table 1.2). The Plan discusses the phase out of hatchery programs as natural production increases (page 30). To avoid confusion, this needs to be reconciled with the coho hatchery production numbers given in Table A-21 of the Plan (page 149). The table does not show that hatchery production is phased out as adult returns increase. It shows just the opposite, i.e., an increase in total hatchery production up to a total of 18 million when adult returns reach more than 15,000 adults.

  To the extent that hatchery releases continue, monitoring to detect ecological interactions among naturally and artificially produced fish must continue. This is particularly important if the large increases in hatchery production are realized. For a detailed explanation of this concern see comments under Recommendation 11.

  Selective harvest gear could also be used to harvest hatchery adults in-river without undue mortality to natural-origin coho needed for recovery and other returning adult species after the 5-year fishing moratorium has ended.

- ***Full Restoration Phase***

  Plan Description. The Elwha Plan is structured around three phases, the last of which is the post dam removal period. There is no equivalent Full Restoration Phase. The Plan calls for implementing fish disease monitoring and control procedures consistent with the Co-manager's Fish Heath Policy (Fisheries Co-Managers of Washington State 1998). NPDES permit standards are being met. Adults will be collected at hatchery facilities and by using gill nets. Smolt releases from the hatchery are timed to reduce interaction with juvenile chum and pink salmon. Sport and commercial in-river harvest of coho will be implemented.

  Observations. If a fully-functioning monitoring and adaptive management plan is in place (see Chapter 7) by the time the Elwha restoration effort reaches the Full Restoration Phase, negative interactions between species and between hatchery produced and naturally produced coho salmon should have been identified and resolved. The expectation is that the coho hatchery program will cease as a tool for restoration.

3.1.4 Summary of Observations and Conclusions for Principle 1—Coho Salmon

Table 3-4 summarizes our findings regarding the consistency of the coho component of the Plan with HSRG Principle 1 and specifically, with the three recommendations that address harvest and conservation goals. Table 3-5 summarizes our observations and conclusions, by restoration phase.

Table 3-4 Principle 1: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 1: Are conservation goals expressed in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)?	Partially
Recommendation 2: Are harvest goals expressed in terms of a population's contribution to specific fisheries?	Yes
Recommendation 3: Are goals for individual populations coordinated and compatible with those for other populations in Elwha Basin?	No

Table 3-5 Observations and conclusions regarding Principle 1—population goals.

Preservation Phase Biologically-based, measurable criteria for preservation of the genetic resource are needed. The Plan lacks a clear statement of goals. A goal statement that complies with Principle 1 and Recommendations 1 – 3 should be developed for each of the four phases.
Recolonization Phase) See above. Biologically-based, measurable objectives for natural production during the Recolonization Phase are needed. These objectives should address abundance, productivity and spatial distribution of naturally spawning fish. Selective fishing gears may assist during this phase to harvest surplus hatchery coho and protect natural-origin coho for recovery purposes.
Local Adaptation Phase See above. Biologically-based, measurable objectives for natural production during the Local Adaptation Phase are needed. Selective fishing gears may assist during this phase to collect natural-origin broodstock, harvest surplus hatchery coho and protect natural-origin coho for recovery purposes.
Full Restoration Phase See above. More clarity is needed for the long term goals for coho in the Elwha Basin.

3.2 Principle 2: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program in terms of benefits and risks must be formulated, explaining how the program expects to achieve its goals. The purpose, operation, and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated. In general, scientific defensibility will occur at three stages:

1) During the deliberation stage, to determine whether a hatchery should be built and/or a specific hatchery program initiated;

2) During the planning and design stage for a hatchery or hatchery program; and

3) During the operations stage.

This approach ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied with citations from the scientific literature. HSRG recommendations 4 through 13 are aimed at ensuring scientifically defensible hatchery programs. The HSRG review of the Elwha plan is presented with reference to these recommendations. The purpose of the hatchery program will vary by phase of the restoration project.

3.2.1 Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. A conservation program is one that is compatible with goals for biological significance (Primary or Contributing) and viability (productivity, abundance, diversity and spatial structure) of a population. A harvest program is one that contributes to specific fisheries at specified rates or harvest numbers, and is compatible with identified conservation objectives for all populations. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program.

<u>General Comment on Recommendation 4</u>

The Plan and the HGMP identify the purpose of the proposed hatchery programs as conservation. With reference to the biological phases we suggested above (Chapter 1.2), the purpose of the coho hatchery program would be:

Preservation Phase	Conservation
Recolonization Phase	Conservation
Local Adaptation Phase	Conservation
Full Restoration Phase	No hatchery program

3.2.2 Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program (harvest, conservation, or both) have been established, the scientific rationale for the program must be documented. The scientific rationale explains, in terms of benefits and risks, how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be documented, so those assumptions can be evaluated and modified as new information becomes available. Documentation should include citations from the scientific literature and analytical tools that take into account the various factors that will affect the success of the program (predation assumptions, cumulative effects, etc.). This approach ensures a scientific foundation for hatchery programs, a means to address uncertainty, and a method to demonstrate accountability.

The following applies to all phases:

Plan Description. The recovery expectation in terms of coho adults calls for 12,100 adults. The Elwha Plan states two benchmarks for coho recovery: terminal abundance will reach 3,000 in 10 years and 12,100 in 25 years. Release strategies for numbers and locations for planting hatchery yearling smolts, natural spawners, eyed eggs, fry and pre-smolts are outlined in Tables 12-14 of the Plan (page 49).

Observations. The Plan lacks a set of clearly articulated assumptions under which the proposed hatchery strategy will meet this recommendation. Survival expectations and reasons for using different release strategies by life stage are not provided. Predefined triggers in terms of numbers of naturally spawning adults (hatchery or natural-origin) for switching between project phases is not provided.

The key assumptions vary by project phase, and while many of the assumptions are contained in either the Plan or the HGMP, the information about critical assumptions, under which the chosen strategy will succeed, should be explicitly stated and summarized by project phase (e.g., preservation, recolonization, local adaptation and full restoration). They should be clearly linked to decision rules and monitoring and evaluation priorities for each phase.

Predefined, quantitative triggers for modifying hatchery programs, including shifting between project phases, should be based on a set of initial assumptions. They should also be explicitly stated.

In summary, the plan requires more information and better organization of existing information to meet this recommendation.

3.2.3 Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

One of the most critical needs in hatchery reform is to improve hatchery broodstock management. Hatchery programs should be managed as either genetically *integrated* with, or *segregate*d from, the natural populations they most directly influence (HSRG 2009, Appendix A, Implementing and Transitioning Hatchery Programs).

A fundamental purpose of most *integrated* hatchery programs is to increase abundance for harvest, while minimizing the genetic divergence and reproductive fitness differences between the hatchery broodstock and the naturally spawning population. In some cases, integrated programs also serve as a demographic safety net to vulnerable natural populations. An integrated program is intended to maintain the genetic characteristics of a locally adapted natural population and minimize the potential genetic effect of domestication. To achieve this, at a minimum, the pNOB has to be greater than the pHOS.

For *segregated* hatchery programs, the intent is to maintain a genetically distinct hatchery population that is isolated from natural populations. Ideally, fish from this type of hatchery program would be propagated solely from hatchery returns and not allowed to spawn with the natural population. The primary intent of a *segregated* program is to create a hatchery-adapted population to meet goals for harvest.

The biological principle behind the broodstock standards for both integrated and segregated populations is *local adaptation*, i.e., allowing a population to adapt to the environment it inhabits. Proper integration or segregation of hatchery programs is the HSRG's recommended means for minimizing adverse effects of hatcheries on local adaptation. The typical benefit of reforming broodstock management is that abundance goals for conservation and harvest can be met while at the same time improving the productivity of natural populations. Hatchery fish on the spawning grounds always represent a compromise between the demographic benefits and the genetic risk, even when they come from a well-integrated program. The HSRG concluded that when its broodstock management standards for an integrated or segregated program are met and managers' abundance goals are achieved, the benefits of the hatchery program outweigh the risks.

The following applies to all phases:

Plan Description. The coho HGMP refers to the program as "*integrated recovery evolving towards integrated harvest*". The HGMP calls for incorporating natural-origin fish into the hatchery broodstock to protect the genetic legacy of the native stock. Current broodstock management is segregated.

Observations. How "*integrated recovery*" and "*integrated harvest*" relate to integrated or segregated broodstock management is unclear. References to collecting broodstock in-river with gill nets are made, but the purpose is unclear as to whether it is for integrated broodstock management or to meet desired numbers of broodstock. The current program is operated as a segregated broodstock, but there is no mention of a broodstock strategy in terms of whether it is integrated or segregated. No strategy for developing an integrated hatchery broodstock is discussed. An explicit strategy or goal to adopt either an integrated or segregated broodstock is lacking. Converting the segregated hatchery broodstock to an integrated hatchery broodstock at the onset of the Local Adaptation Phase to serve as a safety net would be appropriate for a conservation goal.

3.2.4 Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve abundance goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions. The abundance and productivity of the natural population, as well as the ability to fully harvest hatchery-origin fish, determine the effect of hatchery straying on the natural population. This, in turn, determines the proper size of a hatchery program.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. Time, size, age and location of released hatchery fish also affect straying, survival and ecological interactions. When a hatchery program is sized appropriately, the demographic benefits to harvest and/or conservation outweigh the genetic and ecological risks.

The HSRG recommends that managers size their hatchery and harvest programs to reduce these surpluses and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers (see Appendix A).

The following applies to all phases:

Plan Description. The number of hatchery smolt releases and releases by life stage are provided in the HGMP (Section 1.10.1) and are listed in the table below. Hatchery broodstock is assumed to be operated as segregated for all phases. Conflicting information is provided in tables 12-14 of the Plan (page 49) which shows age-1+smolt releases up to 750,000.

Table 3-6 Proposed juvenile coho releases (LEKT 2011b).

		Adult return levels				
Release Stage	Release Location	100	500	1000	2000	5000-15000
Age 1+ smolt	Hatchery	225,000	425,000	425,000		
Eyed eggs	Mid - & Low-Basin	0			100,000	
Fry		0		125,000		
Pre-smolts		0	15,000	75,000		
Age 1+ smolts		0	10,000	30,000		
Adult outplants	Mid - & Low-Basin		300-10,000			

The Plan links changes in the habitat to hatchery activities. Pre-terminal, ocean fisheries are maintained while a 5-year in-river fishing moratorium provides an "all H" restoration strategy.

Page 26 of the Elwha Plan states *"Outplanting strategies include multiple life history patterns including adults, juveniles, and eyed eggs. Selection of life history patterns outplanted is based on stock availability and appropriateness of specific life history patterns to meet outplanting goals. The selection of outplanting strategies employed is dynamic, subject to review by managers, and may shift throughout the duration of the restoration project according to fish responses."*

Observations. As indicated in Chapter 1.2, the HSRG recommends a stronger biological perspective to the phased restoration process. Also, Appendix A provides recommendations regarding nutrification.

The Plan should avoid using the poorly-defined term "supplementation". Describing the hatchery strategies in terms of their purpose is more informative and helps bring focus on the end-points, instead of the process. The purpose of hatchery strategies as described in the Plan are 1) gene conservation and the preservation of the genetic identity and diversity of the extant Elwha coho population during the dam removal period, when habitat limits or precludes in-river natural production; 2) accelerating recolonization of restored and un-populated habitat, once it can again sustain natural production; and 3) a demographic safety net against unforeseen events.

- ***Preservation Phase***

  The Plan addresses the need to maintain genetic identity and diversity of the population as well as possible under the circumstances, though the rationale for the size of the program, from a biological preservation point of view, is not clear.

  The text of the Plan discusses the factors that affect transition from preservation to recolonization, but specific criteria and triggers that drive this transition are not explicitly stated. This is not to suggest that the preservation purpose ends when colonization begins. There will be a need for some hatchery production to create a demographic safety net through the recolonization and local adaptation phases.

- ***Recolonization Phase***

  On page 26, the Plan summarizes the hatchery colonization phase as follows:

  "*Outplanting strategies will include multiple life history patterns including adults, juveniles, and eyed eggs. Selection of life history patterns outplanted is based on stock availability and appropriateness of specific life history patterns to meet outplanting goals. The selection of outplanting strategies employed is dynamic, subject to review by managers, and may shift throughout the duration of the restoration project according to fish response."*

  The HSRG recommends a more structured, predefined process, based on the scientific method, rather than the ad hoc consensus approach suggested in the quote above.

  The text in the Plan discusses the outplanting of multiple life history stages, including adults (see quote above). Yet, Tables 12, 13, and 14 show only minimal numbers of adults allowed to spawn naturally until total returns exceed 2,000 fish. The HSRG encourages outplanting adults, when available, to assist in recolonization. As the Co-managers have done, this outplanting should be initiated in the earlier, preservation phase. The HSRG also recommends limiting the coho hatchery program to the release of 1+ smolts to maximize survival, keeping the program as small as possible, while still meeting objectives.

  Tables 12-14 in the Plan also do not take into account composition of adult escapement (hatchery and natural-origin) and do not explain why hatchery production increases with adult escapement levels. The HSRG would expect the hatchery program to be reduced as adult escapement increases.

  See also discussion about adaptive management, triggers and decision rules in Chapter 1.2 and under Principle 3.

- ***Local Adaptation Phase***

  During this phase, the influence of the hatchery program on the natural population should be reduced and eventually eliminated. The Plan calls the hatchery program "*integrated*", yet makes no mention of pNOB and the PNI index. During this phase, the hatchery broodstock and natural spawning escapement should be managed to meet HSRG standards for a Primary population with a PNI greater than 0.67. In this phase, the hatchery should be downsized to a safety net for demographic and genetic preservation in case re-initiating recolonization becomes necessary. Again, a structured and pre-planned approach should be developed. The statement on page 30, suggests a more ad hoc process:

"Annual review of the status of each population relative to the interim goals will guide decisions regarding continuation of the supplementation program. For example, if at the end of 10 years it is found that the abundance of naturally spawning Chinook salmon is 4,000 fish, productivity is two recruits per spawner, and Chinook salmon are spawning throughout their historic range, then the hatchery program would be phased down to a low maintenance level or eliminated entirely. Conversely, if abundance and productivity were to remain as above, but Chinook salmon were only spawning in the lower 10 miles of the river, then it would be necessary to carefully evaluate the program and decide on a course of action most likely to ensure recolonization of the historic range is achieved."

Selective fishing gears (as discussed in Appendix B) may assist during this phase to collect natural-origin broodstock, harvest surplus hatchery coho and protect natural-origin coho for recovery purposes.

- ***Full Restoration Phase***

  Triggers for the start of this phase should be explicitly stated, along with the decisions on hatchery program size prompted by those triggers.

  The need for hatchery-origin coho will now have been terminated; however, the fate of the associated hatchery facilities is not mentioned.

  Since this phase will begin before natural productivity has been fully restored throughout the watershed, hatchery production should not be reinitiated unless other impediments to natural production occur and have been identified, such as pre-terminal overharvest, poor habitat condition or lack of nutrification.

3.2.5 Recommendation 8: Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

Effectively managing harvest, hatchery broodstock and natural spawning escapement is essential to controlling genetic risks due to straying of hatchery adults. Unless the explicit purpose of the hatchery program is either preservation (gene banking) or recolonization, straying can result in fitness loss in natural populations. To limit these risks and meet conservation goals, the HSRG developed quantitative standards for the pHOS), the pNOB, and the PNI on an integrated population that results from the combination of pHOS and pNOB.

The designation of a population as Primary, Contributing or Stabilizing is, in part, a policy decision; however, for this analysis, the HSRG made assumptions based on the status of each population and manager's objectives. Standards recommended by the HSRG for broodstock management are as follows:

HSRG criteria for hatchery influence on Primary populations

- The pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB $\geq$10%),and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

The following applies to all phases:

Plan Description. The Plan and HGMP prescribe an integrated hatchery recovery program that transitions to an integrated hatchery harvest program.

Observations. As noted in 3.2.3 above, the implied definition of "integrated hatchery program" is not consistent with the HSRG definition. The program is operated as a segregated hatchery broodstock program and there is no reference to standards or guidelines for broodstock composition in either the Plan or the HGMP.

The coho production is externally marked with an adipose clip, but there is no mention of any intent to actively manage hatchery broodstock or monitor and manage hatchery/wild composition on the spawning grounds. The purpose of the HSRG standards is to assure that the coho population adapts to the local environmental conditions over time. For this reason, the HSRG standards are particularly important during the Local Adaptation Phase. Adopting and achieving the HSRG standards would be the most important change as management switches from the Recolonization Phase to the Local Adaptation Phase. These standards apply to the natural spawning population as well as the hatchery population.

The Tribe, with co-manager support, should consider developing and evaluating selective fishing gears to assist in meeting HSRG standards, in collecting broodstock, and in meeting harvest objectives.

3.2.6 Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase harvest and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality.

- ***Preservation Phase***

  Plan Description. The HGMP indicates an integrated hatchery recovery program without terminal harvest during dam removal and for 5 years after dam removal (moratorium). The Plan (page 47), indicates natural-origin coho are exploited at a rate of about 11.6% in pre-terminal fisheries; hatchery coho have an expected 40% to 50% exploitation. Hatchery production is adipose marked and there are CWT index groups to allow estimation of contribution to all fisheries and total survival.

  Observations. The Plan is consistent with HSRG recommendations for managing harvest of hatchery fish.

  The Tribe, with co-manager support, should consider developing and evaluating selective fishing gears during this phase for selective harvest and broodstock collection. Please see Appendix B regarding selective fishing gears.

- ***Recolonization Phase***

  Plan Description. The HGMP indicates an integrated hatchery recovery program with terminal harvest targeting hatchery production, but not to impede recovery. The Plan (page 47) indicates natural origin coho are exploited at a rate of about 11.6% in pre-terminal fisheries; hatchery coho have an expected 40% to 50% exploitation. Terminal harvest rate is limited to 30%, with harvest increasing incrementally to 4,000 fish.

  Observations. It is not clear if the HGMP's described harvest program during this phase is consistent with the priority for population recovery; greater detail is needed. Terminal harvest should be very limited until the escapement trigger to the Local Adaptation Phase is achieved.

  The Tribe, with co-manager support, should consider developing and evaluating selective fishing gears during this phase for later use in selective harvest and broodstock collection. Adult outplants above the dams during the Preservation Phase and Recolonization Phase are likely to be producing natural-origin recruits (NOR). Any terminal harvest should be very minimal or selective to allow NORs to escape. Without selective fishing capability, full and necessary harvest of hatchery-origin recruits (HOR) in excess of escapement needs may be limited to protect NORs.

- ***Local Adaptation Phase***

  Plan Description. The HGMP indicates an integrated hatchery harvest program with terminal harvest targeting hatchery production, but not to impede recovery. If HOR broodstock is limited, the program produces only 1+ smolts to maximize egg to adult survival.

The Plan (page 47) indicates natural origin coho are exploited at a rate of about 11.6% in pre-terminal fisheries; hatchery coho have an expected 40% to 50% exploitation. Terminal harvest rate is limited to 30%, with harvest increasing to 4,000 fish. Hatchery-origin fish will all be adipose fin clipped to allow for their potential full use.

Observations. The HSRG assumes the long-term goal for management of the Elwha coho salmon population is as a Primary population.

Terminal harvest will need to be managed to actively assist in transitioning to HSRG escapement standards for a Primary population (pHOS < 30% and PNI > 0.67). The Plan and HGMP are unclear about how to assure full harvest of surplus hatchery fish from an integrated, safety net hatchery program.

During this phase, coho management needs to emphasize protection and escapement of NORs with HOR escapement limited to meet a minimal escapement objective. Full use of HORs, in excess of hatchery broodstock and a minimal escapement objective, will likely not be possible without developing and deploying live-capture, selective fishing gears in the Elwha watershed.

- ***Full Restoration Phase***

  Plan Description. The HGMP indicates the integrated hatchery harvest program has been phased out. Terminal harvest will be on natural-origin coho with an expectation of 4,000 fish harvested with a harvest rate not to exceed 30%.

  Observations: The Plan would meet this HSRG recommendation.

3.2.7 Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Use of local broodstock and in-Basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations.

- ***Preservation Phase***

  Plan Description. The HGMP indicates an integrated hatchery recovery program without terminal harvest for 5 years after dam removal (moratorium). Broodstock will be taken from HOR volunteers entering the hatchery. Volunteers could be supplemented, if needed, with broodstock collection from the Elwha River. The broodstock collection goal appears to be based on the terminal run size with adult collection up to 5,000 coho. The HGMP assumes a 1% smolt to adult survival rate. Page 47 of the Plan indicates a yearling smolt program of 750,000, while the HGMP indicates a program of up to 425,000 smolts.

  Observations: Adult broodstock collection since 1999 has been highly variable, from 219 to 5,868. Given this variability, it will be important to maximize egg to adult survival; this is best done by limiting the program to production of up to 425,000 1+ smolts, released from the hatchery.

- ***Recolonization phase***

  Plan Description. The HGMP indicates an integrated hatchery recovery program without terminal harvest for 5 years after dam removal (moratorium). Broodstock will be taken from HOR volunteers entering the hatchery. Volunteers could be supplemented, if needed, with broodstock collection from the Elwha River. The broodstock collection goal appears to be based on the terminal run size with adult collection up to 5,000 coho. The HGMP assumes a 1% smolt to adult survival rate. The Plan (page 47), indicates a yearling smolt program of 750,000 while the HGMP indicates a program of up to 425,000 smolts.

  Observations. As in the Preservation Phase, it will be important to maximize egg to adult survival; this is best done by limiting the program to production of up to 425,000 1+ smolts, released from the hatchery. Collected adults surplus to the smolt program should be outplanted into habitats not affected by dam removal.

  Terminal harvest will need to be consistent with ensuring broodstock needs are met.

  Development and testing of live-capture, selective fishing gears during this phase could assist in supplementing broodstock collection, should volunteers to the hatchery be insufficient (as has occurred in several recent years).

- ***Local Adaptation Phase***

  Plan Description. The HGMP indicates an integrated hatchery recovery program without terminal harvest for 5 years after dam removal (moratorium). Broodstock will be taken from HOR volunteers entering the hatchery. Volunteers could be supplemented, if needed, with broodstock collection from the Elwha River. The broodstock collection goal appears to be based on the terminal run size with adult collection up to 5,000 coho. The HGMP assumes a 1% smolt to adult survival rate. The Plan (page 47), indicates a yearling smolt program of 750,000 while the HGMP indicates a program of up to 425,000 smolts. There is no intent to import brood from non-native populations and the program is expected to be self-sustaining.

  Observations. Terminal harvest may be needed to be consistent with ensuring broodstock needs and controlling pHOS on the spawning grounds.

  Use of live-capture, selective fishing gears during this phase could assist in supplementing broodstock collection, should volunteers to the hatchery be insufficient, as has occurred in several recent years.

- ***Full Restoration Phase***

  Plan Description. The HGMP indicates the hatchery program has been phased out.

  Observations. The Plan would meet HSRG recommendations.

3.2.8 Recommendation 11: Coordinate hatchery programs within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

- ***Preservation Phase***

  Plan Description: The HGMP does not address biological interactions of the Elwha coho hatchery program with other populations in the Puget Sound/northern Washington ecosystem.

  Observations. As coho salmon are not an ESA-listed species, there does not appear to be any attention to effects of the Elwha program on other populations and the overall ecosystem. With all Elwha hatchery-origin coho being adipose fin clipped and most coded wire tagged, any straying to other watersheds can be monitored for adverse effects through local spawner surveys. The Elwha hatchery program should not boost mixed-stock harvest rates in local, pre-terminal fisheries, as the Comprehensive Coho Management Plan (PSIT and WDFW 1998) bases such harvest rates on the status of natural-origin populations.

- ***Recolonization Phase***

  Plan Description. The HGMP does not address biological interactions of the Elwha coho hatchery program with other populations in the Puget Sound/northern Washington ecosystem.

  Observations. As coho salmon are not an ESA-listed species, there does not appear to be any attention to effects of the Elwha program on other populations and the overall ecosystem. With all Elwha hatchery-origin coho being adipose fin clipped and most coded wire tagged, any straying to other watersheds can be monitored for adverse effects through local spawner surveys. The Elwha hatchery program should not boost mixed-stock harvest rates in local, pre-terminal fisheries as the Comprehensive Coho Management Plan bases such harvest rates on the status of natural-origin populations.

- ***Local Adaptation Phase***

  Plan Description. The HGMP does not address biological interactions of the Elwha coho hatchery program with other populations in the Puget Sound/northern Washington ecosystem.

  Observations. As coho salmon are not an ESA-listed species, there does not appear to be any attention to effects of the Elwha program on other populations and the overall ecosystem. With all Elwha hatchery-origin coho being adipose fin clipped and most coded wire tagged, any straying to other watersheds can be monitored for adverse effects through local spawner surveys. The Elwha hatchery program should not boost mixed-stock harvest rates in local, pre-terminal fisheries as the Comprehensive Coho Management Plan bases such harvest rates on the status of natural-origin populations.

- ***Full Restoration Phase***

  Plan Description. N/A

  Observations. The HGMP indicates the integrated hatchery harvest program has been phased out.

3.2.9 Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities, as well as structures to remove and discharge water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change in-stream flow, alter riparian habitat and diminish water quality through hatchery discharges. Water for hatchery use is often drawn from an adjacent stream via pumps or gravity. Improperly designed and maintained water intakes can impinge migrant or resident juveniles on hatchery screens or cause fish to be trapped in hatchery facilities. Structures such as adult weirs and water intake dams can also block natural passage of salmonids to spawning or rearing areas. Water diverted from adjacent streams for fish culture purposes is often returned downstream and can reduce the amount of water for juvenile rearing and upstream adult migration between the area of intake and discharge. Hatchery discharge can also diminish water quality below the point of discharge through changes in temperature, settleable and suspended solids, chemical composition, and presence of therapeutic drugs.

The HSRG has noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

- ***Preservation, Recolonization and Local Adaptation Phases***

  Plan Description. Per the HGMP, the Elwha Hatchery operates under NPDES Permit # WA-G13-1023. Screens on the intake supplying surface water to the hatchery are in compliance with all state and federal environmental regulations and requirements.

  Observations. The HSRG is not aware of any issues related to environmental compliance of the Elwha Hatchery or the Elwha weir at this time. As bedload transport in the river increases and salmon and steelhead runs rebuild, the weir should be closely monitored for any effects on fish passage delays, injuries and mortalities. The weir's trap box, fish sorting and handling, and fish release processes will likely need to be upgraded or modified to accommodate increased fish encounters as runs increase.

- ***Full Restoration Phase***

  Plan Description. N/A

  Observations. The HGMP indicates the integrated hatchery harvest program has been phased out. As bedload transport in the river increases and salmon and steelhead runs rebuild, the weir should be closely monitored for any effects on fish passage delays, injuries and mortalities. The weir's trap box, fish sorting and handling, and fish release processes will likely need to be upgraded or modified to accommodate increased fish encounters as runs increase.

3.2.10 Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. Conservation hatcheries producing juveniles with high survival generate more spawners on the spawning grounds. This, in turn, accelerates the rate at which recovery programs move toward meeting their goals. Production programs may have to reduce release numbers to decrease negative ecological impacts on natural populations. Increasing post-release survival can offset this reduction and enable managers to meet their harvest goals.

There are many approaches to increasing fish survival. The release of fish at the appropriate time, size, age and location can significantly increase their recruitment to fisheries and natural escapement. Releasing rapidly migrating smolts rather than fry increases survival and reduces negative ecological interactions in the freshwater environment. Similarly, the release of healthy fish produces more fish for harvest and less opportunity to spread disease to natural populations. Improving water quality and reducing loading and density during rearing are also proven tools used by fish culturists to enhance fish survival. Adoption of volitional release (allowing smolts to out-migrate when they are ready, rather than "forcing" them out at a preset date) with removal of residuals (fish that do not out-migrate) may increase the long-term survival of released fish, while decreasing negative ecological interactions with natural populations. Proper acclimation and imprinting of hatchery juveniles can reduce straying and enhance survival to the desired location for their harvest or artificial spawning.

Developing and adopting these and other culture and release practices that maximize fish survival and minimize negative ecological interactions by reducing production release numbers, can aid conservation programs in rebuilding runs and reducing the conflict between harvest programs and conservation goals for natural populations.

- ***Preservation Phase***

  Plan Description. The HGMP describes life stage survivals for coho production for the past 12 years. The HGMP further describes production and release of 1+ smolts, pre-smolts, fry and eyed-eggs, with numbers of each depending on the extent of broodstock collection.

  The HGMP indicates that coho smolts are released from the hatchery to reduce interaction with and potential predation of juvenile chum and pink salmon.

  Observations. The fish cultural practices and survival rates for each life stage in the Lower Elwha River Hatchery appear consistent with good hatchery practices. These same metrics will need to be quantified and closely monitored for the new Elwha Hatchery.

  As stated previously, the HSRG recommends the hatchery program be limited to the production of 1+ smolts, with any surplus adults being out-planted to the watershed. This limitation in the program would increase survival of the hatchery product and reduce adverse effects of the hatchery program with naturally produced coho.

- ***Recolonization Phase***

  Plan Description. The HGMP describes life stage survivals for coho production for the past 12 years. The HGMP further describes production and release of 1+ smolts, pre-smolts, fry and eyed-eggs, with numbers of each depending on the extent of broodstock collection.

The HGMP indicates that coho smolts are released from the hatchery to reduce interaction with and potential predation of juvenile chum and pink salmon.

Observations. The fish cultural practices and survival rates for each life stage in the hatchery appear consistent with good hatchery practices. These same metrics will need to be quantified and closely monitored for the new Elwha Hatchery.

As stated previously, the HSRG recommends the hatchery program be limited to the production of 1+ smolts, with any surplus adults being out-planted to the watershed. This limitation in the program would increase survival of the hatchery product and reduce adverse effects of the hatchery program with naturally produced coho.

- ***Local Adaptation Phase***

  Plan Description. The HGMP describes life stage survivals for coho production for the past 12 years. The HGMP further describes production and release of 1+ smolts, pre-smolts, fry and eyed-eggs, with numbers of each depending on the extent of broodstock collection.

  The HGMP indicates that coho smolts are released from the hatchery to reduce interaction with and potential predation of juvenile chum and pink salmon.

  Observations. The fish cultural practices and survival rates for each life stage in the Lower Elwha River Hatchery appear consistent with good hatchery practices. These same metrics will need to be quantified and closely monitored for the new Elwha Hatchery. To reduce potential harm to natural coho production and other species through genetic and ecological interactions, hatchery production should be no larger than necessary to meet recolonization objectives. The hatchery program should be resized to function as a safety-net program.

- ***Full Restoration Phase***

  Plan Description. N/A

  Observations. The HGMP indicates the integrated hatchery harvest program has been phased out.

3.2.11 Summary of Observations and Conclusions for Principle 2—Coho Salmon

Table 3-7 summarizes our findings regarding the consistency of the coho component of the Plan with HSRG Principle 2 and specifically, with the seven recommendations that address scientific defensibility. Table 3-8 summarizes our recommendations for improving consistency, by restoration phase.

Table 3-7 Principle 2: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 4: I s the purpose of the hatchery program defined (i.e., conservation, harvest or both)?	Yes
Recommendation 5: Are the scientific assumptions, under which a program contributes to meeting the stated goals, explicitly stated?	No
Recommendation 6: Has an integrated or segregated broodstock management strategy been selected, that is based on population goals and hatchery program purpose?	No
Recommendation 7: Is the size of hatchery programs based on population goals and as part of an "all H" strategy?	Unclear
Recommendation 8: Are harvest, hatchery broodstock, and natural spawning escapement managed to meet HSRG standards appropriate to the affected natural population's designation?	No
Recommendation 9: Is the harvest managed to achieve full use of hatchery-origin fish?	Unclear
Recommendation 10: Do all hatchery programs have self-sustaining broodstocks?	Unclear
Recommendation 11: Are hatchery programs coordinated within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations?	Unclear
Recommendation 12: Are facilities constructed and operated in compliance with environmental laws and regulations?	Yes
Recommendation 13: Is survival of hatchery fish maximized consistent with conservation goals?	No

Table 3-8 Observations and conclusions regarding Principle 2—scientific defensibility.

Preservation phase This phase of the project is generally consistent with Principle 2.
Recolonization Phase The Plan incorporates a mixed strategy in terms of life stages to be planted in the habitat, but limits the option of outplanting adult hatchery fish without explanation. Most importantly, the end-points of the colonization phase are not defined in terms of predetermined triggers and responses.
Local Adaptation Phase For coho, this could be a relatively short, but very critical, phase, where the hatchery program is managed to meet HSRG standards and sized and operated only as a safety net to promote local adaptation. Progress toward local adaptation and increased fitness are balanced against demographic risks, due to uncertainty about habitat conditions. During this phase, specific trigger points in terms of numbers of returning natural origin spawners should be identified to signal transition to the next phase. The trigger points, along with clearly identified uncertainties (see also Recommendation 5) and the accuracy and precision requirements of their estimates, should be major drivers for the monitoring and evaluation plan. Segregated hatchery broodstock should be converted to integrated broodstock. Production should be down-sized to a serve as a "safety-net" in case of a need to revert to Recolonization phase.
Full Restoration Phase Since the hatchery program will be terminated as this phase begins, the main concern here is the determination of when this stage begins. The population may not yet have reached its potential as measured in VSP parameters, but it is now sustainable and increasing over time, without the aid of a hatchery program. The conditions that define the onset of this phase, based on biological triggers, need to be made more explicit.

3.3 Summary of Observations, Conclusions and Recommendations for Coho Salmon

The table below summarizes our assessment of the consistency of the coho salmon component of the Elwha Plan with HSRG Principles 1 and 2. It also provides recommendations for improving consistency with these principles.

Table 3-9 Summary of observations, conclusions and recommendations for coho salmon.

<u>Benefits</u> • The hatchery broodstock originated from native Elwha coho, so the hatchery population represents the best source for hatchery recolonization. • Hatchery intervention is the best solution for recolonization, due to a very limited or non-existent naturally spawning population. • The hatchery population provides significant ocean and terminal-area harvest.
<u>Risks</u> • The heavy reliance on outplanting of hatchery juveniles, rather than releasing juveniles directly from the hatchery to produce adult spawners for recolonization, poses both genetic and ecological risks to the rebuilding of a diverse and productive natural population of coho. • Lack of a clearly-defined end-point to the Recolonization Phase in terms of predefined indicators (triggers) may cause this phase to be prolonged and local adaptation of the natural population to be impeded—the absence of any specific reference to broodstock and natural escapement composition (e.g., pHOS, PNI) implies unknown domestication risk.
<u>Likelihood of meeting goals</u> • Without explicit quantifiable goals, success is not well-defined. • Without predefined, measurable performance indicators, we do not know what success "looks like" even with well-defined goals. • Without a set, structured, information-driven decision-making process, it is not possible to determine whether the project will effectively navigate around risks toward goals.
<u>Recommended modifications</u> • Define coho production goals in terms of VSP parameters. • Adopt HSRG standards for a Primary population to be actively achieved in the Local Adaptation Phase. • Identify measurable performance indicators of project success that reflect viability (VSP). • Develop a set of decision rules that incorporate predefined triggers for change. • Develop and implement a structured adaptive management process that describes annual decision making including schedule, roles and responsibilities, and decision rules. • Develop a monitoring and evaluation plan to resolve uncertainties (to update decision rules) and estimate performance indicators (to measure progress toward goals), and biological triggers (to implement decision rules).

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4 Steelhead Population Report

Winter Steelhead

Population Definition: Native Elwha winter steelhead are considered a distinct, independent population, based on their distinct spawning distribution and the intrinsic capacity of the watershed to support steelhead (WDFW 2005, PSSTRT 2011). An introduced, early-returning run of winter steelhead also occurs in the Elwha River. Genetic analyses show that this was largely derived from releases of the South Puget Sound Chambers Creek Hatchery stock and that the native winter steelhead population and early-returning hatchery run have remained genetically distinct (Winans et al. 2008). This supports similar conclusions from review of the history of introductions and management of this stock in the Basin.

Resident rainbow trout populations also occur above the dam sites on the Elwha River. The relationships of these populations to extant or historical populations of steelhead are unresolved. Genetic evidence shows that that resident rainbow trout are currently genetically different from both of the native and introduced steelhead runs in the Elwha River (Winans et al. 2008). Several resident rainbow trout populations show evidence of introgression with introduced, domesticated McCloud River (California) strains that were released in the basin (Phelps et al. 2001). However, Phelps et al. (2001) also suggested that the genetic characteristics of other resident populations such as those in the Little River may reflect residualization of native steelhead after they were trapped by the dams. Genetic diversity in resident rainbow trout populations is generally less than extant steelhead populations (Winans et al. 2008), suggesting that the genetic characteristics that found in resident rainbow trout now may likely have been influenced by isolation and small population sizes.

ESA Status: The native Elwha steelhead population is part of the Puget Sound steelhead Distinct Population Segment (DPS), listed as threatened under the ESA on July 11, 2007 (72 FR 26722). Hatchery-origin steelhead derived from the native population and propagated through the Lower Elwha Hatchery program will be included as part of the listed DPS and protected under ESA provisions (73 FR 55451 September 25, 2008).

Population Designation: For the purposes of this review the HSRG assumed native winter steelhead to be *Primary,* although this is not stated in the Plan or HGMPs.

Summer Steelhead

Population Definition: A native population of summer steelhead may have existed in the Elwha River prior to the construction of the dams. Little evidence of this population exists now (WDFW 2005) and the NOAA Puget Sound Steelhead Technical Recovery Team considers it to either be extinct or unlikely to have existed historically (PSSTRT 2011). WDFW officially lists the status as “Unknown” because of the lack of information. No efforts have been made to formally document the escapement of summer steelhead within the Elwha River and no escapement goal exists (Ward et al. 2008).

A few steelhead occasionally enter the Elwha River in late spring and summer, which is consistent with a summer steelhead life history. The origin of these fish is unknown. It is possible they represent introductions of non-native summer steelhead to the region. WDFW planted non-native Skamania (Columbia River) hatchery-origin summer steelhead for many years. This practice was discontinued in 2001.

Summer steelhead restoration will rely completely on natural recolonization. The existing lower river native winter population is the primary restoration stock, while native rainbow trout populations isolated above the dams may represent a genetic reserve (LEKT 2011e).

Recent Status and Trends:

Table 4-1 Recent Natural Spawning Escapement

	Natural Spawning Escapement (NOR + HOR) Winter [1]	Natural Spawning Escapement (NOR + HOR) summer [2]	Hatchery Broodstock (early winter) [3]	pNOB
Return Year	Actual	Actual	Actual	Actual
2005	100		139	0
2006	123	unk	138	0
2007	-	unk	140	0
2008	-	unk	147	0
2009	45	unk	153	0
2010	193	unk	139	0
2011	246	unk	175	0

1) These estimates are based on redd counts which are expanded by 2.62 adults/redd. Data from M. McHenry LEKT, October 2011);
2) Assumed to be less than 100 adults annually (Ward et al 2008)
3) Includes only those fish spawned (LEKT 2011d)

Recent Hatchery Production:

Native winter steelhead: The Tribe initiated an artificial propagation program using the native late-returning winter steelhead population as broodstock beginning in 2005. The program is directed at the preservation and restoration of the native stock and will operate parallel to the existing Chambers Creek lineage steelhead program that the Tribe operates for harvest augmentation purposes (Ward et al. 2008).

The strategy of this program is to begin with a captive brood program and transition to an integrated recovery program. The objectives of this program are to preserve the abundance and genetic lineage of the native population of winter steelhead in captivity while its habitat is disrupted by dam removal, then to continue to supplement juvenile abundance and adult returns to promote recolonization of the restored watershed. The ultimate objective is to recover a self-sustaining, natural-origin population of steelhead that maintains the genetic characteristics of the native population, at an abundance approaching historical levels.

Chambers Creek early winter steelhead: The Lower Elwha Chambers Creek early-winter steelhead program was initiated to provide steelhead fishing opportunity in the Elwha River, to enable exercise of tribal treaty rights and also to serve the interests of recreational fishing. The Co-managers assumed that native steelhead natural production was constrained by lack of good habitat below the dams and that the population could not support the desired levels of harvest. The program is similar to many other hatchery programs operated by tribes and WDFW in Puget Sound and on the Washington coast that produce steelhead with earlier run-timing than the local, native winter steelhead populations. These programs are intended to separate the early-winter hatchery stock from the native winter populations to enhance harvest opportunity, while conserving depressed wild populations. The SAR of early-winter steelhead is presumed to be1.0% (LEKT 2011d).

In addition to providing harvest opportunity, the current objectives for the Lower Elwha Chambers Creek early winter steelhead program include minimizing the potential for returning adults to spawn naturally or interbreed with Elwha native steelhead. Targeted fisheries; improved homing to the new tribal hatchery, both from increased flow from the hatchery and release of early-run steelhead exclusively from the hatchery; and removing marked steelhead at the weir are expected to accomplish these objectives. Genetic analysis of returning adults and outmigrant smolts will monitor the extent to which early steelhead are reproducing naturally, or interbreeding with native steelhead.

Table 4-2 Recent hatchery release numbers.

Release Year	Captive brood eggs/fry captured (3)	Fry inventoried (PIT tagging) (3)	Juveniles released	Early winter Chambers ck Steelhead (age-1 smolts) (4)
	Actual	Actual	Actual	Actual
2005	1,130	821		78,565
2006	2,731	1,274		105,723
2007	1,085	193		56,485
2008	850	497		98,889
2009	969	177		124,682
2010	431	244		51,571
2011	879	pending	178,116	61,025

(3) No hatchery program prior to 2005, a post-dam removal target of 175,000 age-2 smolts, outplanting of up to 100,000 eyed eggs, 274,000 pre-smolts and 25,000 age-1 smolts to appropriate habitats has been established.
(4) Includes releases from WDFW rearing channel

Recent Harvest:

Native winter steelhead: No directed harvest currently occurs on the native steelhead stock. A small portion of the run is taken each year during fisheries that target early-winter hatchery steelhead. Fisheries for hatchery steelhead end no later than 28 February each year (Ward et al. 2008) to minimize this take.

The Co-managers' harvest plan for Puget Sound steelhead sets the critical threshold for Elwha steelhead at 100 (PSIT and WDFW 2010). This threshold was developed to inform harvest management in the short term, but it lacks technical basis in current or future potential productivity in the Elwha. Natural-origin winter steelhead production has been confined since 1911 to the 5 miles below the Elwha Dam site, where poor habitat conditions constrain spawning success and rearing survival. Recovery of the population to a viable level is contingent on restoration of access to the upper river, and implementation of other aspects of the Elwha River Fish Restoration Plan (Ward et al. 2008). As abundance and productivity increase following dam removal, critical and viable population thresholds will change (LEKT 2011e).

In addition, a temporary moratorium on in-river fishing is proposed for the Elwha River during dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations (LEKT 2011e).

Summer steelhead: For catch accounting purposes, a steelhead returning to the Elwha River from 1 May to 31 October is assumed to be summer life history. With the elimination of the summer steelhead hatchery program, no fisheries remain targeting summer steelhead. Incidental mortality may occur during recreational and commercial coho fisheries in late September and October.

Chambers Creek early winter steelhead: The objective for tribal and recreational fisheries is to harvest all early steelhead returning to the river in excess of the number of adults required to perpetuate the hatchery program. Incidental harvest impact on native, winter steelhead is minimized by operating tribal and recreational fisheries in December and January. Dam removal activities were initiated in 2011. For a minimum period of 5 years, beginning in 2012, there will be no salmon or steelhead fisheries in the Elwha River. In subsequent years, steelhead returns to the Elwha River will be managed consistent with the Co-managers' steelhead harvest management plan, and with NMFS ESA authorizations for those plans. The post-moratorium harvest objective is 300-500 early-timed steelhead.

The longer-term goal is to recover the native steelhead population to an abundance that will support harvest. Production of early-timed steelhead will be phased out when recovery objectives are achieved (LEKT 2011d).

Table 4-3 Recent catch estimates.

Year	Tribal	Sport	Hatchery rack
2004-05	196	428	290
2005-06	214	403	184
2006-07	308	127	243
2007-08	173	53	137
2008-09	78	37	
2009-10	114	271	
2010-11	103	150	

Table 4-4 presents a summary of status, trends and restoration goals for steelhead.

Table 4-4 Steelhead summary.

Population Designation[1]		Primary
Program Type [2]		Isolated conservation evolving to integrated recovery
Historical Abundance [3]		483 - 5,575
Current Escapement [4]		Redds = 50 - 100 Since 2002 : Fish in escapement based on forecast = 100-200
Restoration Goals	ERFRP	After 10 years: Returns = 1,500 After 25 years: Escapement = 5,757; Total Recruit = 5,757
	HGMP	Adult Escapement: After 10 years – 1,500 After 25 years - 5,757
1) HSRG assumed designation 2) Source LEKT 2011e		3) Range of several estimates 4) Source Ward et al. 2008

4.1 Principle 1: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

Goals for fish populations must be explicitly communicated and fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (harvest, conservation, education, research, etc.). Hatchery production numbers may be the means of contributing to harvest and/or conservation values, but they are not end-points. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when benefits significantly outweigh the risks and when the benefit/risk mix from the program is more favorable than the benefits and risks associated with non-hatchery strategies for meeting the same goals.

The HSRG has developed three general recommendations as guidelines for defining goals for natural and hatchery populations. The HSRG review of the Elwha Plan in terms of its consistency with Principle 1 is presented with reference to these recommendations.

General Comment on Principle 1

The Elwha Plan does not state the restoration goal for steelhead in terms that conform to the HSRG's recommendations. However, scattered throughout the text of the Plan are pieces of information that taken in total would provide some of the information needed to construct a goal. For example, on page 97, Table 25 gives interim restoration targets for abundance after 10 and 25 years; productivity after 10 years and at MSY; and spatial distribution and harvest goals for freshwater. These targets could be part of the goal. The interim targets are quantitative, but they do not separate natural and hatchery populations, nor are they placed in an "all H" context. Four goals on page 95 are called central to the implementation of the Elwha Act. They are:

1) Reestablish self-sustaining anadromous salmonid populations and habitats throughout the Elwha River watershed and its near shore as quickly as possible, using the most appropriate methods.

2) Maintain the integrity of the existing salmonid genetic and life history diversity before, during, and after dam removal and the subsequent periods of elevated sediment levels.

3) Maintain the health of fish populations before, during, and after dam removal.

4) Restore the physical and biological processes of the overall ecosystem through dam removal, including the return of VSPs.

Additionally, a parallel goal is found in the NOAA Fisheries guidance documents for recovering ESA-listed salmon species (NMFS 2010): restoration efforts shall be targeted at achieving viable salmonid populations. These goals are not species specific, nor are they quantitative. They are broad descriptions of things that will be done (tasks), not things that will be achieved (goals). The Elwha Plan needs a comprehensive, species-specific goal statement near the beginning of the Plan's narrative. The goal statement should conform to HSRG's Principle 1.

4.1.1 Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)

The Primary, Contributing and Stabilizing population designations refer to the biological significance of the population in the context of its ESU. The following general viability criteria apply:

- Primary: populations must achieve at least high viability
- Contributing: populations must achieve at least medium viability
- Stabilizing: populations must maintain at least current viability
- Viability goals should be expressed in terms of population productivity and abundance
- Viability goals should also take into account spatial structure and diversity

Different definitions of biological significance are used by managers throughout the Northwest. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board 2004 (LCRFB 2004), under which all distinct salmon and steelhead populations are classified as either *Primary,* which are targeted for restoration to high productivity and abundance; *Contributing,* where small to medium improvements are needed; or *Stabilizing,* populations that may be maintained at current levels. Viability goals are expressed in terms of population productivity and abundance and also take into account spatial structure and diversity.

The following applies to all phases:

Decision rules with measurable triggers for the steelhead population must be identified to determine when to transition to the next phase. For the fourth phase (Full Restoration Phase) the decision rules and triggers should determine when it is necessary to revert to an earlier phase. Decision rules must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision. All key assumptions (See Chapter 1.2, Table 1.2) must be monitored until they are either resolved or it is determined that they are not relevant to the recovery of the Elwha ecosystem.

Plan Description. Not clearly stated in the Plan.

Observations. We have assumed a designation of Primary for the native winter steelhead population.

4.1.2 Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description. A temporary moratorium on in-river fishing beginning in 2012 is proposed for the Elwha River during dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations (LEKT 2011e).

Chambers Creek Early Winter Steelhead

Plan Description. See Native Winter Steelhead Preservation Phase above.

Observations. Production of Chambers Creek stock steelhead will continue during this phase. The lack of harvest and poor weir efficiency during the early winter return timing may pose a risk to the restoration effort through ecological and genetic impacts to native steelhead. Managers should allow harvest on this stock throughout the restoration of Elwha populations. There is a risk that unharvested adults from this program may participate in recolonization.

- ***Recolonization Phase***

Native Winter Steelhead

Plan Description. In subsequent years, steelhead returns to the Elwha River will be managed consistent with the Co-managers' steelhead harvest management plans, and with NMFS ESA authorizations for those plans. Implementation of harvest directed at early-timed steelhead following the fishing moratorium will be contingent on constraining incidental impacts on native steelhead to levels that achieve ESA conservation criteria (i.e., not impeding survival and recovery) (LEKT 2011e).

Observations. The Plan does not identify a minimum number of returning steelhead (NOR + HOR) deemed necessary to achieve this phase.

Chamber Creek Early Winter Steelhead

Plan Description. The post-moratorium harvest objective is 300-500 early-timed steelhead. The objective for tribal and recreational fisheries is to harvest all early steelhead returning to the river in excess of the number of adults required to perpetuate the hatchery program. Annual harvest since 2003-2004 has averaged 376. Incidental harvest impact on native, late-timed steelhead is minimized by operating tribal and recreational fisheries in December and January. Implementation of harvest directed at early-timed steelhead following the fishing moratorium will be contingent on constraining incidental impacts on native steelhead to levels that achieve ESA conservation criteria (i.e., not impeding survival and recovery [LEKT 2011d]).

Observations. Production of Chambers Creek stock steelhead will continue during this phase. The lack of complete harvest and poor weir efficiency during the early winter return timing may pose a risk to the restoration effort through ecological and genetic impacts to native steelhead. The HSRG recommends that managers allow harvest on this stock throughout the restoration of Elwha populations. This will help to minimize the genetic and ecological impacts from unharvested adults from this program that may interact with native winter steelhead intended for recolonization.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description. Initial adult returns from program releases are expected occur in 2013. Hatchery-origin native steelhead produced by this program are initially intended for conservation and recovery purposes only. As stock recovery and natural colonization throughout the Elwha River watershed occurs, commercial, recreational and ceremonial/subsistence fisheries targeting steelhead will be developed and will benefit from this program (LEKT 2011e).

Observations. The Plan does not identify a minimum number of returning steelhead (NOR + HOR) deemed necessary to achieve this phase.

Chambers Creek Early Winter Steelhead

Plan Description. The Plan calls for producing steelhead to enhance in-river harvest opportunities, while minimizing adverse ecological and genetic effects on listed salmonid populations. The post-moratorium harvest objective is 300-500 early-timed steelhead. The objective for tribal and recreational fisheries is to harvest all early steelhead returning to the river in excess of the number of adults required to perpetuate the hatchery program. Annual harvest since 2003-2004 has averaged 376. Incidental harvest impact on native, late-timed steelhead is minimized by operating tribal and recreational fisheries in December and January. For a minimum period of 5 years (2012-2016) following the start of dam removal in 2011, there will be no salmon or steelhead fisheries in the Elwha River. In subsequent years, steelhead returns to the Elwha River will be managed consistent with the Co-managers' steelhead harvest management plans, and with NMFS ESA authorizations for those plans. Implementation of harvest directed at early-timed steelhead following the fishing moratorium will be contingent on constraining incidental impacts on native steelhead to levels that achieve ESA conservation criteria (i.e., not impeding survival and recovery) (LEKT 2011d).

Observations. Production of Chambers Creek steelhead will continue during this phase. The lack of complete harvest and poor weir efficiency during the early winter return timing will allow some of these fish to interact with native winter steelhead and spawn naturally. This may pose risks to the restoration of native steelhead.

- ***Full Restoration Phase***

Native Winter Steelhead

Plan Description. Initial adult returns from program releases are expected occur in 2013. Hatchery-origin native steelhead produced by this program are initially intended for conservation and recovery purposes only. As stock recovery and natural colonization throughout the Elwha River watershed occurs, commercial, recreational and ceremonial/subsistence fisheries targeting steelhead will be developed and will benefit from this program.

Observations. Future harvest goals must be consistent with Recommendation 2.

Chambers Creek Early Winter Steelhead

Plan Description. The longer-term goal is to recover the native steelhead population to abundance that will support harvest. Production of early-timed steelhead will be phased out when recovery objectives are achieved (LEKT 2011d).

Observations. This review assumes no Chambers Creek early winter steelhead stock program during this phase.

4.1.3 Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin

Efforts to harvest abundant hatchery fish from one population can impact natural fish in another population; hatchery strays can and do interact with natural populations from different locations within the region. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

The following applies to all phases:

Plan Description. Hatchery production for steelhead and for all species increases as total adult returns increase (Table 9-11 of the Plan).

Observations. The Plan provides minimal assessment of the interaction between species throughout the phases. The hatchery programs described appear to be based on capacity of the facilities rather than biological assessments of individual species. Hatchery production appears to be maximized even when over 4,000 steelhead are spawning naturally (Table 11 of the Plan).

4.1.4 Summary of Observations and Conclusions for Principle 1—Steelhead

Table 4-5 summarizes our findings regarding the consistency of the steelhead component of the Plan with HSRG Principle 1 and specifically, with the three recommendations that address harvest and conservation goals. Table 4-6 summarizes our observations and conclusions, by restoration phase.

Table 4-5 Principle 1: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 1: Are conservation goals expressed in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)?	Partially
Recommendation 2: Are harvest goals expressed in terms of a population's contribution to specific fisheries?	Yes
Recommendation 3: Are goals for individual populations coordinated and compatible with those for other populations in Elwha Basin?	*No*

Table 4-6 Observations and conclusions regarding Principle 1—population goals.

All Phases The Elwha Plan lacks a clear statement of goals. Goal statements that comply with Principle 1 and Recommendations 1 – 3 should be developed.
Preservation Phase Biologically-based, measurable criteria for preservation of the genetic resource are needed.
Recolonization Phase Biologically-based, measurable objectives for natural production during the Recolonization Phase are needed. These objectives should address abundance and spatial distribution of naturally spawning fish during this phase. Observable indicators for these objectives should be identified (e.g., the number of natural-origin adult returns for abundance and the number of stream miles with one or more redds for distribution). Trigger values for the indicators should be defined that signal the end of this phase and the beginning of the next one (e.g., the return of 500 NORs and 20 stream mile segments with at least one steelhead redd).
Local Adaptation Phase Biologically-based, measurable objectives for natural production during the Local Adaptation Phase are needed. These objectives should address abundance, productivity, diversity and spatial distribution of naturally spawning fish during this phase. Observable indicators for these objectives should be identified. Trigger values for the indicators should be defined that signal the end of this phase and the beginning of the next one.
Full Restoration Phase Long term goals for harvest are unclear.

4.2 Principle 2: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program in terms of benefits and risks must be formulated, explaining how the program expects to achieve its goals. The purpose, operation, and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated.

In general, scientific defensibility will occur at three stages:

1) During the deliberation stage, to determine whether a hatchery should be built and/or a specific hatchery program initiated;

2) During the planning and design stage for a hatchery or hatchery program; and

3) During the operations stage.

This approach ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied with citations from the scientific literature. HSRG recommendations 4 through 13 are aimed at ensuring scientifically defensible hatchery programs. The HSRG review of the Elwha Plan is presented with reference to these recommendations.

The purpose of the hatchery program will vary by phase of the restoration project.

4.2.1 Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. A conservation program is one that is compatible with goals for biological significance (Primary or Contributing) and viability (productivity, abundance, diversity and spatial structure) of a population. A harvest program is one that contributes to specific fisheries at specified rates or harvest numbers, and is compatible with identified conservation objectives for all populations. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program.

Native Winter Steelhead

Plan Description. The Plan and the HGMP identify the purpose of the proposed native winter steelhead hatchery program as conservation.

Observations. With reference to the biological phases we suggested above (Chapter 1.2), the purpose of the native steelhead hatchery program would be as followings:

Preservation Phase	Conservation
Recolonization Phase	Conservation
Local Adaptation Phase	Conservation
Full Restoration Phase	No hatchery program

Chambers Creek Early Winter Steelhead

Plan Description. The Plan and the HGMP identify the purpose of the proposed hatchery program for the Chambers Creek early winter steelhead program as harvest. It is also clear that Chambers Creek early winter steelhead stock is not intended to be used for recolonization.

Observations. With reference to the biological phases we suggested above (Chapter 1.2), the purpose of the Chambers Creek early winter steelhead hatchery program would be as follows:

Preservation Phase	Harvest
Recolonization Phase	Harvest
Local Adaptation Phase	Harvest
Full Restoration Phase	No hatchery program

4.2.2 Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program (harvest, conservation, or both) have been established, the scientific rationale for the program must be documented. The scientific rationale explains, in terms of benefits and risks, how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be documented, so those assumptions can be evaluated and modified as new information becomes available. Documentation should include citations from the scientific literature and analytical tools that take into account the various factors that will affect the success of the program (predation assumptions, cumulative effects, etc.). This approach ensures a scientific foundation for hatchery programs, a means to address uncertainty, and a method to demonstrate accountability.

The following applies to all phases:

The Plan describes the activities that will take place (how broodstock is collected, at what stage fish will be released), but not the expected outcomes of those actions. We note that assumptions about natural production potential are critical both to define success and to the choice of hatchery strategies to meet those goals. These key assumptions are not explicitly stated.

The key assumptions vary by project phase, and while many of the assumptions are contained in either the Plan or the HGMP, the information about critical assumptions under which the chosen strategy will succeed (e.g., expected contribution of eyed eggs, fry and presmolt plants) should be explicitly stated and summarized by project phase (e.g., preservation, recolonization, local adaptation and full restoration). They should be clearly linked to decision rules and monitoring and evaluation priorities for each phase.

Predefined triggers for modifying hatchery programs including shifting between project phases should be based on a set of initial assumptions. They should also be explicitly stated.

In summary, the plan falls short of meeting this recommendation.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description. Restoration activities during this period emphasize capturing and developing a population of late-timed, natural-origin steelhead capable of returning to the hatchery facility. Enhancement efforts will include both the production of yearlings (1- and 2-year-old fish) and development of a captive brood program to accelerate egg and smolt availability. Hatchery facilities during this time will be limited by both space (incubation and rearing) and water quantity. Broodstock required to sustain this program will be acquired either through mainstem river capture and transport of adult fish to hatchery facilities for maturation and spawning, or through hydraulic mining of redds for fry or eggs (Ward et al. 2008, and LEKT 2011e).

  Observations. The strategies describe for using hatchery production to preserve the genetic lineage of the native population are generally accepted as being appropriate for this purpose.

  Chambers Creek Early Winter Steelhead

  Plan Description. The hatchery production of Chambers Creek stock will be maintained at maintenance levels during the entire dam-removal period, as no fisheries are expected (LEKT 2011d).

  Observations. Assumptions about ecological and genetic impacts of this program on native steelhead have been taken from general reviews on the topics. The HSRG concluded that the unique nature of this restoration project (dam removal, a rapidly changing environment, and access to new habitat) and the large number of Chambers Creek steelhead and adults relative to the abundance of natural-origin native steelhead increases the uncertainty surrounding these assumptions. This in turn raises the risk that many of the expected outcomes in the Plan might not occur. Recent papers by Araki et al. (2007) and Kostow (2008) suggest that concerns over the genetic and ecological impacts of hatchery origin fish on native populations may be greater than once thought.

- ***Recolonization Phase***

  Native Winter Steelhead

  Plan Description. During this phase, dam removal will have been completed, the period of greatest turbidity will have passed, the shared water treatment facility will have been taken off-line, hatchery facilities will be receiving raw surface water, and hatchery production levels will no longer be limited by water availability. Table 11 of the Plan summarizes the restoration strategies for the post-dam removal period. Enhancement strategies at low adult return numbers will emphasize the release of smolts and presmolts from the hatchery. As adult return numbers increase, restoration strategies employed will be expanded to include providing upstream passage of adults, outplanting of eyed eggs, and the upstream release of fry, presmolts, and smolts. Hatchery production proposed for this period will be phased out over time as the natural-origin population becomes distributed across the available habitat and increases to a healthy, self-sustaining level. During this time, sport and commercial harvests will target the early timed component of the run. Harvest of the late-timed component will begin, based on stock status assessments that demonstrate achievement by the stock of a population size capable of supporting a directed harvest effort.

Redd pumping may still be used to collect eggs and alevins from the naturally spawning population, but the need to collect eggs and alevins from redds to sustain the hatchery program may be reduced over time, as it is expected that late-run fish needed as broodstock will begin to return directly to the hatchery in addition to spawning naturally in the restored river channel. Other collection strategies for adult winter steelhead during this period will include a capture weir, hook and line capture of adults at selected locations throughout the Elwha River Basin, and gillnet collection (stationary and driftnet) (Ward et al. 2008, LEKT 2011e).

Observations. The HSRG has concluded from its previous reviews of hatcheries that releases at life histories other than smolts produce poor returns. In this case (restoration), the HSRG believes that the adults required to generate these progeny in the hatchery (for outplanting) are better used directly for adult outplanting. Adult plants have been used in other streams with success and would allow for rapid determination of the ability of the watershed to support all life stages. In addition, the Plan lacks triggers expressed in terms of NOR returning adults to scale hatchery production. Triggers (number of returning adults) used to increase hatchery production (but not decrease) are based on aggregate (HOR, NOR) numbers of returning fish.

Chambers Creek Early Winter Steelhead

Plan Description. The production of Chambers Creek stock will be maintained to support fishing opportunities in the Elwha River such that it does not interfere with recovery efforts for the native steelhead stock. Production goals and fisheries will be carefully evaluated and monitored according to the Monitoring and Adaptive Management section of the Plan. Changes shall be made to the program if it appears that natural recolonization is being hindered (LEKT, 2011d).

Observations. Assumptions about ecological and genetic impacts of this program on native steelhead have been taken from general reviews on the topics. The HSRG concluded that the unique nature of this restoration project (dam removal, a rapidly changing environment, and access to new habitat) and the large number of Chambers Creek steelhead and adults relative to the abundance of natural-origin native steelhead increases the uncertainty surrounding these assumptions. This in turn raises the risk that many of the expected outcomes in the Plan might not occur. Recent papers by Araki et al. (2007) and Kostow (2008) suggest that concerns over the genetic and ecological impacts of hatchery origin fish on native populations may be greater than once thought.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description. During this phase, dam removal will have been completed, the period of greatest turbidity will have passed, the shared water treatment facility will have been taken off-line, hatchery facilities will be receiving raw surface water, and hatchery production levels will no longer be limited by water availability.

Enhancement strategies at low adult return numbers will emphasize the release of smolts and presmolts from the hatchery. As adult return numbers increase, restoration strategies employed will be expanded to include providing upstream passage of adults, outplanting of eyed eggs, and the upstream release of fry, presmolts, and smolts. Hatchery production proposed for this period will be phased out over time as the natural-origin population increases to a healthy, self-sustaining level. During this time, sport and commercial harvests will target the early timed component of the run. Harvest of the late-timed component will begin, based on stock status assessments that demonstrate achievement by the stock of a population size capable of supporting a directed harvest effort.

Redd pumping may still be used to collect eggs and alevins from the naturally spawning population, but the need to collect eggs and alevins from redds to sustain the hatchery program may be reduced over time, as it is expected that late-run fish needed as broodstock will begin to return directly to the hatchery in addition to spawning naturally in the restored river channel. Other collection strategies for adult winter steelhead during this period will include a capture weir, hook and line capture of adults at selected locations throughout the Elwha River Basin, and gillnet collection (stationary and driftnet) (Ward et al. 2008, LEKT 2011e).

Observations. Success of eyed eggs, fry and presmolt releases are not presented. The HSRG has concluded from its previous reviews of hatcheries that releases at life histories other than smolts produce poor returns. In this case (restoration), the HSRG believes that the adults required to generate these progeny in the hatchery (for outplanting) are better used directly for adult outplanting. Adult plants have been used in other streams with success and would allow for rapid determination of the ability of watershed to support all life stages. In addition, the Plan lacks triggers expressed in terms of NOR returning adults to scale hatchery production. Triggers (number of returning adults) used to increase hatchery production (but not decrease) are based on aggregate (HOR, NOR) numbers of returning fish. During this phase, the emphasis should be on reducing the hatchery influence on the populations (see Chapter 1).

Chambers Creek Early Winter Steelhead

Plan Description. The production of Chambers Creek stock will be maintained to support fishing opportunities in the Elwha River such that it does not interfere with recovery efforts for the native steelhead stock. Production goals and fisheries will be carefully evaluated and monitored according to the Monitoring and Adaptive Management section of the Plan. Changes shall be made to the program if it appears that natural recolonization is being hindered (LEKT 2011d).

Observations. Assumptions about ecological and genetic impacts of this program on native steelhead have been taken from general reviews on the topics. The HSRG concluded that the unique nature of this restoration project (dam removal, a rapidly changing environment, and access to new habitat) and the large number of Chambers Creek steelhead and adults relative to the abundance of natural-origin native steelhead increases the uncertainty surrounding these assumptions. This in turn raises the risk that many of the expected outcomes in the Plan might not occur. Recent papers by Araki et al. (2007) and Kostow (2008) suggest that concerns over the genetic and ecological impacts of hatchery origin fish on native populations may be greater than once thought.

- ***Full Restoration Phase***

Native Winter Steelhead

Plan Description. The hatchery program phases out.

Observations. The Plan assumes full hatchery production until the Full Restoration Phase is reached. This is likely to delay local adaptation of naturally produced fish and may prevent full restoration from being achieved.

Chambers Creek Early Winter Steelhead

Plan Description. The hatchery program phases out.

Observations. The Plan assumes full hatchery production until full restoration phase is reached. The mechanisms for controlling pHOS from this program are not well defined.

4.2.3 Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

One of the most critical needs in hatchery reform is to improve hatchery broodstock management. Hatchery programs should be managed as either genetically *integrated* with, or *segregate*d from, the natural populations they most directly influence (HSRG 2009, Appendix A, Implementing and Transitioning Hatchery Programs).

A fundamental purpose of most *integrated* hatchery programs is to increase abundance for harvest, while minimizing the genetic divergence and reproductive fitness differences between the hatchery broodstock and the naturally spawning population. In some cases, integrated programs also serve as a demographic safety net to vulnerable natural populations. An integrated program is intended to maintain the genetic characteristics of a locally adapted natural population and minimize the potential genetic effect of domestication. To achieve this, at a minimum, the pNOB has to be greater than the pHOS.

For *segregated* hatchery programs, the intent is to maintain a genetically distinct hatchery population that is isolated from natural populations. Ideally, fish from this type of hatchery program would be propagated solely from hatchery returns and not allowed to spawn with the natural population. The primary intent of a *segregated* program is to create a hatchery-adapted population to meet goals for harvest.

The biological principle behind the broodstock standards for both integrated and segregated populations is *local adaptation*, i.e., allowing a population to adapt to the environment it inhabits. Proper integration and segregation of hatchery programs is the HSRG's recommended means for minimizing adverse effects of hatcheries on local adaptation. The typical benefit of reforming broodstock management is that abundance goals for conservation and harvest can be met while at the same time improving the productivity of natural populations. Hatchery fish on the spawning grounds always represent a compromise between the demographic benefits and the genetic risks, even when they come from a well-integrated program. The HSRG concluded that when its broodstock management standards for an integrated or segregated program are met and managers' abundance goals are achieved, the benefits of the hatchery program outweigh the risks.

The following applies to all phases:

The Plan's definition of "integrated" was not provided, but it does not appear to be consistent with the HSRG concept with the same name and therefore, there does not appear to be an explicit commitment to adopt an integrated broodstock strategy as defined by the HSRG (and by the Washington Hatchery and Fishery Reform Policy POL-C3619 (WDFW 2009).

According to the HSRG definition of an integrated program, broodstock for the hatchery program should be managed to assure that the natural environment drives the adaptation of the population. This in turn requires that natural-origin adults contribute more to the genetic make-up of the hatchery population than hatchery fish contribute to natural production. For a Primary population, this means that the pNOB is twice as large as the pHOS in the wild. In addition, pNOB must be at least 10% (see recommendation 8 below).

- ***Preservation Phase***

  Native Winter Steelhead-

  Plan Description. Isolated conservation (captive brood) transitioning to integrated recovery.

  Chambers Creek Early Winter Steelhead

  Plan Description: Segregated.

- ***Recolonization Phase***

  Native Winter Steelhead

  Plan Description. Isolated conservation (captive brood) transitioning to integrated recovery.

  Chambers Creek Early Winter Steelhead

  Plan Description. Segregated

- ***Local Adaptation Phase***

  Native Winter Steelhead

  Plan Description. Integrated recovery

  Observations. pNOB is estimated to be less than 10% during this phase. This is not consistent with the HSRG definition and therefore, there does not appear to be an explicit commitment to adopt an integrated broodstock strategy as defined by the HSRG (and by the Washington Hatchery and Fishery Reform Policy POL-C3619).

  According to the HSRG definition of an integrated program, broodstock for the hatchery program should be managed to assure that the natural environment drives the adaptation of the population. This in turn requires that natural-origin adults contribute more to the genetic make-up of the hatchery population than hatchery fish contribute to natural production. For a Primary population, this means that the pNOB is twice as large as the pHOS in the wild.

  Chambers Creek Early Winter Steelhead

  Plan Description. Segregated

- ***Full Restoration Phase***

  Native Winter Steelhead

  Plan Description. The hatchery program phases out

  Chambers Creek Early Winter Steelhead

  Plan Description. The hatchery program phases out

4.2.4 Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve abundance goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions. The abundance and productivity of the natural population, as well as the ability to fully harvest hatchery-origin fish, determine the effect of hatchery straying on the natural population. This, in turn, determines the proper size of a hatchery program.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. Time, size, age and location of released hatchery fish also affect straying, survival and ecological interactions. When a hatchery program is sized appropriately, the demographic benefits to harvest and/or conservation outweigh the genetic and ecological risks.

The HSRG recommends that managers size their hatchery and harvest programs to reduce these surpluses and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers.

The following applies to all phases:

Plan Description. The Plan links changes to the habitat to hatchery activities. However, it appears that as habitat improves, so does hatchery production, rather than decreasing (as might be expected). The moratorium on fisheries targeting Elwha steelhead also links the hatchery component of the restoration strategy into an "all H" context.

Observations. As indicated in Chapter 1.2 above, the HSRG recommends a stronger biological perspective to the phased restoration process.

The HSRG recommends that the Plan avoid using the poorly defined term "supplementation". Describing the hatchery strategies in terms of their purpose is more informative and helps bring focus on the end-points instead of the process. The purpose of hatchery strategies as described in Plan are 1) gene conservation, the preservation of the genetic identity and diversity of the extant Elwha Chinook population during the dam removal period, when habitat limits or precludes in-river natural production; 2) acceleration of colonization of restored and un-populated habitat, once it can again sustain natural production; and 3) demographic safety net against unforeseen events.

The Plan addresses the need to maintain genetic identity and diversity of the population as well as is possible under the circumstances, though the rationale for the size of the program from a biological preservation point of view is not clear.

The text of the Plan discusses the factors that affect transition from preservation to recolonization, but specific criteria and triggers that drive this transition are not explicitly stated. This is not to suggest that the preservation purpose ends when colonization begins. There will be a need for some hatchery production as part of a demographic safety net through the recolonization and local adaptation phases.

It is clear from the Plan that the use of Chambers Creek steelhead is not intended for recolonization.

Data for the tables below is taken from the Native Winter Steelhead and Early Steelhead HGMPs (LEKT 2011d, LEKT 2011e).

- ***Preservation Phase***

Native Winter Steelhead

Plan Description.

	Dam Removal 2012-2016
Captive reared broodstock	300
Hatchery-origin broodstock	200-500
Natural origin broodstock	200
Natural escapement	100-200
Age 2+ smolts	175,000
Eyed eggs	
Fry	
Pre-smolts	

Observations. The Preservation Phase allows for removal of up to 100% of NOR returns. The Plan addresses the need to maintain genetic identity and diversity of the population as well as is possible under the circumstances, though the rationale for the size of the program from a biological preservation point of view is not clear.

Chambers Creek Early Winter Steelhead

Plan Description.

	Dam Removal 2012-2016
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-200
Age 1+ smolts	65,000

Observations. Continued production of early winter steelhead without any attempts to harvest may result in high pHOS (>5%). Reproductive success of naturally spawning HORs during dam removal is assumed to be very low due to high siltation. The size of this program during the Preservation Phase (with no harvest) appears to be in excess of the goal of preservation of this stock during this phase (although inconsistent production numbers are provided in the Plan and HGMP).

- ***Recolonization Phase***

Native Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Captive reared broodstock	
Hatchery-origin broodstock	500+
Natural origin broodstock	<50
Natural escapement	100-1000+
Age 2+ smolts	175,000
Eyed eggs	100,000
Fry	275,000
Pre-smolts	20,000

Observations. An integrated program with less than 10% pNOB may not preserve genetic continuity with the native population. It is unclear why the same level of hatchery production is planned for escapements ranging between 100-1,000+ natural spawning adults. Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed.

On page 26, the Plan summarizes the hatchery colonization phase as follows:

"Outplanting strategies will include multiple life history patterns including adults, juveniles, and eyed eggs. Selection of life history patterns outplanted is based on stock availability and appropriateness of specific life history patterns to meet outplanting goals. The selection of outplanting strategies employed is dynamic, subject to review by managers, and may shift throughout the duration of the restoration project according to fish response."

The HSRG recommends a more structured, predefined process based on the scientific method (i.e., using testable working hypotheses), rather than the ad hoc consensus approach suggested in the quote above.

Chambers Creek Early Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-1000+
Age 1+ smolts	65,000

Observations. Continued production of Chambers Creek early winter steelhead and the resulting pHOS may allow these fish to interact with native winter steelhead and interfere with recolonization of watershed. Potential genetic and ecological impacts of this program on native steelhead population are not discussed.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Captive reared broodstock	
Hatchery-origin broodstock	500+
Natural origin broodstock	<50
Natural escapement	100-1000+
Age 2+ smolts	175,000
Eyed eggs	100,000
Fry	275,000
Pre-smolts	20,000

Observations. An integrated program with less than 10% pNOB may not preserve genetic continuity with the native population. A high proportion of HORs on the spawning grounds will limit the population's ability to become locally adapted. During this phase, the influence of the hatchery program on the natural population should be reduced and eventually eliminated. Thus, during this phase, the hatchery should be managed to meet HSRG standards for a Primary population—PNI greater than 0.67. Again, a structured and pre-planned approach is called for.

Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed. Program size at this phase should be for preservation only, allowing the existing population to become locally adapted. A decrease in the abundance of naturally produced fish should be expected as this phase begins.

Chambers Creek Early Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-1000+
Age 1+ smolts	65,000

Observations: Continued production of Chambers Creek early winter steelhead may increase pHOS levels above HSRG standards for primary population at some NOR escapement levels, preventing local adaptation of native population and reducing fitness.

- ***Full Restoration Phase***

Native Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Captive reared broodstock	
Hatchery-origin broodstock	Hatchery program phases out
Natural origin broodstock	
Natural escapement	100-1000+
Age 2+ smolts	
Eyed eggs	
Fry	
Pre-smolts	

Observations. The trigger for phase-out of the hatchery program appears to be “full restoration”; full production is maintained until that point, preventing local adaptation. Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed.

Triggers for the start of this phase should be explicitly stated, along with the decisions prompted by those triggers.

Since this phase will likely begin before natural productivity has been fully restored, there remains a need to identify and address impediments to natural production, including harvest and nitrification, for example.

Chambers Creek Early Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Hatchery-origin broodstock	Hatchery program phases out
Natural origin broodstock	
Natural escapement	100-1000+
Age 1+ smolts	

Observations. The trigger for phase-out of the hatchery program appears to be "full restoration"; full production is maintained until that point, delaying local adaptation.

Conclusion: The Plan is not consistent with Recommendation 7.

4.2.5 Recommendation 8: Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

Effectively managing harvest, hatchery broodstock and natural spawning escapement is essential to controlling genetic risks due to straying of hatchery adults. Unless the explicit purpose of the hatchery program is either preservation (gene banking) or recolonization, straying can result in fitness loss in natural populations. To limit these risks and meet conservation goals, the HSRG developed quantitative standards for the pHOS, the pNOB, and the PNI on an integrated population that results from the combination of pHOS and pNOB.

The designation of a population as Primary, Contributing or Stabilizing is, in part, a policy decision. However, for this analysis, the HSRG made assumptions based on the status of each population and Co-managers' objectives. Standards recommended by the HSRG for broodstock management are as follows:

HSRG criteria for hatchery influence on Primary populations

- The pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater (with pNOB $\geq$10%) and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB $\geq$10%) and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description. 100% NORs for broodstock and to start captive brood program.

Observations. These standards apply to the Local Adaptation and Full Restoration phases. Excess adults planted during this phase (to spawn naturally), rather than increase production, would allow for the most rapid determination of the capacity of the watershed to sustain all life stages.

Chambers Creek Early Winter Steelhead

Plan Description: The Plan calls for continued full smolt production, a moratorium on harvest, and an attempt to remove all returning hatchery origin fish via an adult trap at the hatchery.

Observations. By HSRG standards, the pHOS for a segregated harvest program should be less than 5% of the naturally spawning population. The HSRG concluded that the proposed program is unlikely to meet this standard and that the Plan and HGMPs therefore underestimate the risks of this program. Assuming that NOR escapement of the native winter steelhead in the early phases of recovery will be 140 fish or less (i.e., approximate average escapement of the population now, as presented in the Native Winter Steelhead HGMP), pHOS from this program would need to be 7 Chambers Creek steelhead or less. The Plan relies on improved attraction of Chambers Creek steelhead to the hatchery and removal at the weir as means to achieve this standard. Harvest, which is another means of controlling pHOS, is suspended during this phase. Although these may be good ideas, they are unsupported by any data on efficiency and reliability. For example, based on a presentation to the HSRG in Port Angeles (J. Duda, U.S.G.S., pers. comm. December 19, 2011), a multi-agency collaboration to evaluate performance of the Elwha River Weir found that the weir could not be safely or effectively operated at flows over 2,500 cubic feet per second (cfs). Consequently, the HSRG concluded that it is highly uncertain that these mechanisms will achieve this standard during the early stages of recovery.

Interbreeding between native and non-native populations is likely to significantly hamper adaptation and slow restoration. The Plans correctly notes, however, that the genetically effective pHOS for Chambers Creek steelhead currently may be very low. Chambers Creek steelhead have apparently had little or no genetic impact on native winter steelhead in the degraded 5 miles of habitat below the Elwha Dam site (Winans et al. 2008). Although it is possible that this might continue after the dams are removed, the assumption that the same isolating mechanisms will continue to exist between the two life history forms after the dams are removed and both forms have new opportunities to expand and adapt is untested and highly uncertain. Likewise, for better or worse, ecological interactions are likely to change in ways that have not been anticipated. Evolutionary theory and case studies in many species show that when populations are faced with environmental change or disturbance, they can undergo rapid and unexpected phenotypic changes (e.g., Carroll et al. 2007, Hendy et al. 2008, Lande 2009 and citations therein). Failure to address this possibility that steelhead may react much differently than the Plan predicts significantly increases the risk of this program. Given the uncertainty, the HSRG concludes that continuing a segregated hatchery program with an out-of-basin stock during this phase, as proposed, is significantly less defensible than when the natural population is viable and stable.

The HSRG noted that the managers have agreed to a moratorium on fishing in the near term to protect recovery. The continued production of Chambers Creek steelhead stock during the early phases of recovery therefore appears inconsistent with the priorities and goals the managers have presented.

- ***Recolonization Phase***

Native Winter Steelhead

Plan Description. The Plan describes 100% NORs for broodstock and to start captive brood program.

Observations. These standards apply to the Local Adaptation Phase and Full Restoration Phase. The lack of adult plants during this phase (to naturally recolonize watershed) may slow the speed of restoration. Adult outplants during this phase would allow ecosystem function to be restored by deposition of marine derived nutrients and gravel manipulation during spawning activities. The addition of smolt traps higher in the watershed would allow detection of naturally produced smolts from adult plants. Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed.

Chambers Creek Early Winter Steelhead

Plan Description. The Plan describes continued full smolt production, and harvest resumes. The Plan calls for an attempt to remove all returning unharvested hatchery origin fish via an adult trap at the hatchery and weir.

Observations. By HSRG standards, the pHOS for a segregated harvest program should be less than 5% of the naturally spawning population. The HSRG concluded that the proposed program is unlikely to meet this standard and that the Plan and HGMPs therefore underestimate the risks of this program. Assuming that NOR escapement of the native winter steelhead in the early phases of recovery will be 140 fish or less (i.e., approximate average escapement of the population now, as presented in the LEKT 2011e), pHOS from this program would need to be 7 Chambers Creek steelhead or less. The Plan relies on improved attraction of Chambers Creek steelhead to the hatchery and removal at the weir as means to achieve this standard. Harvest, which is another means of controlling pHOS, is suspended during this phase. Although these may be good ideas, they are unsupported by any data on efficiency and reliability. For example, based on a presentation to the HSRG in Port Angeles (J. Duda, USGS, personal communication December 19, 2011), a multi-agency collaboration to evaluate performance of the Elwha River Weir found that the weir could not be safely or effectively operated at flows over 2,500 cfs. Consequently, the HSRG concludes that it is highly uncertain that these mechanisms will achieve this standard during the early stages of recovery.

Interbreeding between native and non-native populations is likely to significantly hamper adaptation and slow restoration. The Plan correctly notes, however, that the genetically effective pHOS for Chambers Creek steelhead currently may be very low. Chambers Creek steelhead have apparently had little or no genetic impact on native winter steelhead in the degraded 5 miles of habitat below the Elwha Dam site (Winans et al. 2008). Although it is possible that this might continue after the dams are removed, the assumption that the same isolating mechanisms will continue to exist between the two life history forms after the dams are removed and both forms have new opportunities to expand and adapt is untested and highly uncertain. Likewise, for better or worse, ecological interactions are likely to change in ways that have not been anticipated. Evolutionary theory and cases studies in many species show that when populations are faced with environmental change or disturbance, they can undergo to rapid and unexpected phenotypic changes (e.g., Carroll et al. 2007, Hendy et al. 2008, Lande 2009 and citations therein). Failure to address this possibility that steelhead may react much differently than the plans predict, significantly increases the risk of this program. Given the uncertainty, the HSRG concluded that continuing a segregated hatchery program with an out-of-basin stock during this phase, as proposed, is significantly less defensible than when the natural population is viable and stable.

The HSRG noted that the managers have agreed to a moratorium on fishing in the near term to protect recovery. The continued production of Chambers Creek early winter steelhead stock during the early phases of recovery therefore appears inconsistent with the priorities and goals the managers have presented.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description. The Plan proposes 500+ HOR broodstock and less than 50 NOR brood (<10% pNOB). No mention of managing for PNI is found in the Plan.

Observations. For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater, and pHOS should be less than 0.30. Managing for PNI during local adaptation is critical to achieving this goal.

An integrated program with less than 10% pNOB may not preserve genetic continuity with the native population. A high proportion of HORs on spawning grounds (pHOS>30) will limit the population's ability to become locally adapted, due to genetic and ecological interactions. Existence of the Chambers Creek steelhead program reduces the allowable pHOS from the native winter steelhead program accordingly. Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed.

The purpose of the HSRG standards is to assure that populations adapt to the local environmental conditions over time. For this reason, the standards will be particularly important during the Local Adaptation Phase in the Elwha. Adopting the HSRG broodstock standards would be the most important change as management switches from the Recolonization Phase to the Local Adaptation Phase.

Chambers Creek Early Winter Steelhead

Plan Description. No mention of managing pHOS is found in the Plan.

Observations. By HSRG standards, the pHOS for a segregated harvest program should be less than 5% of the naturally spawning population.

During this phase, the natural population reaches a level of demographic resilience that allows the native winter steelhead program to transition to supporting local adaptation. That same level of resilience means that the risks of operating a segregated harvest program for Chambers Creek steelhead are less than in the early stages of the restoration when the native population was much more vulnerable. During this phase, a segregated harvest program for Chambers Creek steelhead may be able to achieve HSRG guidelines for pHOS for a segregated harvest program, and minimize negative ecological interactions. Appropriate decision rules and triggers would be needed for this.

- ***Full Restoration Phase***

  Native Winter Steelhead

  Plan Description. No hatchery program in the Full Restoration Phase.

  Observations. The pHOS should be less than 5% of the naturally spawning population. Monitoring for hatchery "strays" from outside the basin will need to be conducted. Triggers for reverting to earlier phases and decision rules for hatchery intervention should be developed.

  Chambers Creek Early Winter Steelhead

  Plan Description. No hatchery program in the Full Restoration Phase.

  Observations. The pHOS should be less than 5% of the naturally spawning population. Monitoring for hatchery "strays" from outside the basin will need to be conducted.

4.2.6 Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase harvest and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description. A temporary moratorium on in-river fishing is proposed for the Elwha River for a 5-year period following initiation of dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations. (LEKT 2011e)

  Observations. None.

  Chambers Creek Early Winter Steelhead

  Plan Description: A temporary moratorium on in-river fishing is proposed for the Elwha River during dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations (LEKT 2011e).

  Observations. Continued production of early winter steelhead without any attempts to harvest may result in high pHOS (>5%). A combination of selective harvest and adult recapture at the hatchery facility would reduce the resulting pHOS compared to recapture at the hatchery facility alone. Managers should allow selective harvest of Chamber Creek steelhead during the phase.

- ***Recolonization Phase***

  Native Winter Steelhead

  Plan Description. For a minimum period of 5 years, beginning in 2012, there will be no salmon or steelhead fisheries in the Elwha River. In subsequent years, steelhead returns to the Elwha River will be managed consistent with the Co-managers' steelhead harvest management plans, and with the NMFS' ESA authorizations for those plans.

  Observations. None.

  Chambers Creek Early Winter Steelhead

  Plan Description: The Lower Elwha Chambers Creek early winter steelhead program was initiated to provide steelhead fishing opportunity in the Elwha River, to enable exercise of tribal treaty rights and also serve the interests of recreational fishing. The Co-managers assumed that native steelhead production was so constrained by the presence of the dams that their populations would not support harvest. The program is similar to many other hatchery programs operated by tribes and WDFW in Puget Sound and on the Washington coast that produce steelhead with earlier run-timing than local, native winter steelhead populations, to enhance harvest opportunity while conserving depressed wild stocks.

  The advanced return timing of this stock and the adipose clip enable selective harvest prior to freshwater entry of native winter steelhead. Tribal catch in the Elwha River, taken during fisheries conducted in December and January, has involved very low to zero incidental harvest of unmarked (i.e., native) steelhead. Providing harvest opportunity on early-timed steelhead will meet treaty obligations by enabling continued harvest, while allowing listed, native steelhead to recover without harvest pressure.

  In addition to providing harvest opportunity, the current objectives for the Lower Elwha Chambers Creek early winter steelhead program include minimizing the potential for returning adults to spawn naturally or interbreed with Elwha native steelhead. Targeted fisheries, improved homing to the new tribal hatchery both from increased flow from the hatchery and release of early-run steelhead exclusively from the hatchery, and removing marked steelhead at the weir are expected to accomplish these objectives. Genetic monitoring of returning adults and outmigrant smolts will track the extent to which early steelhead are reproducing naturally, or interbreeding with native steelhead (LEKT 2011e).

  Observations. The combination of non-selective tribal harvest, selective sport harvest, adult recapture at hatchery facilities and poor weir efficiencies is likely to allow a significant number (>5%pHOS) of early winter steelhead to remain on the spawning grounds. This may significantly hinder recovery. Managers should allow selective harvest of early chambers steelhead during the phase.

- ***Local Adaptation Phase***

  Native Winter Steelhead

  Plan Description. For a minimum period of 5 years beginning in 2012, there will be no salmon or steelhead fisheries in the Elwha River. In subsequent years, steelhead returns to the Elwha

River will be managed consistent with the Co-managers' steelhead harvest management plans, and with the NMFS' ESA authorizations for those plans.

Observations. None.

Chambers Creek Early Winter Steelhead

Plan Description. The Lower Elwha Chambers Creek early winter steelhead program was initiated to provide steelhead fishing opportunity in the Elwha River, to enable exercise of tribal treaty rights and also serve the interests of recreational fishing. The Co-managers assumed that native steelhead production was so constrained by the presence of the dams that their populations would not support harvest. The program is similar to many other hatchery programs operated by tribes and WDFW in Puget Sound and on the Washington coast that produce steelhead with earlier run-timing than local, native winter steelhead populations, to enhance harvest opportunity while conserving depressed wild stocks. The advanced return timing of this stock and the adipose clip enable selective harvest prior to freshwater entry of native winter steelhead. Tribal catch in the Elwha River, taken during fisheries conducted in December and January, has involved very low (to zero) incidental harvest of unmarked (i.e., native) steelhead. Providing harvest opportunity on early-timed steelhead will meet treaty obligations by enabling continued harvest, while allowing listed, native steelhead to recover without harvest pressure.

In addition to providing harvest opportunity, the current objectives for the Lower Elwha Chambers Creek early winter steelhead program include minimizing the potential for returning adults to spawn naturally or interbreed with Elwha native steelhead. Targeted fisheries, improved homing to the new tribal hatchery both from increased flow from the hatchery and release of early-run steelhead exclusively from the hatchery, and removing marked steelhead at the weir are expected to accomplish these objectives. Genetic analysis of returning adults and outmigrant smolts will monitor the extent to which early steelhead are reproducing naturally, or interbreeding with native steelhead (LEKT 2011d).

Observations. The combination of non-selective tribal harvest, selective sport harvest, adult recapture at hatchery facilities and poor weir efficiencies would allow for a significant number of early winter steelhead to remain on the spawning grounds (>5%pHOS). This could significantly hinder recovery and recolonization.

- ***Full Restoration Phase***

Native Winter Steelhead

Plan Description. For a minimum period of 5 years, beginning in 2012, there will be no salmon or steelhead fisheries in the Elwha River. In subsequent years, steelhead returns to the Elwha River will be managed consistent with the Co-managers' steelhead harvest management plans, and with the NMFS' ESA authorizations for those plans (LEKT 2011e).

Chambers Creek Early Winter Steelhead

Plan Description. Hatchery program phases out.

Conclusion. The Plan is not explicitly consistent with Recommendation 9.

4.2.7 Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Use of local broodstock and in-Basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations.

The following applies to all phases:

The Plan is very clear that there is no intent to import brood from non-native populations, meaning that the program is expected to be self-sustaining. It is also clear that the use of Chamber Creek steelhead is not intended for recolonization.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description. The native steelhead program began in 2005 with collection of eyed eggs and/or emergent fry from natural redds in the Elwha River. Egg/fry collection has continued annually to the present. Initiated at the Tribal facility adjacent to the Tribal center, this program and others now operate at the new facility completed in 2011. Annual natural-spawner abundance is uncertain, but for the period 2005- 2011, it was estimated to range between 60 and 200 per year.

  Since inception of the program to the present, broodstock have been reared from eggs collected from natural redds. During the dam removal period, the program will utilize all the natural-origin adults than can be collected, from the weir and by other means, supplemented by initial adult returns from brood year 2005-2007 smolt releases. In subsequent years, after the river has stabilized, the benefits of incorporating natural-origin broodstock will be evaluated in light of their role in recolonization.

  The annual number of native steelhead eggs, fry, and adults collected for use as broodstock will vary, as determined by the phase of the program (pre-dam removal, dam removal, post-removal), broodstock survival and egg production levels, and the abundance status of adult fish returns to the river. Prior to dam removal (brood years 2010-2012), the annual broodstock collection goal will reflect the intent to collect eggs, or utilize captive reared-adults sufficient to (maintain stocks prior to that period of time in which upstream adult access past the dam sites is possible). During the dam removal period (2012 -2015), the goal of adult collection is to capture as many returning natural-origin adults as feasible, under the assumption that their potential to otherwise spawn successfully in the river will be substantially reduced due to high sediment transport and unstable channel structure. Following dam removal, adult collections will increase to 2,000 pairs of fish. During and after dam removal, collection of natural-origin broodstock will be supplemented with captive-reared adults. Adult returns from hatchery smolt releases, which are expected in 2013 and subsequent years, will also be utilized as broodstock.

  All eggs and fish incorporated into the hatchery program are of native steelhead origin, as indicated in genetic parental lineage analyses.

  Observations. Transitioning away from captive brood as soon as possible is appropriate.

Chambers Creek Early Winter Steelhead

Plan Description. The early-timed stock was chosen to enable selective terminal harvest, with minimal incidental harvest of the late-timed native population (LEKT 2011d).

Adult steelhead return volitionally to the hatchery. The hatchery collects and spawns fish from throughout the run period to ensure representation of all portions of the run timing spectrum. Eggs taken in excess of production goals are culled proportionally through all egg take lots.

All fish returning to the hatchery facility are included in egg-take operations. Early-timed, hatchery-origin adults are identified by absence of the adipose fin (LEKT 2011d).

Observations. The hatchery program appears to be self-sustaining. Hatchery production using a "locally adapted" segregated stock is expected to increase performance, but may increase competition and the likelihood of genetic interactions with the natural population.

- ***Recolonization Phase***

Native Winter Steelhead

Plan Description. The annual number of native steelhead eggs, fry, and adults collected for use as broodstock will vary, as determined by the phase of the program (pre-dam removal, dam removal, post-removal), broodstock survival and egg production levels, and the abundance status of adult fish returns to the river. Prior to dam removal (brood years 2010-2012), the annual broodstock collection goal will reflect the intent to collect eggs or utilize captive reared-adults sufficient to maintain stocks prior to that period of time in which upstream adult access past the dam sites is possible. Between 2012 and 2015, the goal of adult collection is to capture as many returning natural-origin adults as feasible, under the assumption that their potential to otherwise spawn successfully in the river will be substantially reduced due to high sediment transport and unstable channel structure. Following dam removal, adult collections will increase to 2,000 pairs of fish. During and after dam removal, collection of natural-origin broodstock will be supplemented with captive-reared adults. Adult returns from hatchery smolt releases, which are expected in 2013 and subsequent years, will also be utilized as broodstock.

All eggs and fish incorporated into the hatchery program are of native steelhead origin as indicated in genetic parental lineage analyses.

Observations. It is assumed the hatchery program will be self-sustaining. However, the ability of habitat to support all life stage-specific survival is uncertain. Adults planted in the watershed would provide this information much faster than juveniles outplants.

Chambers Creek Early Winter Steelhead

Plan Description. Adult steelhead return volitionally to the hatchery. The hatchery collects and spawns fish from throughout the run period to ensure representation of all portions of the run timing spectrum. Eggs taken in excess of production goals are culled proportionally through all egg take lots. All fish returning to the hatchery facility are included in egg-take operations. Early-timed, hatchery-origin adults are identified by absence of the adipose fin (LEKT 2011d).

Observations. The hatchery program appears to be self-sustaining. Hatchery production using a "locally adapted" segregated stock is expected to increase performance, but may increase competition and the likelihood of genetic interactions with the natural population.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description. The annual number of native steelhead eggs, fry, and adults collected for use as broodstock will vary, as determined by the phase of the program (pre-dam removal, dam removal, post-removal), broodstock survival and egg production levels, and the abundance status of adult fish returns to the river. Prior to dam removal (brood years 2010-2012) the annual broodstock collection goal will reflect the intent to collect eggs, or utilize captive reared-adults sufficient to maintain stocks prior to that period of time in which upstream adult access past the dam sites is possible. During the dam removal period (2012 -2015), the goal of adult collection is to capture as many returning natural-origin adults as feasible, under the assumption that their potential to otherwise spawn successfully in the river will be substantially reduced due to high sediment transport and unstable channel structure. Following dam removal, adult collections will increase to 2,000 pairs of fish. During and after dam removal, collection of natural-origin broodstock will be supplemented with captive-reared adults. Adult returns from hatchery smolt releases, which are expected in 2013 and subsequent years, will also be utilized as broodstock.

All eggs and fish incorporated into the hatchery program are of native steelhead origin as indicated in genetic parental lineage analyses.

Observations. It is assumed the hatchery program will be self-sustaining. The hatchery program should include a higher number of NOR broodstock (even if it means reducing the program) to achieve HSRG standards for a primary population during this phase to increase fitness of hatchery origin fish spawning naturally.

Chambers Creek Early Winter Steelhead

Plan Description. Adult steelhead return volitionally to the hatchery. The hatchery collects and spawns fish from throughout the run period to ensure representation of all portions of the run timing spectrum. Eggs taken in excess of production goals are culled proportionally through all egg take lots. All fish returning to the hatchery facility are included in egg-take operations. Early-timed, hatchery-origin adults are identified by absence of the adipose fin (LEKT 2011d).

Observations. The hatchery program appears to be self-sustaining. Hatchery production using a "locally adapted" segregated stock is expected to increase performance, but may increase competition and the likelihood of genetic interaction with the natural population.

- ***Full Restoration Phase***

Native Winter Steelhead

Plan Description. Hatchery program phases out.

Observations. None.

Chambers Creek Early Winter Steelhead

Plan Description. Hatchery program phases out.

Observations. None.

4.2.8 Recommendation 11: Coordinate hatchery programs within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

Fish production needs to be regionally coordinated if system-wide conservation and harvest goals are to be met. The focus should be on limiting negative ecological and genetic impacts of harvest programs on naturally rearing populations, and ensuring that system-wide hatchery propagation does not overwhelm individual, biologically significant, native populations.

Hatchery fish released in each subbasin will interact with wild and hatchery fish from other subbasins as they migrate through the downstream corridor, estuary and ocean. The effects of these interactions are heightened as the cumulative number of hatchery fish released into the Puget Sound for harvest increases. Therefore, overall hatchery fish production should be limited to the minimum number needed to meet system-wide harvest and conservation goals of the various managers. In addition, the cumulative natural and hatchery production should take into account the carrying capacity of the migratory corridor, estuary and ocean.

Region-wide coordination would require that regional decision-makers have convenient access to reports showing population goals, current status of populations and fisheries, and expected and realized contributions from hatchery programs. This information should be up to date and easily accessible via the Internet. It should be possible to view the information at several levels—by population, ESU and species—for the entire Puget Sound Region.

The following applies to all phases:

Native Winter Steelhead Program

Plan Description. The Puget Sound Salmon Management Plan (PSSMP), developed pursuant to *U.S. v. Washington,* provides the legal framework for co-management of salmon fisheries resources, with procedures specific to management of all salmon hatchery programs. This co-management process requires the State of Washington and the relevant Puget Sound Tribe(s) to develop program goals and objectives and agree on the function, purpose and release strategies of all hatchery programs. The Future Brood Document (PSTT and WDFW 1985) is a detailed listing of annual production goals. This is reviewed and updated each spring and finalized in July. The Current Brood Document (PSIT and WDFW 2010) reflects actual production relative to the annual production goals. It is developed in the spring after eggs are collected.

The Puget Sound Steelhead Harvest Management Plan establishes specific objectives for direct or incidental harvest of listed steelhead in each Management Unit. Annual harvest management plans are developed for each Management Unit prior to the start of the steelhead fisheries.

Observations. The PSSMP (PSTT and WDFW 1985) governing hatchery production lacks coordination between hatchery programs in different subbasins that would allow for evaluation of impacts between programs.

Chambers Creek Early Winter Steelhead

Plan Description. This program operates under the PSSMP (1985), developed pursuant to *U.S. v. Washington*, which provides the legal framework for co-management of fisheries resources. The PSSMP requires the WDFW and the relevant Puget Sound Tribe(s) to develop and agree upon hatchery program goals and objectives. The Equilibrium Brood Document (PSTT and WDFW 1985) is reviewed and updated as objectives change. The Current Brood Document reflects actual annual production.

Harvest management objectives for Elwha steelhead are stated in the Co-managers Puget Sound Steelhead Harvest Management Plan (PSIT and WDFW 2010), which is implemented through annual harvest management plans.

Observations. The current PSSMP governing hatchery production lacks coordination between hatchery programs in different subbasins that would allow for evaluation of impacts between programs.

4.2.9 Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities, as well as structures to remove and discharge water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change in-stream flow, alter riparian habitat and diminish water quality through hatchery discharges. Water for hatchery use is often drawn from an adjacent stream via pumps or gravity. Improperly designed and maintained water intakes can impinge migrant or resident juveniles on hatchery screens or cause fish to be trapped in hatchery facilities. Structures such as adult weirs and water intake dams can also block natural passage of salmonids to spawning or rearing areas. Water diverted from adjacent streams for fish culture purposes is often returned downstream and can reduce the amount of water for juvenile rearing and upstream adult migration between the area of intake and discharge. Hatchery discharge can also diminish water quality below the point of discharge through changes in temperature, settle-able and suspended solids, chemical composition, and presence of therapeutic drugs. The HSRG has noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

The following applies to all phases:

Native Winter Steelhead

Plan Description. Existing facilities are believed to comply with local, state and federal requirements.

Chambers Creek Early Winter Steelhead

Plan Description. Existing facilities are believed to comply with local, state and federal requirements.

4.2.10 Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. Conservation hatcheries producing juveniles with high survival generate more spawners on the spawning grounds. This, in turn, accelerates the rate at which recovery programs move toward meeting their goals. Production programs may have to reduce release numbers to decrease negative ecological impacts on natural populations. Increasing post-release survival can offset this reduction and enable managers to meet their harvest goals.

There are many approaches to increasing fish survival. The release of fish at the appropriate time, size, age and location can significantly increase their recruitment to fisheries and natural escapement. Releasing rapidly migrating smolts rather than fry increases survival and reduces negative ecological interactions in the freshwater environment. Similarly, the release of healthy fish produces more fish for harvest and less opportunity to spread disease to natural populations. Improving water quality and reducing loading and density during rearing are also proven tools used by fish culturists to enhance fish survival. Adoption of volitional release (allowing smolts to outmigrate when they are ready, rather than "forcing" them out at a preset date) with removal of residuals (fish that do not outmigrate) may increase the long-term survival of released fish, while decreasing negative ecological interactions with natural populations. Proper acclimation and imprinting of hatchery juveniles can reduce straying and enhance survival to the desired location for their harvest or artificial spawning.

Developing and adopting these and other culture and release practices that maximize fish survival and minimize negative ecological interactions by reducing production release numbers can aid conservation programs in rebuilding runs and reducing the conflict between harvest programs and conservation goals for natural populations.

The following applies to all phases:

To reduce potential harm to natural population through genetic and ecological interactions, hatchery programs should be no larger than necessary to meet the recolonization objectives. The higher the survival of hatchery fish, the smaller the program can be to produce the required number of adult offspring.

- ***Preservation Phase***

  Native Winter Steelhead

  Plan Description.

	Dam Removal 2012-2016
Captive reared broodstock	300
Hatchery-origin broodstock	200-500
Natural origin broodstock	200

	Dam Removal 2012-2016
Natural escapement	100-200
Age 2+ smolts	175,000
Eyed eggs	
Fry	
Pre-smolts	

Observations. Survival to adult rates for age 2+ smolts are unknown.

Chambers Creek Early Winter Steelhead

Plan Description.

	Dam Removal 2012-2016
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-200
Age 1+ smolts	65,000

Observations. Release of age 1+ smolts is assumed to offer high survival for Chambers Creek steelhead.

- ***Recolonization Phase***

Native Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Captive reared broodstock	
Hatchery-origin broodstock	500+
Natural origin broodstock	<50
Natural escapement	100-1000+
Age 2+ smolts	175,000
Eyed eggs	100,000
Fry	275,000
Pre-smolts	20,000

Observations. Planting of eyed-eggs, fry and presmolts will reduce survival to adult rate and increase competition with naturally produced juvenile steelhead.

Chambers Creek Early Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-1000+
Age 1+ smolts	65,000

Observations. Release of age 1+ smolts is assumed to offer high survival for Chambers Creek steelhead.

- ***Local Adaptation Phase***

Native Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Captive reared broodstock	
Hatchery-origin broodstock	500+
Natural origin broodstock	<50
Natural escapement	100-1000+
Age 2+ smolts	175,000
Eyed eggs	100,000
Fry	275,000
Pre-smolts	20,000

Observations. Planting of eyed-eggs, fry and presmolts will reduce survival to adult rate and increase competition with naturally produced juvenile steelhead.

Chambers Creek Early Winter Steelhead

Plan Description.

	After Dam Removal 2017>
Hatchery-origin broodstock	60
Natural origin broodstock	0
Natural escapement	100-1000+
Age 1+ smolts	65,000

Observations. Release of age 1+ smolts is assumed to offer high survival for Chambers Creek steelhead.

- ***Full Restoration Phase***

  Native Winter Steelhead

  Plan Description. Hatchery program phases out.

  Chambers Creek Early Winter Steelhead

  Plan Description. Hatchery program phases out.

4.2.11 Summary of Observations and Conclusions for Principle 2—Steelhead

Table 4-7 summarizes our findings regarding the consistency of the steelhead component of the Plan with HSRG Principle 2 and specifically, with the seven recommendations that address scientific defensibility. Table 4-8 summarizes our recommendations for improving consistency, by restoration phase.

Table 4-7 Is the Plan consistent with HSRG Principle 2 for Steelhead salmon? Are Harvest and Conservation Goals for Natural and Hatchery Populations Clear, Specific, Quantifiable and developed within an "All H" Context?

Recommendation 4: Is the purpose of the hatchery program defined (i.e., conservation, harvest or both)?	Yes
Recommendation 5: Are the scientific assumptions, under which a program contributes to meeting the stated goals, explicitly stated?	No
Recommendation 6: Has an integrated or segregated broodstock management strategy been selected, that is based on population goals and hatchery program purpose?	No
Recommendation 7: Is the size of hatchery programs based on population goals and as part of an "all H" strategy?	No
Recommendation 8: Are harvest, hatchery broodstock, and natural spawning escapement managed to meet HSRG standards appropriate to the affected natural population's designation?	No
Recommendation 9: Is the harvest managed to achieve full use of hatchery-origin fish?	Not explicitly
Recommendation 10: Do all hatchery programs have self-sustaining broodstocks?	Yes
Recommendation 11: Are hatchery programs coordinated within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations?	No
Recommendation 12: Are facilities constructed and operated in compliance with environmental laws and regulations?	Yes
Recommendation 13: Is survival of hatchery fish maximized consistent with conservation goals?	No

Table 4-8 Observations and conclusions regarding Principle 2—scientific defensibility.

<u>Preservation Phase</u>: This phase of the project is generally consistent with Principle 2. Continued production of Chambers Creek early winter steelhead during this phase increases the risk of genetic and ecological impacts to the native population and may allow these fish to participate in recolonization.
<u>Recolonization Phase:</u> While the Plan lays out a schedule for sizing the program based on combined return of natural- and hatchery-origin adults, the rationale for this schedule is not clearly explained. The Plan incorporates a mixed strategy in terms of life stages to be planted in the habitat, but omits the option of outplanting adult hatchery fish without explanation. Most importantly, the end-points of the Recolonization Phase are not defined in terms of predetermined triggers and responses. Continued production of Chambers Creek early winter steelhead during this phase increases the risk of genetic and ecological impacts to the native population and may allow these fish to participate in recolonization.
<u>Local Adaptation Phase</u>: Progress toward local adaptation and increased fitness are balanced against demographic risks due to uncertainty about habitat conditions. During this phase, the population should be managed to meet PNI levels greater than 0.67 as the native steelhead hatchery program is phased out, and a pHOS of <5% for the early winter steelhead program. Specific trigger points in terms of numbers of returning natural-origin spawners should be identified. The trigger points, along with clearly identified key assumptions (see also Recommendation 5) and the accuracy and precision requirements of the estimates for those assumptions, should be major drivers for the monitoring and evaluation plan. Production of Chambers Creek early winter steelhead during this phase consistent with HSRG pHOS standards may be possible. Appropriate monitoring with established triggers would need to be implemented.
<u>Full Restoration Phase:</u> Since the hatchery program will be terminated as this phase begins, the main concern here is the determination of when this stage begins. The population may not yet have reached its potential as measured in VSP parameters, but it is now sustainable and increasing over time without the aid of a hatchery program. The conditions that define the onset of this phase, based on biological triggers, need to be made more explicit.

4.3 Summary of Observations, Conclusions and Recommendations for Steelhead

The table below summarizes our assessment of the consistency of the steelhead component of the Elwha Plan with HSRG Principles 1 and 2. It also provides recommendations for improving consistency with these principles.

Table 4-9 Summary of observations, conclusions and recommendations for steelhead.

<u>Observations and Conclusions</u> The Elwha Plan lacks a clear statement of goals. Goal statements that comply with Principle 1 and Recommendations 1 – 3 should be developed. While the Plan lays out a schedule for sizing the program based on combined return of natural and hatchery origin adults, the rationale for this schedule is not clearly explained. The Plan incorporates a mixed strategy in terms of life stages to be planted in the habitat, but omits the option of outplanting adult hatchery fish without explanation. Most importantly, the end-points of the phases are not defined in terms of predetermined, biologically-based triggers and responses. Production of Chambers Creek early winter steelhead increases the risk of negative genetic and ecological impacts to the native population during the early phases of the program. Mechanisms to control pHOS and minimize the genetic and ecological impacts are untested and of uncertain reliability and effectiveness. In addition, the vulnerability of the natural population is high.

<u>Benefits</u>

- The hatchery intervention for native steelhead is assumed necessary to preserve the genetic legacy and provide adults for the Recolonization Phase.

<u>Risks</u>

- Continued production of Chambers Creek early winter steelhead increase the risk of genetic and ecological impacts to the native population and could hinder recovery.
- The heavy reliance on outplanting of hatchery juveniles rather than releasing juveniles from the hatchery to produce adult spawners for recolonization poses both genetic and ecological risks to the rebuilding of a diverse and productive natural population of steelhead and may be demographically inefficient.
- Lack of a clearly defined end-point to the outplanting phase in terms of predefined indicators (triggers) may cause this phase to be prolonged and local adaptation of the natural population to be impeded—the absence of any specific reference to broodstock and natural escapement composition (e.g., pHOS, PNI) implies unknown domestication risk.
- Lack of a plan for future use of hatchery facilities in the Basin appears to leave the long-term existence of the hatchery program in question.

<u>Likelihood of meeting goals</u>

- Without explicit, quantifiable goals, success is not well defined.
- Without predefined, measurable performance indicators, we do not know what success “looks like”, even with well-defined goals.
- Without a structured, hypothesis-driven decision-making process that is supported by adequate monitoring and research, it is not possible to determine whether the project is effectively navigating around risks and toward goals.

<u>Recommended modifications</u>

- Eliminate the Chambers Creek early winter steelhead program, at least until the native population has been restored to a sustainable level (Local Adaptation Phase).
- Continue harvest of Chambers Creek early winter steelhead during the harvest moratorium to remove returning adults from previous releases.
- Define steelhead production goals in terms of VSP parameters.
- Identify measurable performance indicators of project success that reflect VSP.
- Develop a set of decision rules that incorporate predefined triggers for change for each phase of the project.
- Develop and implement an adaptive management process that describes an annual decision-making process that includes schedule, roles and responsibilities, and decision rules.
- Develop a monitoring and evaluation plan to resolve uncertainties (to update decision rules) and estimate performance indicators (to measure progress toward goals), and triggers (to implement decision rules).

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5 Chum Salmon Population Report

Population Definition: Elwha chum salmon were identified as a distinct population based on their distinct spawning distribution. They belong to the Strait of Juan de Fuca fall-run GDU (Busack and Shaklee 1994) and are part of the Major Ancestral Lineage that includes the Strait of Juan De Fuca and Washington Coast Fall-run populations. These chum salmon are more closely related to the west coast of Vancouver Island, British Columbia, populations than to Puget Sound populations (Phelps et al. 1994, Busack and Shaklee 1995). The Elwha River received hatchery transfers from the Quilcene National Fish Hatchery in the 1970s and 1980s (Winans et al. 2008).

Population Designation: Assumed to be Primary, though this is not explicitly stated in the Plan.

Population Origin: The existing in-Basin native stock has been identified as the preferred stock for enhancement activities. Elwha fall chum salmon have two distinct run-timing components—an early population (October-November) thought to be the native stock and a later-entering population (December) that is genetically similar to Hood Canal populations (Wunderlich et al. 1994). Adults collected from the river exhibit the run timing of the native fall chum stock, in contrast to later-timed chum that may still return as remnants of the previous introduction of the Walcott Slough stock. The Walcott-stock hatchery program was terminated in 1985. Starting in 2015, gametes will be taken from all adult chum returning to the hatchery facility (LEKT 2011c).

ESA Status: Puget Sound fall chum (including Elwha River chum) are not listed under ESA.

Recent Status and Trends:

Table 5-1 Recent natural spawning escapement.

Return Year	Natural Spawning Escapement (NOR + HOR) (1)	pHOS	Hatchery Broodstock (2)	pNOB
	Actual	Actual	Actual	Actual
2005	unk	unk	2	unk
2006	unk	unk	43	unk
2007	unk	unk	4	unk
2008	unk	unk	21	unk
2009	unk	unk	40	unk
2010	unk	unk	0	unk

1) No Recent Natural Spawning Escapement target (NOR + HOR) has been provided;
2) Recent hatchery broodstock target has been 40 adults

Recent Hatchery Production: The goals of this program are to preserve and rebuild natural chum salmon production in the Elwha River, by supplementing the abundance of juvenile and returning adult fish. Hatchery production will maintain the genetic characteristics of the native stock. Following removal of the dams, the chum program is intended to promote recolonization of suitable chum spawning and rearing habitat (Chum Salmon HGMP, LEKT 2011).

The current hatchery program for Elwha chum salmon is designed for stock maintenance and restoration. Ripe adults captured in the river are spawned and their eggs are brought into the hatchery and incubated to the eyed stage. Eyed eggs are transported for incubation in streamside incubator boxes and located in side-channel habitats to imprint the chum salmon to river areas suitable for natural chum salmon production. After hatching, incubator-produced fry emigrate seaward into lower river, estuarine, and nearshore marine areas in the Strait of Juan de Fuca to rear (Ward et al. 2008).

Table 5-2 Recent hatchery release numbers.

Release Year	Number Released (eggs planted) (3)	Number Released (unfed fry planted) (3)
	Actual	Actual
2005	0	776
2006	23,866	18,577
2007	0	3,883
2008	0	24,763
2009	22,283	31,290
2010	0	0

(3) Recent hatchery production targets have been 75,000 fed fry, 100,000 egg plants; 275,000 unfed fry.

Recent Harvest: No harvest is currently directed at Elwha chum salmon, though some incidental harvest occurs in terminal commercial and sport coho fisheries. During the 2003 coho salmon harvest season, the anticipated incidental in-river exploitation rate for chum was 2.4% (Ward et al. 2008). For a period of 5 years beginning in 2012, there will be no salmon or steelhead fisheries in the Elwha River. Terminal-area chum fishing regimes will be developed as chum abundance recovers to a level that provides harvestable surplus. Prior to attaining long-term recovery goals, fisheries may target surplus hatchery production, yet constrained to not impede recovery. Program fish will, in the interim, contribute to pre-terminal marine fisheries in the U.S. and British Columbia (LEKT 2011c).

Table 5-3 presents a summary of status, trends and restoration goals for chum salmon.

Table 5-3 Chum salmon summary.

Population Designation1		Primary
Program Type 2		Integrated recovery evolving toward integrated harvest
Historical Abundance 3		9,042 - 25,600
Current Escapement 4		Spawners = 150 – 300 1993-1995 Stock status critical
Restoration Goals	Plan	After 10 years: Returns = 3,000 After 25 years: Escapement = 18,000; Recruitment = 36,000
	HGMP	Adult Escapement: After 10 years – 3,000 After 25 years – 18,000

1) HSRG assumed designation 2) Source HGMP 3) Range of several estimates 4) Source Ward et al. 2008

5.1 Principle 1: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

Goals for fish populations must be explicitly communicated and fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (harvest, conservation, education, research, etc.). Hatchery production numbers may be the means of contributing to harvest and/or conservation values, but they are not end-points. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when benefits significantly outweigh the risks and when the benefit/risk mix from the program is more favorable than the benefits and risks associated with non-hatchery strategies for meeting the same goals.

The HSRG has developed three general recommendations as guidelines for defining goals for natural and hatchery populations. The HSRG review of the Elwha plan in terms of its consistency with Principle 1 is presented with reference to these recommendations.

General Comment on Principle 1

The Elwha Plan does not state the restoration goal for steelhead in terms that conform to the HSRG's recommendations. However, scattered throughout the text of the plan are pieces of information that taken in total would provide some the information needed to construct a goal. For example, on page 97, Table 25 gives interim restoration targets for abundance after 10 and 25 years, productivity after 10 years and at MSY, spatial distribution and harvest goals for freshwater. These targets could be part of the goal. The interim targets are quantitative, but they do not separate natural and hatchery populations nor are they placed an "all H" context. Four goals on page 95 are called central to the implementation of the Elwha Act. They are:

1) Reestablish self-sustaining anadromous salmonid populations and habitats throughout the Elwha River watershed and its near shore as quickly as possible, using the most appropriate methods.

2) Maintain the integrity of the existing salmonid genetic and life history diversity before, during, and after dam removal and the subsequent periods of elevated sediment levels.

3) Maintain the health of fish populations before, during, and after dam removal.

4) Restore the physical and biological processes of the overall ecosystem through dam removal, including the return of VSPs.

Additionally, a parallel goal is found in the NOAA Fisheries guidance documents for recovering ESA-listed salmon species (NMFS 2010): restoration efforts shall be targeted at achieving viable salmonid populations. These goals are not species specific, nor are they quantitative. They are broad descriptions of things that will be done (tasks), not things that will be achieved (goals). The Elwha Plan needs a comprehensive, species-specific goal statement near the beginning of the plan's narrative. The goal statement should conform to HSRG's Principle 1.

5.1.1 Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity).

The Primary, Contributing and Stabilizing population designations refer to the biological significance of the population in the context of its ESU. The following general viability criteria apply:

- Primary: populations must achieve at least high viability
- Contributing: populations must achieve at least medium viability
- Stabilizing: populations must maintain at least current viability
- Viability goals should be expressed in terms of population productivity and abundance
- Viability goals should also take into account spatial structure and diversity

Different definitions of biological significance are used by managers throughout the Northwest. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board in 2004, under which all distinct salmon and steelhead populations are classified as either *Primary*, which are targeted for restoration to high productivity and abundance; *Contributing*, where small to medium improvements are needed; or *Stabilizing,* populations that may be maintained at current levels. Viability goals are expressed in terms of population productivity and abundance and also take into account spatial structure and diversity.

The following applies to all phases:

Decision rules with measurable triggers for the coho population must be identified to determine when to transition to the next management phase. For the third and fourth phases (local adaptation and full restoration), decision rules and triggers should also be developed to determine when it may be necessary to revert back to an earlier phase, should the trend toward recovery be significantly reversed. Decision rules and triggers must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision. All key assumptions and uncertainties (See Chapter 1.2, Table 1-2) must be monitored until they are either resolved or it is determined that they are not relevant to the recovery of the Elwha ecosystem. See Chapter 7 for specifics.

The following applies to all phases:

Plan Description. The goal is to operate a conservation program to preserve and rebuild the natural chum population, which is assumed to be a Primary population, but which is now at a critically low level (100-300 spawners per year). During these periods, activities will focus on collecting chum adults by netting them in the river, incubating the eggs in the hatchery, and outplanting eyed eggs as well as juveniles (unfed fry, and age-0 smolts). The long-term goal of the program is to have adult returns to the river of 3,000 fish per year in 10 years and 18,000 fish per year in 25 years. Spawner recruits per spawner are expected to be >1.0. During this period, there will be no harvest of chum in the river until returns reach 10,000 adults per year.

Observations. The strategies described for preserving and increasing the chum population are generally accepted as appropriate for this purpose. However, the HSRG considers that recovery of the population may be expedited by discontinuing eyed egg, unfed fry, and "age-0 smolt outplants." Instead, seeding of the river and its tributaries (including locations in the upper Basin) should be done with returning spawners only. Releases of fry from the hatchery, intended for producing adults to maintain the hatchery program and for seeding the river with adults, should be limited to fed fry that are close to out-migrating. In salmonids, outplants of adults have been used with success; they allow for the rapid determination of the ability of a watershed to support all life stages, and in the Elwha situation, should expedite the production of first generation NORs. Also, the releases of fed fry should allow for their imprinting while reducing ecological interactions with other salmonid juveniles; their rapid out-migration can also be expected to reduce their losses due, for example, to in-river predation by juvenile coho and steelhead.

5.1.2 Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

The following applies to all phases:

Plan Description. No chum harvest will be allowed during dam removal (i.e., the Preservation Phase). However, post-dam removal, some sport and commercial harvest will be permitted if hatchery and natural escapement goals are met (i.e., in the Local Adaptation Phase and Full Restoration Phase, but not in the Recolonization Phase). The trigger for initiating harvest is a run size of 10,000 fish. The intended level of the harvest has not been specified, but the harvest would be terminal (for 1 month in the river).

Observations. Due to the uncertainties involved with dam removal, the HSRG understands that realistic statements about the level of intended harvest may not be possible at this stage. It would stress, however, that every effort should be made to use selective harvest methods so as to reduce the by-catch of other salmonids in the Elwha River Basin (e.g., listed steelhead).

5.1.3 Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin

Efforts to harvest abundant hatchery fish from one population can impact natural fish in another population; hatchery strays can and do interact with natural populations from different locations within the region. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

The following applies to all phases:

Plan Description. The chum hatchery program is being undertaken with other Elwha River salmonid populations in mind. It is judged unlikely that the operation of the chum program will have any significant adverse effects on populations of other salmonid species in the Elwha River. Some in-river ecological competition between chum and Chinook juveniles may occur, but because the former exit the river quite rapidly, this competition is likely to be minimal. Collection of chum broodstock by netting (particularly gill netting) in the river may have some small impact on listed adult steelhead, which may also be inadvertently netted during the chum broodstock collection. However, this impact is likely to be reduced by 2015, when some chum broodstock collection is expected to occur at the hatchery. Also, when harvest on returning chum adults is eventually permitted, some losses of other salmonids (e.g., listed steelhead) can be anticipated. Finally, it is expected that once the chum population has been restored, nutrification of the river with adult chum carcasses will be of benefit to all salmonid populations in the river.

Observations. The HSRG considers that the chum program, as described, should have little negative impact on the other salmonid populations in the Elwha. It stresses the importance, however, of using selective fishing gear during harvest whenever possible.

5.1.4 Summary of Observations and Conclusions for Principle 1—Chum Salmon

Table 5-4 summarizes our findings regarding the consistency of the chum salmon component of the Plan with HSRG Principle 1 and specifically, with the three recommendations that address harvest and conservation goals. Table 5-5 summarizes our observations and conclusions, by restoration phase.

Table 5-4 Principle 1: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 1: Are conservation goals expressed in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)?	Yes
Recommendation 2: Are harvest goals expressed in terms of a population's contribution to specific fisheries?	No
Recommendation 3: Are goals for individual populations coordinated and compatible with those for other populations in Elwha Basin?	Yes

Table 5-5 Observations and conclusions regarding Principle 1—population goals.

Preservation Phase The stated goal for this phase of the hatchery program is the conservation of the native chum population during a period when its survival in the Elwha River would be highly unlikely. Biological triggers for moving from phase to phase are needed. The goal statement complies with Principle 1.
Recolonization Phase See above. Biologically-based, measurable objectives for natural production during the Recolonization Phase are needed. These objectives should address abundance, productivity and spatial distribution of naturally-spawning fish.
Local Adaptation Phase) See above. Biologically-based, measurable objectives for natural production during the Local Adaptation Phase are needed.
Full Restoration Phase See above. The long-term goal for the restored population is conservation and harvest and the biological trigger for initiating harvest is clearly stated.

5.2 Principle 2: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program in terms of benefits and risks must be formulated, explaining how the program expects to achieve its goals. The purpose, operation, and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated.

In general, scientific defensibility will occur at three stages:

1) During the deliberation stage, to determine whether a hatchery should be built and/or a specific hatchery program initiated;

2) During the planning and design stage for a hatchery or hatchery program; and

3) During the operations stage.

This approach ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied with citations from the scientific literature. HSRG recommendations 4 through 13 are aimed at ensuring scientifically defensible hatchery programs. The HSRG review of the Elwha plan is presented with reference to these recommendations. The purpose of the hatchery program will vary by phase of the restoration project.

The following applies to all phases:

Plan Description. The Elwha chum hatchery program (an Integrated Recovery program, later an Integrated Harvest program) was undertaken with the goal to preserve and rebuild a native population that is in decline and threatened by sediment loads anticipated to result from dam removal in the Elwha River. A second goal was to restore the chum population so that it could once again support harvest. To this end, conservation protocols that have been successful in restoring other salmonid populations, including chum salmon, were selected for the recovery effort. To ensure that the recovered population represents as closely as possible the original population, broodstock representing the entire run timing are being used. The program is also designed to have little negative impact on other salmonid populations in the Elwha River, and releases of chum from the hatchery are timed so as to minimize chum losses due to predation by other salmonids. The program will be phased out once it is no longer needed.

Observations. The hatchery program seems likely to be successful once the chum salmon have access to portions of the river that were blocked by the dams. The protocols for rearing the chum are generally accepted as appropriate for chum salmon, as are the protocols being considered for recolonization purposes. The main question to be raised about the program is the statement that starting in 2015 all chum adults returning to the hatchery will be represented in the broodstock (see LEKT 2011c). If the late-timed chum representing the remnants of non-native Walcott chum return to the hatchery, and if they are included in the broodstock, this would appear to be inconsistent with the stated goals of the program (see observations in Chapter 5.2.7, below).

5.2.1 Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. A conservation program is one that is compatible with goals for biological significance (Primary or Contributing) and viability (productivity, abundance, diversity and spatial structure) of a population. A harvest program is one that contributes to specific fisheries at specified rates or harvest numbers, and is compatible with identified conservation objectives for all populations. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program.

- ***Preservation and Recolonization Phases***

  Plan Description. The immediate purpose of the chum program during these phases is conservation of the population. To this end, activities will focus on collecting chum adults by netting them in the river, incubating the eggs in the hatchery, and outplanting eyed eggs as well as juveniles (unfed fry, and age-0 smolts) (see the Plan and HGMP).

  Observations. The strategies described for preserving and increasing the chum population are generally accepted as appropriate for this purpose. However, the HSRG considers that during the Preservation Phase, releases of fry from the hatchery, intended for producing adults to maintain the hatchery program and for seeding the river, should be limited to fed fry. Releases of fed fry should allow for their imprinting while reducing ecological interactions with other salmonid juveniles; their rapid outmigration can also be expected to reduce their losses due, for example, to in-river predation by juvenile coho and steelhead. During the Recolonization Phase, seeding of the river and its tributaries (including locations in the upper Basin) should be done with returning spawners only. In salmonids, outplants of adults have been used with success; they allow for the rapid determination of the ability of a watershed to support all life stages, and in the Elwha situation, should expedite the production of first generation NORs.

- ***Local Adaptation and Full Restoration Phases***

  Plan Description. The longer-term purpose of the chum program is to have a self-sustaining chum population capable of providing for harvest, starting perhaps during the Local Adaptation Phase and certainly during the Full Restoration Phase. The trigger for initiating terminal harvest is when the run size reaches 10,000 adults per year.

  Observations. Attaining the Full Restoration Phase will be expedited by reducing hatchery influence. Thus, consideration should be given to reducing the size of the hatchery program as early as possible (during the Local Adaptation Phase), by which stage there should be strong signs that the population is recovering.

5.2.2 Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program (harvest, conservation, or both) have been established, the scientific rationale for the program must be documented. The scientific rationale explains, in terms of benefits and risks, how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be documented, so those assumptions can be evaluated and modified as new information becomes available. Documentation should include citations from the scientific literature and analytical tools that take into account the various factors that will affect the success of the program (predation assumptions, cumulative effects, etc.). This approach ensures a scientific foundation for hatchery programs, a means to address uncertainty, and a method to demonstrate accountability.

- ***Preservation Phase***

  Plan Description. During this phase, environmental conditions in the river will be severely degraded and will be unsuitable for spawning. Chum salmon production will be constrained in response to the limited availability of rearing space and water (due to the treatment capacity of the shared water treatment facility). At low return levels, enhancement will emphasize hatchery releases of age-0 smolts. With increased adult returns, the enhancement program will expand to include outplants of eyed eggs and fry into the lower Elwha, and passage of adults upstream of the hatchery into the lower Elwha. Collection of chum adults will be largely by netting them in the river. During this period, there will be no harvest of chum in the river. The objective will be to maintain, and if possible, increase the chum population.

Observations. Considering the unsuitable conditions in the river during this phase, hatchery releases of fed fry that are close to migrating may well be more successful at ensuring the survival of chum population than the three other methods using outplants of eyed eggs, fry, and adults. Fed fry that are close to migrating should exit the river rapidly, reducing the likelihood of exposure to unfavorable and possibly lethal conditions in the river during this phase. However, if hatchery space and water supplies do indeed prove limiting, all of the proposed strategies could be used, although it seems unlikely that significant numbers of adults surplus to broodstock needs would be available for this purpose at this stage.

- ***Recolonization, Local Adaptation, and Full Restoration Phases***

  Plan Description. During these phases, dam removal will have been completed, the period of greatest turbidity will have passed, the water treatment facility will have been taken off line, hatchery facilities will be receiving raw surface water, and hatchery production will no longer be constrained by water availability. During these phases, restoration activities will emphasize the continuing hatchery production of 0-age smolts and the outplanting of eyed eggs throughout the Basin. Also, returning adults will be encouraged to spawn naturally throughout the Basin. Hatchery enhancement will be phased out in response to increases of natural-origin spawning as the population begins to achieve self-sustainability by the Full Restoration Phase. Phasing out of the program will occur in 20 years or when the 5-year running average of the aggregate terminal run exceeds 10,000 adults per year.

  Observations. The strategies described for rebuilding the chum population are generally accepted as appropriate for this purpose. However, the HSRG considers that recovery of the population will be expedited by focusing on seeding the river with adults only and by reducing the effects of hatchery influence as early as the Local Adaptation Phase, by which stage there should be strong signs that the population is on the road to recovery.

5.2.3 Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

One of the most critical needs in hatchery reform is to improve hatchery broodstock management. Hatchery programs should be managed as either genetically *integrated* with, or *segregate*d from, the natural populations they most directly influence (HSRG 2009, Appendix A, Implementing and Transitioning Hatchery Programs).

A fundamental purpose of most integrated hatchery programs is to increase abundance for harvest, while minimizing the genetic divergence and reproductive fitness differences between the hatchery broodstock and the naturally spawning population. In some cases, integrated programs also serve as a demographic safety net to vulnerable natural populations. An integrated program is intended to maintain the genetic characteristics of a locally adapted natural population and minimize the potential genetic effect of domestication. To achieve this, at a minimum, the pNOB has to be greater than the pHOS.

For *segregated* hatchery programs, the intent is to maintain a genetically distinct hatchery population that is isolated from natural populations. Ideally, fish from this type of hatchery program would be propagated solely from hatchery returns and not allowed to spawn with the natural population. The primary intent of a *segregated* program is to create a hatchery-adapted population to meet goals for harvest.

The biological principle behind the broodstock standards for both integrated and segregated populations is *local adaptation*, i.e., allowing a population to adapt to the environment it inhabits. Proper integration and segregation of hatchery programs is the HSRG's recommended means for minimizing adverse effects of hatcheries on local adaptation. The typical benefit of reforming broodstock management is that abundance goals for conservation and harvest can be met while at the same time improving the productivity of natural populations. Hatchery fish on the spawning grounds always represent a compromise between the demographic benefits and the genetic risk, even when they come from a well-integrated program. The HSRG concluded that when its broodstock management standards for an integrated or segregated program are met and managers' abundance goals are achieved, the benefits of the hatchery program outweigh the risks.

- ***Preservation and Recolonization Phases***

  Plan description. Integrated Recovery. During these phases, the emphasis will be on maintaining the population (Preservation Phase) and allowing it to colonize available habitat within the entire Elwha Basin (Recolonization Phase). Assuming that the population is to be regarded as Primary, it will be necessary to manage the pHOS and the pNOB to conform with that appropriate for a Primary population. To protect the genetic legacy of the population, broodstock will be selected to represent the native population run timing, and all hatchery releases will be otolith-marked to differentiate between hatchery-origin and natural-origin recruits.

  Observations. While otolith marking will distinguish between HORs and NORs, it will not be adequate to ensure proper integration of the hatchery and natural-origin components of the chum population on a real-time basis. Thus, yearly monitoring of the otoliths from spawned-out hatchery broodstock will have to be carried out, as will monitoring of spawned-out carcasses of fish on the spawning grounds. Only with such monitoring will it be possible to determine if progress toward the degree of integration appropriate for a Primary population is occurring. Also see Chapter 5.2.7 concerning selection of broodstock based on run timing.

- ***Local Adaptation and Full Restoration Phases***

  Plan Description. Integrated Harvest. During these phases, the emphasis will be in getting the population size to the stage where it appears to be self-sustaining, at which stage harvest will be possible when the run size exceeds 10,000 fish per year. As long as the hatchery continues to operate, monitoring efforts will be continued to track whether progress toward the appropriate pHOS and pNOB values for a Primary population is being made. However, once hatchery influence has been eliminated, monitoring for this purpose will no longer be necessary.

  Observations. See above comments under the Preservation and Recolonization phases.

5.2.4 Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve abundance goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions. The abundance and productivity of the natural population, as well as the ability to fully harvest hatchery-origin fish, determine the effect of hatchery straying on the natural population. This, in turn, determines the proper size of a hatchery program.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. Time, size, age and location of released hatchery fish also affect straying, survival and ecological interactions. When a hatchery program is sized appropriately, the demographic benefits to harvest and/or conservation outweigh the genetic and ecological risks.

The HSRG recommends that managers size their hatchery and harvest programs to reduce these surpluses and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers (see Appendix A).

The following applies to all phases:

Plan Description. The Plan links changes in the habitat to hatchery activities. The moratorium on fisheries targeting Elwha chum salmon also brings the hatchery component of the restoration strategy into an "all H" context.

The HGMP presents historical information on collection and production from 2001-2010.

Table 5-6 Broodstock collection and hatchery production levels for last 12 years.

Year	Females	Males	Egg take	Fecundity	Egg Plants	Fry Release
2001	21	20	49,434	2,354	47,080	0
2002	20	19	65,678	3,284	59,600	0
2003	33	33	66,063	2,002	57,600	0
2004	12	14	21,556	1,796	12,400	0
2005	1	1	2,088	2,088	0	776
2006	21	22	52,089	2,480	23,886	18,577
2007	2	2	6,254	3,127	0	3,883
2008	11	10	31,583	2,871	0	24,763
2009	22	18	67,623	3,074	22,283	31,290
2010	0	0	0	0	0	0

(HGMP Section 7.4.2)

The size of the hatchery releases by life stage is provided in the HGMP for three periods.

Table 5-7 Proposed annual release information by life history stage (HGMP Section 1.10.2).

	Before Dam Removal 2005 - 2011	Dam Removal 2012 - 2016	After Dam Removal 2017 >
Natural escapement	250	20-1600	83-1000+
Age 0 smolts	75,000	650,000	300,000
Eyed eggs	100,000	100,000	250,000
Fry	275,000	275,000	275,000

Fish production goals will vary in response to the availability of adults returning to the Elwha River. More detailed information on hatchery production at varying adult escapement levels is presented in Tables 15-17 in the Plan (p. 53).

During the dam removal period (2011-2014), the goal is to capture 100-200 adults (Chum Salmon HGMP, LEKT 2011). As numbers of adults increase, production strategies will expand to include a greater variety of production and release options (HGMP Section 1.10.2).

Observations. Describing the hatchery strategies in terms of their purpose is more informative and helps bring focus on the end-points instead of the process. The purposes of the hatchery as described in the HGMP are 1) stock preservation during the dam removal period, when habitat limits or precludes in-river natural production, and 2) to quickly rebuild chum salmon abundance to the level that can sustain terminal-area fisheries.

The rationale for the size of the program from a biological preservation point of view is not clearly identified in the HGMP or the Plan. The HGMP sets the performance indicator of 3,000 natural spawners after 10 years. This number is consistent with the predicted recovery from the Plan (p. 93, Figure 17), although there appear to be inconsistencies with the target of 3,000 and the numbers presented above (83-1,000+ in 2017) from the HGMP (Section 1.10.2). Also, the use of fry and eyed eggs is not recommended (see discussion under Recommendation 4) and should be taken into account when sizing the program.

The current very low numbers of spawning adults available for restoration amplify potential risks of artificial propagation, including loss of genetic diversity, decreased effective population size, and over-representation of family groups. These risks should be assessed and considered in the selection of broodstock (see Recommendation 10 below).

5.2.5 Recommendation 8: Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

Effectively managing harvest, hatchery broodstock and natural spawning escapement is essential to controlling genetic risks due to straying of hatchery adults. Unless the explicit purpose of the hatchery program is either preservation (gene banking) or recolonization, straying can result in fitness loss in natural populations. To limit these risks and meet conservation goals, the HSRG developed quantitative standards for the pHOS, the pNOB, and the PNI on an integrated population that results from the combination of pHOS and pNOB.

The designation of a population as Primary, Contributing or Stabilizing is, in part, a policy decision; however, for this analysis, the HSRG made assumptions based on the status of each population and manager's objectives. Standards recommended by the HSRG for broodstock management are as follows:

HSRG criteria for hatchery influence on Primary populations

- The pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

- ***Preservation and Recolonization Phases***

  Plan Description. Enhancement activities will focus on increasing the population size and preservation.

  Observations. As noted above, the implied definition of an integrated hatchery program is not consistent with the HSRG definition. There is no reference to standards or guidelines for broodstock composition of an integrated Primary population in either the Plan or the HGMP. Rather the HGMP Section 11.1 states that "*The weir will provide data necessary to estimate natural escapement. Methods will be developed and implemented to assess the survival of hatchery releases, and their contribution to escapement.*" The HSRG recommends that further consideration be given to methodological development and use of otolith marks to accomplish this goal. The purpose of the HSRG standards is to assure that the chum salmon population adapts to the local environmental conditions over time. For this reason, they are particularly important during the Local Adaptation Phase. Adopting the HSRG broodstock standards would be the most important change as management switches from the Recolonization Phase to the Local Adaptation Phase. No specific information has been presented to address pHOS, pNOB, and PNI.

  Escapements since 2005 are unknown, but presumed to be very low (see Table 5.1). Consequently, hatchery broodstock goals have not been met. Hatchery volunteers in excess of broodstock needs could be outplanted in suitable habitats. Currently, hatchery-origin fish in excess of broodstock needs are surplused to Tribal cultural programs, donated to food banks, or used in carcass nutrient enrichment programs in the Elwha Basin (HGMP Section 7.5).

- ***Local Adaptation and Full Restoration Phases***

  Plan Description. The Plan (page 52) indicates that post-dam removal, returning adults will be encouraged to spawn naturally throughout the system, and hatchery enhancement will be phased out in response to increases in natural-origin spawning. Information on varying production levels after dam removal is presented in Table 17 in the Plan (page 53).

  Observations. Although the Plan states that hatchery enhancement will be phased out in response to increases in natural-origin spawning (as summarized in Table 17), production goals remain the same. Increases are allocated to natural spawners. The HSRG notes that no direct information is presented to address items such as pHOS, pNOB and PNI.

  Pre-terminal and particularly terminal harvest should be managed to actively assist in transitioning to HSRG escapement standards for a Primary population (pHOS < 30% and PNI > 0.67). Broodstock collection should include sufficient NORs to transition to a natural population PNI of > 0.67.

5.2.6 Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase harvest and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality.

- ***Preservation and Recolonization Phases***

  Plan Description. The Plan and HGMP indicate an integrated recovery program without terminal harvest during dam removal and for 5 years following dam removal. The Plan states that some incidental harvest occurs in terminal commercial and sport fisheries for coho salmon.

  Observations. The HSRG assumes the long-term goal for management of the Elwha chum salmon population is as a Primary population and for the use of HORs at the lower run sizes. Hatchery marks appear to be limited to an otolith mark.

  The HGMP’s described program during these s phases is consistent with HSRG standards for escapement management. The Tribe, with co-manager support, should consider developing and evaluating selective fishing gears during these phases for later use in selective harvest and broodstock collection.

  The Plan and the HGMP are unclear as to how full harvest (removal) of surplus hatchery fish will be accomplished.

- ***Local Adaptation and Full Restoration Phases***

  Plan Description. The HGMP states that the long-term objective is to quickly rebuild chum abundance to a level that can sustain terminal-area fisheries. Further, the HGMP states that harvests targeting hatchery production will be assessed as natural production increases (HGMP Section 1.8). The HGMP performance indicators specify that the program will phase out in 20 years or when the 5 year running average of the aggregate terminal run exceeds 10,000 (HGMP Section 1.9). Terminal harvest will be initiated when run size reaches 10,000, and exercise of treaty rights will be prioritized.

  Observations. The HSRG assumes the long-term goal for management of the Elwha chum salmon population is as a Primary population based on natural production. The Plan and HGMP assume the Tribe's treaty fishing rights will be achievable through natural production only. The Plan and the HGMP indicate that hatchery fish are not externally marked. Since the hatchery program will be terminated, this is not an issue in the long-term (i.e., Full Restoration Phase), but it would be an issue during the Local Adaptation Phase.

5.2.7 Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Use of local broodstock and in-Basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations.

The following applies to all phases:

Plan Description. The Plan and HGMP refer to the two distinct run-timing components in several sections**.** The Plan states that Elwha fall chum salmon have two distinct run-timing components—an early population (October-November) thought to be the native stock and a later-entering population (December) that is genetically similar to Hood Canal populations (Wunderlich et al. 1994).

Similar statements are made in the HGMP (Section 7.3), which states that adults collected from the river exhibit the run timing of the native fall chum stock, in contrast to later-timed chum that may still return as remnants of the previous introduction of the Walcott Slough stock. The Walcott-stock hatchery program was terminated in 1985.

However, the HGMP also states that the hatchery collects and spawns fish from throughout the run period to insure representation of all portions of the run timing spectrum (HGMP Section 7.2). Starting in 2015, gametes will be taken from all adult chum returning to the hatchery facility (HGMP Section 7.3).

The HGMP outlines M&E performance indicators for protecting the genetic legacy of the native stock as follows (HGMP Section 11.2): *Selection of adult chum exhibiting native run timing will assure use of appropriate broodstock.*

Observations. The origin and strategy for maintaining the broodstock and protecting the genetic legacy should be more thoroughly evaluated. Both the Plan and HGMP highlight the differences in run-timing between the native fall Elwha chum (October-November) and what is presumed to be the later-timing remnants of the Walcott Slough introduction (December).

Genetic analyses comparing the early and late-timing runs were conducted in the mid-1990s (WDFW 1996). There was some variability across years, but in most instances the early run collections grouped more closely with other Strait of Juan de Fuca wild stocks, while the late runs showed an elevated evidence of Hood Canal genes. More recent analyses (Winans et al. 2008) did not include samples to evaluate temporal stratification in the Elwha or comparisons to other chum salmon from the Strait of Juan de Fuca. Winans et al. (2008) did observe the highest level of diversity from the Elwha collection and hypothesized that this could be due in part to the hatchery transfers from Hood Canal. Apparently, no additional data have been collected to address this question (M. Small, WDFW, personal communication).

Inconsistencies are apparent in the Plan and the HGMP concerning the temporal collection of the broodstock. Some sections suggest that only the early part of the run will be collected; while other sections indicate collection will be made across the run. Further, the HGMP states that all adults returning to the hatchery will be incorporated into the broodstock beginning in 2015.

The risks and uncertainties associated with each approach should be explicitly stated, and a consistent strategy developed. For example, if broodstock are collected from only the early timing of the run, chum salmon allowed to spawn in the wild may include an increased level of out-of-Basin genes originating from the Hood Canal hatchery stock. Alternatively, collecting across the run will maximize the demographic benefit to the population, but may continue to propagate the remnants of the Hood Canal introduction.

5.2.8 Recommendation 11: Coordinate hatchery programs within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

The following applies to all phases:

Plan Description. The Plan recognizes that collection of chum salmon broodstock from the river may involve handling of listed adult steelhead and states that in the short term any steelhead caught will be used for broodstock in the steelhead program.

Age-0 chum smolts may compete with juvenile Chinook during the period they co-occur in the lower river and nearshore marine waters, but the period is expected to be very short. Smolts released higher in the Basin and juveniles from the egg box program may interact with juvenile Chinook for a longer period.

Observations. Straying of hatchery chum salmon from the Elwha program to adjacent chum salmon populations can be monitored through analysis of otolith marks. Because of the program's size and genetic affinities, straying to other Strait of Juan de Fuca populations is unlikely to pose significant risks.

5.2.9 Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities as well as structures to remove and discharge water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change instream flow, alter riparian habitat and diminish water quality through hatchery discharges. Water for hatchery use is often drawn from an adjacent stream via pumps or gravity. Improperly designed and maintained water intakes can impinge migrant or resident juveniles on hatchery screens or cause fish to be trapped in hatchery facilities. Structures such as adult weirs and water intake dams can also block natural passage of salmonids to spawning or rearing areas. Water diverted from adjacent streams for fish culture purposes is often returned downstream and can reduce the amount of water for juvenile rearing and upstream adult migration between the area of intake and discharge. Hatchery discharge can also diminish water quality below the point of discharge through changes in temperature, settleable and suspended solids, chemical composition, and presence of therapeutic drugs.

The HSRG has noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

The Lower Elwha Fish Hatchery in which the chum are being reared is screened to avoid entrainment of juvenile salmonids, and effluent water will be maintained to meet NPDES guidelines (Chum Salmon HGMP, page 249). The HSRG assumes that all NPDES permits are in place.

5.2.10 Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. Conservation hatcheries producing juveniles with high survival generate more spawners on the spawning grounds. This, in turn, accelerates the rate at which recovery programs move toward meeting their goals. Production programs may have to reduce release numbers to decrease negative ecological impacts on natural populations. Increasing post-release survival can offset this reduction and enable managers to meet their harvest goals.

There are many approaches to increasing fish survival. The release of fish at the appropriate time, size, age and location can significantly increase their recruitment to fisheries and natural escapement. Releasing rapidly migrating smolts rather than fry increases survival and reduces negative ecological interactions in the freshwater environment. Similarly, the release of healthy fish produces more fish for harvest and less opportunity to spread disease to natural populations. Improving water quality and reducing loading and density during rearing are also proven tools used by fish culturists to enhance fish survival. Adoption of volitional release (allowing smolts to outmigrate when they are ready, rather than “forcing” them out at a preset date) with removal of residuals (fish that do not outmigrate) may increase the long-term survival of released fish, while decreasing negative ecological interactions with natural populations. Proper acclimation and imprinting of hatchery juveniles can reduce straying and enhance survival to the desired location for their harvest or artificial spawning. Developing and adopting these and other culture and release practices that maximize fish survival and minimize negative ecological interactions by reducing production release numbers, can aid conservation programs in rebuilding runs and reducing the conflict between harvest programs and conservation goals for natural populations.

The following applies to all phases:

Plan Description. The Chum Salmon HGMP presents survival data by hatchery life stage for chum salmon production for the period 2001-2012 (HGMP, Table 9.2.1). No emigrated fry are documented for 2006 (HGMP, Table 10.3), although 23,886 eggs were planted (HGMP, Section 7.4.2). This is likely a simple omission, since survival rates for that year are given in Table 9.2.1. Age-0 smolts are being released volitionally from the hatchery beginning in March or April and timed to reduce smolt contact with outmigrant coho (late March to mid-May) and with Chinook smolts (Mid June to late June).

Observations. No data on survival to adult are presented. To reduce potential harm to natural populations through genetic and ecological interactions, the hatchery program should be no larger than necessary to meet the recolonization objectives. The higher the survival of hatchery fish the smaller the program can be to produce the required number of adult offspring.

5.2.11 Summary of Observations and Conclusions for Principle 2—Chum Salmon

Table 5-8 summarizes our findings regarding the consistency of the chum salmon component of the Elwha Plan with HSRG Principle 2 and specifically, with the seven recommendations that address scientific defensibility. Table 5-9 summarizes our observations and conclusions, by restoration phase.

Table 5-8 Principle 2: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 4: Is the purpose of the hatchery program defined (i.e., conservation, harvest or both)?	Yes
Recommendation 5: Are the scientific assumptions, under which a program contributes to meeting the stated goals, explicitly stated?	No
Recommendation 6: Has an integrated or segregated broodstock management strategy been selected, that is based on population goals and hatchery program purpose?	No
Recommendation 7: Is the size of hatchery programs based on population goals and as part of an "all H" strategy?	No
Recommendation 8: Are harvest, hatchery broodstock, and natural spawning escapement managed to meet HSRG standards appropriate to the affected natural population's designation?	No
Recommendation 9: Is the harvest managed to achieve full use of hatchery-origin fish?	No
Recommendation 10: Do all hatchery programs have self-sustaining broodstocks?	Yes
Recommendation 11: Are hatchery programs coordinated within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations?	No
Recommendation 12: Are facilities constructed and operated in compliance with environmental laws and regulations?	Yes
Recommendation 13: Is survival of hatchery fish maximized consistent with conservation goals?	Unknown

Table 5-9 Observations and conclusions regarding Principle 2—scientific defensibility.

Preservation Phase This phase of the project is generally consistent with Principle 2. However, the risks and uncertainties associated with broodstock selection strategies should be explicitly stated, and a consistent approach developed.
Recolonization Phase While the Plan lays out a schedule for sizing the program based on combined return of natural and hatchery origin adults, the rationale for this schedule is not clearly explained. The Plan incorporates a mixed strategy in terms of life stages to be planted in the habitat, but omits the option of outplanting adult hatchery fish without explanation. Most importantly, the end-points of the colonization phase are not defined in terms of predetermined triggers and responses.
Local Adaptation Phase For chum salmon, this would be a very critical phase, where the hatchery program is managed to meet HSRG standards and sized and operated only as a safety net to promote local adaptation. Progress toward local adaptation and increased fitness are balanced against demographic risks due to uncertainty about habitat conditions. During this phase, specific trigger points in terms of numbers of returning natural-origin spawners should be identified to signal transition to the next phase. The trigger points along with clearly identified uncertainties (see also Recommendation 5) and the accuracy and precision requirements of their estimates should be major drivers for the monitoring and evaluation plan.
Full Restoration Phase Since the hatchery program will be terminated as this phase begins, the main concern here is the determination of when this stage begins. Population may not yet have reached its potential as measured in VSP parameters, but it is now sustainable and increasing over time without the aid of a hatchery program. The conditions that define the onset of this phase, based on biological triggers, need to be made more explicit.

5.3 Summary of Observations, Conclusions and Recommendations for Chum Salmon

The table below summarizes our assessment of the consistency of the chum component of the Elwha Plan with HSRG Principles 1 and 2. It also provides recommendations for improving consistency with these principles.

Table 5-10 Summary of observations, conclusions, and recommendations for chum salmon.

Observations and Conclusions The overall goals for the program are clearly stated, but the biological triggers for moving between the various phases need to stated/developed. A clear strategy for selecting broodstock should be developed and stated explicitly. The risks and benefits associated with selecting for an early-timing broodstock that is thought to be the native stock should be compared to a strategy of collecting across the entire run to achieve demographic advantages and increased diversity. It is essential when managing an integrated hatchery program for a Primary population that the values for pHOS and PNI are managed to comply with those appropriate for a Primary population. It was not apparent that this fact was appreciated, based on review of the Plan and HGMP documents. Managing a population to this end with only otolith marks will be problematic, but monitoring of otoliths from spent carcasses on the spawning grounds and from the spent broodstock should be done to assess progress toward achieving the desired pHOS and PNI values. The advantage of using adults for seeding the Elwha River Basin is emphasized, as this approach should expedite recovery of the native chum population. The speed of restoration will also be expedited by turning off all hatchery influence as soon as the population is showing clear signs of recovery (a biological trigger should be developed for this). Fed fry should be used solely for maintaining the hatchery program while it is needed.
Benefits • The benefit of the hatchery program is that the population is likely to be restored.

<u>Risks</u> • The risks associated with the program can be minimized if care is taken to adopt the suggestions detailed in the commentary provided above.
<u>Likelihood of meeting goals</u> • Good, if the suggestions provided in the foregoing commentary are followed.
<u>Recommended modifications</u> • See above.

6 Pink Salmon Population Report

Population Definition: Elwha odd year pink salmon were identified as a distinct population based on their distinct spawning distribution. Fall- and summer-run collections of odd year pink salmon from the Elwha were compared to neighboring populations in the Dungeness River (fall and summer run) and Morse Creek (summer run). Moderate levels of variability were observed in 13 microsatellite (mSAT) loci with 3 loci exhibiting > 20 alleles per locus. There was little variability among samples in the estimates of genetic diversity. Eight of the 13 loci were out of Hardy Weinberg equilibrium. Fall-run fish from the Dungeness and Elwha clustered together in the dendrogram; the FST value between the collections was statistically significant (Winans et al. 2008).

Population Designation: Assumed to be Primary for odd-year and Contributing for even-year run components.

Population Origin: This is a native population with natural production:

Odd Year Population: Two odd year-returning pink salmon aggregations - an early (summer) component and a late (fall) component - persist in the Elwha River. Elwha odd year pink salmon are a genetically unique, discrete population, as identified through genetic analyses (Small et al. 2005). Both odd year aggregations will be targeted for inclusion in the preservation and enhancement effort, using artificial propagation.

Even Year Population: Even year pink salmon are observed in the Elwha River at low abundance levels. No genetic analysis of the population has been completed, and it is unknown whether it is a genetically unique, discrete population, or if even year returns reflect on-going colonization of the river by pink salmon from another watershed (LEKT 2011a).

Native even year pink salmon populations have not been observed historically in Washington State; self-sustaining returns of the race are confined to regions north of Vancouver Island. Even year pink salmon have become more common throughout Puget Sound in recent years in an apparent range expansion through natural colonization. It is unclear if a self-sustaining even year pink salmon population was ever present in the Elwha River.

ESA Status: The odd and even year pink salmon aggregations in the Elwha River are included as part of the Washington Odd and Puget Sound Even Year Pink Salmon ESUs, respectively (Hard et al. 1996). NMFS reviewed the status of Elwha River and other Washington-origin pink salmon in response to a March, 1994 petition to list the species as protected under the ESA. After reviewing the status of pink salmon in Washington, NMFS determined that ESA listing for the two ESUs and their component populations, including Elwha, was not warranted (60 FR 192, October 4, 1995). Pink salmon were thought to once be the most abundant salmonid species in the watershed, and likely of great importance to the Elwha River ecosystem. Currently, however, both Elwha River populations are at a critically low abundance status, and are in danger of extirpation.

Recent Status and Trends: Recent natural spawning escapement is shown in Table 6-1.

Table 6-1 Recent natural spawning escapement.

Return Year	Natural Spawning Escapement (NOR + HOR) Odd Year (1)	Natural Spawning Escapement (NOR + HOR) Even Year (1)	Hatchery Broodstock (Odd Year)(2)	pNOB
	Actual	Actual	Actual	Actual
2001	106			
2002		Unk		
2003	55			
2004		Unk		
2005	15			
2005		unk		
2007	26			
2008		14		
2009	35			
2010		13		
2011			112	100%

1) Annual magnitude of Elwha River adult pink salmon escapement based on peak live counts in side channel and mainstem river index areas (Data from M. McHenry LEKT October 2010).
2) No hatchery program prior to 2011.

Historic Hatchery Production: There has never been a historic hatchery program for Elwha River pink salmon and introductions of nonnative pink salmon have not occurred (Ward et al. 2008, page 56).

Recent Hatchery Production: Recent hatchery release numbers are shown in Table 6-2.

Table 6-2 Recent hatchery release numbers.

Release Year	Number Released (Eggs Planted) (1)	Number Released (Unfed Fry Planted) (1)
	Actual	Actual
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	0	0

(1) No hatchery program prior to 2011; a target of 50,000 odd year pink fed fry for release in 2012 has been established.

Recent Harvest: No terminal harvest is currently directed at Elwha River pink salmon. The Elwha River is closed to all fishing during the period of river entry and through spawning. Mixed stock sport and commercial fisheries in the Strait of Juan de Fuca and off Vancouver Island likely intercept Elwha pink salmon, but the impacts are not currently known (Ward et al. 2008)

Over the term of this project, pink salmon adults produced through the program will not be the target of any fisheries, nor will returning adult fish lead to elevated harvest levels for other salmonid species, including listed salmon and steelhead. Pink salmon returns to the Elwha River will be managed consistent with Co-manager Chinook, coho, and steelhead harvest resource management plans, and with NMFS ESA authorizations for those plans. In addition, a temporary moratorium on in-river fishing is proposed for the Elwha River during dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations (LEKT 2011a).

Table 6-3 presents a summary of status, trends and restoration goals for pink salmon.

Table 6-3 Pink salmon summary.

Population Designation[1]		Odd years - Primary
Program Type [2]		Integrated Recovery
Historical Abundance [3]		3,147 - 137,600
Current Escapement [4]		In 2001: 200 fish In 2005: <50 (this is a place holder estimate)
Restoration Goals	Plan	Escapement = 96,000, Recruitment = 251,968 10-15 years
	HGMP	Adult Escapement: After 10 years – 10,000 After 25 years – 96,000

1) HSRG assumed designation
2) Source: HGMP
3) Range of several estimates
4) Source Ward et al. 2008

6.1 Principle 1: Develop Clear, Specific, Quantifiable Harvest and Conservation Goals for Natural and Hatchery Populations within an "All H" Context

Goals for fish populations must be explicitly communicated and fully understood by the managers and operators of hatchery programs. These goals should be quantified, where possible, and expressed in terms of values to the community (harvest, conservation, education, research, etc.). Hatchery production numbers may be the means of contributing to harvest and/or conservation values, but they are not end-points. When population goals are clearly defined in terms of conservation and harvest, hatcheries can be managed as tools to help meet those goals.

To be successful, hatcheries should be used as part of a comprehensive strategy where habitat, hatchery management and harvest are coordinated to best meet resource management goals that are defined for each population in the watershed. Hatcheries are by their very nature a compromise—a balancing of benefits and risks to the target population, other populations, and the natural and human environment affected by the hatchery program. Use of a hatchery program is appropriate when benefits significantly outweigh the risks and when the benefit/risk mix from the program is more favorable than the benefits and risks associated with non-hatchery strategies for meeting the same goals.

The HSRG has developed three general recommendations as guidelines for defining goals for natural and hatchery populations. The HSRG review of the Elwha Plan in terms of its consistency with Principle 1 is presented with reference to these recommendations.

General Comment on Principle 1

The Elwha Plan does not state the restoration goal for pink salmon in terms that conform to the HSRG's recommendations. However, scattered throughout the text of the plan are pieces of information that taken in total would provide some the information needed to construct a goal. For example, on page 97, Table 25 gives interim restoration targets for abundance after 10 and 25 years, productivity after 10 years and at MSY, spatial distribution and harvest goals for freshwater. These targets could be part of the goal. The interim targets are quantitative but they do not separate natural and hatchery populations nor are they placed an "all H" context. There are four goals on page 95 that are called central to the implementation of the Elwha Act. They are:

1) Reestablish self-sustaining anadromous salmonid populations and habitats throughout the Elwha River watershed and its near shore as quickly as possible, using the most appropriate methods.

2) Maintain the integrity of the existing salmonid genetic and life history diversity before, during, and after dam removal and the subsequent periods of elevated sediment levels.

3) Maintain the health of fish populations before, during, and after dam removal.

4) Restore the physical and biological processes of the overall ecosystem through dam removal, including the return of VSPs.

Additionally, a parallel goal is found in the NOAA Fisheries guidance documents for recovering ESA-listed salmon species (NMFS 2010): restoration efforts shall be targeted at achieving viable salmonid populations. These goals are not species specific, nor are they quantitative. They are broad descriptions of things that will be done (tasks), not things that will be achieved (goals). The Elwha Plan needs a comprehensive, species-specific goal statement near the beginning of the Plan's narrative. The goal statement should conform to HSRG's Principle 1.

6.1.1 Recommendation 1: Express conservation goals in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity).

The Primary, Contributing and Stabilizing population designations refer to the biological significance of the population in the context of its ESU. The following general viability criteria apply:

- Primary: populations must achieve at least high viability
- Contributing: populations must achieve at least medium viability
- Stabilizing: populations must maintain at least current viability
- Viability goals should be expressed in terms of population productivity and abundance
- Viability goals should also take into account spatial structure and diversity

Different definitions of biological significance are used by managers throughout the Northwest. In order to provide a consistent analysis, the HSRG used the classification system adopted by the Lower Columbia Fish Recovery Board in 2004 (LCFRB 2004), under which all distinct salmon and steelhead populations are classified as either *Primary*, which are targeted for restoration to high productivity and abundance;

Contributing, where small to medium improvements are needed; or *Stabilizing,* populations that may be maintained at current levels. Viability goals are expressed in terms of population productivity and abundance and also take into account spatial structure and diversity.

The following applies to all phases:

Decision rules with measurable triggers for the coho population must be identified to determine when to transition to the next management phase. For the third and fourth phases (local adaptation and full restoration), decision rules and triggers should also be developed to determine when it may be necessary to revert back to an earlier phase, should the trend toward recovery be significantly reversed. Decision rules and triggers must be predetermined and specific to assure that the appropriate variables (that define the triggers) are monitored with sufficient accuracy and precision. All key assumptions and uncertainties (See Chapter 1.2, Table 1-2) must be monitored until they are either resolved or it is determined that they are not relevant to the recovery of the Elwha ecosystem. See Chapter 7 for specifics.

Plan Description. Elwha odd year pink salmon are a genetically unique, discrete population, as identified through genetic analyses. It is unclear if a self-sustaining even year pink salmon population was present historically in the Elwha River (LEKT 2011a chapters 1.2 and 1.8).

- ***Preservation Phase***

  The initial goal of this program is to use supportive breeding to preserve the native populations of odd and even year pink salmon in the Elwha River during the Elwha dam removal period, when river turbidity and sediment conditions will cause the lower river to be inhospitable for natural production (HGMP, page 6). These efforts are considered necessary to increase egg to out-migrant, and out-migrant to adult survival rates above minimal to nil levels expected for naturally spawning fish during the dam removal and early river recovery phases (HGMP, p. 9). No harvest will occur. Preservation activities include:

  Even-year run component: The goal for even-year pink salmon is to preserve the population through the dam removal period only (HGMP, page 7). Attempts will be made to use supplementation hatchery releases to simply preserve even year pink salmon, albeit at their current, low abundance level. No captive broodstock program is planned for the even year stock. Supportive breeding for Elwha even year pink salmon will be confined to a short-term supplementation program only (HGMP, page 5).

  Odd-year run component: Creation of a captive broodstock using the native odd- year stock, and implementation of a supplementation program are needed in the short term to preserve the stock during the dam removal phase. Odd year pink salmon, which include both summer (early) and fall (late) adult return components (considered together in this document) are known to have been present in the Elwha River prior to dam construction (HGMP, page 7). The odd year pink captive broodstock program is planned to phase out after 6 years of operation (three odd year [2011, 2013, 2015] pink salmon generations) and transition the program to supplementation only, with the goal of restoring abundant, naturally-producing, self-sustaining pink salmon populations that maintain the genetic characteristics of the native stocks (LEKT 2011a, page 9).

- ***Recolonization Phase***

  Even-year run component: After dam removal and when the river above RM 5.0 will be accessible to migrating anadromous salmonids (i.e., post-2014), the goal for the even year pink salmon will be to allow the population to naturally colonize the Elwha River without supportive breeding.

  Odd-year run component: Post-dam removal, the goal for odd year pink salmon is to bolster the abundances of emigrating juvenile and returning adult fish to restore self-sustaining natural-origin populations that maintain the genetic characteristics of the native stock, and return to annual adult abundances approaching estimated historic levels. The captive brood program will be terminated after three generations unless adult return rates exceed 10,000 fish per year in any given year and Puget Sound pink salmon populations are stable or increasing over the past three brood cycles. If return rates to the Elwha River fall below 5,000 fish per year at the end of three generations, the Co-managers and cooperators will meet to discuss alternatives for future supplementation (HGMP, page 6).

- ***Local Adaptation Phase***

  After dam removal and as natural habitat recovers, supplementation of the odd-year aggregation will cease. Natural returns of both even- and odd-year run components should foster restoration of viable naturally-spawning pink salmon returns to the Elwha River that approach estimated historic levels.

- ***Full Restoration Phase***

  The estimated escapement of pink salmon to the Elwha River at MSY levels is a pristine potential production of 251,968 (no harvest). Substantial recovery of this stock is estimated to occur 10 to 15 years following the start of dam removal. Adverse habitat conditions in the lower river following dam removal may prolong recovery timing. Additionally, as with most pink salmon populations of Puget Sound, it is assumed that odd-year runs will be the predominant population (Ward et al. 2008, page 93).

Observations. The HSRG has made the following observations about how the Plan and HGMP address biological significance and viability for pink salmon.

- ***Preservation Phase***

  Odd year = Primary
  Even year = Contributing

- ***Recolonization Phase***

  Odd year = Primary
  Even year = Contributing

- ***Local Adaptation Phase***

  Odd year = Primary
  Even year = Contributing

- ***Full Restoration Phase***

  Odd year = Primary
  Even year = Contributing

6.1.2 Recommendation 2: Express harvest goals in terms of a population's contribution to specific fisheries

Harvest goals should be expressed quantitatively where possible, either in terms of catch (number of fish) in specific fisheries (e.g., tributary sport or other terminal fisheries), or as mixed-stock, pre-terminal, sustainable harvest rates.

Plan Description. Over the term of this project, pink salmon adults produced through the program will not be the target of any fisheries, nor will returning adult fish lead to elevated harvest levels for other salmonid species, including listed salmon and steelhead. Elwha River pink salmon are proposed for artificial propagation for conservation purposes only, and no fisheries are intended to benefit from pink salmon adults produced through this program (LEKT 2011a, chapter 3.3).

- ***Preservation Phase***

  A temporary moratorium on in-river fishing is proposed for the Elwha River during dam removal to protect returning adults during this period when survival and spawning success is expected to be low due to elevated suspended sediment concentrations.

- ***Recolonization Phase***

  See Plan Description, above.

- ***Local Adaptation Phase***

  See Plan Description, above.

- ***Full Restoration Phase***

  In a best case scenario, where rebuilding occurs rapidly, limited fisheries designed to harvest Elwha River pink salmon may be implemented if escapement goals are met. However, the benefit of escaping an abundance of pink salmon into upstream spawning areas as a mechanism for enhancing marine-derived nutrients in the Elwha River ecosystem will be factored into any consideration of pink salmon-directed harvests in fisheries (Ward et al. 2008, page.. 59).

Observations. None.

6.1.3 Recommendation 3: Ensure goals for individual populations are coordinated and compatible with those for other populations in Elwha Basin

Efforts to harvest abundant hatchery fish from one population can impact natural fish in another population; hatchery strays can and do interact with natural populations from different locations within the region. The contribution of each hatchery program to the cumulative impact of all hatchery programs in the Basin also needs to be considered.

The following applies to all phases:

Plan Description. Over the term of this project, pink salmon adults produced through the program will not be the target of any fisheries, nor will returning adult fish lead to elevated harvest levels for other salmonid species, including listed salmon and steelhead. Pink salmon returns to the Elwha River will be managed consistent with Co-managers' Chinook salmon, coho, and steelhead harvest resource management plans, and with NMFS ESA authorizations for those plans (LEKT 2011a, chapter 3.3).

Observations. The HSRG notes that the mechanisms for this coordination among management plans are not well described in the HGMP or the Plan.

6.1.4 Summary of Observations and Conclusions for Principle 1—Pink Salmon

Table 6-4 summarizes our findings regarding the consistency of the pink salmon component of the Plan with HSRG Principle 1 and specifically, with the three recommendations that address harvest and conservation goals. Table 6-5 summarizes our observations and conclusions, by restoration phase.

Table 6-4 Principle 1: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 1: Are conservation goals expressed in terms of a population's biological significance (Primary, Contributing, Stabilizing) and viability (natural-origin spawning abundance and productivity)?	Partially
Recommendation 2: Are harvest goals expressed in terms of a population's contribution to specific fisheries?	No directed harvest
Recommendation 3: Are goals for individual populations coordinated and compatible with those for other populations in Elwha Basin?	Unknown

Table 6-5 Observations and conclusions regarding Principle 1—population goals.

<u>All Phases</u> The HGMP lacks a clear statement of population status in terms of Primary, Contributing, and Stabilizing. Additionally, the HGMP lacks a clear statement of how goals are coordinated and compatible with those for other populations. These should be clarified.

6.2 Principle 2: Design and Operate Hatchery Programs in a Scientifically Defensible Manner

Once a set of well-defined population goals has been identified, the scientific rationale for a hatchery program in terms of benefits and risks must be formulated, explaining how the program expects to achieve its goals. The purpose, operation, and management of each hatchery program must be scientifically defensible. The strategy chosen must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be articulated.

In general, scientific defensibility will occur at three stages:

1) During the deliberation stage, to determine whether a hatchery should be built and/or a specific hatchery program initiated;

2) During the planning and design stage for a hatchery or hatchery program; and

3) During the operations stage.

This approach ensures a scientific foundation for hatchery programs, a means for addressing uncertainty, and a method for demonstrating accountability. Documentation for each program should include a description of analytical methods and should be accompanied with citations from the scientific literature. HSRG recommendations 4 through 13 are aimed at ensuring scientifically defensible hatchery programs. The HSRG review of the Elwha Plan is presented with reference to these recommendations.

The purpose of the hatchery program will vary by phase of the restoration project.

6.2.1 Recommendation 4: Identify the purpose of the hatchery program (i.e., conservation, harvest or both)

Once the goals for a population have been established, it is necessary to identify the purpose of hatchery programs affecting that population. A conservation program is one that is compatible with goals for biological significance (Primary or Contributing) and viability (productivity, abundance, diversity and spatial structure) of a population. A harvest program is one that contributes to specific fisheries at specified rates or harvest numbers, and is compatible with identified conservation objectives for all populations. Unless the purpose of a hatchery program is clear, it is not possible to effectively design, operate or evaluate the program.

Plan Description. The HGMP identifies the purpose of the proposed hatchery programs as Integrated Recovery (LEKT 2011a, chapter 1.6). The initial goal of this program is to use supportive breeding to preserve the native populations of odd and even year pink salmon in the Elwha River during the dam removal period, when river turbidity and sediment conditions will cause the lower river to be inhospitable for natural production. Post-dam removal, the goal for odd year pink salmon is to bolster the abundances of emigrating juvenile and returning adult fish to restore self-sustaining natural-origin populations that maintain the genetic characteristics of the native stock, and return to annual adult abundances approaching estimated historic levels. The goal for even year pink salmon is to preserve the population through the dam removal period only, and then allow the population to naturally colonize the Elwha River after dam removal, when the river above RM 5.0 will be accessible to migrating anadromous salmonids (i.e., post-2014) without supportive breeding (LEKT 2011a, chapter 1.7).

Observations. The HSRG suggests, with reference to the biological phases above (Chapter 1.2), that the purpose of the hatchery program, by phase, should be:

- ***Preservation Phase***

  Conservation

- ***Recolonization Phase***

  Conservation

- ***Local Adaptation Phase***

  Conservation

- ***Full Restoration Phase***

  No hatchery program

6.2.2 Recommendation 5: Explicitly state the scientific assumptions under which a program contributes to meeting the stated goals

Once population goals have been defined and the purpose(s) of a hatchery program (harvest, conservation, or both) have been established, the scientific rationale for the program must be documented. The scientific rationale explains, in terms of benefits and risks, how the hatchery program is expected to achieve its purpose. The purpose, operation and management of the program must be scientifically defensible and the chosen strategy must be consistent with current scientific knowledge. Where there is uncertainty, hypotheses and assumptions should be documented, so those assumptions can be evaluated and modified as new information becomes available. Documentation should include citations from the scientific literature and analytical tools that take into account the various factors that will affect the success of the program (predation assumptions, cumulative effects, etc.). This approach ensures a scientific foundation for hatchery programs, a means to address uncertainty, and a method to demonstrate accountability.

The following applies to all phases:

Plan Description. The HGMP (Section 1.8) provides rationale that the proposed pink salmon hatchery program should reduce the risk that the species will become extirpated during the dam removal period due to the likelihood for lethal turbidity and sediment levels in the lower river that will result from dam removal and downstream transport of accumulated materials behind the dams.

Observations. The HSRG notes that neither the HGMP nor the Plan present the scientific basis or citations for assumptions. Scientific assumptions and rationale for captive broodstock and supplementation efforts are not provided. In fact, the Plan (page 55) states "*attempts to establish pink salmon populations within their native range have mostly failed. Hard et al. (1996) cite the failure despite repeated attempts to establish even year Pink salmon runs in Puget Sound.*" Northwest Science (Vol. 82, Special Issue, 2008) includes a number of articles on the Elwha that provide information that could be used to strengthen the scientific defensibility of the Plan and HGMP.

6.2.3 Recommendation 6: Select an integrated or segregated broodstock management strategy based on population goals and hatchery program purpose

One of the most critical needs in hatchery reform is to improve hatchery broodstock management. Hatchery programs should be managed as either genetically *integrated* with, or *segregate*d from, the natural populations they most directly influence (HSRG 2009, Appendix A, Implementing and Transitioning Hatchery Programs).

A fundamental purpose of most *integrated* hatchery programs is to increase abundance for harvest, while minimizing the genetic divergence and reproductive fitness differences between the hatchery broodstock and the naturally spawning population. In some cases, integrated programs also serve as a demographic safety net to vulnerable natural populations. An integrated program is intended to maintain the genetic characteristics of a locally adapted natural population and minimize the potential genetic effect of domestication. To achieve this, at a minimum, the pNOB has to be greater than the pHOS.

For *segregated* hatchery programs, the intent is to maintain a genetically distinct hatchery population that is isolated from natural populations. Ideally, fish from this type of hatchery program would be propagated solely from hatchery returns and not allowed to spawn with the natural population. The primary intent of a *segregated* program is to create a hatchery-adapted population to meet goals for harvest.

The biological principle behind the broodstock standards for both integrated and segregated populations is *local adaptation*, i.e., allowing a population to adapt to the environment it inhabits. Proper integration and segregation of hatchery programs is the HSRG's recommended means for minimizing adverse effects of hatcheries on local adaptation. The typical benefit of reforming broodstock management is that abundance goals for conservation and harvest can be met while at the same time improving the productivity of natural populations. Hatchery fish on the spawning grounds always represent a compromise between the demographic benefits and the genetic risk, even when they come from a well-integrated program. The HSRG concluded that when its broodstock management standards for an integrated or segregated program are met and managers' abundance goals are achieved, the benefits of the hatchery program outweigh the risks.

Plan Description. The HGMP (Section 1.11.1) indicates "*adults collected for use as broodstock will vary, as determined by: the phase of the program (preservation v. restoration).*" The HGMP (Section 1.6, p. 6) indicates the type of program is "Integrated Recovery".

Observations. The HSRG notes that no information is provided to determine how guidelines for a properly integrated population would be met (e.g., for pHOS, pNOB, PNI).

- ***Preservation Phase***
  Integrated—methods to meet standards need to be defined.
- ***Recolonization Phase***
  Integrated—methods to meet standards need to be defined.
- ***Local Adaptation Phase***
  Integrated—methods to meet standards need to be defined.
- ***Full Restoration Phase***
  No hatchery program

6.2.4 Recommendation 7: Size hatchery programs based on population goals and as part of an "all H" strategy

A hatchery program should be sized to achieve abundance goals for harvest and conservation, while reducing the effects on natural populations from straying, ecological interactions and from collecting more natural broodstock than the population can support. The appropriate size of an integrated or segregated program is directly related to the productivity and abundance of the natural population, taking into account the effects of harvest, hydropower operations and habitat conditions. The abundance and productivity of the natural population, as well as the ability to fully harvest hatchery-origin fish, determine the effect of hatchery straying on the natural population. This, in turn, determines the proper size of a hatchery program.

Concerns about ecological interactions can be addressed in part by making the hatchery program as small as possible, while assuring that benefits from the program still outweigh the risks. Time, size, age and location of released hatchery fish also affect straying, survival and ecological interactions. When a hatchery program is sized appropriately, the demographic benefits to harvest and/or conservation outweigh the genetic and ecological risks.

The HSRG recommends that managers size their hatchery and harvest programs to reduce these surpluses and use some of the surplus fish to provide ecological benefit through nutrient enhancement of streams and rivers (see Appendix A).

Plan Description. Information presented at the Port Angeles meeting described the hatchery size and operation levels described below. Information on hatchery production at varying adult escapement levels is presented in Tables 18-20 in Ward et al. (2008, page 60).

Table 6-6 Production goals.

Average facility escapement	50 to 2,000
Average adult escapement	100 to 250,000
Potential production strategies:	
Yearling smolts	225,000 to 425,000
Eyed eggs	100,000
Fry	125,000
Pre-smolts	75,000
Natural spawners	100 to 200,000

Table 6-7 Release strategies.

Natural spawners	Mid & lower basin
Age-0 smolts	On-station & lower-basin
Eyed eggs	Lower basin

Table 6-8 Adult broodstock use.

Return year	Number of fish	Broodstock use
2011 & 2012	200	Seed odd year captive broodstock and odd/even supplementation programs
2013 & 2014	Up to 200	Seed odd year captive broodstock and odd/even supplementation programs
2015 & 2017	500	Seed last brood year of odd year captive broodstock program, and support odd year supplementation program
2019 & 2021	3,000	Support odd year supplementation program

Table 6-9 Juvenile fish production locations and use.

Brood year	Production location	Broodstock use
2011	Manchester Field Station	1,000 to 2,000 (captive brood)
	Lower Elwha Hatchery	158,000 (supplementation)
2013	Manchester Field Station	1,000 to 2,000 (captive brood)
	Lower Elwha Hatchery	958,000 (supplementation)
2015 & 2017	Manchester Field Station	1,000 to 2,000 (captive brood)
	Lower Elwha Hatchery	1,200,000 (supplementation)
2017, 2019 & 2021	Manchester Field Station	0 (captive brood)
	Lower Elwha Hatchery	3,000,000 (supplementation)

Observations. The HSRG notes that the rationale for the size of the program from a biological preservation point of view is not clearly identified in either the HGMP or Plan.

- ***Preservation phase***
  Identify rationale for the size of the program from a biological preservation point of view
- ***Recolonization Phase***
  Identify rationale for the size of the program from a biological preservation point of view
- ***Local Adaptation Phase***
  Identify rationale for the size of the program from a biological preservation point of view
- ***Full Restoration Phase***
  No hatchery program

6.2.5 Recommendation 8: Manage harvest, hatchery broodstock, and natural spawning escapement to meet HSRG standards appropriate to the affected natural population's designation

Effectively managing harvest, hatchery broodstock and natural spawning escapement is essential to controlling genetic risks due to straying of hatchery adults. Unless the explicit purpose of the hatchery program is either preservation (gene banking) or recolonization, straying can result in fitness loss in natural populations. To limit these risks and meet conservation goals, the HSRG developed quantitative standards for the pHOS, the pNOB, and the PNI on an integrated population that results from the combination of pHOS and pNOB.

The designation of a population as Primary, Contributing or Stabilizing is, in part, a policy decision; however, for this analysis, the HSRG made assumptions based on the status of each population and manager's objectives. Standards recommended by the HSRG for broodstock management are as follows:

HSRG criteria for hatchery influence on Primary populations

- The pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS by at least a factor of two, corresponding to a PNI value of 0.67 or greater (with pNOB $\geq$10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Contributing populations

- The pHOS should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, the proportion of natural-origin adults in the broodstock should exceed pHOS, corresponding to a PNI value of 0.50 or greater (with pNOB ≥10%), and pHOS should be less than 0.30.

HSRG criteria for hatchery influence on Stabilizing populations

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for pHOS or PNI.

  In order to meet these standards, the number of hatchery fish on the spawning grounds must be monitored and controlled. Marking or tagging all hatchery fish so they are easily distinguished (in real time) from natural-origin fish is a basic requirement for selective harvest, as well as for monitoring and achieving desired levels of pHOS, pNOB and PNI.

The following applies to all phases:

Plan Description. No directed harvest is planned for pink salmon (LEKT 2011a, chapter 3.3). Hatchery production will be utilized during the dam removal period. The Plan (page 59) indicates that post dam removal, "*monitoring programs will provide critical information regarding recolonization rates and genetic makeup of Elwha pink salmon populations. Returning adults will be encouraged to spawn naturally throughout the Basin and captive brood fish will be used to supplement the population. Hatchery enhancement of pink salmon may be considered if populations are not responding*". Information on hatchery production at varying adult escapement levels is presented in Tables 18-20 in the Plan (page 60). Most hatchery fish will apparently only be thermally treated to create an otolith mark (LEKT 2011a page 50).

Observations. The HSRG notes that no direct information is presented to address items such as pHOS, pNOB and PNI. Mass marking of hatchery fish and some form of selective harvest is essential for broodstock and natural population management and to make optimal use of all hatchery fish.

6.2.6 Recommendation 9: Manage the harvest to achieve full use of hatchery-origin fish

Because salmon survival in any given year can vary by an order of magnitude, fisheries must be flexible enough to harvest highly variable numbers of hatchery salmon. In many cases, if fisheries are not managed to remove more hatchery salmon, hatchery programs need to be reduced or terminated to avoid adverse effects on natural populations.

To both increase harvest and minimize adverse biological effects on natural populations, the HSRG recommends that most fisheries be managed as selective fisheries, where marked hatchery fish are retained and unmarked fish are released with minimal mortality.

Plan Description. Elwha River pink salmon are proposed for artificial propagation for conservation purposes only, and no fisheries are intended to benefit from pink salmon adults produced through this program (LEKT 2011a, page 28). No directed harvest is planned for pink salmon for pre- and post- dam removal periods. The Plan (page 59) states that in a best-case scenario, where rebuilding occurs rapidly, limited fisheries designed to harvest Elwha River pink salmon may be implemented if escapement goals are met.

Observations. The HSRG notes that mass marking of hatchery fish and some form of selective harvest is essential for broodstock and natural population management and to make optimal use of all hatchery fish. Also, see Recommendation 8, above.

6.2.7 Recommendation 10: Ensure all hatchery programs have self-sustaining broodstocks

Use of local broodstock and in-Basin rearing promotes selection for traits favorable to survival in the local environment and improves homing fidelity, thereby reducing straying risks to other populations. In this context, the same biological principles used to manage wild populations should be used to manage hatchery populations.

Plan Description. The HGMP (Section 1.11.1) indicates that the annual number of pink salmon adults collected for use as broodstock will vary, as determined by: the phase of the program (preservation vs. restoration); captive broodstock survival and egg production levels; and, the abundance status of adult fish returns to the river (Table 1). Information presented at the Port Angeles meeting (L. Ward, LEKT, pers. comm. December 20, 2011) indicated that broodstock collection would occur at the Elwha River Weir located at RM 4.0 on the Elwha River; and through opportunistic seining, gillnetting, and hook and line capture in the Elwha River mainstem downstream of the weir location (RM 4.0) to the river mouth (RM 0). For at least the first two phases, adult fish used as broodstock will also be supplied through a captive broodstock program. Adult returns to the Lower Elwha Hatchery established through on-station releases of fed fry that are progeny of supplementation program-origin releases will be collected and spawned at the site. Collections and egg takes will be augmented by capture and transport of pink salmon from the Elwha River mainstem weir to meet annual production goals, if needed, after taking into account captive broodstock contributions.

Broodstock would also be developed for the odd-year run component through the captive broodstock rearing effort (LEKT 2011a, page 5). The HGMP (Section 7.5, page 41) indicates the captive broodstock component will be initiated with more juvenile fish than can be reared to adulthood (because of space constraints), to allow for expected mortality during rearing. An off-ramp schedule is provided where fish from the captive broodstock would be removed at different size thresholds (LEKT 2011a, pages 40-41). The HGMP states that "*All Pink salmon surviving to age-1 at the facility will be DNA-sampled to identify familial origin. If necessary DNA results will be used as the basis for the selection of fish that will be culled/removed from the captive brood population*".

Observations. The HSRG notes that implementation of these strategies would require that survival of hatchery fish is sufficient to return the broodstock needed to maintain the program over time. It also would require a high rate of broodstock capture at the hatchery rack and weir.

The HSRG also cautions that DNA sampling or similar measures should be used to identify fish to be removed from the captive broodstock at all life stages, including subyearlings. Risks include random culling, resulting in broodstock that are no longer representative of the parent population (as discussed by authors such as N. Ryman, L. Laikre, and R.S. Waples).

The following applies to Preservation, Recolonization, and Local Adaptation Phases:

- ***Preservation Phase***
  See Observations.

- ***Recolonization Phase***
  See Observations.

- ***Local Adaptation Phase***
  See Observations.

- ***Full Restoration Phase***
  No hatchery program.

6.2.8 Recommendation 11: Coordinate hatchery programs within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations

The following applies to Preservation, Recolonization, and Local Adaptation Phases:

Plan Description. The Plan indicates that five criteria are to be used for selecting fish stocks for artificial propagation: "*1) current population size, 2) genetic stock identification results, 3) phenotypic and life history traits, 4) run timing, and 5) accessibility of broodstock. Substantial uncertainty exists regarding the appropriate juvenile life history at release stage needed to meet fish restoration objectives. A fish release approach that includes a broad cross section of life history alternatives is proposed to address this uncertainty. This approach will be implemented in conjunction with careful monitoring to assess the relative contribution and survival of each alternative release type.*" This explanation suggests that the hatchery programs are to be coordinated. The HGMP (Section 3.1) presents information describing hatchery program relationships to management objectives. The HGMP (Section 3.5) suggests that all anadromous salmonid species could benefit from increased pink salmon productivity in the watershed as a result of increasing amounts of marine-derived nutrients dispersed by salmon carcasses after the fish spawn.

Observations. The HSRG notes that no information is presented in the Plan or the HGMP regarding coordination of pink salmon captive broodstock and supplementation programs with biological objectives for other programs. In particular, information would be useful on overall habitat carrying capacities and demographic effects.

- ***Full Restoration Phase***
  No hatchery program.

6.2.9 Recommendation 12: Assure that facilities are constructed and operated in compliance with environmental laws and regulations

Hatchery facilities include adult collection, spawning, incubation and rearing and release facilities as well as structures to remove and discharge water. These structures are usually located in riparian areas or within streams and can affect habitat quality and quantity, as well as the use of habitat by juvenile and adult fish. Hatchery structures can create obstacles to migration for juvenile and adult fish, change in stream flow, alter riparian habitat and diminish water quality through hatchery discharges. Water for hatchery use is often drawn from an adjacent stream via pumps or gravity. Improperly designed and maintained water intakes can impinge migrant or resident juveniles on hatchery screens or cause fish to be trapped in hatchery facilities. Structures such as adult weirs and water intake dams can also block natural passage of salmonids to spawning or rearing areas. Water diverted from adjacent streams for fish culture purposes is often returned downstream and can reduce the amount of water for juvenile rearing and upstream adult migration between the area of intake and discharge. Hatchery discharge can also diminish water quality below the point of discharge through changes in temperature, settle-able and suspended solids, chemical composition, and presence of therapeutic drugs.

The HSRG has noted that, for the most part, existing laws and regulations related to facilities and operations are adequate to protect the environment. If hatchery facilities and operations are not in compliance with environmental laws and regulations, the consequence could be loss of natural production. In addition, failure to comply with these requirements could lead to closure of facilities and the loss of any harvest or conservation benefit derived from the programs.

The following applies to Preservation, Recolonization and Local Adaptation Phases:

The HSRG is not aware of any issues related to environmental compliance of the LEKT Hatchery. We assume that all NPDES permits are in place and that the water treatment plant intake is safely screened. The HSRG notes a particular concern regarding implementation of the captive broodstock effort for pink salmon. This species is highly susceptible to disease during fingerling to adult culture phases, and a high level of biosecurity will be required for the captive broodstock program.

- ***Full Restoration Phase***
  No hatchery program.

6.2.10 Recommendation 13: Maximize survival of hatchery fish consistent with conservation goals

Maximizing the survival of hatchery fish enables conservation programs to accelerate their rebuilding efforts. It allows production hatcheries to reduce their ecological impacts on natural populations. Conservation hatcheries producing juveniles with high survival generate more spawners on the spawning grounds. This, in turn, accelerates the rate at which recovery programs move toward meeting their goals. Production programs may have to reduce release numbers to decrease negative ecological impacts on natural populations. Increasing post-release survival can offset this reduction and enable managers to meet their harvest goals.

There are many approaches to increasing fish survival. The release of fish at the appropriate time, size, age and location can significantly increase their recruitment to fisheries and natural escapement. Releasing rapidly migrating smolts rather than fry increases survival and reduces negative ecological interactions in the freshwater environment. Similarly, the release of healthy fish produces more fish for harvest and less opportunity to spread disease to natural populations. Improving water quality and reducing loading and density during rearing are also proven tools used by fish culturists to enhance fish survival. Adoption of volitional release (allowing smolts to outmigrate when they are ready, rather than "forcing" them out at a preset date) with removal of residuals (fish that do not outmigrate) may increase the long-term survival of released fish, while decreasing negative ecological interactions with natural populations. Proper acclimation and imprinting of hatchery juveniles can reduce straying and enhance survival to the desired location for their harvest or artificial spawning.

Developing and adopting these and other culture and release practices that maximize fish survival and minimize negative ecological interactions by reducing production release numbers, can aid conservation programs in rebuilding runs and reducing the conflict between harvest programs and conservation goals for natural populations.

The following applies to Preservation, Recolonization and Local Adaptation Phases:

To reduce potential harm to natural population through genetic and ecological interactions, the hatchery program should be no larger than necessary to meet the recolonization objectives. The HSRG notes that the higher the survival of hatchery fish, the smaller the program can be to produce the required number of adult offspring (see also Recommendation 11 above).

- ***Full Restoration Phase***

  Plan Description. No Hatchery Program.

  Observations. None.

6.2.11 Summary of Observations and Conclusions for Principle 2—Pink Salmon

Table 6-10 summarizes our findings regarding the consistency of the pink salmon component of the Plan with HSRG Principle 2 and specifically, with the seven recommendations that address scientific defensibility. Table 6-11 summarizes our observations and conclusions, by restoration phase.

Table 6-10 Principle 2: Are harvest and conservation goals for natural and hatchery populations clear, specific, quantifiable and developed within an "All H" context?

Recommendation 4: Is the purpose of the hatchery program defined (i.e., conservation, harvest or both)?	Yes
Recommendation 5: Are the scientific assumptions, under which a program contributes to meeting the stated goals, explicitly stated?	No
Recommendation 6: Has an integrated or segregated broodstock management strategy been selected, that is based on population goals and hatchery program purpose?	Apparently; but not identified as such
Recommendation 7: Is the size of hatchery programs based on population goals and as part of an "all H" strategy?	No
Recommendation 8: Are harvest, hatchery broodstock, and natural spawning escapement managed to meet HSRG standards appropriate to the affected natural population's designation?	No
Recommendation 9: As the harvest managed to achieve full use of hatchery-origin fish?	No
Recommendation 10: Do all hatchery programs have self-sustaining broodstocks?	Not currently
Recommendation 11: Are hatchery programs coordinated within the Elwha Basin and surrounding independent drainages to account for the effects of all hatchery programs on each natural population and each hatchery program on all natural populations?	Unclear
Recommendation 12: Are facilities constructed and operated in compliance with environmental laws and regulations?	Yes
Recommendation 13: Is survival of hatchery fish maximized consistent with conservation goals?	Unknown

Table 6-11 Observations and conclusions regarding Principle 2—scientific defensibility.

<u>All Phases</u>
All phases of the project appear generally consistent with Principle 2. Nonetheless, neither the Plan nor the HGMP clearly lay out the scientific rationale for the proposed actions. Northwest Science (Vol. 82, Special Issue, 2008) has a number of good articles on the Elwha that could be cited regarding aspects of scientific defensibility.

6.3 Summary of Observations, Conclusions and Recommendations for Pink Salmon

The table below summarizes our assessment of the consistency of the pink salmon component of the Elwha Plan with HSRG Principles 1 and 2. It also provides recommendations for improving consistency with these principles.

Table 6-12 Summary of observations, conclusions and recommendation for pink salmon.

<u>Observations and Conclusions</u> The HSRG has made the following assumptions regarding the biological significance for the populations: odd year = Primary; even year = Contributing. The purpose of the pink salmon program is Integrated Recovery, with a conservation focus that transitions to a no-hatchery alternative in the Full Restoration Phase. The initial goal of this program is to use supportive breeding to preserve the odd- and even- year pink salmon run components in the Elwha River. This includes a supplementation program for both odd- and even-year fish, and additionally a captive broodstock for the native odd-year stock. Over the term of this project, pink salmon adults produced through the program will not be the target of any fisheries, nor will returning adult fish lead to elevated harvest levels for other salmonid species, including listed salmon and steelhead.
<u>Benefits</u> • The use of the captive broodstock program will reduce the risk of losing the genetic resources during the Preservation Phase and Recolonization Phase when habitat conditions are unstable. • A major benefit of increasing pink salmon abundance will be enhanced marine-derived nutrients in the Elwha River ecosystem.
<u>Risks</u> • The primary risk of the program is that pink salmon can be highly susceptible to disease during fingerling to adult culture phases and, therefore, a plan to provide a high level of biosecurity should be described for the captive broodstock phase.
<u>Likelihood of meeting goals</u> • Without explicit, quantifiable goals based on the best available science, success cannot be well defined. • Without predefined, measurable performance indicators, we do not know what success “looks like” even with well-defined goals and it is unlikely that the managers will be able to meet the objectives of the stated adaptive management strategy. • Without a structured, information-driven decision-making process, it is not possible to determine whether the project is effectively navigating around risks toward goals.

Recommended modifications

- The scientific assumptions and rationale for captive broodstock and supplementation approaches should be provided, including those associated with program size. Information should be presented in the Plan or the HGMP regarding coordination of pink salmon captive broodstock and supplementation programs with biological objectives for other programs.
- Key assumptions for all aspects of the pink salmon program need to be stated and citations provided, including specifics for all hatchery and natural population actions. Northwest Science (Vol. 82, Special Issue, 2008) has a number of good articles on the Elwha that could be cited regarding aspects of scientific defensibility.
- Information should be provided to determine how standards and guidelines for a properly integrated population would be met (e.g., for pHOS, pNOB, PNI). Proper understanding and evaluation of population dynamics and a strong monitoring and evaluation component is critical for success of the program. The HSRG notes that mass marking of hatchery fish and some form of selective harvest is essential for broodstock and natural population management and to make optimal use of all hatchery fish.
- Key monitoring and evaluation methods to meet standards need to be described. Details and mechanisms should be provided for performance reviews to adaptively manage direction and operations of both hatchery programs and natural run components.

7 Principle 3: Monitoring, Evaluation and Adaptive Management

HSRG Principle 3 is to monitor, evaluate and adaptively manage hatchery programs in the context of conservation and harvest goals. The HSRG reviewed the Elwha Plan and accompanying HGMPs to evaluate their consistency with Principle 3 and with the four recommendations (Recommendations 14, 15, 16, and 17) that specifically support Principle 3. In this chapter, we discuss the basis for Principle 3 and the four recommendations as they apply to any hatchery programs, followed by specific findings and recommendations for strengthening the monitoring, evaluation, and adaptive management components of the Elwha Plan and HGMPs.

7.1 Basis for Principle 3

In addition to establishing resource goals (Principle 1) and a defensible scientific rationale for a hatchery program (Principle 2), the HSRG recommends that for any hatchery, the managers' decisions be informed and modified by continual evaluation of existing programs, changing circumstances and new scientific information. Systems affected by hatchery programs are dynamic and complex; therefore, uncertainty is unavoidable. The only thing certain is that the unexpected will occur. Therefore, managing hatchery programs is an ongoing and dynamic process.

To address uncertainties within a changing management environment, decision-making processes must include provisions and commitments to monitor the results of hatchery programs to determine when environmental conditions or scientific knowledge have changed. Climate change, ocean acidification, and the effects of human population growth on salmon and steelhead habitat are examples of the factors that must be taken into consideration in the future. Likewise, new findings from research and modeling will improve our understanding of the ecological and genetic impacts of hatchery programs and help to refine fish culture practices. Finally, variations in the performance of individual hatchery programs can alert managers to otherwise undetected problems. Recognizing these changes should lead directly to changes in hatchery operations.

Implementation of effective monitoring and evaluating plans requires substantial scientific oversight of hatchery operations, particularly in the areas of assessing genetic and ecological risks, in addition to monitoring fish health, growth, and growing conditions. The associated decision-making process must be explicitly structured to incorporate the results of key monitoring elements, directed research, innovation, and experimentation, and to document the logic of subsequent management decisions. With such a structure in place, hatchery programs can be modified, as needed, to ensure they make the greatest possible contribution to stated goals.

7.2 Principle 3 Assessment of the Elwha Plan and HGMPs

The Elwha Plan and HGMPs include commitments to monitoring, evaluation, and adaptive management, but lack a structured process for implementation. Although the monitoring and evaluation component of the Plan provides a high-level overview of recovery hypotheses, the HSRG concludes that the Plan lacks the necessary structure and detail to effectively support the adaptive decision-making process. The Plan currently lacks a description of a rigorous monitoring and evaluation program that is needed to implement decision rules that are informed by science (Principle 2) and to trigger necessary project adjustments. The monitoring roles of the different partners in recovery of the Elwha are not well defined. Finally, the Plan provides no evidence of funding to support a rigorous adaptive management program.

The HSRG recommends the Plan (and each HGMP) be expanded to include:

- a clear statement of explicit working hypotheses (Principle 2),
- predetermined decision rules or triggers for making key changes to the program,
- implementation of a focused and rigorous monitoring and evaluation program, and
- scheduled reviews (annual and periodic) of the results of the monitoring and evaluation program, as part of an adaptive management process.

7.2.1 Working Hypothesis

A working hypothesis, as used here, is a suite of assumptions used for the purpose of explaining the conditions under which a set of proposed actions will achieve their intended purpose. The assumptions must be consistent with current science and available data. A working hypothesis is temporary, in the sense that it will change as assumptions are modified based on research and/or monitoring. Assumptions are often expressed as null hypotheses for the purpose of study design and analysis.

7.2.2 Decision Rules and Triggers

Absent a set of predetermined decision rules and a structured monitoring and evaluation plan, the rate of recovery of natural populations may be slowed or jeopardized by undetected intrinsic and extrinsic factors including, for example, failure to minimize genetic and ecological impacts of the hatchery at different stages during recovery. Decision rules are also needed to identify priorities that the monitoring program must address to inform key decisions.

7.2.3 Monitoring and Evaluation Plan

The HSRG recommends that as an immediate first step, the partners in recovery develop a rigorous monitoring and evaluation plan. Such a plan should focus on 1) identifying ecological and population indicators that drive decisions and define management thresholds, 2) testing uncertainties about key assumptions that can be resolved and that affect decisions, and 3) collecting information on external factors that have a significant effect on desired outcomes (e.g., changes in critical habitat stressors, climate change predictions, etc.). Indicators should be chosen that are measureable, precise, specific, sensitive, technically feasible, and cost effective. The monitoring plan should meet NOAA guidelines for precision and accuracy (Crawford and Rumsey 2011). The plan should describe monitoring roles and responsibilities and the audiences for the monitoring data. Finally, adequate, sustainable funding for monitoring and evaluation must be secured at least through the first three phases of the project (preservation, recolonization, local adaptation).

7.2.4 Annual Review/Adaptive Management

The HSRG recommends that the monitoring plan be implemented as part of a structured annual adaptive management decision process. This process should specify roles and responsibilities, schedules, and data and information sharing and coordination. Appendix C presents examples of two approaches to incorporating annual review activities into overall adaptive management plans.

7.3 Recommendation 14: Regularly review goals and performance of hatchery programs in a transparent, regional, “all-H” context

7.3.1 Basis for Recommendation 14

For any hatchery, the HSRG recommends that managers’ decisions be informed and modified by regularly scheduled, annual, and periodic evaluations to incorporate new scientific information and comprehensively assess existing programs. The HSRG believes that hatcheries can be managed in a flexible and dynamic manner in response to changing environmental conditions, new data, and the changing economic value of the resource. Decisions about hatcheries must also be made in a broader, integrated context and hatchery solutions must meet the test of being better, in a benefit-risk sense, than alternative available means to meet similar goals. Results of monitoring and evaluation must be brought into the decision-making process in a clear and concise way, so needed changes can be implemented. This responsive process should be structured to allow for innovation and experimentation, so hatchery programs may incorporate new goals and concepts in fish culture practice.

As described above, for many programs, this approach will require a substantial increase in scientific oversight of hatchery operations, particularly in the areas of monitoring to assess genetic and ecological risks and benefits. Well-defined, responsive decision-making processes will need to be in place to accommodate new information and recommendations resulting from these hatchery reviews. These periodic reviews will help monitor and communicate benefits and risks over time, keep the region focused on hatchery reform implementation, and integrate hatchery reform with what is occurring in other management areas, such as harvest or habitat restoration and protection.

In general, the HSRG has concluded that certain information is critical to operating hatchery programs if they are to be integrated in an "all-H" context. This information includes accurate estimates of:

- annual contributions of hatchery fish to natural spawning escapement, which is essential before hatchery fish are released;
- annual or potentially in-season contributions from each hatchery program to fisheries; and
- annual natural-spawner abundance of populations, with the Primary populations having the highest priority for accurate, precise monitoring.

Increased tagging rates and improved sampling of fisheries and spawning escapement will be needed to assure sufficient accuracy in estimating contributions of specific hatchery programs to harvest and natural spawning.

7.3.2 Recommendation 14 Assessment of the Elwha Plan and HGMPs

This recommendation, together with Principle 2, implies that hatchery programs should be sized and operated consistent with best available science and according to the scientific method. Scientifically, this means the review process is based on a clearly stated, testable working hypothesis. The working hypothesis should explicitly state the assumptions under which the chosen hatchery strategy contributes to goals in a manner where benefits outweigh unintended harm.

The HSRG concludes the current plan lacks an explicit working hypothesis and notes that the authors cite scientific uncertainty as a reason for a less structured approach. For example, the Plan (page 86) states

> "…*it is important to provide an estimate or "recovery goal" for expectations of recovery rates and long-term abundance in order to evaluate the success of efforts used to facilitate recolonization following dam removal"*

but then later explains that:

> "*True productivity, escapement, and harvest goals will be developed at a later date, when specific information is available for the Elwha Basin. More importantly, initial goals for total*

production and rates of recovery will be updated as the recolonization process proceeds and information is gathered regarding the inherent productivity of the Elwha watershed."

The HSRG appreciates the Plan's acknowledgment of the scientific uncertainty in restoration and the desire to refine objectives and strategies using better information. However, the scientific process reduces uncertainty best by testing explicit hypotheses. For the Plan to have scientifically defensible adaptive management strategies, it needs to be based on testable, working hypotheses that are consistent with available knowledge and information and explicitly stated assumptions. These then lead to a monitoring plan and a set of decision rules that form the adaptive management framework.

The decision rules based on the working hypotheses can also help reduce uncertainty. Decision rules for strategies during each restoration phase and decision rules that trigger transition to a different phase or strategies are needed for each phase of the restoration project. These should be based on predetermined abundance thresholds for natural- and hatchery-origin returns to the Elwha River (e.g., per Table 1-2). Hatchery programs during each phase should be sized to return specified numbers of HORs that maximize the demographic, genetic, and ecological benefits and minimize the risks. These HOR targets should, in turn, be based on the best available estimates of productivity and capacity of the natural habitat.

In other words, for each phase of the restoration process, the distribution of returning NORs and HORs between natural spawning, hatchery brood, and surplus (harvest) should be determined by a set of decision rules. The monitoring program should be tailored to the decision rules to assure a high probability of making the right decision.

For each phase of the restoration project, the decision rules should specify a target program size and target pHOS and pNOB, as a function of the number of returning NORs and HORs each year. The basis for the rules should be a set of key assumptions about natural production and hatchery production. The uncertainty, sensitivity, and measurability of these key assumptions, in turn, inform the design of the monitoring plan along with population status monitoring (e.g., NOR and HOR abundance and distribution).

Uncertainty is also reduced and transparency is increased through regularly scheduled, annual, and periodic evaluations that can incorporate new scientific information and comprehensively evaluate existing programs. The annual adaptive management review process should be formalized, with a schedule, agenda, and objectives. The ultimate objective is an updated annual "all H" work plan, including the monitoring and evaluation component. Two different models for this review – one from the Cowlitz River and one from the Yakima River - are described in Appendix C. Although different in the details, they have four key common elements:

- They are regularly scheduled, annual parts of an overall adaptive management process.
- They review key monitoring results and new scientific information against hypotheses and decision rules.
- They are public, transparent processes.
- The results contribute to changes in the work plan.

7.4 Recommendation 15: Place a priority on research that develops solutions to potential problems and quantifies factors affecting relative reproductive success and long-term fitness of populations influenced by hatcheries

7.4.1 Basis for Recommendation 15

Hatcheries have demonstrated that they can successfully provide fish for harvest. Scientific uncertainty remains about the reproductive success of hatchery-origin fish in the wild. A growing body of research has shown that traditional hatchery practices produce adults that may exhibit lower reproductive success in nature than locally adapted natural fish. In addition, it appears that a number of natural populations continue to have low productivity and are at risk of going extinct.

Hatcheries have played a role in preserving some at-risk populations in the short term, but the longer-term effects are unknown. Hatcheries will continue to be used to preserve natural populations in the foreseeable future. Current research is focused on quantifying the relative reproductive success between hatchery- and natural-origin fish using traditional practices, but has not attempted to identify factors or test solutions to improve upon this performance.

The environmental phenotypic component (i.e., the reproductive success of first generation hatchery-origin fish) needs further investigation for different species and culture conditions. Also, long-term fitness loss as a function of the proportion of hatchery fish in natural spawning populations and the proportion of natural fish in the hatchery broodstock must be addressed, among other factors. Future research should be prioritized to identify factors that may be reducing fitness and reproductive success of hatchery fish and investigate whether changes to fish culture practices can overcome these problems.

7.4.2 Recommendation 15 Assessment of the Elwha Plan and HGMPs

The HSRG concludes that the Elwha Basin offers a unique opportunity to address fundamental questions about ecosystem restoration and the capacity of hatchery and wild fish to recolonize a watershed. The legacy of the populations that will have access to these areas is mixed, ranging from species that may have had many generations of fish culture to species that have only been cultured in more recent years. In addition, nearly all the populations of these species have been reduced to abundance levels that could have compromised genetic diversity. The removal of the dams in the Elwha Basin, however, opens up high-quality habitat for recolonization that does not exist in most other salmon reintroduction efforts.

- For the Elwha Basin, place a priority on research that addresses the unique opportunity to study the role of hatcheries in establishing natural populations that could inform other reintroduction efforts elsewhere. Although both research and monitoring rely on testable hypotheses, in this regard, research is different from monitoring, because research results have value and scope on a broader scale.
- To the extent that resources are limited and to assure local success, the Elwha project should place priority on monitoring over research.
- Monitoring programs, though different in scope from research, must be no less rigorous and must be designed to meet standards for precision and accuracy.

Some research questions could be addressed as part of the required monitoring and evaluation program. Managers should look for opportunities to integrate research questions with monitoring.

7.5 Recommendation 16: Design and operate hatcheries and hatchery programs with the flexibility to respond to changing conditions

7.5.1 Basis for Recommendation 16

Adaptive management is a structured, iterative process of optimal decision-making in the face of uncertainty, aimed at reducing uncertainty over time through systematic monitoring and evaluation. It will be important for hatchery managers to design and operate hatchery programs with the flexibility to respond to both new knowledge and changing conditions. This is likely to be increasingly important in light of changing climate conditions.

7.5.2 Recommendation 16 Assessment of the Elwha Plan and HGMPs

- *See Recommendation 14*
- Annual performance reviews will affect decisions and operations of hatchery programs; the expectation should be that there will be changes – maybe even annually.
    - Annual reviews should be species-specific and coordinated with all activities (all "Hs") related to restoration of the Elwha native fish species and ecosystem. Hatchery programs must be able to make adjustments on an annual time scale in response to new information.
    - Triggers based on annual returns of natural and hatchery adults will require immediate adjustments to hatchery programs. Change should be the rule, not the exception.

7.6 Recommendation 17: Discontinue or modify programs if risks outweigh the benefits

7.6.1 Basis for Recommendation 17

Scientific information in recent decades has shown that hatchery fish can pose significant risks to natural populations if managed improperly. In addition, recent ESA listings of salmon and steelhead have elevated conservation of viable natural populations to a management priority. Many of the hatchery programs designed to support a single harvest objective must be modified to also achieve conservation goals for natural populations. Both conservation and harvest goals can be achieved if resources are provided to modify these hatchery programs. Without these investments, programs will have to be reduced or discontinued, in order to achieve the conservation goals.

7.6.1 Recommendation 17 Assessment of the Elwha Plan and HGMPs

As passage to high-quality habitat becomes available and degraded habitat recovers, the negative genetic and ecological effects of hatchery fish become perhaps the greatest concerns for the successful restoration of sustainable, locally-adapted natural populations of salmon and steelhead. As fish become distributed throughout these areas and become self-sustaining, these negative effects will begin to outweigh any of the demographic benefits of hatchery releases that existed early in the recolonization phase. When this "tipping point" occurs, hatchery influence should be withdrawn and hatchery conservation programs terminated. Predetermined decision rules based on working hypotheses of how demographic and genetic risks and benefits occur should identify triggers for discontinuing hatchery programs for each species. Managers should review these triggers annually in light of the monitoring data gathered for them, and apply decision rules accordingly.

The transition between restoration phases could be dynamic. In particular, the status of the populations early in a phase could revert to the previous stage. For this reason, the HSRG recommends, in general, that any hatchery program involved in the Recolonization Phase be converted to a small safety net at the onset of the Local Adaptation Phase, and that those hatchery programs be terminated permanently when predetermined NOR abundance triggers for recovery are met.

Hatchery programs initiated after restoration objectives are met should adhere to HSRG standards for hatchery influence (i.e. pHOS and PNI constraints).

7.7 Consistency with Principle 3 – All Species

Table 7-1 summarizes our findings regarding the consistency of the monitoring, evaluation, and adaptive management aspects of the Elwha Plan and HGMPs with HSRG Principle 3, and specifically, with the four recommendations that address these issues.

Table 7-1 Principle 3: Will hatchery programs be monitored, evaluated and adaptively managed in the context of conservation and harvest goals?

Recommendation 14: Does the plan assure that goals and performance of hatchery programs will be reviewed regularly, in a transparent, regional, "all-H" context?	No
Recommendation 15: Is priority placed on research that develops solutions to potential problems and quantifies factors affecting relative reproductive success and long-term fitness of populations influenced by hatcheries?	Not clearly
Recommendation 16: Are hatcheries and hatchery programs designed and operated with the flexibility to respond to changing conditions?	Not clearly
Recommendation 17: Does the plan assure that programs will be discontinued or modified if risks outweigh the benefits?	Not clearly

7.8 Summary of Observations and Recommendations for Monitoring, Evaluation, and Adaptive Management

Table 7-2 provides a summary of the HSRG's observations regarding Principle 3. It also provides recommendations for modifications that would improve consistency of the Elwha Plan and HGMPs with Principle 3.

Table 7-2 Summary of observations and recommendations for Principle 3.

Observations: The plan lacks a structured adaptive management process The plan lacks a complete, decision-focused monitoring and evaluation plan Recommended modifications: • Incorporate a description of an adaptive management structure in the plan and/or the HGMP for each species. • Design and describe a detailed monitoring and evaluation program in the plan and/or the HGMP for each species.

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Appendix A

Nutrification

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Appendix A. Nutrification

Prior to construction of the Elwha and Glines Canyon dams, Pacific salmon and steelhead contributed significant amounts of marine-derived carbon, nitrogen and phosphorous to the Elwha River Basin ecosystem and served as the primary method of nutrient transport. The watershed has now been without naturally spawning salmonids since the early 1900s, and the freshwater environment should be considered nutrient-poor. To compensate for this nutrient deficit and resulting lowered stream productivity, the HSRG recommends the Co-managers design and conduct an artificial nutrient enhancement program. Due to the limited number of hatchery carcasses that will be available and limited vehicle access into the upper watershed, carcass analogs should be used, in addition to hatchery carcasses.

The most appropriate locations for nutrient enhancement and the specific amounts of artificial nutrient enhancement needed during each restoration phase will vary, depending on juvenile rearing locations and numbers of naturally spawned carcasses.. The HSRG recommends the Co-managers refer to comprehensive protocols, guidelines and minimum application rates for artificial nutrient enhancement that are available through Ashley and Stockner (2003), Michael (2004) and Wipfli et al. (2003).

The literature implies that artificial nutrient enhancement can be of great benefit in raising the level of nutrients in freshwater systems and improving survival of salmonids. However, like other hypotheses underlying the Elwha restoration program, a well-designed monitoring and evaluation plan is needed to determine whether the intended goals are being met. References and greater detail regarding monitoring and evaluation plans can be found in the Columbia River Hatchery Reform System-Wide Report, Appendix A, White Paper No. 6 (HSRG 2009).

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Appendix B

Live-Capture Selective Fishing Gears

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Appendix B. Live-Capture Selective Fishing Gears

INTRODUCTION

Selective fishing gears allow the live capture of salmon and steelhead. Live-capture gears allow fishermen to keep the targeted fish for harvest while releasing non-target fish largely unharmed. The non-targeted fish can be species not intended for harvest or natural-origin (NOR) fish of the target species (unmarked). Selective salmon fisheries can increase harvest of available hatchery-origin (HOR) salmon (marked) while protecting the NOR salmon for priority use as hatchery broodstock or natural escapement. Selective fisheries can allow greater harvest of targeted fish when they are inter-mixed with non-target species. This allows fisheries to occur when they otherwise might not due to constraints on the take of the non-targeted fish. Fishing seasons can be expanded and catch increased by deploying selective rather than non-selective gears.

Critical metrics for selective fisheries are the catch efficiency of the gear for the targeted fish and the release mortality of non-targeted fish. Other important considerations include the costs of the gears (capital and operating costs), fisherman safety while using the gear, and consistency with cultural practices. The best selective gears are ones that passively trap or capture the fish. Such passive capture reduces stress and injury, thereby promoting release survival of the non-targeted fish. Selective salmon and steelhead fishing can be limited to only marked HOR fish or include harvest of unmarked, NOR fish, to the extent the productivity and abundance of the wild population support harvest.

Successful selective fisheries can accelerate recovery and sustainability of natural populations while allowing priority harvest, such as tribal treaty fisheries. Selective fishing gears can be fished by individual fishermen, a team of fishermen, or communally, depending on fishing objectives and gear type.

ELWHA RIVER

During restoration of the Elwha River ecosystem and recovery of its salmon and steelhead populations, selective fishing could provide a vital role in achieving the Co-managers' dual goals of anadromous fish conservation and harvest.

Broodstock Collection

Live-capture, selective fishing gears can be used to collect broodstock for the various hatchery programs during the earlier management phases: Preservation, Recolonization, and Local Adaptation. HOR fish can be collected to the extent sufficient broodstock cannot be obtained from volunteers into the hatchery facilities or from the Elwha weir. During the Local Adaptation Phase, the selective fishing gears can be used to collect NOR fish for broodstocks to help meet any pNOB and PNI objectives for that species' safety net hatchery program and natural population. Use of such gears can provide added certainty that sufficient broodstock will be collected. Also, broodstock collection in the course of tribal fishing can be an added income for the fishermen, if such collection is more cost-effective than other means.

Protecting Natural-Origin Fish

During the recolonization and local adaptation phases, recovery of the salmon and steelhead populations will depend on the production and subsequent protection of the NOR adults. Production of NORs will be the primary driver of the pace and ultimate success of the Elwha River recovery. As fishing moratoriums expire, use of selective fishing gears can provide for priority harvest on HORs while not impeding the success towards conservation goals. Experience in selective fishing gained during these earlier recovery phases may allow continuation of some hatchery programs, if needed, into the Full Restoration Phase to provide more certain (stable) treaty fisheries compatibly with self-sustaining, wild populations.

Fully Utilizing Hatchery Origin Fish

During the Local Adaptation Phase, needs to protect NORs will limit any non-selective fisheries. In most years, such fishery limitations may result in underutilization of the available HORs. Selective fisheries can be implemented at greater intensities than non-selective fisheries, thereby allowing greater harvest of the HORs. Figure B-1 displays the increased harvest possible using selective fishing compared to non-selective fishing.

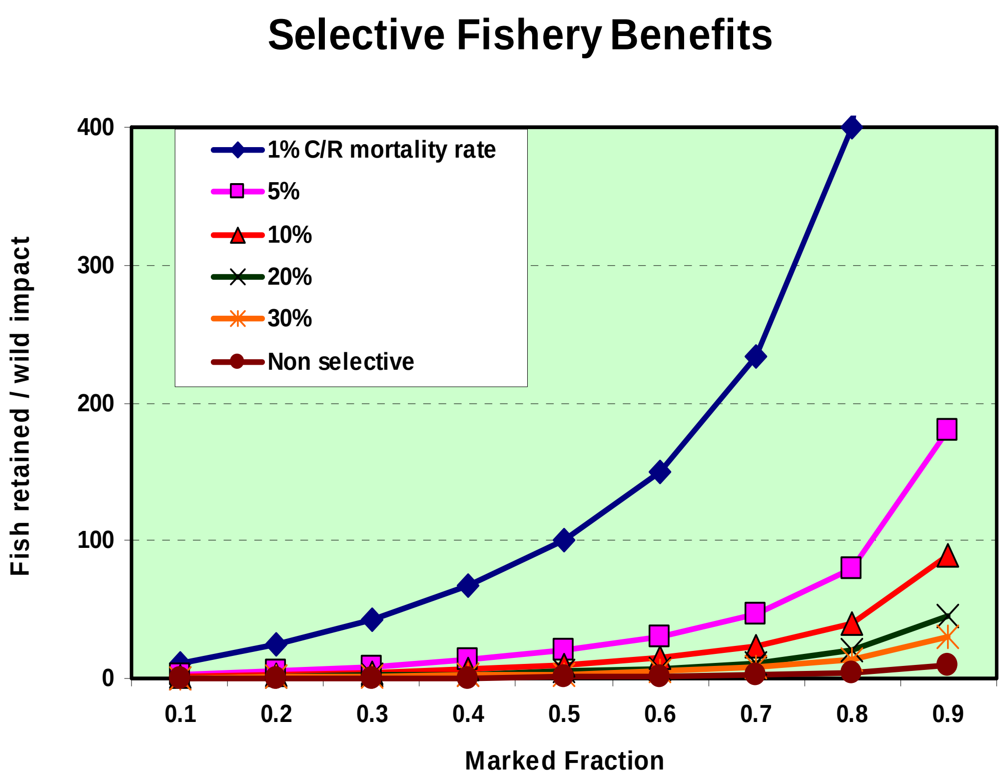

Figure B-1 Effects of 1) catch and release mortality and 2) proportion of marked hatchery fish in a salmon run to 3) hatchery fish harvest per wild fish mortality.

Managing for pHOS:

During the Local Adaptation Phase, limiting the proportion of HORs in the naturally spawning population will be critical to the ability of the various salmon and steelhead populations to readapt to their restored habitats, restore full life history diversity, and achieve intrinsic productivity levels. Use of selective fisheries is one important tool, along with properly sizing the hatchery programs, and use of the Elwha weir, to increase the likelihood and certainty that pHOS and PNI objectives can be met or exceeded.

Selective fisheries, where fishermen are reducing the escapement of HORs while exercising treaty rights, could be a cost-effective means to manage pHOS with fewer requirements on state and federal agency or tribal budgets to operate the weir or collect excess HORs from the spawning grounds.

Full Restoration Phase (Contingency)

Presently, hatchery programs are not planned during this phase; all terminal fisheries will be targeting natural-origin salmon and steelhead. In this case, use of selective gears in the fisheries will not be necessary. However, should the productivity of the self-sustaining natural populations later be determined to be insufficient to also meet tribal fishing needs, effective selective fisheries on a properly sized hatchery program could be an option that is consistent with maintaining self-sustaining and viable natural populations.

Elwha Weir

The weir can be used as an effective selective fishing gear with benefits as stated above. As a fishing device, a weir can provide an effective communal fishery, but, the need and benefits (as described above) cannot be achieved for all species with the current weir. To provide selective harvest, broodstock collection and pHOS management for all species, the current weir would require significant upgrades or total reconstruction to operate effectively over a greater range of flows and with increased runs of salmon and steelhead. Such modification or reconstruction would be expensive, very risky until bedload transport stabilizes, and could create problems during species migration.

Monitoring and Evaluation (M&E)

Effective selective fishing gears deployed, particularly in the lower river, offer an important M&E tool. Gears can be used to:

1) Provide an early estimate of run strength,
2) Provide information on run composition (species and hatchery vs. wild fish),
3) Collect biological data on returning adults, including tag interrogation,
4) Allow marking of adult fish for M&E purposes.

Design, Evaluation and Deployment:

Design and testing of one to three gear types could begin during the Preservation and Recolonization phases. Use of selective fishing gears would be most important in the Local Adaptation Phase or once the harvest moratorium expires to facilitate the conservation and harvest goals.

GEAR TYPES

Selective fishing gear evaluations are occurring at several locations in the Pacific Northwest and Canada. Based on the experience of Canadian First Nations, states, and the Colville Tribes, Co-managers on the Elwha River might consider:

1) Beach seines (lower river)
2) Pound nets (lower river)
3) Colville Floating Fish Trap (modified Alaskan trap) (lower river)

4) Fish Wheels (mid river)

5) Elwha Weir

6) Platforms with hoop and dip nets (mid river and tributaries)

7) "Miniature" Purse Seine (lower river)

The Colville Tribes have been demonstrating success with the use of a small purse seiner and beach seines both in catch efficiency and particularly low direct release mortalities (near 0%) on non-target fish. The Tribes are currently designing and preparing to test a floating fish trap design for passive capture of Chinook and sockeye salmon and steelhead in the Okanogan and Columbia rivers. In 2012, the Colville Tribes will also start testing selective net gears fished from platforms by individual fishermen. Oregon and Washington are showing similar successes with beach seines and small purse seines in the lower Columbia River.

Several of the gear types listed above are shown in figures B-2 through B-5. References on these gear types and other fishing trials can be provided upon request.

Figure B-2 Model of a Columbia River pound net trap.

Figure B-3 Beach seine testing on the Okanogan River – Colville Tribes.

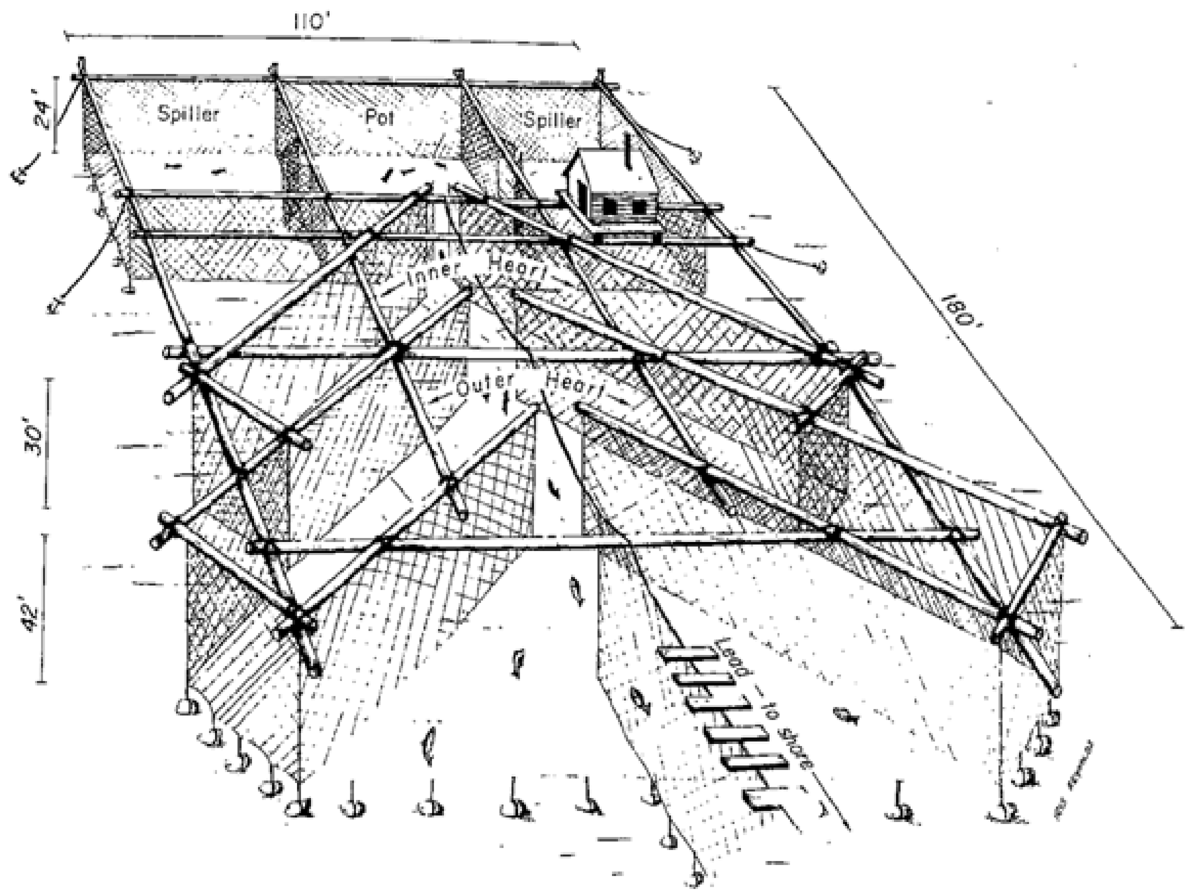

Figure B-4 Alaskan floating fish trap design.

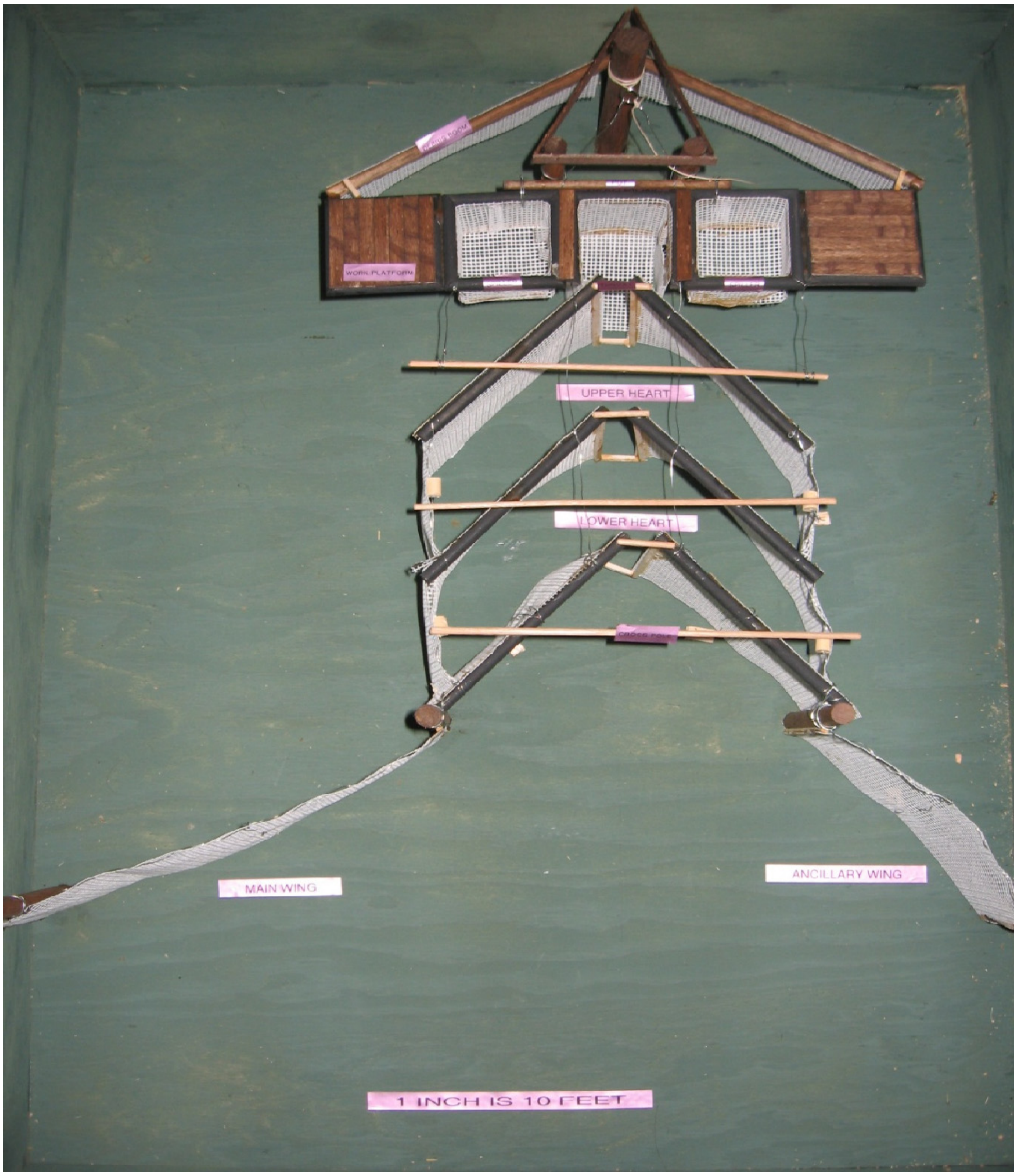

Figure B-5. Model of proposed Colville floating fish trap (modified Alaskan trap).

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Appendix C

Examples of Annual Project Reviews

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Appendix C. Examples of Annual Project Reviews

Regular program review is a key element of any adaptive management process. Reviews must be regularly scheduled, and may include both annual and periodic evaluations to allow for incorporation of new scientific information and comprehensive evaluation of existing programs. The ultimate objective is an updated annual "all H" work plan, including the monitoring and evaluation component. Below are two different models – one from the Cowlitz River and one from the Yakima River – that provide examples of this process. Although different in their details, they have four common elements:

- The reviews are regularly scheduled, annual parts of an overall adaptive management process
- The reviews address key monitoring results and new scientific information against hypotheses and decision rules
- They are public, transparent processes
- The results contribute to changes in the work plan.

Excerpt from Cowlitz River Fisheries and Hatchery Management Plan (FHMP 2011)

2 Adaptive Management and Science Framework

Section 2.1 describes the process whereby an annual, scientifically defensible work plan is established that is consistent with the SA and that meets resource goals (Section 2.2). The science framework consists of a set of key assumptions that defines the working hypothesis (Section 2.3), status and trend information that shows progress toward goals (Section 2.4), and a set of decision rules that prescribes the appropriate action, given the goals, the key assumptions, and the forecast for the coming season (Section 2.5).

2.1 Annual Decision Making Process (Adaptive Management)

The purpose of the annual decision process described in this document is to produce an annual action plan that assures progress toward the long-term goals for harvest and recovery of indigenous populations (Section 2.1). The action plan incorporates monitoring and evaluation (M&E) components, which are then fed back into the decision process to complete the adaptive management loop, assuring that the most recent information is used to guide decisions. The annual decision process also provides an important opportunity to inform and engage the public.

The process has four steps: 1) establish and document a scientifically defensible working hypothesis (key assumptions); 2) report and review most recent empirical data on key population metrics (status and trends); 3) establish biological targets and management triggers to assure appropriate response to annual variation in population abundance (Decision Rules); and 4) update the natural escapement, hatchery broodstock, and terminal harvest targets and M&E priorities for the coming season (Action Plan). This process is illustrated in Figure 2-1.

The opportunities to make progress will vary from year to year depending on status and trends in population abundance and productivity and forecasts for the coming season. Other unforeseen events and circumstances may also warrant in-season management responses.

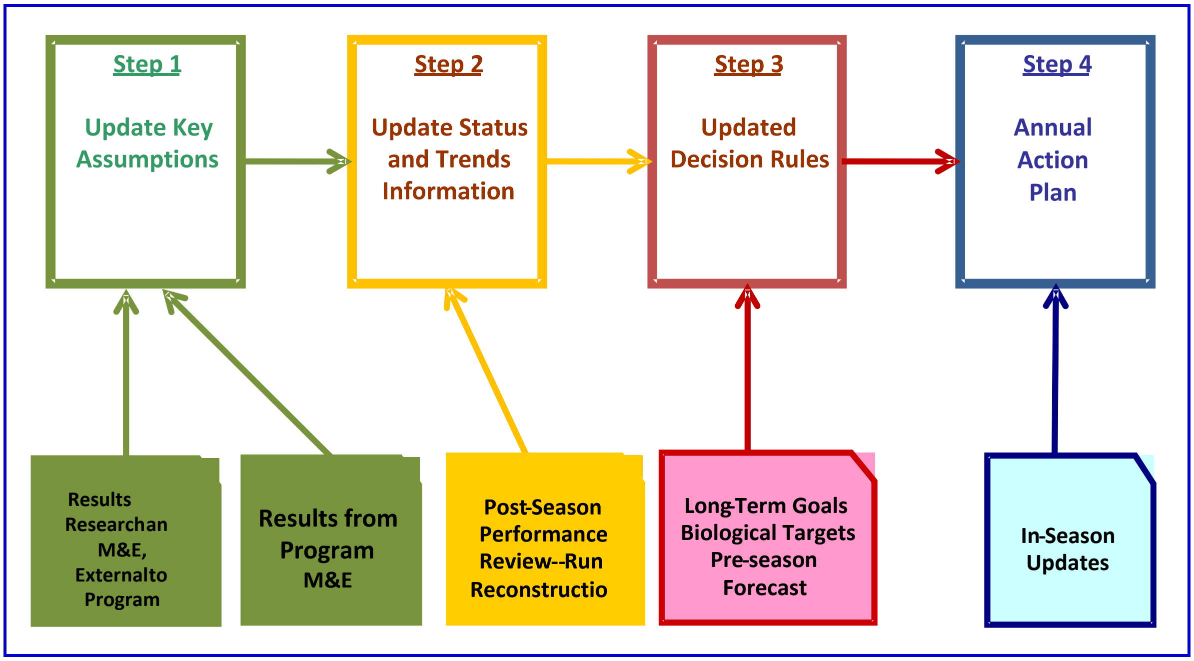

Figure 2-1. Components of the annual decision/adaptive management process.

2.1.1 Process

The annual decision making process centers around a pre-season workshop, held under the FTC auspices, where status and trends, key assumptions, and previously agreed upon decision rules are reviewed and translated into an Annual Action Plan (Section 3). Prior to this workshop, Washington Department of Fish and Wildlife (WDFW) and Tacoma Power will update key assumptions and status and trends based on monitoring results from the most recent season. That information is captured in the In-Season Implementation Tool (ISIT), a database and calculator described in Appendix I. Decision rules will be reviewed each year, but are expected to change less frequently. Barring extraordinary circumstances, the decision rules should only be updated every 6 years, as the FHMP is updated. In other words, decisions will change each year due to new information, but the rules for making those decisions should remain the same. The decision rules are described below for each Cowlitz population in Section 3.

The agenda for the pre-season workshop is driven by the outline of the Status and Trends and Key Assumptions sections, where the new information brought in through the M&E program will be highlighted. The Status and Trends portion of the agenda will cover natural production (e.g., most recent spawning escapement abundance and composition), harvest, and hatchery production by species and hatchery program. The Key Assumptions part of the agenda will include, for each population: habitat and natural production parameters, smolt to adult survival parameters (e.g., most recent estimates of average fish passage survival at Cowlitz Falls, harvest parameters (e.g., pre-terminal exploitation rates), and hatchery production parameters (e.g., updated in-hatchery survival projections).

2.1.2 Roles and Responsibilities

The process described here is not intended to in any way alter the legal and policy mandates and responsibilities of the management entities involved in the fishery management process in the Cowlitz

Basin. Instead it is meant to provide a structure within which those responsibilities can be carried out in a manner that is consistent with the SA. The role of the FTC will be to review information brought forward at the annual workshop, apply decision rules and approve the action plan for the coming year. The FTC may also convene to review progress during the year at selected milestones identified in the annual work plan. In agreeing to this FHMP Update, Tacoma Power and the managers (WDFW and NOAA) commit to provide the data and information required to complete the action plan at the end of the workshop.

The FTC will conduct an annual meeting/workshop to inform the public about this process, results to date and identify the most effective way for the public to stay informed.

2.1.3 Annual Work Products

End products of the workshop, which will be held in March of each year, will be an updated version of the status and trends, key assumptions, and previously agreed upon decision rules. This will be followed by a meeting in April to allow the FTC to finalize the recommended Action Plan in Section 3, and status reports on the five FHMP topics identified in Section 6 of the SA (quantity and size of the fish to be produced, rearing and release strategies for each stock, credit mechanisms, and monitoring and evaluation and a fisheries management strategy). The Annual Action Plan is the blueprint for actions related to the FHMP Update for the coming year. All work products produced as part of the annual review process, including the Action Plan, will be included in a comprehensive annual report. "

Description of Yakima/Klickitat Fisheries Project Review Process

The Yakima/Klickitat Fisheries Project (YKFP) annual review process has two annual review components:

Internal Project Annual Review

The internal project annual review occurs in December. At this time, project scientists meet for two days to review all projects. Principal investigators present updates of results for the previous year, problems encountered in past year, potential solutions or new venues to reduce risk from problems, and monitoring concerns. The annual review provides an opportunity for discussion with the entire YKFP scientific community. The YKFP has Monitoring Implementation Planning Teams (MIPTs) set up for each species, with a designated team leader. Teams are not limited to staff directly involved in YKFP, but also include biologists from around the region who have some level of expertise on a particular species. These teams report to the Scientific Technical Advisory Committee, which is comprised of one member from the Washington Department of Fish and Wildlife and one member from the Yakama Nation. They make recommendations to the Policy Committee, which makes the final decision as to what to do with developing situations or changes in programs. A decision document is written up, listing the issue, proposed solutions and supporting documentation, so that there is a record of how changes to initial program were made.

The Yakima Basin Science and Management Conference

The Yakima Basin Science and Management Conference is held at Central Washington University in June of each year to present the status of progress for all species under the YKFP. Reports on the status of habitat programs are also presented at the conference. This is the "public" arm of the YKFP, and all members of the public and user groups are invited to attend. The progress of other Yakima Basin programs not under the YKFP is also presented at this two-day conference to capture the breadth of ongoing programs in the Basin, including those being implemented by the Bureau of Reclamation, conservation groups, the irrigation community, and others.

All YKFP research is also posted on the YKFP website (www.YKFP.org) to allow for open access and transparent communication with the public. Publications (peer reviewed) and reports to BPA are available from this web site.

Review of the Elwha River Fish Restoration Plan and Accompanying HGMPs

Prepared for:

Lower Elwha Klallam Tribe

Washington Department of Fish and Wildlife

Prepared by:

Hatchery Scientific Review Group

Pacific Salmon Hatchery Reform

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With Support from:

Washington Department of Fish and Wildlife
Washington State Recreation and Conservation Office
U.S. Congress

Cover photo of fish by Mary Edwards Photography, Joseph, Oregon
Cover photo of Elwha Dam before removal from U.S. Geological Survey (http://soundwaves.usgs.gov/2006/11/fieldwork3.html)

APPENDIX B

Hatchery Scientific Review Group
Pacific Salmon Hatchery Reform
www.hatcheryreform.us

HSRG - Washington
Andy Appleby, Co-Chair
Dr. Peter Paquet, Co-Chair
Lee Blankenship, Vice-Chair
Heather Bartlett
Dr. Don Campton
Dr. Ken Currens
Dr. Trevor Evelyn
Dr. Dave Fast
Tom Flagg
Dr. Conrad Mahnken
Dr. Lars Mobrand
Dr. Lisa Seeb
Stephen Smith

July 27, 2012

Mr. Jon Anderson
Washington Department of Fish and Wildlife
600 Capitol Way North
Olympia, WA, 98501

Subject: Review of the Draft Elwha Summer/Fall Chinook Hatchery and Genetic Management Plan (HGMP)

Dear Mr. Anderson,

The HSRG has reviewed the updated draft Elwha Summer/Fall Chinook HGMP dated June 4, 2012 and is providing the following general and specific comments.

General Comments:

The restoration of the Elwha River has to date consumed many millions of dollars and many years of work by hundreds of people, but much is left to do. Hatchery and Genetic Management Plans are designed to provide critical direction to hatchery operations and overall fisheries management and should be an aid in the successful restoration of the Elwha River. The success of the investments in Elwha River restoration will depend not only on dam removals and habitat restoration but also on complementary fisheries management.

The HSRG is pleased to see the adoption of four biologically based phases of restoration compared to the three temporally based phases described in the original HGMP. The HSRG is also pleased to see adoption of HSRG standards for operating the hatchery program for a "Primary" population during the "local adaption" phase and beyond. In addition, the development, at least conceptually, of biological triggers based on Viable Salmonid Population criteria for determining when to transition between the four biological phases also improves the HGMP.

The HSRG did find the current draft lacking in two important areas noted below. In general, the lack of specificity prevented a more detailed review. The HSRG would have preferred to see a more detailed and aggressive experimental approach towards re-colonization and conservation. For example, while the HSRG was pleased to see that all juvenile releases were to occur at the hatchery to minimize negative ecological interactions, it was disappointed to see that the transporting of adults into the upper watershed was not being prioritized.

Specific Comments:

1. Draft Elwha Monitoring and Adaptive Management Plan-Example Performance and Trigger table, p. 43):

The key biological triggers must be worded clearly within a decision tree structure and adopted as management standards that can be adjusted via adaptive management based on results from a sound biological monitoring and evaluation program. These critical decision rules and triggers should be firm and not presented as "examples". The HGMP would be improved if the biological rationale were also provided that describes how the triggers were developed. The HSRG cannot provide comments on the triggers themselves without knowing the biological rationale behind them.

   a. Triggers should be included within carefully worded decision rules as to when the management moves from one biological phase to another.
   b. The decision to move from the Preservation to Recolonization Phase should be based on removal of barriers and most of the sediment load, ***and evidence*** of natural production. Triggers should not include productivity measures that indicate population sustainability that would not be expected during this Phase.
   c. The abundance and productivity triggers are too high to direct transition from the Recolonization to Local Adaptation Phase, (i.e., >5,000 adults spawning naturally (HOR+NOR) for four years before transition to the Local Adaptation Phase). Escapement to the river has not exceeded 5,000 adults from all sources (hatchery and wild) since 1990 when the hatchery program was much larger. One would not expect such levels of abundance and sustaining productivity until the Local Adaptation Phase or even the final Self-Sustaining Population Phase.
   d. Management actions in the Recolonization Phase will likely require more than just producing and releasing programmed numbers of juveniles from the hatchery. To improve distribution, abundance, and productivity sufficient to move the population into the Local Adaptation Phase will require flexibility in hatchery and fish management to allow improved pNOB and pHOS when possible. Otherwise, the population may remain in the Recolonization Phase.
   e. While the HGMP commits to a pHOS standard, it is not identified in the Performance and Trigger table and no pHOS objective is provided. In addition, there are no actions provided in the HGMP to actively manage for this standard (e.g., more terminal selective harvest, removal of hatchery fish at the weir, reduced hatchery production, etc.).

2. Marking plan for hatchery fish:

The two keys to successful local adaptation are 1) accurately identifying and 2) actively managing for hatchery-origin and natural-origin recruits in the hatchery broodstock and escapement to habitat. This requires first, a clear plan on marking. Section 10.7 details a history of the previous marks applied and the planned marking for the 2011 brood. This planned marking will not allow for non-lethal identification of returning adults by origin in the future, or the level of catch in northern fisheries. Both of these keys to successful adaptation were recommended by the HSRG during our recent review. Estimates of hatchery returns by non-lethal marking have not ever been possible and evidence of catch in northern fisheries not possible since the 1994 brood (Section 10.7). In addition, the proposed marking plan will not meet the standards described in the APR Performance Standards table (3.2.2) found in Section 1.10.2 of the draft HGMP. Application of marks/tags in the future to achieve these objectives is described in Section 1.16.2 as *"will be considered as the EMAMP becomes finalized and implemented."* (p. 11).

Finally, the HGMP does not make it clear exactly what marks will be applied to hatchery releases in the near future. Section 7.3 indicates both an otolith mark and a blank CWT will be applied to all sub-yearling and yearling smolts, while Section 10.7 indicates that sub-yearling smolts will receive only an otolith mark. The HSRG recommends a non-lethal identification method for all hatchery releases to commence with ensuing brood years.

3. The fourth phase of restoration is called two different things: "Self-sustaining exploitable populations" (p. 4) and "Full restoration" (p. 5, 6). We infer that the two names mean the same thing, but there should consistency for clarity.

4. Why are yearling fish going to be released, as opposed to releasing sub-yearlings only (p. 8)? Based on data presented (p. 9), there does not appear to be any survival/return advantage for yearlings versus sub-yearlings, but we assume releasing fish as yearlings increases disease risks and feed and maintenance costs.

We hope you find this information helpful.

Sincerely,

Peter Paquet Ph.D.
HSRG Co-Chair

Andy Appleby
HSRG Co-Chair

CC: Ron Warren, Region 6 Fish Program Manager, WDFW
Heather Bartlett, Hatchery Division Manager, WDFW
Mike Grossmann, Senior Counsel, Washington State Office of Attorney General
Doug Morrill, Natural Resource Director, Lower Elwha Klallam Tribe
Steve Suagee, General Counsel, Lower Elwha Klallam Tribe
Brian Winter, National Park Service
Ken Berg, USFWS
Will Stelle, NMFS
Congressman Norm Dicks

TD39748

APPENDIX C

HONORABLE BENJAMIN H. SETTLE

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT TACOMA

WILD FISH CONSERVANCY, *et al.*, Plaintiffs, v. NATIONAL PARK SERVICE, *et al.*, Defendants,	)))))))))	No. 3:12-CV-05109-BHS FIRST DECLARATION OF JAMES A. LICHATOWICH

I, James A. Lichatowich, declare the following to which I am competent to testify under penalty of perjury of the laws of the United States:

1. My current address is 36343 Miloris Way, Columbia City, Oregon 97018. I have been retained by Plaintiffs to provide expert opinion testimony on salmon management and recovery in this matter. This declaration supports the Plaintiffs' First Motion for Partial Summary Judgment and Plaintiffs' First Motion for Preliminary Injunction;

SMITH & LOWNEY, P.L.L.C.
2317 EAST JOHN STREET
SEATTLE, WASHINGTON 98112
(206) 860-2883

PROFESSIONAL QUALIFICATIONS

2. I have 42 years of professional experience with salmon and steelhead research and management. I held positions with the Oregon Department of Fish and Wildlife during the first half of my career, and I have worked as a fishery consultant during the second half;

3. I received Bachelor of Science (B.S.) and Master of Science (M.S.) degrees in Fishery Science from Oregon State University in 1969 and 1970, respectively;

4. I worked for the Oregon Department of Fish and Wildlife from 1973 to 1988. I held the position of Supervisor of the Fisheries Research Section from 1979 to 1983. I was the Assistant Chief of Fisheries from 1983 to 1988, where I was responsible for all fisheries management programs in the State's fresh water areas and for the development of statewide species management plans and river basin management plans;

5. Since leaving the Oregon Department of Fish and Wildlife, I served on ten independent science panels investigating several aspects of salmon management and recovery programs. The geographical area covered by these panels ranged from the Skeena River in British Columbia to the Sacramento River in California. Three of the panels were standing bodies;

6. I served for ten years, from 1991 to 2001, on the Independent Science Advisory Board ("ISAB") of the Northwest Power Planning Council, during which I was the Chairman from 1999 to 2001. The ISAB was established by NOAA Fisheries Service ("NMFS") and the Northwest Power and Conservation Counsel to provide independent scientific advice and recommendations on various aspects of the restoration of Columbia River salmonids;

7. I served from 1997 to 1999 on the Independent Scientific Review Group ("ISRP"). The ISRP is a panel of eleven scientists mandated by Congress and established by the

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Northwest Planning Council to provide scientific peer review for projects proposed to be funded through the Bonneville Power Administration's annual fish and wildlife budget;

8. From 1997 to 2002 I served on Oregon's Independent Multidisciplinary Scientific Team, which was established by the Oregon Legislature to provide independent scientific evaluation of the Oregon Plan for Salmon and Watersheds and its implementation;

9. I served as a special consultant to the Hatchery Scientific Review Group ("HSRG") for its evaluation of the Elwha River Fish Restoration Plan and associated Hatchery Genetic Management Plans ("HGMPs"), which was conducted in late-2011 and early 2012. The HSRG is a congressionally chartered independent scientific panel charged with evaluating hatchery programs and their impacts on wild salmonids;

10. I have received numerous awards and recognitions for my work in fishery science, including the 2002 Distinguished Graduate Award from Oregon State University's Department of Fisheries and Wildlife. I received Awards of Merit from the American Fisheries Society in 1977, 1992 and 2000, and have been named the Fishery Worker of the Year from the Oregon Chapter of the American Fisheries Society;

11. I have authored or co-authored numerous book chapters, papers and reports on the management and recovery of salmonids. I am the author of the book *Salmon without Rivers: A History of the Pacific Salmon Crisis*, which won the Washington Governor's Writers Award, has been translated into Russian, and is marketed as a university level text book. In writing this and other documents, I have studied extensively the history of the decline of Pacific salmonid populations, including the causes thereof;

12. Attached hereto as Exhibit 1 are my curriculum vitae, which include a list of all my peer reviewed publications;

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13. I have not provided expert testimony at trial or deposition during the last four years;

14. I am receiving no compensation for my work in preparing this declaration. My reasonable hourly rate is $150, and spent approximately 20 hours reviewing materials and preparing this declaration;

15. In addition to drawing upon my personal experience, I reviewed the following documents in developing my opinions expressed herein: the Elwha River Fish Restoration Plan (April 2008) ("Restoration Plan"), the HSRG's Review of the Elwha River Restoration Plan and Associated HGMPs (January 2012) ("HSGR Report"), the steelhead HGMP signed by Larry Ward and dated July 31, 2012 ("Steelhead HGMP"), NMFS' Biological Opinion on the reinitiation of consultation for the Elwha River and Fisheries Restoration Project dated July 2, 2012 ("2012 BiOp"), and the declarations of Jack Stanford and Gordon Luikart. From 1988 to 2000 I lived in Sequim, Washington and during that time I visited the Elwha River on several occasions. From 1988 to 1991 I worked for the Jamestown S'klallam Tribe in Sequim, Washington as a salmon biologist in the Timber Fish and Wildlife program. During that time I visited the Elwha River on a professional basis. Since 1988, I have spoken with individuals familiar with the Elwha River watershed and its salmonids, including Wild Fish Conservancy's Aquatic Ecologist Nick Gayeski. In addition, I am familiar with the weight of evidence on the consequences of hatchery operations to native salmon and steelhead populations that has been published in scientific papers;

SUMMARY OF OPINIONS

16. In summary, it is my professional opinion that the releases of native Elwha River winter-run steelhead as described in the Steelhead HGMP: (a) will harm and kill threatened

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Puget Sound Chinook, and threatened Puget Sound steelhead; and (b) will cause severe and long-term harm to the wild Elwha River winter-run steelhead population and its ability to fully recover. It is further my opinion that the scale of the program is not necessary to prevent the extirpation of the stock during the dam removal process;

HISTORICAL BACKGROUND ON THE ELWHA RIVER

17. To fully appreciate the current problems associated with the hatchery programs in the Elwha River, it is important to understand their historical context. When Thomas Aldwell constructed his dam across the Elwha River it was a violation of Washington State statutes that prohibited the building of barriers to salmon migration in rivers. However, there was one exception to the statute. A river's salmon could be blocked for the purpose of collecting fish for a hatchery. The Washington State Fish Commissioner, Leslie Darwin, found a way to make the dam legal. He said the dam could be considered a tool for collecting salmon for a hatchery that would be built below the dam. This twisted logic was the birth of a tragedy. It opened the door for the massive trade of salmon habitat destroyed by dams for hatcheries, a trade that was repeated over and over for the next 80 years. And it was all done before there was clear evidence that hatcheries could replace salmon-sustaining ecosystems. Today the dams on the Elwha River are being removed. The hatchery is not only remaining, but a new one has been constructed. This time the hatchery is being justified by the farcical notion that salmonids need the help of a hatchery to do what they have been doing for millions of years – recolonizing newly opened habitat. The hatchery program on the Elwha River is an example of the adage that history repeats itself first as tragedy then as farce;

18. When Leslie Darwin decided to trade a salmon-sustaining ecosystem for a hatchery he was following the advice of the first U. S. Fish Commissioner Spencer Baird, who

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introduced hatcheries to the Pacific Northwest. Baird said that the use of hatcheries would make salmon so abundant that there would be no need to regulate harvest or protect habitat. He drew that conclusion before there was even the most basic understanding of the salmon's biology and ecology or any evidence that hatcheries were successful in replacing natural production systems. It was a myth so imbued with faith that salmon managers avoided any critical evaluation of it. Today, with salmon extinct in forty percent of their natural range and many of the remaining populations protected by the federal Endangered Species Act (including the Chinook and winter steelhead in the Elwha River), it is clear that hatcheries failed to meet the expectations that justified their initial acceptance. In the late 1960s, fishery scientists began looking into the possibility that hatcheries not only failed to achieve their goals, but that they were contributing to the decline in the productivity of natural, salmon-sustaining ecosystems. The evidence has been accumulating and today the weight of that evidence is clear: hatcheries are part of the salmon's problem. The myth that hatcheries are the solution to the problem of the salmon's declining abundance is still strong and it is a formidable impediment to the incorporation of our current scientific understandings of the effects of hatcheries into salmon management and recovery programs. A situation clearly exemplified by the Elwha recovery program. (for a discussion of the failures to incorporate science see J. Lichatowich, and R. Williams. 2009. Failures to incorporate science into fishery management and recovery programs: Lessons from the Columbia River. Pages 1005 – 1019, in Krueger, C. and C. Zimmerman eds. Pacific salmon: Ecology and management of western Alaska's populations. American Fisheries Society Symposium 70. Bethesda, MD.);

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RISKS TO WILD FISH FROM HATCHERY OPERATIONS

19. I agree with the statements contained in the declarations of Jack Stanford and Gordon Luikart regarding the genetic, ecological, and pathogen risks and harms hatchery programs pose to wild salmonids;

COMMENTS ABOUT THE PROPOSED HATCHERY PROGRAMS IN GENERAL

20. The plan to use a hatchery to restore native winter steelhead in the Elwha River will impede the recovery of native Elwha River winter–run steelhead. The plan poses significant risks to the survival and fitness of wild Elwha River steelhead and Chinook salmon. These risks are magnified by a monitoring and evaluation plan that is not complete, peer reviewed or fully funded, which means that the problems described in the Stanford and Luikart declarations will not be detected in a timely manner and the appropriate corrective actions will not be taken;

21. In its review of the Restoration Plan, the HSRG recognized that the lack of an effective monitoring and evaluation program will jeopardize the successful recovery of native steelhead. The HSRG Report summarizes this concern as follows:

- Inadequate program monitoring may lead to management decisions that reduce or delay recovery, rather than promoting it, and prevent managers form identifying and testing alternatives that could be more effective.
- Inadequate monitoring may lead to poorly-informed management responses to external events and conditions (e.g., changing climate conditions) that affect program outcomes.
- Inadequate monitoring and evaluation represents a lost opportunity to gain knowledge that could lead to more effective restoration and long-term fisheries management in the Elwha Basin and elsewhere.

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The Steelhead HGMP mentions an Elwha River monitoring and adaptive management plan ("MAMP") that is being developed. Once the plan is developed, it needs to undergo peer review and then acquire the funding to implement it. With regard to the last step, the Restoration Plan admits that there is not enough funding to fully implement the necessary monitoring. Fully implementing the hatchery program for the native winter-run steelhead in the Elwha River before the monitoring and evaluation program is complete, peer reviewed and funded will most likely result in excessive take of winter-run steelhead that will cause irreparable harm to the wild steelhead population and will impede the recovery of this listed population of the Puget Sound Steelhead Distinct Population Segment, but just as troubling, the responsible officials will be ignorant of the cause of the lack of recovery and they will not be able to take the proper remedial steps;

22. NMFS has reinforced the importance of adequate monitoring and evaluation of hatchery programs by making an adequate and existing monitoring and evaluation program one of the criteria for approval of a HGMP. By putting off the development and implementation of a monitoring and evaluation program to some unspecified future date, the hatchery program for native winter-run steelhead in the Elwha River is proceeding under a proposed HGMP that does not meet the criteria for approval;

OPINIONS ON THE STEELHEAD HATCHERY PROGRAMS

23. The native Elwha River winter-run steelhead hatchery program began with a captive rearing program in 2005. Under this program, native Elwha River steelhead eggs and fry were collected and captured from the wild each year from 2005 through 2011. These fish are then reared to age 4 adults at the hatchery before being spawned. The resultant offspring are

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reared to age 2 smolts prior to release into the Elwha River. Releases under this program began in the spring of 2011 and are expected to last through 2017;

24. Starting this winter adult winter-run steelhead returning to the Elwha River will be captured for broodstock to support a supplementation program. A maximum of 500 adult steelhead are proposed to be captured each year for this purpose, including both hatchery-origin and wild ("natural-origin") adult steelhead;

25. An annual release of approximately 175,000 native Elwha River winter-run steelhead is targeted to occur between April and June. Such releases began in 2011 with a release of approximately 178,000 smolts;

26. I agree with the opinions expressed in the First Declaration of Gordon Luikart that the hatchery reared steelhead will most likely have reduced fitness and lower survival in the wild, and that the maladaptive genes will be spread to the wild steelhead population via interbreeding. Wild native Elwha River winter-run steelhead with such maladaptive genes will die without successfully spawning at greater rates than would otherwise occur. Therefore it is my opinion that each of these releases will harm wild native Elwha River winter-run steelhead through genetic interactions with released hatchery fish;

27. It is also my opinion that the large releases of hatchery steelhead smolts will harm and kill some juvenile wild native Elwha River winter-run steelhead and Chinook salmon through competition for food and space and predation in the lower Elwha River. The current wild Elwha River Chinook salmon population follows an "ocean-type" life history. Juveniles rear briefly in the river for a period of weeks or months and then migrate to the estuary as "fingerlings" about 3 inches long. As a result, juvenile wild Chinook salmon are particularly susceptible to displacement and mortality due to competition from large releases of hatchery fish,

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both of their own species and species like coho salmon and steelhead that are larger than Chinook salmon when they are released as smolts;

28. The first sentence in section 1.8 of the Steelhead HGMP states: "The program will be implemented pursuant to the Elwha River Fish Restoration Plan (ERFRP) (Ward et al. 2008) in order to restore steelhead to the Elwha River watershed following the removal of hydroelectric dams on the Elwha River." The Restoration Plan describes a large, prolonged hatchery program for steelhead that the HSRG analysis determined posed a risk to the recovery efforts. For example, data in Table 11, page 41 of the Restoration Plan suggest that the hatchery program will continue at a high level of production even when the number of natural spawning adult steelhead reaches 4,537 fish. This would impede the actual recovery for the genetic and ecological reasons explained in the declarations of Drs. Gordon Luikart and Jack Stanford. As those declarations explain in further detail, any legitimate short-term conservation concern for the Elwha winter steelhead can be achieved by a much smaller hatchery program of limited duration;

29. I agree with the opinion of Jack Stanford described in his declaration that the native steelhead artificial propagation program is not necessary to prevent the extirpation of the native Elwha River winter-run steelhead population from the dam removal process;

30. As explained above and in the First Declaration of Gordon Luikart, the hatchery program has a high probability of delaying and otherwise impairing the recolonization of the Elwha River by native steelhead. As soon as passage above Elwha Dam is provided, steelhead will begin to recolonize highly suitable tributary spawning and rearing habitat. This has already started to occur during the winter and spring of 2012. As explained in the Declaration of Dr. Jack Stanford, the levels of suspended sediment observed in 2012 and that are likely to occur are

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unlikely to be of a magnitude and duration as to threaten the existence of Elwha winter-run steelhead and Chinook salmon and other salmon. Tributaries between the two dams will be entirely unaffected by suspended sediments resulting from the removal of Glines Canyon Dam. Many of these tributaries contain high quality spawning and rearing habitat, and have already (in 2012) experienced spawning by wild steelhead. Wild steelhead are already showing that they can colonize habitats made accessible by the start of the removal of Elwha Dam. I therefore concur with the opinion expressed in the declaration by Dr. Stanford that the hatchery program described in the Steelhead HGMP is not necessary to prevent the extirpation of this stock from the effects of dam removal;

31. It is my opinion that the hatchery program described in the Steelhead HGMP should be immediately eliminated to prevent likely long term severe harm to the wild native Elwha River winter-run steelhead population and its ability to fully recovery. To the extent this hatchery program is not entirely eliminated, it is my opinion that it should be reduced in the manner suggested in the First Declaration of Gordon Luikart to minimize adverse impacts to the wild steelhead population. Such a program would continue to provide insurance against the loss of the wild population during dam removal;

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 13 day of November, 2012.

James Lichatowich

James Lichatowich

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EXHIBIT 1

Resume of

JAMES A. LICHATOWICH

PERSONAL DATA

Address:	P O Box 439, 36343 Miloris Way, Columbia City, OR 97018
Phone:	503/366-6959
Email:	jalich@comcast.net
Date of Birth:	May 10, 1941
Military Service:	U.S. Marine Corps, 1959-63

EDUCATION

M.S.	Oregon State University, Corvallis, Oregon - Fisheries Science	1970
B.S.	Oregon State University, Corvallis, Oregon - Fisheries Science	1969

PROFESSIONAL EXPERIENCE (partial)

Alder Fork Consulting, Private Consultant, Columbia City, OR, 1990 to present.

I have provided consulting services to: Oregon Business Council, State of Oregon, National Marine Fisheries Service, EcoTrust, Interrain Pacific, The Wilderness Society, Gordon and Betty Moore Foundation, Pacific Rivers Council, Native American Rights Fund, Jamestown S'Klallam Tribe, U. S. Forest Service-Quilcene Ranger District, Portland General Electric, PacifiCorp, Trout Unlimited, Tetra Tech/KCM, Inc., and California Bay-Delta Authority.

Five Independent Science Science Panels on various topics for the CalFed Bay-Delta program. Various times from 2004 to present.

Special Consultant for the Elwha River Fish Restoration Plan Review. December, 2011 to January 2012.

Co-Editor (with Dr. James Anderson) for species models prepared for the Delta Regional Ecosystem Restoration Implementation Plan. August 2007 to March 2010

Skeena Independent Scientific Review Panel, Panel member. January to May 2008.
The panel reviewed the management of salmon and steelhead in the Skeena River, British Columbia.

Independent Scientific Advisory Board (ISAB), Board Member (formerly Independent Scientific Group), Portland, OR, 1991 to 2001. Chairman 1999-2001.
ISAB is a panel of senior research scientists representing a broad range of disciplines. The ISAB provides an oversight function for the implementation of the Columbia River Fish and

Wildlife Plan. The ISAB provides scientific review of various aspects of the restoration of Columbia River salmon for the National Marine Fisheries Service and the Northwest Power Planning Council.

Independent Scientific Review Panel (ISRP), Panel Member, Portland, OR, March 1997 to 1999.

The ISRP is a panel of eleven scientists mandated by Congress and implemented by the Northwest Power Planning Council. The panel's purpose is to provide scientific peer review for project proposals submitted to the Northwest Power Planning Council.

Independent Multidisciplinary Scientific Team (IMST), Team Member, Salem, OR. November 1997 to 2002.

The IMST was established by the 1997 Oregon Legislature to provide an independent evaluation of the science that underlies the Oregon Plan for Salmon and Watersheds and to provide scientific peer review of the plan's implementation.

Timber, Fish and Wildlife Biologist, Jamestown S'Klallam Tribe, Sequim, WA, 1988 to 1991

My duties included review of timber harvest on federal, state, and private lands to ensure fishery habitat received adequate protection. I worked with Timber, Fish and Wildlife Committees at the technical and policy levels.

Assistant Chief of Fisheries, Oregon Department of Fish and Wildlife, Portland, OR, 1983 to 1988

Duties included the following:

(i) Budget Development and Control – I was responsible for the preparation of the division's biennial budget, presentation to the State of Oregon Executive Department, and testimony before the Legislative Ways and Means Committee. Total budget was $30,000,000 annually with 575 FTE.

(ii) Planning – I was responsible for the development of statewide species management plans. In addition, I was responsible for the preparation of management plans for Oregon's river basins. To accomplish the latter, public advisory groups were set up to encourage public involvement in the management of the state's fishery resource.

(iii) Fresh Water Fishery Management – I was responsible for all fisheries management programs in the state's fresh water areas.

Chief, Fisheries Research Section, Oregon Department of Fish and Wildlife, Corvallis, OR, 1979 to 1983

I supervised fisheries research programs within all the major river basins in the state. The projects ranged from genetics of salmonids, life history, management, environmental impact of dams, hatchery evaluation, and population dynamics. I reviewed all project proposals and reports for technical quality, assigned new project responsibilities, and served as chairman of the Research Advisory Committee. This committee approved all new fish research projects. Administered a staff of 55 permanent and 50 seasonal employees.

PEER REVIEWED PUBLICATIONS

Books and Book Chapters

Lichatowich, J. and R. Williams. 2009. Failures to incorporate science into fishery management and recovery programs: Lessons form the Columbia River. Pages 1005-1019 in C. Krueger and C Zimmerman, (eds.) *Pacific Salmon: Ecology and Management of Western Alaska's Populations.* American Fisheries Society, Symposium 70, Bethesda, MD.

Williams, R. and J. Lichatowich. 2009. Science and politics – and uncomfortable alliance: Lessons learned from the Fish and Wildlife Program of the Northwest Power Planning Council. Pages 1021-1046 in C. Krueger and C Zimmerman, (eds.) *Pacific Salmon: Ecology and Management of Western Alaska's Populations.* American Fisheries Society, Symposium 70, Bethesda, MD.

Williams, R. N. (ed.). 2006. *Return to the River: Restoring Salmon to the Columbia River.* Elsevier Academic Press, London. J. A. Lichatowich co-authored Chapters 1, 2, 3, 4, 8, 10, 12, 13. ISBN 13: 978-0-12-088414-8 and ISBN 10: 0-12-088414-3.

Lichatowich, J. A. 2004. *Salmon Without Rivers: A History of the Pacific Salmon Crisis.* Russian Translation. ISBN 5-7663-0441-2 paper copy.

Lichatowich, J. A. 1999. *Salmon without Rivers: A History of the Pacific Salmon Crisis.* Island Press, Washington, DC. ISBN 1-55963-360-3 hard copy, 1-55963-361-1 paper copy.

Lichatowich, J. A., G. R. Rahr III, S. M. Whidden, and C. R. Steward. 1999. Sanctuaries for Pacific Salmon. In E. E. Knutson, C. R. Steward, D. D. McDonald, D. W. Reiser and J. E. Williams (eds.) *Sustainable Fisheries Management: Balancing the Conservation and Use of Pacific Salmon,* Ann Arbor Press.

Lichatowich, J. A. 1997. Evaluating the performance of salmon management institutions: The importance of performance measures, temporal scales and production cycles. Pages 69-87 in D. J. Stouder, P. A. Bisson, and R. J. Naiman (eds.) *Pacific Salmon and Their Ecosystems*, Chapman and Hall, New York, NY.

Lichatowich, J. A. and J.D. McIntyre. 1987. Use of hatcheries in the management of Pacific anadromous salmon. Pages 131-136 in M.J. Dadswell, R.J. Klauda, C.M. Moffitt, R.L. Saunders, R..A. Rulifson, and J.E. Cooper (Eds.), *Common Strategies of Anadromous and Catadromous Fishes*. American Fisheries Society, Symposium I, Boston, MA, March 9-13, 1986.

Lichatowich, J. A. 1989. Habitat alteration and changes in abundance of coho (*Oncorhynchus kisutch*) and chinook (*O. tshawytscha*) salmon in Oregon's coastal streams. Pages 92-99 in C.D. Levings, L.B. Holtby, and M.A. Henederson, (Eds.), *Proceedings of the National Workshop on Effects of Habitat Alteration on Salmonid Stocks*. Canadian Special Publication of Fisheries and Aquatic Sciences 105, Ottawa, CAN.

Papers

Reeve, T., J. Lichatowich, W. Towey, and A. Duncan. 2006. Building science and accountability into community-based restoration: Can a new funding approach facilitate effective and accountable restoration? *Fisheries* 31:1 17-24.

Bission, P. A. and 11 others. 2002. Hatchery surpluses in the Pacific Northwest. *Fisheries* 27:12 16-27.

Gresh, T., J. Lichatowich, and P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the Northeast Pacific Ecosystem: Evidence of a nutrient deficit in the freshwater systems of the Pacific Northwest. *Fisheries* 25:1 15-21.

Lichatowich, J. A., L. E. Mobrand, and L. C. Lestelle. 1999. Depletion and extinction of Pacific salmon (*Oncorhynchus* Spp.): A different perspective. *ICES Journal of Marine Science*, 56: 467-472.

Independent Scientific Group. 1999. Return to the river: Scientific issues in the restoration of salmonid fishes in the Columbia River. *Fisheries* 24:3 10-19.

Independent Scientific Group. 1998. Return to the river: An ecological vision for the recovery of the Columbia River salmon. *Environmental Law* 38:3 503-518.

Currens, K. P., F. W. Allendorf, D. Bayles, D. L. Bottom, C. A. Frissell, D. Hankin, J. A. Lichatowich, P. C. Trotter, and T. A. Williams. 1998. Conservation of Pacific salmon: Response to Wainwright and Waples. *Conservation Biology* 12: 1148-1149.

Rahr, G. R., J. A. Lichatowich, R. Hubley, and S. M. Whidden. 1998. Sanctuaries for native salmon: A conservation strategy for the 21st century. *Fisheries* 23:4: 6-7.

Mobrand, L. E., J. A. Lichatowich, and L. C. Lestelle. 1997. An approach to describing ecosystem performance "Through the eyes of salmon." *Canadian Journal of Fisheries and Aquatic Sciences* 54(12): 2964-2973.

Stanford, J. A., J. V. Ward, W. J. Liss, C. A. Frissell, R. N. Williams, J. A. Lichatowich and C. C. Coutant. 1996. A general protocol for restoration of entire river catchments. *Regulated Rivers: Research and Management*, 12: 391-413.

Allendorf, F. W. and 9 others. 1997. Prioritizing Pacific salmon stocks for conservation. *Conservation Biology*, 11(1): 140-152.

Lichatowich, J., L. Mobrand, L. Lestelle, and T. Vogel. 1995. An approach to the diagnosis and treatment of depleted Pacific salmon populations in Pacific Northwest watersheds. *Fisheries* 20:1 10-18.

Nehlsen, W., J. E. Williams and J. A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho, and Washington. *Fisheries* 16:2 4-21.

Ewing, R. D., H. J. Pribble, S. L. Johnson, C. A. Fustish, J. Diamond, and J. A. Lichatowich. 1980. Influence of size, growth rate, and photoperiod on cyclic changes in gill (Na+K)-ATPase activity in chinook salmon (Oncorhynchus tshawytscha). *Canadian Journal of Fisheries and Aquatic Sciences* 37: 600-05.

Ewing, R. D., S. L. Johnson, H. J. Pribble, and J. A. Lichatowich. 1979. Temperature and photoperiod effects on gill (Na+K)-ATPase activity in chinook salmon (Oncorhynchus tshawytscha). *Journal of Fisheries Research Board of Canada* 36:11 1347-53.

Johnson, S. L., R. D. Ewing, and J. A. Lichatowich. 1977. Characterization of gill (Na+K)-activated adenosine triphosphatase from chinook salmon, Oncorhynchus tshawytscha. *Journal of Experimental Zoology* 199:3 345-54.

Seim, W. K., J. A. Lichatowich, R. Ellis, and G. Davis. 1977. The effect of kraft mill effluent on juvenile salmon production in laboratory streams. *Water Research* 11: 189-96.

AWARDS

Inducted into the Wild Salmon Hall of Fame, Pacific Northwest Salmon Center, 2007
Fishery Worker of the Year, Oregon Chapter American Fisheries Society, 2005
Aldo Leopold Conservation Award, Federation of Fly Fishers, 2003
River Stewardship Award, Metro, Oregon Trout, Mt. Hood National Forest and Portland Water Bureau, 2002
Scientific Contribution of the Year, Native Fish Society, 2002
Distinguished Graduate Award, Oregon State University Department of Fisheries and Wildlife, May 8, 2000
American Fisheries Society Award of Merit, Western Division, 2000
Washington Trout Conservationist of the Year, 2000
Oregon Rivers Council Conservation Achievement Award, 1992.
Trout Unlimited, Conservation Award, 1992
American Fisheries Society Award of Merit, Western Division, 1992
Clallam County, Washington Conservation Education Award, 1991
Oregon Trout, Wild Trout Award, 1987
American Fisheries Society Award of Merit, 1977
Graduated with Honors, Oregon State University, 1969
Crown Zellerbach Scholarship in Fisheries, 1967

APPENDIX D

HONORABLE BENJAMIN H. SETTLE

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT TACOMA

WILD FISH CONSERVANCY, *et al.*, Plaintiffs, v. NATIONAL PARK SERVICE, *et al.*, Defendants,	)))))))))	No. 3:12-CV-05109-BHS FIRST DECLARATION OF JACK A. STANFORD

I, Jack A. Stanford, declare the following on the basis of personal knowledge to which I am competent to testify:

1. My current address is 32111 BioStation Lane, Polson, Montana 59860. I have been retained as an expert on salmonid ecology and river ecology by the Plaintiffs in this matter. This declaration supports Plaintiffs' First Motion for Partial Summary Judgment and Plaintiffs' First Motion for Preliminary Injunction;

PROFESSIONAL QUALIFICATIONS

2. I have 47 years of professional experience with the ecology of salmonid fishes and river ecology, including 38 years teaching at the university level. For most of my career I

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have specialized in research and teaching in the area of large river ecosystems, and since 1990 my work has focused on large salmon-bearing rivers of the North Pacific Rim, Argentina and Norway;

3. I received a Ph.D. in Limnology (freshwater science) from the University of Utah in 1975, following a M.S. in Limnology and a B.S. in Fisheries Science, both from Colorado State University;

4. I have served in my current positions as director of the University of Montana's Flathead Lake Biological Station since 1980 and as the Jessie M. Bierman Professor of Ecology at the University of Montana since 1986;

5. I have worked at the Flathead Lake Biological Station since 1971. The Biological Station is a multidisciplinary research and education center with 8 resident faculty and some 50 staff members, including graduate students and postdoctoral scholars, with an annual budget currently exceeding $3 million from competitive grants;

6. My research and teaching encompass many aspects of fresh water ecology, including the natural and cultural interactions of large river ecosystems, food webs, nonnative species, salmon and steelhead life histories, aquatic species population dynamics, and river and salmonid conservation;

7. I have conducted numerous research investigations on these subjects, including long term studies of the Flathead River-Lake Ecosystem in Montana and British Columbia that demonstrated the pervasive food web changes caused by introduction of nonnative species, and extensive work comparing salmon and steelhead life histories and floodplain ecology across rivers in Kamchatka, Argentina, Alaska, and British Columbia;

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8. I have authored or co-authored approximately 184 peer-reviewed research papers. The topics of these publications include salmon population collapse from shrimp stocking, Pacific salmon conservation, salmonid spawning, genetic diversity, and population structure. I also co-authored an article setting forth a general protocol for restoration of rivers regulated by dams in River Research and Applications that is the most-cited paper the journal has published to date;

9. In 2004, I received the Award of Excellence of the Society for Freshwater Science, and in 2011 I received the Lifetime Achievement Award from the International Society for River Science;

10. I have served on many national and international science review panels and editorial boards concerning the ecology and conservation of rivers and salmonid fishes. These duties include tenure on National Research Council panels on aspects of river ecology and 10 years on the Independent Science Advisory Board of the Northwest Power Planning Council evaluating proposals and plans for restoration of salmonid fishes in the Columbia River Basin. For over 20 years I have served on the editorial board of the journal River Research and Applications and I served one term on the editorial board of Ecological Applications;

11. I have substantial familiarity with interactions between wild and hatchery salmonids, ecological impacts from the introduction of nonnative salmonids, and the efficacy of salmonid population management and recovery efforts including restoration of flows in regulated rivers to create salmon habitat and restoration of riparian and shallow water habitat as rearing areas for juveniles;

12. Attached hereto as Exhibit 1 are my curriculum vitae, which include a list of all peer reviewed publications I have authored since 2007. My career publications list of over 180

papers can be viewed on the following Flathead Lake Biological Station website: http://www2.umt.edu/flbs/Research/Publications.aspx;

13. I have not provided expert testimony at trial or by deposition during the last four years;

14. I am receiving no compensation for my work in preparing this declaration. My reasonable hourly rate is $207, and I have spent approximately 50 hours reviewing information and preparing this document;

15. In addition to drawing upon my knowledge and experience, I have reviewed the following documents in developing my opinions expressed herein: the Elwha River Fish Restoration Plan (April 2008) ("Restoration Plan"), the Hatchery Scientific Review Group's ("HSRG") Review of the Elwha River Restoration Plan and Associated HGMPs (January 2012) ("HSGR Report"), the steelhead Hatchery Genetic Management Plan ("HGMP") signed by Larry Ward and dated July 31, 2012 ("Steelhead HGMP"), the coho salmon HGMP signed by Larry Ward and dated July 31, 2012 ("Coho Salmon HGMP"), National Marine Fisheries Service's ("NMFS") Biological Opinion on the reinitiation of consultation for the Elwha River and Fisheries Restoration Project dated July 2, 2012 ("2012 BiOp"), United States Geological Survey ("USGS") sediment data from gages on the Elwha River. I have also had conversations with individuals familiar with the Elwha River watershed and its salmonids, including Nick Gayeski, John McMillan, Tim Beechie, Guido Rahr, Pete Soverel and George Pess. I have been to the Elwha River several times, including the lower river below Elwha Dam and the Elwha Dam site, before and during dam removal. Further, I am familiar with extensive professional papers published in scientific journals that deal with the interactions between hatchery and wild salmonids;

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SUMMARY OF OPINIONS

16. In summary, it is my professional opinion that the releases of native Elwha River winter-run steelhead as described in the Steelhead HGMP: (a) will harm and kill threatened Puget Sound Chinook, threatened Puget Sound steelhead, and threatened bull trout; (b) are not necessary to prevent the extirpation of native Elwha River winter-run steelhead; and (c) will cause severe and long-term harm to the wild Elwha River winter-run steelhead population and its ability to fully recovery;

17. It is also my professional opinion that the releases of Chambers Creek steelhead into the Elwha River in 2010 and 2011 will harm wild native Elwha River winter-run steelhead;

18. It is further my professional opinion that the releases of coho salmon as described in the Coho Salmon HGMP: (a) will harm and kill threatened Puget Sound Chinook, threatened Puget Sound steelhead, and threatened bull trout; (b) are not necessary to prevent the extirpation of the Elwha River coho salmon population; and (c) will cause severe and long-term harm to the wild Elwha River winter-run steelhead population and its ability to fully recovery;

RISKS TO WILD FISH FROM HATCHERY OPERATIONS

19. Hatchery operations harm wild fish and inhibit the ability of depressed wild fish populations to recover through a variety of mechanisms;

20. Hatchery operations pose genetic threats to wild salmonids. Hatchery fish adapt through evolutionary processes to hatchery environments, making them less fit to survive and reproduce in the wild. When these fish are allowed to interbreed with wild fish, the resulting offspring are less fit to survive and reproduce in the wild than the wild parent. Genetic threats include those caused by introgression of genetic material from hatchery fish into the native population through interbreeding. Genetic threats from introgression include: (a) loss of fitness

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and locally adaptive characteristics of the native population; (b) loss of genetic diversity within the native population; and (c) loss of diversity among populations;

21. Hatchery operations also pose ecological threats to wild fish, which include: (a) competition with wild juvenile fish for local food resources and rearing space (territory); (b) competition with wild adults for spawning territory, which can include displacement of wild adults from preferred spawning locations; (c) preying on wild fish by hatchery fish; and (d) disruption of normal migratory behavior of returning wild adult salmonids from passage barriers or false attractions to hatchery outfalls;

22. Hatchery salmonids are, in general, significantly more tolerant of high densities of conspecifics than native, wild, salmonids. Consequently, when local abundances of hatchery fish are sufficiently high, the competition with hatchery fish can result in displacement of native wild juveniles and adults to less optimal rearing, feeding, sheltering, and spawning locations. These significant disruptions to behavioral patterns can create the likelihood of injury, and can kill the native fish;

23. Steelhead and salmon home to water in their natal rivers that contain strong odors of other salmon and steelhead. This is an evolutionary mechanism to increase the odds of finding mates. This is especially important to small populations recolonizing newly accessible habitats. The effluent water discharged from fish hatcheries contains highly concentrated odors of salmon and/or steelhead, compared to concentrations in a natural river. It is common for upstream migrating wild salmonids to be diverted to hatchery outfall waters and to enter hatchery holding ponds or to spend significant amounts of time and energy attempting to do so if the gates to the outfall are closed to prevent more adult fish than the hatchery needs from entering hatchery holding ponds. The delay in their upstream migration to natural spawning grounds

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caused by this “false attraction” to hatchery outfalls can result in wild individuals either not making it to the spawning grounds at all or not arriving in times to secure the best locations for spawning and thus having to compete more strenuously for mates and spawning sites than if they were not delayed. In addition to delay, steelhead and salmon commonly injure themselves on the structures that block the hatchery outfalls as they repeatedly attempt to swim or jump past these barriers;

24. Release of hatchery fish into the wild also poses a risk of introducing pathogens and parasites to wild populations that can result in temporary epidemics or permanent reductions in wild populations. While this risk is more difficult to quantify than genetic and competitive effects, they are unlikely to be negligible. Even a single hatchery individual carrying a pathogen to which local, native wild fish are susceptible can have devastating consequences. This is especially of concern with regard to local wild populations, such as Elwha River winter-run steelhead, that are already at depressed levels of abundance;

BACKGROUND ON ELWHA RIVER SALMONIDS

25. The Puget Sound steelhead Distinct Population Segment (“DPS”) is listed as a “threatened” species under the Endangered Species Act (“ESA”). Recovery of the native Elwha River winter steelhead population is essential to the recovery of the Puget Sound steelhead DPS. The size and pristine condition of the Elwha River watershed provide the largest potential population size for winter steelhead of all the rivers entering the Strait of Juan de Fuca. This watershed constitutes a unique component of the geographic and evolutionary diversity of the Puget Sound steelhead DPS. Threats to the recovery of native Elwha River winter steelhead therefore pose a significant threat to the recovery and de-listing of the Puget Sound steelhead

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DPS. This has been noted by other experts, including NMFS' staff biologists in a letter dated April 14, 2010 to the Lower Elwha Klallam Tribe;

26. The upper Elwha River contains a native rainbow trout population that produces steelhead included within the Puget Sound DPS. There are also native Elwha River winter-run steelhead, which are also members of the Puget Sound steelhead DPS, that have been confined to the lower Elwha River downstream of Elwha Dam. Wild recovery from these two sources provides the greatest potential to a fully recovered Elwha River basin;

27. The Elwha River and its estuary also contain wild bull trout, which are listed as a threatened species under the ESA;

28. The Elwha River further contains Chinook salmon that are included within the Puget Sound Chinook salmon Evolutionary Significant Unit that is listed as a threatened species under the ESA. This ESA-listed species includes wild and hatchery produced Chinook salmon in the Elwha River;

OPINIONS REGARDING THE NATIVE WINTER-RUN STEELHEAD PROGRAM

29. The native Elwha River winter-run steelhead hatchery program began in 2005. The Steelhead HGMP states that the purposes of this plan are to preserve the stock during dam removal and to support fishing opportunities after dam removal;

30. Broodstock for this program was developed by collecting and capturing native Elwha River steelhead eggs and fry from the wild. Each year from 2005 through 2011 between 431 and 2,731 wild steelhead eggs and fry were collected and captured from the Elwha River. These fish have been taken to the hatchery, reared for four years to adults, and then spawned to provide hatchery broodstock. The last year that wild steelhead eggs and fry were collected was in 2011, and those fish will remain at the hatchery until they are spawned in 2015;

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31. Starting this winter, eggs and fry from wild steelhead will no longer be collected in the Elwha River, and returning adults will instead be captured to supply broodstock. It is proposed that a maximum of 500 adult steelhead will be captured each year for this purpose. Both hatchery-origin and wild ("natural-origin") adult steelhead returning to the Elwha River will be captured and killed for broodstock;

32. The native Elwha River steelhead broodstock are reared to age 2 smolts prior to their release. Approximately 175,000 steelhead are released under this program each year beginning in March or April and lasting through June. The first such release (of approximately 178,000 smolts) occurred in 2011;

33. It is my opinion that each of these releases will harm wild native Elwha River winter-run steelhead through genetic interactions with released hatchery fish. I agree with the opinions expressed in the First Declaration of Gordon Luikart that the hatchery released steelhead will most likely have reduced fitness for survival and spawning in the wild, that the maladaptive genes will be spread to the wild steelhead population via interbreeding, and that this will result in reduced fitness of the wild native Elwha River winter-run steelhead. Wild native Elwha River winter-run steelhead with such maladaptive genes will die without successfully spawning at greater rates than would otherwise occur;

34. It is further my opinion that each of these large releases of hatchery steelhead smolts will harm wild native Elwha River winter-run steelhead smolts, juvenile bull trout, and Chinook salmon smolts through competition for food, rearing and sheltering space in the lower Elwha River and the estuary and nearshore environments. Releases of approximately 175,000 age-2 hatchery smolts constitute significant modifications to the habitat of these wild salmonids. Most or all of the hatchery smolts will be approximately 200 millimeters, or nearly 8 inches, long

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when they are released. Wild steelhead smolts are often as small as 150 mm and commonly 170 to 180 mm, 1 to 2 inches smaller than the hatchery smolts. Most competitive interactions among juveniles of the same species are determined simply on the basis of size. Thus there will be a high probability that numerous wild smolts will be outcompeted in the lower Elwha River, the estuary, and the nearshore environment by hatchery smolts. Some wild native Elwha River winter-run steelhead smolts, juvenile bull trout, and Chinook salmon will most likely be killed and injured by these releases due to competition for food, rearing, and sheltering space;

35. It is my opinion that some of the approximately 175,000 age-2 smolts released each year will residualize, meaning that they will not migrate to salt water, but will instead remain in the river as resident “trout.” The addition of these residualized hatchery fish constitutes a significant modification to the habitat of wild salmonids. These residualized hatchery fish will harm and most likely kill some rearing wild native Elwha River winter-run steelhead and rainbow trout, rearing juvenile Chinook salmon, and bull trout throughout the accessible reaches of the Elwha River through predation and competition for food and rearing and sheltering space;

36. It is my opinion that the Elwha River steelhead hatchery operations will harm adult wild steelhead returning to the river to spawn by creating a false attractant. Some wild native Elwha River winter-run steelhead will be attracted to the discharges from the hatchery operations, and will attempt enter the outfall. If the outfall gates are closed, these fish will be injured by repeatedly attempting to swim or jump past those barriers. If the gates are open, the wild steelhead will enter the hatchery and become trapped in holding ponds. Either way, spawning migration will be disrupted, which will likely result in less successful spawning. This

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would harm the wild native Elwha River winter-run steelhead population by delaying and impairing its ability to recover and recolonize the newly accessible habitat above the dam sites;

37. It is my opinion that the steelhead hatchery operations described in the Steelhead HGMP will most likely cause severe and long lasting harm to the wild native Elwha River winter run steelhead population and to its ability to fully recover, and to the Puget Sound steelhead DPS to which that population belongs. Such harm will result, separately and in combination, from the fitness/genetic effects, the competition effects, the predation effects, and the false attractant effects. These hatchery programs will most likely hinder, and may even prevent, the full recovery of the wild native steelhead population;

38. It is further my opinion that the native steelhead artificial propagation program is not necessary to prevent the extirpation of the native Elwha River winter-run steelhead population from the dam removal process;

39. The Steelhead HGMP states two very different justifications for the hatchery program. First, it states that the program will be operated pursuant to the Elwha River Fish Restoration Plan to restore steelhead to the Elwha River following removal of the two dams. Second, it states that steelhead spawning and rearing habitats will be adversely affected by high sediment transport associated with the period of dam removal and channel stabilization and that the hatchery program will ensure persistence of the stock by providing refugia for adult spawners during this high impact period. The hatchery program is not needed for either of these purposes;

40. The first justification is not well supported by science and poses considerable genetic risks to the wild steelhead population. As explained above and in the First Declaration of Gordon Luikart, the hatchery program has a high probability of delaying and otherwise impairing the recolonization of the Elwha River by native steelhead. As soon as passage above Elwha

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Dam is provided, steelhead will begin to recolonize highly suitable tributary spawning and rearing habitat. This has already started to occur during the winter and spring of 2012. No hatchery program is needed to accomplish recovery;

41. The second justification considerably exaggerates the evidence of the risk posed by the likely sediment levels. I have reviewed sediment data from gages on the Elwha River below the Elwha Dam since dam removal began. The sediment levels that have occurred in the mainstem of the Elwha River downstream of Elwha Dam in the winter and spring of 2012 are comparable to those that occur for longer period of time in large glacier-fed rivers, such as the Copper and Susitna Rivers in Alaska, that have healthy populations of wild salmon and steelhead. Furthermore, both the Elwha River below Elwha Dam and between the two dams contain numerous side-channel in which steelhead and salmon can spawn and in which juveniles can rear. These side channels will have much lower levels of suspended sediments than the mainstem during the brief periods when sediment levels in the mainstem are greatest. Tributaries between the two dams will be entirely unaffected by suspended sediments resulting from the removal of Glines Canyon Dam. Many of these tributaries contain high quality spawning and rearing habitat, and have already (in 2012) experienced spawning by wild steelhead and Chinook salmon. Wild steelhead are already showing that they can colonize habitats made accessible by the start of the removal of Elwha Dam. The removal of Glines Canyon Dam is also already well underway and is or will be passable by adult steelhead this winter (2012-2013). These fish will thus have access to the entire upper Elwha River where no suspended sediment due to dam removal will be present. It is therefore my opinion that the hatchery program described in the Steelhead HGMP is not necessary to prevent the extirpation of this stock from the effects of dam removal;

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42. It is my opinion that the hatchery program described in the Steelhead HGMP should be immediately eliminated to prevent likely long term severe harm to the wild native Elwha River winter-run steelhead population and its ability to fully recovery. Further, as indicated, recovery of this population is critical to recovery of the Puget Sound steelhead DPS. Thus, any such harm to the Elwha River population constitutes significant harm to the Puget Sound steelhead DPS. To the extent this hatchery program is not entirely eliminated, it is my opinion that it should be reduced in the manner suggested in the First Declaration of Gordon Luikart to minimize adverse impacts to the wild steelhead population. Such a program would continue to provide insurance against the loss of the wild population during dam removal;

OPINIONS REGARDING CHAMBERS CREEK STEELHEAD PROGRAM

43. The non-native Chambers Creek steelhead program in the Elwha River began over thirty years ago. This program has targeted a release of approximately 65,000 to 150,000 yearling smolts each year. I understand that Chambers Creek steelhead are not currently being reared at the Elwha River hatchery, but that approximately 51,500 smolts were releases in the spring of 2010 and approximately 61,000 in the spring of 2011.. Chambers Creek hatchery steelhead released under this program will continue to return to the Elwha River for the next two to three years from pervious smolt releases;

44. The Chambers Creek hatchery steelhead are visibly marked by a missing adipose fin and so are easy to identify as non-native. Managers correctly do not want these fish spawning in the wild and are planning fisheries actions (i.e., harvests in the Elwha River downstream of Elwha dam during management seasons 2012-13 and 2013-14). However, the Steelhead HGMP provides no details concerning such harvests and does not acknowledge or discuss the risk these fisheries pose to native steelhead due to use of non-selective fishing gears

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(such as gill nets) and from capture-and-release using selective gear (such as beach seines). It is therefore my opinion that these harvest activities will likely result in the capture, injury, and killing of some wild native Elwha River winter-run steelhead;

45. Chambers Creek and wild native winter-run steelhead generally return to spawn in the Elwha River from December through April. In general, the natural conditions that exist in the river during this period make it nearly impossible to contain the threats posed by Chambers Creek hatchery steelhead to native Elwha River steelhead within pre-determined limits. For example, it is not possible to limit the number of Chambers Creek adult steelhead on the spawning grounds to a maximum number or percentage of total spawners or to limit the number of Chambers Creek hatchery steelhead on the spawning grounds to a maximum absolute number. This could only be achieved with a reasonable degree of certainty if there were a structure in the river located downstream of the spawning grounds that was capable of non-lethally blocking all passage and trapping all upstream-bound fish until their status as wild or hatchery could be determined, and allowing only wild fish to continue moving upstream. There is a removable weir that can be set up in the lower Elwha River to trap salmon in the summer and fall. The weir cannot be maintained throughout the period when Chambers Creek and wild native winter-run steelhead return to the Elwha River because of the higher flows of winter and early spring—it cannot be operated at flows above about 2000 cubic feet per second. In fact, it cannot be maintained during the majority of the time during which winter-run steelhead return. Consequently, it is inevitable that some of the adult Chambers Creek steelhead returning in the next two winters will be able to migrate to newly-opened spawning grounds upstream of Elwha Dam. It is further inevitable that these hatchery fish will interact reproductively on the spawning grounds with wild native steelhead;

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46. It is my opinion that the previous releases of Chambers Creek steelhead into the Elwha River constitute significant modifications to the habitat of wild native Elwha River winter-run steelhead. It is likely that some Chambers Creek steelhead previously released into the Elwha River in 2010 and 2011 will interact genetically (crossbreed) with wild native steelhead when they return to the Elwha River as adults. The resultant offspring will very likely be less fit to survive and reproduce in the wild, and will therefore die without spawning at a higher rate that would otherwise occur. Further, the returning Chambers Creek steelhead will compete with wild native steelhead for mates and for preferred spawning locations and will most likely prevent some wild adult steelhead from spawning and cause others to spawn in suboptimal locations. This will reduce the spawning success of wild steelhead;

47. Deleterious impacts on wild native Elwha River steelhead resulting from the release of Chambers Creek juvenile steelhead (smolts) can be difficult to detect in a timely manner due to the relatively high level of natural variability in natural populations. This is true even when well-designed monitoring programs are in place, which does not appear to be the case with the Chambers Creek program. Consequently, it is highly likely that the adverse effects of the return of Chamber Creek adult steelhead during 2012-2013 and 2013-2014 described above will occur and will impose long-lasting harmful impacts on the native steelhead and rainbow trout populations by the time such impacts can be detected. Further, in the case of the Elwha River, where the monitoring program is in general significantly under-funded and many details of the necessary kinds of monitoring remain to be determined, harmful genetic and/or ecological impacts are likely to go undetected;

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OPINIONS REGARDING THE COHO SALMON PROGRAM

48. It is my understanding that the Elwha River coho salmon program began around 1978. The program previously targeted an annual release of 750,000 fish, but that number has been reduced to 425,000 fish;

49. The artificial hatchery program described in the Coho Salmon HGMP currently targets an annual collection of 400 to 600 adult coho salmon for broodstock purposes. These returning adults voluntarily enter the hatchery between October and December each year. The coho salmon are reared at the hatchery for one year before the target release of 425,000 smolts occurs beginning in March or April and lasting through May. Available information indicates that the actual number of smolts released has varied—the lowest number of smolts released between 2005 and 2009 was approximately 218,400 in 2008, and the greatest number was approximately 426,300 in 2009;

50. It is my opinion that each of these large releases of hatchery coho smolts harms and kills some wild native Elwha River winter-run steelhead smolts, juvenile bull trout, and Chinook salmon smolts through competition for food, rearing and sheltering space, and through predation, in the lower Elwha River and the estuary and nearshore environments. Releases of 218,400 to 425,000 hatchery coho smolts constitute significant modifications to the habitat of these wild salmonids. The Coho Salmon HGMP states that the hatchery smolts will be released at a size of 16 smolts per pound. This is equivalent to a length of approximately 140 millimeters or 5.5 inches. This is one-half to one inch larger than most wild coho smolts, and considerably larger than typical Chinook salmon smolts (one and a half to twice the size). Consequently, hatchery coho smolts will be able to outcompete and prey upon smaller juvenile Chinook salmon and steelhead. Some wild native Elwha River winter-run steelhead smolts, juvenile bull trout,

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and Chinook salmon will most likely be killed and injured by these releases due to competition for food, rearing, and sheltering space, and due to predation by hatchery coho;

51. It is my opinion that the hatchery operations described in the Coho Salmon HGMP will most likely cause severe and long lasting harm to the wild native Elwha River winter run steelhead and Chinook salmon populations and to their abilities to fully recover, and to the Puget Sound steelhead DPS and Puget Sound Chinook salmon ESU to which these populations belong. Such harm will result, separately and in combination, from the competition and predation effects. The wild native steelhead and Chinook salmon populations are currently at severely depressed states, and harm caused by the coho salmon program to individuals can therefore be significant to the populations. The coho salmon hatchery program will most likely hinder, and may even prevent, the full recovery of the wild native steelhead and Chinook salmon populations;

52. It is further my opinion that the coho salmon artificial propagation program is not necessary to prevent the extirpation of the Elwha River coho salmon from the dam removal process. This opinion is based upon the same information and analysis as described above in relation to the justification for the steelhead program;

53. It is my opinion that the hatchery program described in the Coho Salmon HGMP should be immediately eliminated to prevent likely harm to the wild native Elwha River winter-run steelhead and Chinook salmon populations and their ability to fully recover;

54. To the extent this hatchery program is not entirely eliminated, it is my opinion that it should be reduced to the minimum amount necessary to ensure the annual broodstock collection goal of 400 to 600 adults. This would ensure that the stock is not extirpated during the dam removal process, while greatly reducing the likely harm caused to wild native steelhead and

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Chinook salmon. Based upon the information provided in the Coho Salmon HGMP, an annual release of no more than 50,000 smolts would be sufficient to meet the broodstock collection objectives. At the anticipated minimum smolt-to-adult survival rate of 1.0%, 50,000 smolts would return 500 adults annually. This is more than enough to provide the egg take required to sustain the annual smolt releases and support a conservation program;

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 13th day of November 2012.

Jack A. Stanford, Bierman Professor and Director
Flathead Lake Biological Station, The University of Montana

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EXHIBIT 1

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PERSONAL INFORMATION

U.S. citizen; born, February 18, 1947 (Delta, Colorado); married to Bonnie K. Ellis; 2 children (Jack A., Jr., Christian F.); avid skier, fly fisherman, conservationist.

EDUCATION

B.S.	Fisheries Science	Colorado State University, Ft. Collins	1969
M.S.	Limnology	Colorado State University	1971
Ph.D.	Limnology	University of Utah, Salt Lake City	1975

PROFESSIONAL POSITIONS

Director, Flathead Lake Biological StationThe University of Montana (1980–now). Administrative responsibility for all Biological Station activities including academic, research and community service programs. The Station is a center of excellence for hypothesis-oriented ecological, limnological and fisheries research conducted worldwide but focused on the Crown of the Continent region of Montana and British Columbia. FLBS has 8 faculty and 30 staff with a $3–6M annual budget. Associate Director for operations is Sue Gillespie. Assistant Director for facilities and properties is Mark Potter.

Jessie M. Bierman Professor of Ecology, The University of Montana (1986–now). Distinguished chair with permanent endowment, includes Directorship of the Flathead Lake Biological Station.

Associate Professor (1979–1980) and Assistant Professor (1974–1978), Department of Biological Sciences, North Texas State University (NTSU–now University of North Texas), Denton. Taught graduate and undergraduate ecology, biometrics and limnology. Studied primary and secondary production in southwestern reservoirs (H. H. Moss Reservoir, North Lake and Lake Texoma) and life history strategies of aquatic insects in the Brazos River, Texas. Also developed the Analytical Water Quality Laboratory in the Institute of Applied Sciences, NTSU, and continued limnological research on the Flathead River - Lake ecosystem in Montana.

Chairman, Ecology Division, Department of Biological Sciences, NTSU (1975–1977). Coordinator for development of academic programs and joint research projects within the Ecology Division (8 faculty).

Research Biologist and Instructor in Limnology, University of Montana Biological Station (1973–1974). Directed a limnological investigation of phytoplankton dynamics in response to nutrient input in Flathead Lake, while also completing doctoral research on ecology of stoneflies (Insecta:Plecoptera) in the Flathead River. Professor Arden R. Gaufin – dissertation advisor, University of Utah, Department of Biology.

Graduate Teacher and Research Fellow in Zoology, Colorado State University, Fort Collins, Colorado (1969–1971). Developed an improved quantitative sampling procedure for use in an ecological study of the macrobenthic community of the Cache la Poudre River, Colorado. Dr. Edward B. Reed – thesis advisor.

Fisheries Biologist, Alaska Department of Fish and Game, Dillingham, Alaska (1968–1969). Studied spawning habits of Pacific herring in Nunavarchuk Bay, Alaska, and escapement and reproductive ecology of five species of Pacific salmon in the Nushagak River, Bristol Bay.

Curator of Ichthyology Collection, Department of Fisheries and Wildlife, Colorado State University (1966–1969). Collected fishes throughout Colorado; conducted taxonomic study and cataloging for Professors Robert Behnke and Harold Hagen; prepared Ichthyology teaching materials for graduate TAs.

RESEARCH GOAL

To achieve a holistic understanding of natural (biophysical) and cultural (social) controls on biodiversity and bioproduction in a landscape ecosystem context.

CURRENT RESEARCH

- Development of a decision support system that will assist salmon conservation across the North Pacific Rim, based upon a robust classification (typology) of rivers and river habitats using remote sensing.
- Biodiversity and bioproductivity, as controlled by natural and cultural processes, of a suite of pristine Pacific salmon river ecosystems in the Russian Far East (Kamchatka), Alaska and British Columbia.
- Linkages between river ecology and the distribution and abundance of wild steelhead and trout and their relationships to and interactions with other biota.
- Floodplain ecology of gravel-bed rivers: groundwater controls on aquatic and riparian biodiversity and bioproduction in a landscape ecology context.
- Spatial and temporal linkages between terrestrial and aquatic components of large watersheds.
- Restoration ecology of large river systems, especially salmon rivers.
- Interactions between hydro-manipulation, nutrient loading and food webs in oligotrophic river-lake ecosystems.

TEACHING (See FLBS web site www.flbs/umt.edu for FLBS academic programs.)

Graduate – Various seminars and thesis/dissertation topics
Undergraduate – Field Ecology

HONORS

Fellowship, Nordic Council for Ecology, Universities of Oslo, Bergen and Trondheim, Norway (1980); Awarded distinguished and endowed Jessie M. Bierman professorship, University of Montana (1986); Fellowship, Foundation for Research Development, Republic of South Africa (1989); Golden Trout Award for Professional Service, West Slope Chapter, Trout Unlimited (1991); Nominated for PEW Scholarship in Conservation and the Environment (1995); Recipient of the Mershon Award of the Montana Academy of Science for Outstanding Scholarship (1996); Elected President of the North American Benthological Society (1996–1997); Elected President of the Organization of Biological Field Stations (1996–1998); Distinguished Scholar Award, The University of Montana (1997); Candidate for

President of the American Society of Limnology and Oceanography (1998); Nominated for the Earle A Chiles Award for Conservation Activities (1999); Named a Fellow of the American Association for Advancement of Science (2000); Award of Merit issued by the Society for Technical Communication for a paper in Fisheries titled "Return to the River: Scientific issues in the restoration of salmonid fishes in the Columbia River," (2001); Received the Award of Excellence, North American Benthological Society (2004); Named an all time "Grizzly Great" by The University of Montana (2005); Presented with Lifetime Achievement Award by the International Society of River Science (2011); Received Federation of Fly Fishers' Leopold Conservation Award (2011); Drs. Jack Stanford and Bonnie Ellis honored with Montana Environmental Information Center Conservationist of the Year award (2012).

PROFESSIONAL MEMBERSHIPS

North American Benthological Society (Executive Committee 1979, 1987, 1988; Program Chair 1996, President 1996–97)
Ecological Society of America (Public Affairs Comm. 1993–1996)
Organization of Biological Field Stations (President 1996–1998, Executive Comm. 1996–2000)
Council of Aquatic Sciences (Chair 1998–2001)
International Society for Theoretical and Applied Limnology (National Representative, 2001–2004)
American Society of Limnology and Oceanography
American Association for the Advancement of Science
American Institute of Biological Sciences
Society for Conservation Biology
Northwest Scientific Association
American Fisheries Society
Montana Academy of Science
Sigma Xi
North American Lake Management Society
Association of Ecosystem Research Centers

EDITORIAL AND PEER REVIEW DUTIES

River Research and Applications (Regional Editor, 1986–now); Ecological Applications (Board of Editors, 1996–99); Academic Press (Board of Editors, Aquatic Series, 1994–2003); Freshwater Invertebrate Biology (Board of Editors, 1982–84); National Science Foundation (Ecology Panel, 1985–88; Facilities for Field Stations and Marine Labs Panel, 1989–90; LTER site reviewer, 1992–93; LTER Supplementation Panel, 1993–94; Water and Watersheds Panel, 1995; Biocomplexity in the Environment Panel, 2001; National LTER Advisory Board, 2003–now); Independent Scientific Advisory Board for Fish and Wildlife Programs, Bonneville Power Administration and National Marine Fisheries Service (1990–98); National Academy of Science (National Research Council Panel on Watershed Science, 1996–97; Panel on Riparian Ecology 1999–00); U.S. Fish and Wildlife Service (review of Trinity River Flow Evaluation, 1998); Science Technical Committee, Alaska Sustainable Salmon Initiative (2005–now). Ad hoc reviewer for: National Academy of Science, National Science Foundation, American Fisheries Society, Academic Press, Science, Ecology, Canadian Journal of Fisheries and Aquatic Sciences, Conservation Biology, Oikos, Journal of the North American Benthological Society, Freshwater Biology, BioScience, Copea and other international journals in ecology.

SYMPOSIA ORGANIZED

First International Symposium on Regulated Streams (NSF), 1979 (with J. V. Ward); Community Structure and Function in Temperate and Tropical Streams (NSF), 1987 (with A. P. Covich); Workshop on Groundwater Limnology, 24th Congress of the International Association of Theoretical and Applied Limnology, Munich, West Germany, 1989 (with J. Gibert, G. Bretschko); Fifth International Symposium on Regulated Streams, Flathead Lake Biological Station, 1991 (with F. R. Hauer); National Workshops on Groundwater Ecology, Flathead Lake Biological Station (1995–2000); 1996 Annual Meeting of the North American Benthological Society (Program Chair), International Workshop on Riparian and Groundwater Ecology, Kastanienbaum, Switzerland, 1996 (with T. Gonser); Workshop on Data Bases and Networking, Organization of Biological Field Stations, National Center for Ecological Synthesis, Santa Barbara, CA., 1998 (with A. McKee), XI International Conference on Ephemeroptera XV International Symposium on Plecoptera 2004 Joint Meeting (with F. R. Hauer); 2006 Annual Meeting of the Organization of Biological Field Stations, Flathead Lake Biological Station, Polson, MT (with A. McKee).

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Stanford, J. A. and T. Gonser. (eds.). 1998. Rivers in the Landscape: Riparian and Groundwater Ecology. Special Issue. Freshwater Biology 40(3):401–585.

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Stanford, J. A. 1977. Limnology of North Texas reservoirs and its interpretive value in studies of natural lakes. Texas Christian University, Fort Worth, Texas. Host: Dr. Ray Drenner.

Stanford, J. A. and J. K. G. Silvey. 1977. An historical overview of reservoir limnology in the Southwestern USA. Symposium on Problems Associated with River Impoundments, North American Benthological Society, Roanoke, Virginia. Host: Dr. John Cairns.

Stanford, J. A. 1979. Ecology of aquatic insects in the Flathead Rivers, Montana. Special Symposium on Ecology of Rocky Mountain Aquatic Insects. Entomological Society of America, Denver, Colorado. Hosts: Drs. J. V. Ward and R. K. Baumann.

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Stanford, J. A. 1989. Consequences of stream regulation on biodiversity and ecosystem stability and new approaches to management. Keynote address. Fourth South African National Hydrological Symposium, Pretoria, South Africa. Host: South African Foundation for Research Development. (Honorarium)

Stanford, J. A. 1990. Lake Powell and Colorado River water chemistry. Plenary paper. Symposium on Colorado River Ecology and Dam Management, Santa Fe, New Mexico. Host: Water Science and Technology Board of the National Research Council. (Honorarium)

Stanford, J. A. 1990. Ecosystem management in large watersheds regulated by dams and diversions. Plenary paper. New Perspectives for Watershed Management: Balancing Long-Term Sustainability with Cumulative Environmental Change. Seattle, WA. Host: University of Washington, Oregon State University, U.S. Forest Service and the Environmental Protection Agency.

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Stanford, J. A. 1991. Distribution of groundwater organisms along geomorphic gradients in gravel bed rivers. Northern Arizona University, Flagstaff, AZ. Host: Dr. Dean Blinn. (Honorarium).

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Stanford, J. A. 1993. Hyporheic insects of the Flathead River. Montana State University, Bozeman, Montana. Host: Florence Dunkel.

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Stanford, J. A. 1995. Flow dynamics, endangered fishes and floodplain ecology in the Colorado River. Symposium on the Colorado River. Ecological Society of America Annual Meeting, Snowbird, Utah. Host: Ray Hermann.

Stanford, J. A. 1996. River resources of the USA inland west: influences on cultures, economies and environments. Symposium on Fresh water: linking social, economic and environmental vitality. Ecological Society of America Annual Meeting, Providence, Rhode Island. Organized by Robert Naiman, John Magnuson and Penelope Firth.

Stanford, J. A. 1997. Conservation of fresh water: using our science to make a difference. Presidential Address. North American Benthological Society Annual Meeting, San Marcos, Texas.

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Stanford, J. A. 1998. Protocol for integrated management of watershed ecosystems. Plenary Address. Toward ecosystem-based management in the Upper Columbia River Basin. An International Conference and Workshop, Castlegar, British Columbia.

Stanford, J. A. 1998. Role of science in conservation and restoration of river ecosystems. Invited Seminar. EAWAG-ETH Swiss Institute for Science and Technology, Zurich, Switzerland. Host: Dr. James V. Ward. (Honorarium).

Stanford, J. A. 1998. Flathead Lake as a natural-cultural ecosystem. Invited presenter at the International Fellows Meeting(IF – VIP Military leaders from 31 countries), Flathead Lake Lodge, Montana. Host: Doug Averill.

Stanford, J. A. 1999. One hundred years of ecological research at the Flathead Lake Biological Station. Invited Address. Beyond the NSF LTER Network: Lesser Known Long-Term Ecological Research. Ecological Society of America Annual Meeting. Spokane, Washington.

Stanford, J. A. 1999. Achieving a comprehensive aquatic conservation strategy on public lands: What scientists bring to developing sound policy. Ecological Society of America Annual Meeting, Spokane, Washington. Host: James Karr.

Stanford, J. A. 2000. The Normative River Concept. American Association for Advance of Science. Washington, DC. Hosts: Andy Rosenberg and Usha Varanasi.

Stanford, J. A. 2000. Rationale, criteria and documentation for normative flows in regulated rivers. Invited paper at the 8th International Symposium on Regulated Streams. Toulouse, France. Host: Henri Décamps

Stanford, J. A. 2000. Concepts and practices of the normative river concept and stream restoration. Invited Address for the National Research Council Committee on Missouri River Science Conference, July 9–10, 2000, Bismarck, ND. Host: Jeff Jacobs.

Stanford, J. A. and R. J. Naiman. 2001. Linking aquatic and terrestrial landscapes. Invited Paper at the Riverine Landscape Symposium, Ascona, Switzerland. Host: K. Tockner

Stanford, J. A. 2001. Mysids and other food web scourges. Congressional Briefing. The Organization of Biological Field Stations and National Association of Marine Laboratories Briefing on Invasive Species, February 20, 2001, Washington, DC.

Stanford, J. A. 2001. The need for ecosystem-level salmon conservation: Management lessons from salmon research in large floodplain river systems. Invited Paper at Pacific Wild Salmon and Steelhead Conference, November 5–6, 2001. Portland, Oregon.

Stanford, J. A. 2002 Biostation initiatives. Invited presentation at Scientific Oversight Committee Meeting, Center for Applied Biodiversity Science, Conservation International, February 25, 2002. Washington, DC

Stanford, J. A. 2002. The shifting habitat mosaic of flood plains and its importance to salmonid fishes. Plenary Paper. American Fisheries Society, Spokane, WA.

Stanford, J. A. 2002. Habitat condition and restoration potential of Columbia River flood plains: a critical, missing element of fisheries recovery science and policy. Invited seminar for Bonneville Power Administration, July 17, 2002. Portland, OR.

Stanford, J. A. 2003. Variability in Salmon River Landscapes: Factors Affecting Restoration Strategies. The World Summit on Salmon, June 12, 2003. Vancouver, BC, Canada.

Stanford, J. A. 2003. Long-term ecosystem science at Flathead Lake, Montana: The key to conservation of water quality. Keynote Address at Washington State Lake Protection Association. Chelan, WA.

Stanford, J. A. 2003. River Surna – Atlantic salmon: Effect of river regulation and management strategies. Seminar paper at the University of Oslo, Norway. Host: Svein Saltveit. (Honorarium)

Stanford, J. A. 2004. Reconciling fisheries with conservation in freshwater montane habitats. Keynote Address at 4th World Fisheries Congress. Vancouver, BC, Canada.

Stanford, J. A. 2004 Floodplain biocomplexity: Dynamic controls on emergent properties of river ecosystems. Plenary Lecture. International Association of Theoretical and Applied Limnology (Societas Internationalis Limnologiae, SIL), XXIX Congress. Lahti, Finland.

Stanford, J. A. 2005. Assessing real and potential productivity of salmon habitat in freshwater. State of the Salmon Conference, Anchorage, AK.

Stanford, J. A. 2006. Regulated river ecology: Three decades of regulated river research: Coherence of theory and practice. Keynote Paper. Tenth (and last) Symposium on Regulated Rivers. Stirling, Scotland.

Stanford, J. A. 2007. Sustaining wild salmon: Lessons from Kamchatka. Invited Presentation. Bevan Series on Sustainable Fisheries, University of Washington, School of Aquatic and Fishery Sciences, 22 February 2007, Seattle, WA.

Stanford, J. A**.** and M. S. Lorang. 2008. Self-organization of biophysical complexity in riverscapes. Invited Oral Presentation, North American Benthological Society (NABS) 56th Annual Meeting, 25–30 May 2008, Salt Lake City, UT.

Stanford, J. A. 2008. Salmon riverscapes: role of marine derived nutrients in the shifting habitat mosaic of river ecosystems. Keynote Address. Inland Northwest Aquatic, Riparian, and Wetland Symposium. Eastern Washington University 22–23, February 2008, Riverpoint Campus, Spokane, WA.

Stanford, J. A. 2008. Invited Speaker. "LeRoy's River: Using science to mediate environment protection." Aquatic Conservation Science: Merging Theory and Application Symposium. Odum School of Ecology, University of Georgia, 3–4 October 2008, Athens, GA.

Stanford, J. A. 2009. Keynote Speaker. "Self-organization of biophysical complexity in riverscapes: a fundamental tenet for ecohydrology." Universidad de Concepción, 7th International Symposium on Ecohydraulics, 12–16 January 2009, Concepción, Chile**.**

Stanford, J. A. 2009. Oral Presentation. "Three decades of regulated river research: coherence of theory and practice." Universidad de Concepción, 7th International Symposium on Ecohydraulics, Special Session on Dams, 12–16 January 2009, Concepción, Chile**.**

Ellis, B. E. and Stanford, J. A. 2009. Oral Presentation. "Marine derived nutrients in riverine food webs." First Triennial Symposium for the International Society of River Science (ISRS), 12–17 July 2009, St. Pete Beach, FL.

Stanford, J. A. Oral Presentation. 2009. "Efficacy and selection of riverine protected areas to conserve wild pacific salmon." First Triennial Symposium for the International Society of River Science (ISRS), 12–17 July 2009, St. Pete Beach, FL.

Stanford, J. A. 2009. Invited Speaker. "Climate change effects on Skeena River, British Columbia." Skeena Salmon Habitat Conference, Bulkley Valley Centre for Natural Resources Research and Management, 15 September 2009, Smithers, BC, Canada.

Stanford, J. A. 2009. Invited Speaker. "Importance of Estuary-River linkages in salmon productivity." Estuary Habitat Expert Group (EHEG) Meeting. Tracey Yerxa, BPA, 8–10 October 2009, Portland, OR.

Stanford, J. A. 2009. Invited Speaker. "Aquatic Ecosystem Impacts of River Diversion for Hydro Power." Building a Vision for Green Energy in British Columbia, Simon Fraser University, 3 November 2009, Vancouver (done via electronic connection).

Stanford, J. A. 2009. Invited Speaker. "Climate warming, megamines and the energy glut: Can river, people, and their food webs adapt?" at Flathead Lake Biological Station, Polson, MT and Rudbach Lecture, Sigma Xi Lecture, The University of Montana, 7 December 2009, Missoula. MT.

Stanford, J. A. 2010. Invited Speaker. "A Conceptual Foundation for Ecosystem Restoration." Klamath Basin Science Conference, USGS, 2 February 2010, Medford, OR.

Stanford, J. A. 2010. Invited Speaker. "The Riverscape Analysis Project" Wild Salmon Ecosystems Initiative Partner's Workshop, Moore Foundation, 7–8 April 2010, Palo Alto, CA.

Stanford, J. A. 2010. Keynote Address. "Importance of wild salmon rivers." National Symposium on Ecological Interactions Between Wild and Hatchery Salmon, 4–7 May 2010, Portland, OR.

Stanford, J. A. 2011. Keynote Address. "Corridors and boundries: rivers, their floodplains and biota." 2nd Biennial Symposium of the International Society of River Science (ISRS), 8-12 August 2011, Berlin, Germany.

—One or two contributed papers have been presented or coauthored at annual meetings of professional societies each year since 1973.

RESEARCH GRANTS AND CONTRACTS ($33.6M)

Stanford, J. A. Ecological Studies of Texas Temporary Pools. NTSU Faculty Research Grant. $2,500. (1974)

Stanford, J. A. Plankton-Nutrient Dynamics in a North Texas Reservoir. NTSU Faculty Research Grant. $23,471. (1974, 1975)

Silvey, J. K. G., Director; J. A. Stanford, Associate Director. Training Grants in Water Supply, Water Quality and Pollution Control. U.S. Environmental Protection Agency. $180,000. (1975–1979)

Stanford, J. A. Lake Texoma Water Quality Study. U.S. Army Corps of Engineers, Tulsa, Oklahoma. $162,062. (1976–1979)

Stanford, J. A. Benthic Ecology in the South Fork of Flathead River, Montana, below Hungry Horse Dam. U.S. Bureau of Reclamation, Boise, Idaho. $7,100. (1977)

Tibbs, J. and J. A. Stanford. Construction of the Freshwater Research Laboratory, Flathead Lake Biological Station. The University of Montana, Fleishman Foundation. $1,000,000. (1978–1980).

Stanford, J. A. The Formation and Influence of Clay-Detritus Complexes in Relation to Temporal Carbon Dynamics in Three River-Lake Systems. NTSU Faculty Research Grant. $2,500. (1979)

Stanford, J. A. Limnology of the Flathead Lake-River Ecosystem, Montana. U.S. Environmental Protection Agency, Helena, Montana. $565,132. (1978–1983)

Stanford, J. A. and E. G. Zimmerman. Ecology of Big Pine Creek, Texas, with Emphasis on Temporal Carbon Dynamics. U.S. Army Corps of Engineers, Tulsa, Oklahoma. $55,000. (1979–1981)

Stanford, J. A. and T. L. Beitinger. Effects of Chronic pH Stress on Limnology and Fishery of an East Texas Lake. Ferndale Lake Club, Leesburg, Texas. $4,740. (1979)

Stanford, J. A. and J. V. Ward. First International Symposium on Regulated Streams. National Science Foundation. $15,220. (1979)

Stanford, J. A. and F. R. Hauer. Clean Lakes Study. Montana Department of Health and Environmental Sciences, Helena, Montana. $38,533. (1980–1981)

Stanford, J. A. and J. V. Ward. Evaluation of the Effects of Stream Regulation on the Limnology of the Gunnison River, Colorado. U.S. Environmental Protection Agency, Denver, Colorado. $40,098. (1979–1982)

Stanford, J. A., F. R. Hauer and J. N. Moore. Nutrient Subsidy in Alpine Lake Ecosystems by Volcanic Ash Import. U.S. Department of the Interior, Office of Water Research and Technology. $70,341. (1981–1982)

Stanford, J. A. Limnology of Whitefish Lake, Montana. Flathead County. $32,965. (1982–1983)

Stanford, J. A. Groundwater Resources Connected to Flathead Lake: Impact on Nutrient Mass Balance. Montana Department of Natural Resources. $100,000. (1983–1985)

Stanford, J. A. Verification of Sewage Leachates in Glacial Moraine Lakes. Office of Water Policy. U.S. Department of the Interior. $54,000. (1983–1985)

Stanford, J. A. A Water Quality Monitoring Program for Evaluating Management Options in the Flathead River Basin, Montana, with Emphasis on Determination of Phosphorus Bioavailability. Montana Department of Health and Environmental Sciences, Water Quality Bureau. $49,198. (1984–1985)

Stanford, J. A. and D. Kicklighter. The Use of Riffle Community Metabolism as a Measure of Water Quality in the Clark Fork River, Montana. Montana Department of Health and Environmental Sciences, Water Quality Bureau. $17,250. (1984–1985)

Stanford, J. A. Verification of Sewage Leachates in Whitefish Lake, Montana. Whitefish County Water and Sewer District. $26,106. (1984–1985)

Stanford, J. A. Bioavailability of Phosphorus Fractions in Tributary Waters of Flathead Lake, Montana. U.S. Environmental Protection Agency. $108,000. (1984–1985)

Stanford, J. A. Systems Analysis of the Cumulative Effects of Lake and Stream Regulation by Kerr Dam. Montana Power Company. $31,000. (1984–1987)

Stanford, J. A. Periphyton Dynamics in Flathead Lake. Bitterroot Fund, San Francisco. $12,000. (1985–1986)

Stanford, J. A. and F. R. Hauer. Aquatic Insect Ecology in the Lower Flathead River, Montana. Bureau of Indian Affairs. $50,000. (1985–1988)

Stanford, J. A. Limnology of Lakes in Glacier National Park. National Park Service. $114,400. (1982–1991)

Noble, R. A. and J. A. Stanford. Characterization of Suspended Sediment and Baseline Conditions - Proposed Cabin Creek Coal Mine - North Fork of Flathead River. Montana Bureau of Mines and Geology. $36,176. (1985–1988)

Stanford, J. A. and A. P. Covich. Workshop on Factors Controlling Community Structure and Function in Tropical and Temperate Streams. National Science Foundation. $59,900. (1987–1988)

Stanford, J. A. and F. R. Hauer. Research Vessel for Flathead Lake Biological Station. National Science Foundation. $88,000. (1987–1988)

Stanford, J. A. and J. V. Ward. Ecology of Riverine Hyporheos. National Science Foundation. $220,000. (1987–1989)

Stanford, J. A. and M. S. Lorang. Sediment Dynamics on the North Shore of Flathead Lake, Montana. Montana Power Company. $29,600. (1988)

Hauer, F. R., J. A. Stanford and C. N. Spencer. Water and Stream Ecosystem Quality as Effected by Forest Management Practices. Flathead Basin Commission. $72,501. (1989–1990)

Stanford, J. A. Independent Scientific Group. Pacific States Marine Fisheries Commission and Columbia Basin Fish and Wildlife Foundation. $402,228. (1989–1999)

Stanford, J. A. Analysis of the Interrelationship of Ecological Studies to Proposed Fish, Wildlife and Erosion Mitigation Plans in the Flathead Lake Area. Montana Power Company. $35,000. (1989–1991)

Stanford, J. A. and B. K. Ellis. Monitoring the Limnology of Two Subalpine Lakes in the Bob Marshall Wilderness, Montana: Quantifying Sensitivity to Acidic Precipitation. USDA Forest Service. $72,447. (1989–1995)

Stanford, J. A. and F. R. Hauer. Effects of Stream Regulation in the Upper Missouri River. Montana Power Company. $188,000. (1989–1994)

Spencer, C. N. and J. A. Stanford. Differential Impacts of *Mysis relicta* on the Plankton of Flathead and Swan Lakes. Montana Department of Fish, Wildlife and Parks. $50,000. (1990–1991)

Stanford, J. A., F. R. Hauer, L. F. Marnell, S. W. Running, A. L. Sheldon and C. N. Spencer. Complex Interactions in Large Oligotrophic Lakes: Nonnative Species as Strong Interactors Controlling Spatial and Trophic Linkages. National Science Foundation (EPSCoR). $204,421. (1990–1994)

Stanford, J. A., F. R. Hauer, C. N. Spencer and B. K. Ellis. Data Acquisition and Management System for Flathead Lake Biological Station. National Science Foundation. $82,640. (1990–1993)

Stanford, J. A. and B. K. Ellis. Relation Between Discharge and Distribution of Hyporheic Habitat within Selected Stream Segments in Glacier National Park, Montana. National Park Service. $114,500. (1990–1994)

Spencer, C. N., F. R. Hauer and J. A. Stanford. Comparative Effects of Wildfire on Pristine Streams in Glacier National Park Versus Streams on Managed Timber-Harvest Lands. National Park Service. $50,000. (1990–1994)

Stanford, J. A. and B. K. Ellis. Analyses of Long-Term Limnological Data Collected on Lakes in Glacier National Park. National Park Service. $6,500. (1991–1992)

Stanford, J. A. A Diagnostic Study of the Nutrient Loading in Flathead Lake, Montana (Phase I Project, Clean Lakes Program of the USEPA). Montana Water Quality Bureau. $100,000 (1991–1993)

Stanford, J. A. Complex Interactions in Large Oligotrophic Lakes: Nonnative Species as Strong Interactors Controlling Spatial and Trophic Linkages. National Park Service (CPSU). $9,500. (1991 – 1993)

Hauer, F. R. and J. A. Stanford. Long-Term Influence of Hungry Horse Dam Operation on the Ecology of Macrozoobenthos of the Flathead River. Montana Department of Fish, Wildlife and Parks. $25,000. (1992–1994)

Hauer, F. R. and J. A. Stanford. Effects of Climate Change on Hydrologic Systems and Associated Aquatic Biotas. National Park Service (CPSU). $504,000. (1992–1999)

Stanford, J. A. A Diagnostic Study of the Nutrient Loading and Sediment Bioavailability at Swan Lake, Montana (Phase I Project, Clean Lakes Program of the USEPA). Montana Water Quality Bureau. $142,909. (1992–1995)

Stanford, J. A. Review of Instream Flow Methods and Recommendations for the Endangered Fishes of the Upper Colorado River Basin. U.S. Fish and Wildlife Service. $120,821. (1992–1993)

Stanford, J. A. Review and Synthesis of Lotic Studies in Zion National Park. National Park Service (CPSU). $36,000. (1992–1994)

Frissell, C. A. and J. A. Stanford. Potential Effects of Climate Change in Thermal Complexity and Biotic Integrity of Streams: Seasonal Intrusion of Nonnative Fishes. U.S. Environmental Protection Agency. $370,000. (1993 –1995)

Frissell, C. A. and J. A. Stanford. A Strategy for Conservation of Aquatic Biodiversity in the Northern Rocky Mountains Ecosystem. Pacific Rivers Council. $82,764. (1993–1995)

Stanford, J. A. Expert Witness for Virgin River Adjudication. U.S. Department of Justice, Environment and Natural Resources Division. $15,301. (1993)

Stanford, J. A. Development of a Guidance Document for States to Protect Critical Zones of GW/SW Interaction. National Park Service (CPSU). $150,000. (1993–1999)

Hauer, F. R. and J. A. Stanford. Effects of Stream Regulation on the Macrozoobenthos of the Kootenai River. Montana Department of Fish, Wildlife and Parks. $37,517. (1994–1996)

Stanford, J. A. Review of Experimental Instream Flows to Protect and Enhance Riverine Resources in the Grand Canyon. Arizona State University. $15,269. (1994)

Stanford, J. A. Expert Witness Research and Testimony: Snake River Adjudication. U.S. Department of Justice, Environment and Natural Resources Division. $68,312. (1994–1998)

Stanford, J. A. Identification of Specimens of Invertebrates Collected in Zion National Park, Utah. Zion National Park, Utah. $1,500. (1994–1995)

Stanford, J. A. Workshop on Research Agenda for Sustainability of Montana Ecosystems. Bureau of Reclamation. $35,000. (1994–1995)

Stanford, J. A. Peer Review Recovery Implementation Program: Upper Colorado River Endangered Fishes. U.S. Fish and Wildlife Service. $4,418. (1994–1995)

Stanford, J. A. and B. K. Ellis. Flathead Lake Total Maximum Daily Loads. Montana Department of Health and Environmental Sciences. $15,000. (1994–1995)

Stanford, J. A. and F. R. Hauer. Monitoring of Surface Water Quality in the Flathead Basin: A Proposal for Modification of the Master Plan of the Flathead Basin Commission. Flathead Basin Commission. $52,686. (1994–1996)

Stanford, J. A., F. R. Hauer, N. M. Butler and B. K. Ellis. Lake Water System, Boat Dry Dock and Replacement of Obsolete Instruments at the Flathead Lake Biological Station. National Science Foundation. $130,000. (1994–1996)

Ellis, B. K. and J. A. Stanford. Developing a Lake-Specific Water Quality Target for Flathead Lake. Flathead Basin Commission. $115,000. (1995–1997)

Stanford, J. A. Review of Science Pertaining to the Fish and Wildlife Plan. Northwest Power Planning Council. $127,600. (1995–1996)

Stanford, J. A. Instream Flow Needs of Aquatic Biota of the Gunnison River, Black Canyon National Monument, Colorado. National Park Service (CPSU). $12,631. (1995–2000)

Stanford, J. A. and A. D. Barnosky. Determinants of Biodiversity, Social and Economic Patterns in Montane Ecosystems. National Science Foundation, EPSCoR. $1,806,639. (1995–1999)

Stanford, J. A. and J. Pastor. Grizzly Bear Digging in Subalpine Meadows: Influences on Plant Distributions and Nitrogen Availability. National Science Foundation. $259,478. (1995–1999)

Stanford, J. A. The Impact of River Recreation on the North Fork of the Virgin River, Zion National Park: A Comparative Analysis of Zoobenthos Biomass. National Park Service (CPSU). $15,389. (1996–1997)

Ellis, B. K. and J. A. Stanford. Baseline Water Quality Study of Little Bitterroot, Mary Ronan, Ashley and Lindburgh Lakes, Montana. Plum Creek Timber Company. $78,842. (1996–1998)

Ellis, B. K. and J. A. Stanford. Determination of Nutrient and Carbon Loading in the Swan River, Montana. Montana Department of Environmental Quality. $30,224. (1997–1999)

Ellis, B. K. and J. A. Stanford. Water Quality of Goat and Lion Creeks. Friends of the Wild Swan, Inc. $17,905. (1997–1998)

Stanford, J. A. Independent Scientific Review Panel (ISRP). Northwest Power Planning Council. $30,750. (1997)

Stanford, J. A. The Teanaway River Enhancement Project. Bureau of Reclamation. $57,000. (1997–2000)

Stanford, J. A. Ongoing Peer Review of Effort to Produce a Report that Defines a Process for Establishing Biologically-Based Instream Flow Recommendations for the Yakima River Basin. Bureau of Reclamation. $20,580. (1997–1998)

Ellis, B. K. and J. A. Stanford. Water Quality of Selected Headwater Streams of the Flathead National Forest. Swan Ecosystem Center. $500. (1998–1999)

Ellis, B. K., J. A. Craft and J. A. Stanford. Water Quality of Selected Headwater Streams of the Flathead National Forest. USDA Forest Service, Flathead National Forest. $38,675. (1998–2000)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $24,900. (1998)

Stanford, J. A. Review and Synthesis of Data Related to Instream Flow Provision in the Yakima River Ecosystem, Washington. Bureau of Reclamation. $149,541. (1998–2000)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (1999)

Stanford, J. A. Study of Surface and Groundwater Interactions in Five Reaches of the Yakima River. Bureau of Reclamation. $767,719. (1999–2001)

Wicklum, D. and J. A. Stanford. Ecology of *Mysis relicta* on Flathead Lake. Confederated Salish and Kootenai Tribes. $53,968. (1999)

Ellis, B. K., T. S. Bansak and J. A. Stanford. Effects of Wildfire on Nutrient and Sediment Transport in Skyland and Dodge Creeks, Flathead National Forest. USDA Forest Service, Flathead National Forest. $2,981. (1999–2000)

Stanford, J. A. Snake River Resources Review - Biologically Based River/Reservoir Systems Management Assessment Strategy. Bureau of Reclamation. $8,000. (1999–2000)

Stanford, J. A. Yakima Basin Side Channel Survey and Rehabilitation. Yakama Indian Nation. $154,255. (1999–2001)

Stanford, J. A. and F. R. Hauer. FSML: Equipment to Enhance Research and Electronic Data Management at Flathead Lake Biological Station. National Science Foundation. $99,205. (1999–2001) (with cost share)

Stanford, J. A. and J. S. Kimball. Analysis of Flow and Habitat Relations in Yakima River Associated with Proposed Water Exchange. Bureau of Reclamation. $300,000. (1999–2001)

Hauer, F. R., M. S. Lorang and J. A. Stanford. Floodplain Ecology of the Snake River, Idaho and Wyoming: Development of Biologically-Based System Management. Bureau of Reclamation. $431,284. (2000–2003)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (2000)

Stanford, J. Impact of Flow Regulation on Riparian Cottonwood Ecosystems. Bioquest International Consulting, Ltd. $16,000. (2000–2001)

Stanford, J. A. Diet, Spatial Distribution and Life History of *Neomysis mercedis* in John Day Pool. Bonneville Power Administration. $180,539. (2000–2002)

Stanford, J. A. Biocomplexity Incubation Activity: Dynamic Controls on Emergent Properties of River Flood Plains. National Science Foundation. $101,010. (2000–2003)

Stanford, J. A. Limnological Survey of Ptarmigan Lake. National Park Service. $18,000. (2000–2003)

Wicklum, D. and J. A. Stanford. The Productivity of Flathead Lake. Confederated Salish and Kootenai Tribes. $59,402. (2000–2001)

Ellis, B. K. and J. A. Stanford. Analysis of Potential Sources of Nutrient Pollution Reaching Flathead Lake from Atmospheric Fallout. Flathead Basin Commission. $10,000. (2001)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (2001).

Stanford, J. A. Flathead Lake TMDL. Montana Department of Environmental Quality. $10,000. (2001)

Stanford, J. A. Critical Lands Project. Flathead Lakers. $5,829. (2001)

Stanford, J. A. Yakima River Water Enhancement Project. Bureau of Reclamation. $10,000. (2001–2004)

Stanford, J. A. Continuing American Participation in the Kamchatka Wild Salmon Sanctuary Project. Trust For Mutual Understanding. $30,000. (2001–2002)

Stanford, J. A. and J. Craft. Revisit the Limnology of Whitefish Lake. Whitefish County Water and Sewer District. $75,000. (2001–2003)

Stanford, J. A., F. R. Hauer, J. S. Kimball and M. S. Lorang. Biocomplexity-Dynamic Controls on Emergent Properties of River Flood Plains. National Science Foundation. $2,600,000. (2001–2005)

Stanford, J. A., F. R. Hauer, J. S. Kimball and M. S. Lorang. REU Supplement: Biocomplexity – Dynamic controls on emergent properties of river flood plains. National Science Foundation. $15,750. (2001–2005)

Stanford, J. A., F. R. Hauer, J. S. Kimball and M. S. Lorang. REU Supplement: BCP cost share. National Science Foundation. $2,250. (2001–2005)

Stanford, J. A., F. R. Hauer, J. S. Kimball and M. S. Lorang. REU Supplement: FSML cost share. National Science Foundation. $1,500. (2001–2005)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (2002)

Hauer, F. R., M. S. Lorang and J. A. Stanford. Floodplain Ecology of the Snake River, Idaho and Wyoming: Development of Biologically-Based System Management. Bureau of Reclamation. $191,000. (2000–2003)

Stanford, J. A. Continuing American Participation in the Kamchatka Wild Salmon Sanctuary Project. Trust For Mutual Understanding. $35,000. (2003)

Stanford, J. A. and B. K. Ellis. Groundwater quality assessment and monitoring plan for the North Flathead Valley and Flathead Lake perimeter. Flathead Basin Commission (regrant of Environmental Protection Agency funds). $26,946. (2003)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (2003)

Stanford J. A. and F. R. Hauer. FSML: Site improvement and equipment enhancement to secure long-term research capabilities at Flathead Lake Biological Station. National Science Foundation. $171,451. (2002–2005) (with cost share)

Stanford, J. A. and F. R. Hauer. REU Supplement to FSML: Site improvement and equipment enhancement to secure long-term research capabilities at Flathead Lake Biological Station. National Science Foundation. $12,000. (2003–2005)

Relyea, S. E. and J. A. Stanford. Water quality monitoring of the Whitefish River and its tributaries. Montana Department of Environmental Quality. $50,000. (2003–2005)

Stanford, J. A. Ground Water-Surface Water Interaction Training Workshop. U.S. Environmental Protection Agency. $25,000. (2004)

Stanford, J. A. and J. S. Craft. Limnological studies of Fish Creek, Glacier National Park. National Park Service CESU. $2,350. (2004–2005)

Gannon, J., W. Holben, M. Rellig, W. Woessner and J. A. Stanford. Nyack microbial observatory project. National Science Foundation Microbial Observatory Program. $1,126,154. (2004–2006)

Stanford, J. A. Rapid assessment of salmonid ecology in the headwater rivers of Tierra del Fuego with emphasis on lands managed by the Wildlife Conservation Society. Wildlife Conservation Society. $29,000. (2005)

Stanford, J. A. Modeling studies to support Pacific salmon conservation planning. University of Washington. $109,223. (2006–2007).

Stanford, J. A.. Nyack microbial observatory project MCB-0348773. National Science Foundation Microbial Observatory Program. $288,959. (2004–2010)

Stanford, J. A. and F. R. Hauer. Population status and ecology of brown trout Rio Grande, Tierra del Fuego, Argentina. Nervous Waters of Argentina. $145,000. (2006–2008)

Stanford, J. A. The Salmonid Rivers Observatory Network (SaRON): Relating habitat and quality to salmon productivity for Pacific Rim rivers. Gordon and Betty Moore Foundation. $4,620,000. 2007–2010

Stanford, J. A. and S. Chilcote. Remote analysis of aquatic habitat areas – Pebble Mine. The Nature Conservancy. $20,000. (2008)

Stanford, J. A. Kamchatka Salmon and Biodiversity Project (KSBP). Wild Salmon Center. $796,916. (2003–2008).

Stanford, J. A. Ecology of North American salmon rivers. Gordon and Betty Moore Foundation. $1,600,842. (2003–2008)

Stanford, J. A. Crown of the Continent REU program. National Science Foundation. $220,575. (2004–2008)

Stanford, J. A. AYK sustainable salmon initiative research and restoration plan. Bering Sea Fishermen's Association. $41,760. (2004–2007)

Stanford, J. A. Hierarchical typology of north Pacific Rim rivers and application to wild salmon conservation. Gordon and Betty Moore Foundation. $1,659,533. (2005–2008)

Stanford, J. A. Modeling studies to support Pacific salmon conservation planning. University of Washington. $63,504. (2006–2009).

Stanford, J. A. AYK sustainable salmon initiative. Bering Sea Fishermen's Association. $30,992. (2006–2008)

Stanford, J. A. The Salmonid Rivers Observatory Network (SaRON): Relating habitat and quality to salmon productivity for Kamchatka rivers. Gordon and Betty Moore Foundation. $992,160. (2007–2010)

Rillig, M. C., D. L. Mummey and J. A. Stanford. Succession and changing roles of arbuscular mycorrhizal fungal communities in a floodplain chrono-sequence model system. National Science Foundation. $200,000. (2006–2008)

McPhee, M. V., T. P. Quinn and J. A. Stanford. Ecotypic variation in AYK sockeye stocks. Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYK-SSI). $242,403. (2008–2010)

Ellis, B. K., J. A. Stanford and J. A. Craft. Flathead Monitoring Project. Flathead Basin Commission, Montana Department of Environmental Quality, Bureau of Reclamation and Agency Consortium. $2,672,200. (1984–2012)

Stanford, J. A, B. K. Ellis and F. R. Hauer. Collaborative research: FSML-enhanced cooperative research and education at Flathead Lake Biological Station and Taylor Wilderness Research Station (in collaboration with University of Idaho, James R. Gosz, PI). National Science Foundation. $155,377. (2009–2012)

Hauer, F. R., A. J. Hansen, J. A. Stanford and M. J. Young, Collaborative Research: Cyberinfrastructure for a virtual observatory and ecological informatics system (VOEIS). National Science Foundation. $2,998,589. (2009–2012)

Stanford, J. A. Columbia River Estuary Science Panel Work Session. PC Trask & Assoc., Inc. $3,679. (2009–2010)

Stanford, J. A. Icicle Creek Mykiss sample analysis. Wild Fish Conservancy. $1,263. (2009–2010)

Stanford, J. A. Kuskokwim River tributary biological baseline production assessment. U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge. 12/09 – 6/10 = $10,637. (2009–2010)

Stanford, J. A. Development of a series of salmon science white papers. Gordon and Betty Moore Foundation. $21,000. (2010–2011)

Stanford, J. A. Kuskokwim River tributary biological baseline production assessment. U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge. $40,137. (2010–2011)

Stanford, J. A. Linking salmon portfolios to geomorphology of Pacific Rim rivers. University of Washington. $284,016. (2010–2012)

Stanford, J. A. Consulting services for restoration of the Colorado River Delta. Walton Family Foundation. $28,336. (2011)

Stanford, J. A. Expert report in relation to potential impacts on fish and water of the Enbridge Northern Gateway Pipelines project. West Coast Environmental Law. $16,000. (2011)

Stanford, J. A. Columbia River Estuary Science Panel Work Session. PC Trask & Assoc., Inc. $6,685. (2011)

Stanford, J. A. Enbridge impact mapping project., NW Institute for Bioregional Research. $25,000. (2011–2012)

Stanford, J. A. Columbia River Estuary Science Panel Work Session. PC Trask & Assoc., Inc. $2,408. (2012)

Stanford, J. A. Systems Ecology Science and Technology Center, Walton Family Foundation. $370,239. (2012)

Stanford, J. A. RiverNet expertise for the Taylor Wilderness Research Station, University of Idaho. $2,472. (2012)

Stanford, J. A. Chinook salmon expert panel process, Bering Sea Fishermen's Association. $6,500. (2012)

ENDOWMENTS AS OF 10/14/11 ($3.7M)

Jessie M. Bierman Professorship in Ecology at FLBS – $1.3M (1986, 1995)
McKnight Foundation Professorship in Limnology at FLBS – $1M (2001)
Scholarships at FLBS – $1.1M
Research Endowments – $325K

GRADUATE STUDENTS MENTORED (14 PH.D., 27 M.S., 4 M.A.; TOTAL 45)

1. Comparative chemistry of thermally stressed North Lake and its water source, Elm Fork Trinity River. M.S. Thesis by Barry L. Sams, 1976. (NTSU)

2. Limitation of primary productivity in a southwestern reservoir due to thermal pollution. M.S. Thesis by Tom J. Stuart, 1977. (NTSU)

3. The use of ATP assays in describing the limnology of H. H. Moss Reservoir, Texas. Ph.D. Dissertation by James T. Boswell, 1977. (NTSU)

4. Relation between carbon assimilation and biomass dynamics in a phytoplankton community. M.S. Thesis by Douglas P. Wilcox, 1977. (NTSU)

5. Seasonal and vertical distribution of organic carbon and biomass in H. H. Moss Reservoir, Texas. M.S. Thesis by William B. Perry, 1978. (NTSU)

6. Phytoplankton-salinity relationships in Lake Texoma. M.S. Thesis by William C. McCullough, 1978. (NTSU)

7. Distribution and population dynamics of zooplankton in Lake Texoma. M.S. Thesis by Larry B. Crist, 1979. (NTSU)

8. Size fractionation of metabolically active phytoplankton and bacteria in three diverse lake systems. M.S. Thesis by Bonnie K. Ellis, 1980. (NTSU)

9. Population dynamics of benthic macroinvertebrates in response to altered thermal and salinity regimes in the Brazos River, Texas. M.S. Thesis by James D. Coulter, 1981. (NTSU)

10. Ecological studies of Trichoptera in the upper Flathead Rivers, Montana. Ph.D. Dissertation by F. Richard Hauer, 1980. (NTSU)

11. The effects of freshet turbidity on selected aspects of biogeochemistry and trophic status of Flathead Lake, Montana. Ph.D. Dissertation by Thomas J. Stuart, 1983. (NTSU)

12. Consequences of fluctuating discharges from Hungry Horse Reservoir on benthic and larval fish ecology in the Flathead River, Montana. Ph.D. Dissertation by Sue A. Perry, 1985. (NTSU)

13. Limnology of Whitefish Lake, Montana. M.A. Thesis by Thomas Golnar, 1985. (University of Montana - OBE)

14. Trophic ecology of net-spinning caddisflies (Hydropsychidae) in the Flathead Rivers, Montana. M.A. Thesis by Maurice Valett, 1986. (University of Montana - OBE)

15. The use of riffle community metabolism as a measure of water quality in the Clark Fork River, Montana. M.S. Thesis by David Kicklighter, 1987. (University of Montana - EVST)

16. Effects of nutrient enrichment and lake level fluctuation on the shoreline periphyton of Flathead Lake, Montana. M.A. Thesis by Carolyn Hooper-Bauman, 1988. (University of Montana - OBE)

17. An ecological study of a regulated palouse prairie stream. M.S. Thesis by Juan Bosco Imbert, 1990. (University of Montana - OBE)

18. Ecology of an impacted northern Rocky Mountain stream. M.S. Thesis by Darlene Nardi, 1993. (The University of Montana - EVST)

19. Ecology of juvenile yellow perch in Lolo Bay, Flathead Lake, Montana M.S. Thesis by Michael Pol, 1993. (The University of Montana - OBE)

20. Distribution and abundance of zoobenthos in channel, springbrook and hyporheic habitats of an alluvial flood plain. M.A. Thesis by Georgia Case, 1995. (The University of Montana - OBE)

21. Phenologies of Plecoptera in the Virgin River, Zion National Park, Utah. M.S. Thesis by Mikel Shakarjian, 1997. (The University of Montana - EVST)

22. Phenology of *Mysis relicta* and influences on zooplankton of Flathead Lake. Ph.D. Dissertation by Dale Chess, 1998. (The University of Montana - OBE)

23. Grizzly bear digging in subalpine meadows: plant distributions and nitrogen availability. Ph.D. Dissertation by Sandra Tardiff, 1998. (The University of Montana - OBE)

24. Metabolism of hyporheos of the Flathead River, Montana. M.S. Thesis by James Craft, 1998. (The University of Montana - OBE)

25. Controls on seston dynamics alpine lakes. Ph.D. Dissertation by Dan Wicklum, 1998. (The University of Montana - OBE)

26. Determinants of primary production hot spots on alluvial flood plains. M.S. Thesis by Thomas Bansak, 1998. (The University of Montana - OBE)

27. Experimental fertilization of disturbance plots associated with grizzly bear digging in subalpine meadows. M.S. Thesis by Allison Young, 1998. (The University of Montana - OBE)

28. Analysis and dynamic simulation of morphologic controls on surface- and ground-water flux in a large alluvial flood plain. Ph.D. Dissertation by Geoffrey Poole, 2000. (The University of Montana -Forestry)

29. Ecology and population structure of cottonwoods on the Nyack Flood Plain, Montana. M.S. Thesis by Mary Harner, 2001. (The University of Montana - EVST)

30. Introduced *Mysis relicta*: Implications for pelagic food web structure and function. Ph.D. Dissertation by Craig P. Stafford, 2002. (The University of Montana - OBE)

31. The ecology of an invasive estuarine Mysid, *Neomysis mercedis,* in John Day Reservoir, Columbia River. M.S. Thesis by Craig Haskell, 2003. (The University of Montana - OBE)

32. Long-term osprey *(Pandion haliaetus)* population dynamics in relation to food web change at Flathead Lake, Montana. M.S. Thesis by Brandon Jackson, 2003. (The University of Montana - OBE)

33. Ecology of parafluvial ponds. Ph.D. Dissertation by Samantha Chilcote, 2004. (The University of Montana - OBE)

34. The importance and seasonal variation of terrestrial invertebrates as prey for juvenile salmonids on the Kol River Floodplain, Kamchatka, Russian Federation. M.S. Thesis by Lorri Eberle, 2007. (The University of Montana - OBE)

35. Sedimentary legacy of sockeye salmon (*Oncorhynchus nerka*) and climate change in an ultra-oligotrophic, glacially-turbid British columbia nursery lake. M.S. Thesis by Aaron Hill, 2007. (The University of Montana - OBE)

36. Amphipods are strong interactors in the food web of a brown water salmon river. M.S. Thesis by Audrey Thompson, 2007. (The University of Montana - OBE)

37. Lessons to learn from all out invasion: life history of brown trout (*Salmo trutta*) in a Patagonian river. M.S. Thesis Sarah O’Neal, 2008. (The University of Montana – OBE)

38. The edge effect: lateral habitat ecology of an alluvial river flood plain. Ph.D. Dissertation by Michelle Anderson, 2008. (The University of Montana - OBE)

39. The contribution of spawning Pacific-salmon to nitrogen fertility and vegetation nutrition during riparian primary succession on an expansive flood plain of a large river. Ph.D. Dissertation by Michael Morris, 2008. (The University of Montana - OBE)

40. Ecology of riverine sockeye in the Kwethluk River, Alaska. M.S. Thesis by Tyler Tappenbeck, 2008. (The University of Montana - OBE)

41. History, ecology and restoration potential of salmonid fishes in the Umpqua River, Oregon. M.S. Thesis by Kelly Crispen, Graduated 2010, defended 2011. (The University of Montana - OBE)

42. The ecology of parafluvial ponds on a salmon river. M.S. Thesis by Zachary J. Crete, 2012. (The University of Montana – Environmental Studies)

43. Ecology of Beaver and Salmon in a large Floodplain River. Ph.D. Candidate to finish 2012, Rachel Malison. (The University of Montana – Systems Ecology)

44. Salmon Dynamics and Brown Bear Behavior, Kodiak Island Alaska, Ph.D. research ongoing. William Deacy. (The University of Montana – Systems Ecology)

45. Food web ecology of the Nyack Aquifer. Ph.D. research ongoing, Amanda Delvecchia. (The University of Montana – Systems Ecology).

46. Reconstructions of Historic Salmon Runs using Baysian Inference. Ph.D. research ongoing. Nick Gayeski (The University of Montana – Systems Ecology)

POST DOCTORAL SCHOLARS SPONSORED (CURRENT AFFILIATION)

Charles A. S. Hall – Department of Biology, State University of New York, Syracuse
Thomas M. Gonser – Swiss Institute of Science and Technology, Zurich
Martin Pusch – Department of Biology, University of Berlin, Germany
Eric M. Snyder – Grand Valley State University, Michigan
Maria Laura Miserendino – Centro Nacional Patagónico University, Esquel, Argentina
Hugo M. Fernandez – Nacional University, Tucaman, Argentina
Samantha D. Chilcote – US Forest Service, Shasta-Trinity National Forest Headquarters
Megan V. McPhee – University of Alaska, Juneau
Matt Luck – Rubenstein School of Natural Resources and Environment, University of Vermont
Huan Wu – University of Maryland Goddard Earth Sciences and Technology Center
Meredith Wright – USDA, Albany, California
Youngwook Kim – Flathead Lake Biological Station, The University of Montana
Ashley Helton – Duke University

EXTRAMURAL COLLEAGUES OF LONG ASSOCIATION

James V. Ward – Swiss Institute of Technology (ETH), Zurich. (retired)
Svein J. Saltveit – University of Oslo, Norway
Klement Tockner – Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany
Charles A. S. Hall – State University of New York, Syracuse
Dmitry S. Pavlov – Russian Academy of Science, Moscow
Kirill V. Kuzishchin – Department of Ichthyology, Moscow State University, Russian Federation
Ksenia A. Savvaitova – Department of Ichthyology, Moscow State University, Russian Federation
Geoff Poole – Montana State University, Bozeman
Dan Goodman – Montana State University, Bozeman

SYNERGISTIC ACTIVITIES

- Frequent participant in national and international colloquia on strategic research agendas to sustain ecosystem goods and services (e.g., The Freshwater Imperative; National Environmental Observatory Network; Long-Term Ecological Research network).
- Gratis Consultant to The Nature Conservancy, Trout Unlimited, Gunnison River (Colorado) Coalition.
- Board Member of the Flathead Lakers, a conservation organization dedicated to the protection of Flathead Lake (1986–1990).
- Member of Finley Point (Montana) Volunteer Fire Department (1985–1994).
- Co-operator of Yellow Bay Advanced Wastewater Treatment Plant (1980–now).
- Public Speaker on environmental issues (several invited presentations per year, some international).
- Expert Witness, U.S. Congress on environmental issues: Senate Committee on Environment and Public Works (hearings on clean water and endangered species); Senate Subcommittee on Science and Technology (hearings on salmon restoration).
- Co-operator (with B. K. Ellis) of Duckhaven Ranch, an intermountain prairie wetlands restoration and education site located adjacent to the Ninepipes National Waterfowl Production Area, Ronan, Montana (1990–present).
- Expert Witness in successful adjudication of virgin river flows as permanent Federal reserve water rights for Glacier, Yellowstone and Zion National Parks.
- Founder of Nyack Flood Plain Research Natural Area, Middle Flathead River, Montana.
- Board Member of the Wild Salmon Center, Portland, Oregon (2003–2011). Conservation NGO dedicated to preservation of wild salmon and wild salmon rivers.

APPENDIX E

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT TACOMA

WILD FISH CONSERVANCY, *et al.*, Plaintiffs, v. NATIONAL PARK SERVICE, *et al.*, Defendants,	)))))))))	No. 3:12-CV-05109-BHS FIRST DECLARATION OF GORDON LUIKART

I, Gordon Luikart, declare the following to which I am competent to testify under penalty of perjury of the laws of the United States:

1. My address is 41229 Haystack Mountain Lane, Polson, Montana 59860. I have been retained as an expert on salmonid genetics by the Plaintiffs in this matter. This declaration supports Plaintiffs' First Motion for Partial Summary Judgment and Plaintiffs' First Motion for Preliminary Injunction;

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PROFESSIONAL QUALIFICATIONS

2. I have 20 years of professional experience researching and teaching at the college and university level. Since 2000, I have specialized in research and teaching in the area of animal conservation and population genetics;

3. From 1997-2000, I was a postdoctoral researcher in Europe working on large (five country) animal genetics projects funded by the European Union and also NSF-NATO. I received a Ph.D. in Organismal Biology and Ecology in 1997 and a M.S. in Zoology in 1992, both from the University of Montana (but including a year in Australia on a Fulbright fellowship). I received a Bachelor of Science degree in Biology from Iowa State University in 1988, with a minor in Animal Ecology;

4. Since 2005 I have spent part of each year researching and teaching as a visiting professor and senior research scientist at the Center for Investigation of Biodiversity and Genetic Resources at the University of Porto, in Portugal. For the last three years, I have spent the majority of each year researching and teaching as an associate professor at the University of Montana's Flathead Lake Biological Station. Courses I teach include graduate level wildlife genetics classes;

5. I have conducted genetic research on fish and wildlife populations in several different countries in addition to the United States and Portugal, including in Australia as a Fulbright Fellow, and in France as a government scientist where I won the bronze medal as a top researcher with the Centre National de la Recherche Scientifique. I have researched a wide range of species, including goats and other ungulates, carnivores, fish, and other aquatic species;

6. My research and teaching embraces various topics related to animal genetics/genomics, including disease-diagnostics (via pathogen DNA testing), modeling, captive

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and domesticated populations, endangered and threatened species recovery, gene flow affects on individual fitness and adaptation, and population size and structure, and monitoring of the genetically-effective population size and the effective number of breeders using genetic markers in natural populations;

7. I have conducted numerous research investigations on these subjects. Serving as a principal or co-principal investigator on more than 40 scientific research projects, my work has produced chapters in four l books, all relating to wildlife population genetics (one on animal domestication), and nearly 100 scientific papers in peer-reviewed international journals; and I recently (2007) co-authored a major textbook on conservation genetics (the second edition of this book is now in press);

8. My recent research projects involved developing a computer program simulator to model landscape level gene flow for aquatic species in complex river systems and papers on genetic sequencing in trout and in wild and domestic populations (including development of novel estimators of the number of breeders (spawners per generation) from genetic marker data);

9. My scholarship includes service on the editorial board of the journal Conservation Biology and as an associate editor for both Molecular Ecology Resources and the Journal of Heredity;

10. In the last five years I was recruited as an advisor for the Swan Ecosystem Center Native Fish Committee, and I am a member of the American Fisheries Society, the Ecological Society of America, the Society for Conservation Biology, the Society for the Study of Evolution, the Wildlife Disease Association, and the Wildlife Society;

11. Attached hereto as Exhibit 1 are my curriculum vitae, which include a list of all peer-reviewed publications I have authored since 1996;

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12. I have substantial familiarity with the genetics of animal domestication, adaptation to captivity, the effects of gene flow on fitness and population persistence in fish and wildlife, local adaptation in salmonids, and statistical and molecular empirical genomics;

13. I have not testified as an expert at trial or by deposition during the last four years;

14. I am being compensated for my work on this matter. My cost per hour is approximately $122, and I have worked for approximately 32 hours at this point;

15. In addition to drawing upon my knowledge and experience, I have reviewed and considered the following documents in developing my opinions expressed herein: The Hatchery Genetic Management Plan dated July 31, 2012, signed by Larry Ward for the propagation of native Elwha River winter-run steelhead ("Steelhead HGMP"), the Endangered Species Act section 7(a)(2) Biological Opinion on Reinitiation of Elwha River Ecosystem and Fisheries Restoration, issued to the National Park Service by NOAA Fisheries Service ("NMFS") dated July 2, 2012 ("2012 BiOp"), the Elwha River Fish Restoration Plan, dated April 2008 ("Fish Restoration Plan"), the Hatchery Scientific Review Group's ("HSRG") Review of the Elwha River Fish Restoration Plan and Accompanying HGMPs, dated January 2012 ("HSRG Report"), and the Letter of April 14, 2010 from George Pess, Jim Myers, and Jeff Hard of NMFS' Northwest Fisheries Science Center to the Lower Elwha Klallam Tribe. I have also spoken with individuals familiar with the Elwha River watershed, including Wild Fish Conservancy's Aquatic Ecologist Nick Gayeski and Dr. Jack Stanford;

SUMMARY OF OPINIONS

16. In summary, it is my professional opinion that implementation of the winter steelhead artificial production programs described in the Steelhead HGMP: (a) will most likely produce returning adult offspring that will have lower fitness (survival and reproduction) in the

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wild than native Elwha steelhead; (b) will result in the spreading of maladaptive genes from the hatchery fish to the wild population via interbreeding in the wild that will result in lower fitness and reduced local adaptation to the newly accessible riverine environments upstream of Elwha and Glines Canyon Dams of native winter-run steelhead; (c) will cause, through these adverse genetic effects, significant and likely long lasting harm to the native Elwha winter-run steelhead population and to the Puget Sound steelhead Distinct Population Segment ("DPS") to which the population belongs that will hinder and may prevent the full recovery of native Elwha River winter-run steelhead. The effects will also likely lower adaptive potential (i.e., the ability to adapt to environmental change such as climate change). It is my opinion that these programs should be discontinued, or at least significantly reduced (and then closely monitored), to prevent such damage to wild steelhead. Finally, the hatcheries and the release of hatchery fish introduces substantial risks of spread of infectious disease pathogens to wild fish, which is of enormous and increasing concern given spread of both native (endemic) and recently introduced European salmonid pathogens (e.g. viruses);

17. It is further my professional opinion that the previous releases of Chambers Creek steelhead into the Elwha River will likely result in the production of offspring from interbreeding between returning adult Chambers Creek steelhead and wild native steelhead that will have lower fitness (survival and reproduction), and thus result in fewer returning adults, than if those wild steelhead bred with only wild native stealhead;

THREATENED PUGET SOUND STEELHEAD

18. The Puget Sound steelhead DPS is listed as a "threatened" species under the Endangered Species Act ("ESA");

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19. The upper Elwha River contains a native rainbow trout population that produces steelhead included within the Puget Sound DPS, and the river downstream of Elwha Dam contains native Elwha River winter-run steelhead that have been confined to the lower Elwha River and are also ESA-protected. Adult fish from these two sources that return to the Elwha River in the coming years will now be able to recolonize the Elwha River basin upstream of Elwha and Glines Canyon dams;

20. Recovery of the Elwha River winter steelhead is essential to the recovery of the Puget Sound steelhead DPS. The Elwha River provides habitat capable of supporting the largest winter-run steelhead population of all the rivers entering the Strait of Juca de Fuca. The Elwha River steelhead constitutes a unique component of the geographic and evolutionary diversity of the Puget Sound steelhead DPS;

ADVERSE EFFECTS FROM HATCHERY DOMESTICATION

21. Hatchery domestication results from a process analogous to natural selection, but occurring under unnatural conditions—the individual fish "selected" are those better adapted to live in unnatural conditions (high density, no predators, no disease or different disease, unnatural food, artificial spawning). The process results in loss of the ability to avoid predation, loss of disease resistance, loss of ability to forage and spawn efficiently, etc. This artificial selection pressure is strong; it results in rapid adaptation to captivity with loss of the ability to survive and reproduce effectively in the wild. The genes underlying these maladaptive traits will be fixed (or at high frequency) in hatcheries (even after only a few months of differential survival of embryos to smolts). These domestication effects occur even when the hatchery fish are derived from the local wild population and the hatchery operations regularly incorporate local wild fish into the

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hatchery broodstock, as will be the case with the program at issue here as described in the Steelhead HGMP;

22. Bad genes from hatchery fish will likely be transmitted to wild fish and thereby reduce the fitness of wild fish if the hatchery fish are allowed to spawn in the wild, as is the express intention of the Elwha River program described in the Steelhead HGMP. The negative fitness effects of hatchery fish on natural populations are widely documented in the scientific literature (e.g., Araki et al., 2007a,b, Araki et al. 2009, Christie et al. 2011, Christie et al. 2012, Normandeau et al. 2009; Theriault et al. 2011; Grant 2011; Lorenz et al. 2012). The negative effects from hatchery gene introgression would likely persist for many years (generations), however few empirical data exist on duration of effects;

23. A wild winter-run steelhead supplementation program in the Hood River, Oregon was started in 1991 and has continued to the present. Conditions there allow the program to control the collection of adults for broodstock and the numbers of hatchery-produced steelhead that spawn naturally. It is important to note that such ideal conditions are not present for the Elwha River programs. The success of the Hood River program has been studied intensively by Dr. Michael Blouin and colleagues at Oregon State University, with key results reported in numerous peer-reviewed scientific publications (including Araki et al. 2007a,b, Araki et al. 2009, Christie et al. PNAS 2011, and Christie et al. Heredity 2012). Araki et al. have shown that on average first-generation hatchery fish produced from native wild broodstock have only 60% to 80% of the reproductive success in the wild compared to the native wild fish themselves. Araki et al. have also shown that when second-generation supplementation hatchery fish (i.e., the offspring of wild-spawning first-generation hatchery fish) spawn in the wild, they also produce fewer surviving adult offspring than pure wild fish (W x W). If two second generation hatchery

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fish spawn together, they have less than 40% of the reproductive success of two wild fish spawning together; spawning between a pure wild and a second generation hatchery fish (H x W) have less than 90% the success of two wild fish;

24. In a follow-up analysis of this same long-term data, Christie et al. (2011) have shown that the majority of offspring from matings in the hatchery between two wild parents (W x W) that survive to return and spawn in the wild will be produced by a few large families. Progeny from these few families are those that adapt best to the hatchery rearing environment and thus produce the majority of the migrating (released) smolts. It will be these hatchery progeny with lower relative fitness in the wild that will constitute the majority of hatchery-origin spawners each year. In other words, the majority of returning adults from a hatchery supplementation program will be made up of individuals with the lowest fitness in the wild of all returning hatchery adults. This was demonstrated as was the fact that the loss of fitness is a genetic effect (i.e., has a genetic basis), and was not an effect of the hatchery rearing environment;

25. In a recent publication, Christie et al. (2012) further showed that these phenomena result in the genetically effective population size of wild steelhead populations subjected to such supplementation programs is significantly reduced compared to a similar size wild population that is not subject to supplementation. This effect significantly increases the rate at which adaptive genetic material will be lost from the wild population under supplementation;

OPINIONS REGARDING THE NATIVE WINTER-RUN STEELHEAD PROGRAM

26. The hatchery programs described in the Steelhead HGMP are intended to apply to the initial "phases" of the Elwha River native fish restoration process, referred to in the Steelhead HGMP as the "preservation" and the "recolonization" phases. The principal motivation for the

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use of artificial production (hatchery) techniques during these phases is a concern that the process of removing the dams will result in high levels of suspended sediments in the mainstem of the river downstream of each dam that will produce extremely low survivals of salmon and steelhead eggs and juveniles, thus threatening the continued existence of the remaining native salmon and steelhead populations. The Steelhead HGMP is not clear regarding the definition of these two phases and the distinction between them. To the best of my understanding, the preservation phase is the phase from the start of dam removal in September 2011 to the period one or more years after the completion of the removal of Glines Canyon Dam when suspended sediment levels (during some relevant period of time) drop below some threshold levels of concern. Such levels have not, to my knowledge, been clearly defined. In any event, this phase is expected to last anywhere from three to five years;

27. The stated purpose of hatchery programs during the preservation phase is to "ensure persistence of the stock through the period of dam removal and channel stabilization by providing refugia for adult spawners during this high impact period." Subsequently, (presumably during the 'recolonization' phase) "the hatchery programs will increase adult returns to promote recolonization of suitable spawning habitat, by natural migration (once passage is restored) and by transport of some hatchery-origin adults into suitable habitat in side-channels and tributary areas unaffected by the dam removal process…. Recovery will be the primary objective of the hatchery program during the preservation and recolonization phases." Thus, the proposed steelhead hatchery program is intended to be entirely a conservation program. I address several concerns that arise in connection with the hatchery programs and practices in the context of these recovery objectives;

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28. I refer to hatchery programs in the plural because the Steelhead HGMP actually proposes two distinct kinds of hatchery activities that are to apply to the preservation and recolonization phases: a native winter-run steelhead captive broodstock program followed by a supplementation hatchery program;

29. The captive broodstock program involves (a) collecting fertilized eggs or newly-hatched "fry" from spawning nests of wild Elwha River steelhead in the river below Elwha dam, (b) taking them into the hatchery and rearing them in captivity at the hatchery until they are adults, (c) spawning them among one another when they are mature (typically at age 3 according to the Steelhead HGMP, although the sampling design section indicates an intention to rear them to adulthood at age 4), and (d) then rearing the offspring to smolt size at age 2. The egg/fry collection phase of this program began in 2005 and ran through 2011. The first groups of age-2 smolts (from the 2005 and 2006 collections) were released in the spring of 2011 and 2012. Future releases from succeeding broods are planned to be released annually through 2017 (from the 2011 collections). The Steelhead HGMP states that it is the objective of the program to release 175,000 smolts annually between April and June. Available information indicates that approximately 178,000 smolts were released in 2011 under this program;

30. What I will refer to as the supplementation phase involves bringing returning adults into the hatchery, mating and spawning them in the hatchery, rearing their progeny to age-2 smolts and releasing them from the hatchery. The Steelhead HGMP is unclear regarding when this program will formally begin, but it has either started in the spring of 2012 or is planned to begin in 2013 when adults from the 2011 smolt release from the captive broodstock program are first expected to return to the Elwha River;

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31. The primary purpose of both programs is to produce returning adults that will spawn in the newly-accessible habitat above Elwha and Glines dams. These returning hatchery adults will either mate on the spawning grounds with themselves (H x H) or with wild, naturally-produced native Elwha River steelhead (H x W). It is hypothesized by proponents of these kinds of programs that because all adults used as hatchery broodstock are either wild native fish or are founded therefrom, that all or a majority of the native gene pool will be preserved, along with the fitness of the wild population and its local adaptations. There are several concerns and risks with these assumptions;

32. The captive rearing of juveniles to adulthood and the subsequent rearing of their offspring to age-2 smolts poses significant risks of domestication selection (adaptation to captivity). The hatchery smolts released under this program will most likely have reduced fitness for survival and reproduction in the wild. Hatchery fish released under this program will interact genetically with native wild steelhead and resident rainbow trout that retain the genetic legacy of native Elwha River steelhead, and the resultant offspring will die at higher rates prior to spawning than would occur with two wild parents. Such reduced reproductive success is a direct harm to the Elwha River winter-run steelhead population and its ability to fully recover;

33. Typical steelhead hatchery programs, including most supplementation programs, reared smolts to age 1 to reduce program costs. Age 2 is a more normal age for wild winter-run steelhead in Puget Sound, and presumably Elwha River program managers are hoping that rearing hatchery juveniles more slowly to smolt size at age 2 will produce smolts that are more fit and will survive to adulthood at a higher rate than one-year smolts. Rearing in captivity for an additional year will provide even more opportunity for domestication to occur. If the additional rearing time in the hatchery increases the domestication effect, the program will produce both

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greater numbers of returning adults and less fit returning adults than a one year program. Even if there is no measurable difference in fitness reduction between returning adults from one-year and two-year smolt supplementation programs, if rearing to age two increases survival rates, the program will produce greater numbers of returning adults (which will have some level of lowered fitness) to spawn with native steelhead in the upper Elwha River than would a one-year-smolt program;

34. Approximately 175,000 winter-run steelhead were released from the hatchery in each of 2011 and 2012 during the months of April through June. It is my opinion that both of those releases constitute significant modifications to habitat that will kill and injure wild native Elwha River winter-run steelhead by significantly impairing essential behavioral patterns. These releases will result in some amount of cross breeding of hatchery and wild winter run steelhead, the progeny of which will have reduced fitness and therefore die prior to spawning at a higher rate than would otherwise occur. The proposed next release of approximately 175,000 native winter-run steelhead smolts to begin in April or May of 2013 will have the same result. It is not possible to quantify the precise number of steelhead that will die prior to successful spawning as a result of each release given the lack of available data. However, published studies, including those cited in paragraphs 22 through 25 above and 35 below, indicate that such reductions are significant;

35. The reduction in reproductive success that is expected from the hatchery programs described in the Steelhead HGMP is likely to have serious and long-lasting harmful effects on the rate that the native steelhead population can rebuild and recolonize the newly accessible habitat made available by the removal of the two dams. Araki and colleagues (Araki et al. 2009) estimated that the net effect on the whole naturally spawning winter-run steelhead

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population in Hood River resulting from the reduced reproductive success of fish from the supplementation program was 8% relative to a purely wild population of the same size. This is a significant amount. For example, if the size of the population that included the supplementation hatchery fish was 100 and this population had an annual growth rate of 1.0 (meaning that it just replaced itself every year), a purely wild population of 100 would have an annual growth rate of 1.087 (1/0.92). At this growth rate the purely wild population would double in approximately 8.5 years. Conversely, if the purely wild population was 8% less productive (annual growth rate of 0.92), it would decline to one-half of its initial size (50) in about 8.5 years;

36. The harmful effects on the fitness of wild spawning steelhead caused by the hatchery programs described in the Steelhead HGMP are highly likely to cause significant impairment to the fitness of the Elwha River wild winter-run steelhead population and thereby to the Puget Sound steelhead DPS. The Steelhead HGMP discounts the scientific literature demonstrating these adverse effects, stating:

> However, very few steelhead studies have utilized an experimental design that distinguishes the genetic basis for this difference from the effects of different rearing environments. Thus it is unclear how much this reduced fitness is from phenotypic plasticity and would therefore potentially be reversible relatively rapidly. The actual risk to the genetic integrity of a wild population is, to some extent, offset by post-release selective forces and by reduced spawning success of hatchery origin adults due to spawning site and mate selection.

The Hood River studies described herein in fact show that the domestication effect causing loss of fitness unequivocally contains a genetic component. Consequently, the lower reproductive success of hatchery spawners in the wild, which will include spawning between hatchery and wild steelhead and native rainbow trout, will result in the spread of maladaptive genes to the already depressed wild population. This risk to the genetic integrity of the wild population will therefore assuredly not be offset by the reduced spawning success of hatchery origin adults.

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Further, as noted herein, the circumstances on the Hood River provided precisely the (rare) conditions needed for creating an experimental design capable of distinguishing the effects of genetics from those of the rearing environment and this is precisely what Dr. Blouin and his colleagues achieved. The serious risks that are thus known to attend hatchery supplementation of winter-run steelhead appear to be largely dismissed or ignored by those moving forward with the hatchery programs on the Elwha River;

37. The domestication effects and resulting loss of fitness in the wild due to hatchery supplementation shown by Michael Blouin and colleagues in Hood River occur under nearly ideal conditions that permit only wild, non-first-generation hatchery progeny, to be used for hatchery broodstock. These effects will be worse, fitness in the wild even lower, when returning adults produced by either the captive brood or the supplementation program (first-generation hatchery adults) are taken back into the hatchery for broodstock as proposed in the Steelehad HGMP. The Steelhead HGMP does not call for achieving a specific proportion of its broodstock from wild (natural origin) fish until the "local adaptation" phase. That is planned to occur after the "recolonization" phase—at least ten years, or two steelhead generations—after the release of hatchery smolts in 2011. This violates the reasonable guidelines for the composition of broodstock for conservation hatchery programs recommended by the HSRG. The HSRG recommends that at least 50% of the broodstock should be obtained from natural origin adults. By ignoring even these modest guidelines, the program described in the Steelhead HGMP will incur a high risk of producing two or more generations of hatchery fish to spawn in the wild that will have increasingly reduced fitness relative to the current wild population;

38. Compounding this, the expected returns in the near-term from the release of 175,000 hatchery smolts in 2011, 2012, and planned for 2013, will be approximately 1300 per

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generation. Most of these fish will return after one or two years in the ocean, and are expected to result in 500 to 700 returning in 2013 and twice that many in succeeding years. The wild population returns in the near-term will be smaller than 200. As a result, during the next five or more years the hatchery-origin fish will outnumber wild (natural-origin) fish on the spawning grounds by anywhere from 3-to-1 to 8-to1. This ratio is far in excess of that deemed acceptable by the HSRG. At most, hatchery-origin adults from such programs should constitute no more than one-half of all adults on the spawning ground, and the percentage should only be that high when the hatchery broodstock is composed entirely of wild, natural-origin, fish. When wild fish are a small percentage of the hatchery broodstock, as is proposed in the Steelhead HGMP, the percentage of hatchery fish allowed on the spawning grounds must be much lower than 50%. The hatchery programs described in the Steelhead HGMP ignore these guidelines and plan for returning hatchery-origin adults to compose at least two-thirds of the steelhead spawning in the Elwha River during the first two generations of the hatchery program. This will result in significantly lowered fitness of the wild population through repeated cross-breeding between the remaining wild adults and the domesticated and increasingly inbred hatchery fish;

39. The risks posed by the steelhead hatchery programs are exacerbated by the Steelhead HGMP's reliance on a plan for monitoring, evaluation, and modification—the Elwha Monitoring and Adaptive Management Plan ("MAMP")—that either does not exist or has not been finalized. Thus, it is essentially unknown whether or not the hatchery programs will be properly monitored, nor whether sufficient funding even exists for timely monitoring and evaluation of likely harmful effects of the proposed hatchery actions. This is not a minor deficiency. Rigorous monitoring and evaluation of the success of hatchery programs and of their impact on wild salmonids, along with clearly defined adaptive management protocols, are

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essential to preventing unwarranted and severe harm to wild fish populations. It is not possible to adequately evaluate the risks the hatchery programs pose to wild salmonids and their recovery without knowing how those programs will be monitored, evaluated, and modified in response to changing conditions. In other words, the MAMP is a central and critical part of the hatchery programs, not a tangential document that should be developed seven or eight years after the program was first initiated. This is especially important given the rapidly improving ability of biologists to use molecular and computational tools to monitor gene flow and the effects of hatchery introgression on individual fitness and population performance (i.e., growth rate and probability of persistence);

40. The hatchery programs pose additional risks to the native steelhead population due to the Steelhead HGMP's vague and qualitative characterizations of goals, performance standards, and performance indicators that render it nearly impossible to know whether the goals of the program are or can be attained, or whether adverse effects will be detected in a timely fashion so as to permit appropriate management actions to be taken to prevent adverse effects from continuing;

41. The lack of plans for measuring the rates at which returning hatchery-origin adults are able to reproduce in the wild and comparing them to the rates of wild, non-hatchery-origin fish poses additional concerns. The Steelhead HGMP includes a "performance indicator" for this, but it does not describe how the program will be measured or monitored to determine whether the indicator is being achieved. Further, there is no description of what, if any, changes will be made if and when monitoring shows that this indicator is not being attained. Unless the relative reproductive success of the hatchery fish can be monitored in an accurate and timely manner, the annual growth rate of the wild population could be declining while the numerical

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increase in the total population spawning in the wild annually is increasing due to the returns of hatchery fish. It is critical for the program to have standards in place to limit these harmful effects and monitoring in place to detect them in a timely fashion;

42. The failure of the hatchery programs to appropriately monitor and limit the total numbers of hatchery-origin adults on the spawning grounds and the proportion of those fish to the natural-origin fish is of further concern. The Steelhead HGMP includes a "performance indicator" for the number of naturally spawning adults ("Adult return numbers of >= 200) but it does not restrict this number to natural-origin recruits (returning adults whose parents spawned in the wild) as it should, nor is this number explained or justified. The hatchery programs alone are likely to insure that an annual return of 200 or more winter-run steelhead reach spawning grounds even if no natural-origin adults do. The expected or intended target levels of hatchery-origin adult returns must be balanced proportionately to expected levels of wild adult returns and tied clearly to monitoring of these proportions and to the fundamental objective of steadily increasing the total number of wild (non-hatchery-origin) adults. In order to contain and minimize significant genetic risks, both the total numbers of hatchery adults on the spawning grounds in the wild annually and the proportion of these fish to the total naturally-spawning population must be limited;

43. The Steelehad HGMP states that the objective of the program is to release 175,000 age-2 smolts from the hatchery program annually. This is far in excess of what can be justified on the conservation ground of providing a "refuge" for the native winter-run steelhead population from high suspended levels. The Steelhead HGMP indicates that a smolt-to-adult survival of 0.75% (0.0075) is expected. At this rate, 175,000 smolts would result in the return of over 1,300 adult hatchery fish to the Elwha River annually. The hatchery programs propose an

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annual broodstock collection goal of 200-500 hatchery-origin adults. Given the information on egg-to-smolt survival for the captive broodstock phase provided in the Steelhead HGMP, no more than 100 females would be needed to produce the annual target number of 175,000 age-2 smolts. The data provided in the Steelhead HGMP indicates that annual releases of 175,000 smolts will result in anywhere from 800 to 1,100 hatchery-origin adults returning to spawn in the wild (accounting for adults collected for broodstock). This is far in excess of what is appropriate for a short-term safety-net hatchery program, especially in light of the significant risk that the hatchery-origin fish pose to the fitness and long-term viability of the native winter-run steelhead population;

44. The Steelehad HGMP implies that there may be three distinct types of parents used to produce hatchery smolts: captive broodstock adults, returning hatchery-origin adults, and returning wild-origin adults. It makes a very big difference genetically how many of each of these three potential parent types are used to produce any particular brood year of smolts, and there should be a clear quantitative protocol governing the numbers and proportions of each. The hatchery programs' failure to include such protocols greatly increases the genetic risks posed to the wild steelhead population;

45. The hatchery programs propose not to visibly mark hatchery steelhead until 2015. Consequently, it will not be possible to readily identify hatchery-origin adults at trapping facilities such as the weir downstream of Elwha Dam or in hatchery holding ponds, or by visual inspection on the spawning grounds or in tribal net catches planned for removing the returning Chambers Creek hatchery adults in 2012-13 and 2013-14. Wild steelhead are exposed to greater risks if the number of hatchery fish allowed to spawn in the Elwha River cannot be accurately monitored and controlled;

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46. Another problem caused by hatcheries and the release of hatchery fish is that they greatly increase risks of disease transmission to wild fish. This occurs because of the unnaturally high densities of fish maintained in captivity leads to increased risk of infection and thus subsequent transmission through water or directly from fish released by hatcheries into wild native populations;

47. It is my professional opinion that, to the extent that there is no legitimate concern regarding the extirpation of the wild Elwha River winter-run steelhead population from dam removal, the hatchery programs described in the Steelhead HGMP should be immediately discontinued. This includes hatchery releases and broodstock collection activities. Any introgression of maladapted genes from hatchery fish into the wild fish population will likely have long-lasting adverse effects on that population and its ability to fully recover. The 175,000 hatchery steelhead proposed to be released between April and June, 2013, will return in years two and three after their release. Some of these fish will most likely cross-breed with wild steelhead, and it is highly likely that the resultant offspring will have reduce fitness for survival and reproduction in the wild. Maladapted genes introduced into the wild steelhead population will likely persist for many generations even after the returns of hatchery fish have ceased, thereby causing long-lasting harm to the population. Similarly, the broodstock collection activities proposed this winter of 2012-2013 are likely to interfere with wild steelhead spawning migration and success. Any reduction in the spawning success will harm this depressed wild steelhead population and its ability to recover. Given that wild steelhead have already been observed to have migrated and spawned in safe habitats upstream of Elwha dam, it appears that there is little risk that the wild population would be extirpated from the dam removal process in the absence of the hatchery programs;

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48. To the extent that there are legitimate concerns about the potential for extirpation, then it is my professional opinion that the hatchery programs should be minimized to that level necessary to achieve the Steelhead HGMP's stated objective of conserving the stock during dam removal. Such a program would greatly reduce the genetic risks posed to wild steelhead. No more than 50,000 steelhead smolts should be released annually. At the anticipated smolt-to-adult survival rate of 0.75%, 50,000 smolts would return 375 adults annually. This is more than enough to provide the egg take required to sustain the annual smolt releases and support a conservation program. There is no need for broodstock collection activities to occur during the winters of 2012-2013 or 2013-2014, as the captive broodstock program will continue to provide broodstock for releases through 2017. Accordingly, any potential harm to the spawning success of wild steelhead from these activities should be greatly limited or entirely prevented;

49. As previously noted, recovery of the Elwha River winter steelhead is essential to the recovery of the Puget Sound steelhead DPS. The steelhead hatchery programs proposed in the Steelehad HGMP pose a threat to the recovery and de-listing of the Puget Sound DPS of steelhead. These programs should be terminated or, at a minimum, reduced to prevent severe and lasting harm to this species;

OPINIONS REGARDING THE CHAMBERS CREEK STEELHEAD PROGRAM

50. It is my understanding that the non-native Chambers Creek steelhead program began over thirty years ago. This program has targeted a release of approximately 65,000 to 150,000 yearling smolts each year. The two most recent releases of smolts under this program occurred in spring 2010 and spring 2011, with releases of approximately 51,500 smolts and approximately 61,000 smolts, respectively;

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51. The Chambers Creek steelhead stock is a highly domesticated, non-native stock. The origin and history of this stock is well described by NMFS staff biologists in the Letter of April 14, 2010 to Lower Elwha Klallam Tribe;

52. Chambers Creek hatchery steelhead will continue to return to the Elwha River for the next two to three years from pervious smolt releases. These fish are visibly marked by a missing adipose fin and so are easy to identify as non-native. Managers correctly do not want these fish spawning in the wild and are planning fisheries actions (i.e., harvests in the Elwha River downstream of Elwha dam during management seasons 2012-13 and 2013-14). However, the Steelhead HGMP provides no details concerning such harvests and does not acknowledge or discuss the risk these fisheries pose to native steelhead due to use of non-selective fishing gears (such as gill nets) and from capture-and-release using selective gear (such as beach seines). Many of these returning Chambers Creek-origin adults will likely return to the hatchery where they could easily be removed. Keeping the gates to the hatchery outfall open and the adult holding ponds regularly staffed over the entire duration of the winter-run steelhead return would help greatly to reduce the risk of Chambers Creek fish spawning in the wild;

53. It is likely that some Chambers Creek steelhead previously released into the Elwha River in 2010 and 2011 will interact genetically (crossbreed) with wild native steelhead when they return to the Elwha River as adults. The resultant offspring will very likely be less fit to survive and reproduce in the wild, and will therefore die without spawning at a higher rate that would otherwise occur;

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

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Executed this 13 day of November, 2012.

Gordon Luikart

Gordon Luikart, Associate Professor
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EXHIBIT 1

Curriculum Vitae

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Visiting Senior Scientist, Center for Investigation of Biodiversity and Genetic Resources (CIBIO), University of Porto, Portugal, 4485-661 Vairão, Portugal. http://cibio.up.pt/

BIRTH/FAMILY: Born 30 October, 1964; Sioux City, Iowa, USA; American citizen; France residency card; married, two children

EDUCATION: Ph.D., University of Montana, 1997, Organismal Biology and Ecology
Supervisor: Dr. Fred Allendorf; Field supervisor: Dr. J. T. Hogg
M.S., University of Montana, 1992, Zoology
B.S., Iowa State University, 1988, General Biology, minor in Animal Ecology

POSTDOCTORAL:
Research Fellow, Population Genetics and Demographic History, CNRS, France, 1999-2000.
NSF-NATO Postdoc Fellowship, Conservation Biology and Population Genetics, 1998-1999
Advisors: P. Taberlet (Université Joseph Fourier, France), J.-M. Cornuet (Institue Nationale Recherche Agriculture, France).
European Postdoc Fellow, Conservation & Evolutionary Genetics, Université Joseph Fourier, 1997-1998.

RESEARCH INTERESTS: Conservation Biology, Ecology, Evolution, Population/Landscape Genomics

EMPLOYMENT:
2010-current, Associate Professor, Flathead Lake Biological Station, University of Montana, USA
2005-2010, Research Associate Professor, Organismal Biology and Ecology, University of Montana, USA
2005-current, Visiting Professor, University of Porto, Porto, Portugal
2005-current, Visiting Senior Research Scientist, CIBIO, Vairão, Portugal
2003-2005, Faculty Affiliate, University of Montana, USA
2004-2005, Research Scientist, Montana Conservation Science Institute (MOCSI), USA
2001-2005, Research Scientist (CR1), CNRS (Centre National Recherche Scientifique), France
(Officially on leave without pay since 2005)
2000-2001, CNRS, Research Fellow, Statistical and Population Genetics, France
1991-1992, Teaching Assistantships, Biological Station, U. of Montana (Aquatic Botany, Mammal Ecology)
1989-1995, Teaching Assistantships, U. of Montana (Genetics & Evolution, Conservation Genetics, Mammalogy, Ecology, Anatomy & Physiology),
1987, Research and Teaching Assistant, Sumilon University, Philippines (SCUBA diving & Marine Biology)
1986, Field Research Assistant, Virginia Polytech Institute (trapping & banding passerine birds)
1985-1986, Iowa Department of Natural Resources (gill-netting, radio-telemetry of fish, grouse, & otters)

ACADEMIC HONORS:
Adjunct Professor (can supervise grad students), Wildlife Program, University of Montana, 2010-current
Bronze medal, a top scientist in France CNRS (Centre Nationale de la Recherche Scientifique), 2004-2005
Doctoral Research Fellowship, University of Montana, 1996
Fulbright Fellow, La Trobe Univ., Melbourne, Australia, 1994-95 (Genetics of Endangered Marsupials)
Scholarship: top 5% of graduate students in research at The University of Montana, 1991, 1994
Phi Beta Kappa National Honors Society Award (top 5% of liberal arts students in USA), 1988

PROFESSIONAL ACTIVITIES: 2001-2004, Journal editorial board member for *Conservation Biology*
2003-2006, Journal associate editor for *Molecular Ecology Resources*
2009-2011, Associate editor for *Journal of Heredity*
2001-current, Member IUNC Caprinae Specialist Group
2006-2011, ConGen International Course on Population Genetic Data Analysis (http://popgen.eu/congen2011/)
2010-curent, Member Swan Ecosystem Center Native Fish Committee

SOCIETIES (Last five years): American Fisheries Society
Ecological Society of America
Society for Conservation Biology
Society for the Study of Evolution
Wildlife Disease Association
Wildlife Society

BOOKS:

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Amish, S., Y. Hoareau, C. Almendra, N. Anderson, P.R. Clark, H. Edwards, R. Frey, M. Gruber J. Henningsen, R. Wallen, G. Luikart. Sensitive pathogen detection in nonlethal and noninvasive ungulate samples using PCR. In prep.

SELECTED GRANTS AND CONTRACTS AWARDED OR CONTINUED (Selected recent grants & contracts):

a. Grants Awarded or Continued as Principal Investigator/Project Director

NSF–EID (Ecology of infectious diseases): Effects of land-use and predation risk on wildlife contact networks and *Brucella* transmission in the Yellowstone Ecosystem. 2010-2014.
NSF-EID: Microparasite-Macroparasite Interactions: Dynamics of Co-infection and Implications for Disease Control. V. Ezenwa, A. Jolles, G. Luikart, E. Nunn. 2007-2011.
NSF-IGERT: Montana Ecology of Infectious Diseases: Integrative Graduate Training on Multi-scalar Computational, Mathematical and Empirical Approaches to Complex Biological Problems. Added as co-PI with Bill Holben, Jesse Johnson, Jonathan Graham. 2006-2012.
NSF-OPUS: Evolutionary genetics and the conservation of exploited populations. DEB0639770. Co-PI Gordon Luikart with Fred Allendorf (PI). 2008-2011.
USGS-PNW Climate center: Predicting Climate Change Impacts on River Ecosystems and Salmonids across the Pacific Northwest: Combining Vulnerability Modeling, Landscape Genomics, and Economic Evaluations for Conservation. Funded 2012-2014. $208,000.
ARC (Australian Research Council) Linkage grant funding for a research project entitled "Genomics for persistence of Australia freshwater fish". P. Sunnucks et al. 2010-2015.
USFWS: Development and application of SNPs for estimating the number of breeders in lake trout following suppression. 2012-2013.
MFWP: New DNA Markers to assess hybridization, local adaptation, and restoration success in bull trout. 2011-2014.
MFWP: Hundreds of new SNP markers to detect hybridization in westslope cutthroat trout. 2011-2014.

MFWP: Development and Validation of Q-PCR Tests for Early Detection of *Dreissenid* mussels. 2011-2012.

USFS: Admixture and diversity assessments in westslope cutthroat trout of the Swan River drainage: SNP-chip analyses, 2011-2013.

POBS (Park Oriented Biological Research): Developing non-invasive techniques for bighorn sheep population estimation using fecal DNA. Kathryn A. Schoenecker, et al. 2009-2011.

APPENDIX F

Comments on WDFW Elwha Summer/Fall Chinook Hatchery Program

Nick Gayeski

Wild Fish Conservancy

July 20, 2012

Introduction.

The draft HGMP (Draft) is, as the Department acknowledges, incomplete. Among the missing elements necessary for a substantive technical review is a copy of the Elwha Monitoring and Adaptive Management Plan (EMAMP) that is referenced numerous times throughout the HGMP. Most of these references regard substantive monitoring objectives and quantitative indicators of program objectives. Absent the details that are presumably contained in the EMAMP, we cannot evaluate the merits of the sections of the Draft that rely on these references. It is equally clear that NOAA cannot evaluate whether the Draft merits the 4(d) take exemption for which the HGMP is an application without these and related kinds of details.

We, therefore, interpret the request for public comments on the Draft to be a request for constructive criticism and suggestions to improve the Draft. It is in this collegial spirit that we submit the following comments. We provide our comments primarily as general comments addressing issues or topics of general concern that we think are of the most importance to revising the Draft and making the program a genuine integrated conservation program. Specific comments are provided on a few specific points in sections 1 and 6 of the Draft to help illustrate some of the deficiencies described in the general comments as they occur in the HGMP template. These are by no means meant to be exhaustive but rather we hope that the general comments will sufficiently indicate the primary kinds of changes and added detail we believe should be added, and we trust that these comments are taken in the constructive spirit intended.

General Comments.

The decision to pattern the purpose, goals, and objectives of the Elwha Chinook program after the temporal division recommended by the Hatchery Science Review Group (HSRG) in its review of the EFRP (Hatchery Science Review Group, Review of the Elwha Fish Restoration Plan and Accompanying HGMPs, January 2012) viz., Preservation, Recolonization, Local Adaptation, Full Restoration phases, is overall a sound one. However, it is important to take into account the fact that there is not a sharp division between the first three phases, and that consequently objectives relevant to a later phase such as Recolonization or Local Adaptation may need to be accommodated during the preceding phases(s). Evidence of upstream migration of Chinook and winter steelhead since the start of the removal of Elwha Dam in the fall and winter of 2011/2012 suggest that recolonization will occur during the Preservation stage, and since natural reproduction is expected to occur as a result of natural spawning upstream of Elwha Dam, it should also be expected that local adaptation will begin to occur, and this must be considered in the shaping and conduct of the program during the Preservation phase.

In view of the degree of uncertainty regarding the speed with which each of these first three stages may occur, it does not seem likely that NOAA Fisheries will grant a 4(d) take permit for the entirety of the expected duration of the Chinook program. We therefore are supportive in principal of the Department's request for coverage "only through the Preservation and Recolonization Phases…" (Draft, page 4). Rather, given the uncertainties regarding the duration of each of these initial phases, it seems wisest to request coverage for a short term of no more than five (5) years, and to plan from the outset to revise the HGMP in light of the monitoring data that should be collected during this time period. Then, an appropriately revised HGMP should be submitted and the duration of this second HGMP should be based on the status of the Chinook population at that time and the performance of the hatchery program over the initial five-year period.

The fundamental purpose of the Preservation phase is "to ensure an adequate number of fish survive the dam removal process to effectively preserve and restore currently extant fish populations in the watershed", including to "[m]aintain the integrity of the existing salmonid genetic and life history diversity before during and after dam removal…" (HGMP, Section 1.16, page 10). Much is made in the Draft specifically with regard to the Chinook population of the need for the program in order to preserve the genetic diversity of the remnant Elwha Chinook summer/fall population. Yet, the HGMP provides no specifics whatsoever regarding extant levels of genetic diversity that are important to preserve, nor the kinds of genetic data that should be monitored. If the primary purpose of the program is to preserve extant genetic variation, that variation should be described and the appropriate parameters and their threshold levels identified: e.g., marker types and names of loci, heterozygosity/gene diversity, number of alleles. Without identifying these genetic parameters and their current levels in the population, it will not be possible to determine whether the program is succeeding in preserving these, nor is it really possible to determine how the program should best be conducted to insure that the requisite diversity is maintained. We note that the HSRG has made the same point in its review of the EFRP (e.g., HSRG Review, Table 2-6, page 16).

Since some degree of recolonization appears to already be occurring, local adaptation is likely to be occurring as well and the program needs to insure that this process is not being interfered with by program activities, such as broodstock collection. This requires some dedicated research and associated monitoring of the population (both hatchery and wild), that should include the identification and use of genetic markers that may reflect selection and local adaptation, such as SNP's and MHC genes. It also requires careful consideration of the scale of the hatchery's brood program itself, which on the face of it appears to be entirely too large.

The survival data from the program raise a serious concern whether the program, as it has been conducted to date, has been successful in preserving the genetic diversity of the extant Chinook population and its fitness for life in the wild. The poor survival of both hatchery yearling and subyearling releases is suggestive of a severe loss of fitness. This overall loss of fitness is likely further exacerbated by the high level of releases (in excess of 2.5 million subyearlings annually) that are required to obtain the number of adult returns to the hatchery needed to sustain the program at its current size (1700 adult broodstock). The fact that the current Elwha population has retained its genetic distinctness from other population within the Puget Sound ESU is entirely consistent with its having become highly domesticated.

The recent documentation by Beamish and colleagues of a wide disparity in the survivals of hatchery and wild fall Chinook in southern Georgia Strait (Beamish et al. 2012) is further cause for concern regarding the past performance of the Elwha Chinook program, and indicates a need for directed research on the survival of juvenile Chinook in the Elwha nearshore. Yet, Section 12 of the Draft identifies no research, and merely indicates that research needs will be identified in the EMAMP.

It seems imperative that the program be altered so as to significantly reduce the level of domestication. This likely requires at least two actions: a reduction in the size of the program and the planned incorporation of natural-origin (non-F1) returning adults into the hatchery broodstock sufficient to attain a minimum target level of pNOB. The minimum levels of pNOB and the time and methods required to achieve this should be given the highest priority in the revision of the HGMP in conjunction with the timely involvement of members of the HSRG and/or NOAA Fisheries Conservation Biology Division genetics staff (e.g., Jeff Hard or Mike Ford). Consideration should also be given to genotyping all hatchery broodstock and conducting parentage analyses of as many returning adults as possible to evaluate relative reproductive success of hatchery adults spawning in the wild (within pHOS limits that also need to be identified and monitored).

In regard to the number of broodstock, in addition to the above concerns and issues, it would appear to be more consistent with the Preservation strategy that the program be sized so as to achieve a minimum viable annual population size (Nb) in the hatchery on the order of no more than 500 including a minimum number of NOR's to attain or exceed a minimum level of pNOB. This will require consideration of how best to mark hatchery-origin progeny so that they can be identified at least before they are spawned, and preferably sooner. A similar minimum viable population size for the wild-spawning population, with maximum permissible levels of pHOS (also on the order of at least Nb = 500), that the hatchery program is primarily intended to support needs to be identified. These two population sizes – a maximum hatchery broodstock population meeting minimum pNOB standards, and a minimum viable naturally-spawning population meeting maximum allowable pHOS standards (or the two combined meeting PNI standards) – together determine the overall size of the conservation hatchery program during the first two phases while at the same time facilitating local adaptation.

The conservation purpose of the Chinook program – to preserve specified, quantitative levels of genetic diversity, constrain the risks of domestication selection, and facilitate the local adaptation of naturally spawning Chinook recolonizing the Elwha basin upstream of Elwha Dam – should be the sole focus of the HGMP during at least the initial ten years. Accordingly, the HGMP should not endorse conjectures about the expected size of the rebuilt population and potential levels of MSY escapement. These have no direct bearing on how best to carry out and achieve the delimited, short-term conservation objectives. Supporting to the minimal extent possible the achievement and maintenance of a minimum viable Nb in the naturally-spawning population should be the sole purpose of the program.

It is also imperative to consider how to mark all or at least a significant subset of coded-wire-tagged hatchery releases in order to allow for the analysis of current harvest impacts, as recommended by the HSRG (Review, page 31). At the same time WDFW and the tribal co-managers should encourage US representatives to the Pacific Salmon Treaty to work to require all commercial fisheries to monitor their catches for CWTs so that adipose clips will not be required. In addition (or as a possible alternative), an effort should be made to include Elwha Chinook in the regional Genetic Stock Identification database, so that harvest impacts can be evaluated on the basis of GSI. These need to be included explicitly in Section 12 (Research) of the final HGMP.

The identification of the Preservation and Recolonization phases is driven largely by the concern that during and immediately following dam removals suspended sediment levels will frequently reach levels lethal to rearing juveniles and pre-spawning adults and that no refuges from high sediment levels exist in the Elwha basin downstream of Glines Dam. This is a hypothesis and there is some controversy among knowledgeable biologists surrounding it. This hypothesis needs to be explicitly articulated and monitoring designed, funded, and conducted to evaluate it. In the event that some levels of successful natural spawning and juvenile rearing occur during the dam removal period, these data must be linked back to the scale of the hatchery program so that the program can be appropriately modified if it appears that significant successful natural spawning is occurring sooner than expected during this initial period.

The HGMP should also make clear whether or not it endorses the recommendation of the HSRG (HSRG Review, page 27) that all hatchery juvenile Chinook should be released from the hatchery and that the various plans for releasing juvenile Chinook upstream of Elwha Dam described in the EFRP have been abandoned. This seems to be implied in the Draft but not explicitly stated and it would be helpful for the HGMP to make this clear. We strongly support the HSRG recommendation.

Specific Comments.

Section 1.

1.6. Type of Program. "Integrated recovery". The HGMP here needs to be clear about whether it means by integrated recovery what the HSRG meant by this term, and if so, what specific levels of pHOS and pNOB the program will achieve, why, and how.

The parenthetical citing to section 2.2.3 for estimated levels of pHOS and 6.2.3 for pNOB is insufficient and inappropriate here. Section 2.2.3 does not discuss pHOS levels much less report any quantitative estimates of past or current levels of pHOS. Section 6.2.3 commits to no minimum levels of pNOB during the Preservation and Recovery phases.

The issue of the levels of pHOS and pNOB that are required in order that the program operates during the Preservation and Recovery phases as a valid integrated recovery program (as defined by the HSRG) is critical and needs to be addressed clearly here at the beginning of the HGMP.

1.7. The goals for each phase should first be informed by a determination of the minimum number of spawners in the wild that is required to maintain fitness of the remaining wild Chinook population. The hatchery program should be clearly subordinated to assisting in the attainment of this objective, within the constraints required by pHOS standards. Minimum viable annual spawner numbers (effective breeders, Nb) should be the guiding target. This should be noted and the requisite Nb number identified here at the outset. As noted in the General Comments above, a broodstock of 1700 spawners annually appears to be unjustifiably large. Further, the composition of the broodstock (with respect to F1 hatchery-origin and natural-origin) needs to be identified. In any case whatever number is decided upon a clear justification in terms of the conservation purposes needs to be provided.

1.7. Goal, Phase 1, Preservation. This needs an Adaptive Management provision to evaluate the *hypothesis* that sediment levels during dam removal may result "in a high probability of complete loss of native fish populations…". As noted in General Comments. several highly qualified scientists dispute this claim. This concern needs to be explicitly acknowledged to be a hypothesis and appropriate monitoring to evaluate it identified.

“Hatchery program role”: The text is far too general and vague.

What is required, quantitatively, to “[m]aintain the genetic characteristics of the extant population” needs to be clearly stated, and if it is not known (as appears to be the case), specific plans for acquiring the information necessary to describe these characteristics need to be provided.

The “desired adult return levels” need to be stated explicitly and justified with respect to the conservation purposes of the program. The relationship of the specific desired levels of adult returns, to the preservation of the genetic characteristics of the population in particular need to described and justified. Why, for example, are 1700 adults required when far fewer hatchery spawners will suffice? The current escapement goal of 2900 needs to be reconsidered and revised in terms of NOR’s and in view of the conservation objectives of the program during the Preservation and Recolonization phases. An escapement of 2900 predominately F1 domesticated hatchery-origin adults is in direct conflict with the conservation objectives.

Phase 2, Re-colonization:

“hatchery program role”: “continue operation of the hatchery program, allowing returning hatchery fish to escape to spawning grounds to supplement natural spawning abundance”. This is too vague.

Reference should be made to specific threshold levels of pHOS (proportion of F1 spawners) and to the absolute number of Chinook spawners (Nb) in the wild. We have suggested how the program should be scaled in this regard in the General Comments above. We also recommend that the advice of the HSRG be sought to help determine these targets.

Phase 3, Local adaptation.

As noted above, the minimum “number of spawning adults” and associated pHOS standard required to initiative this phase should be identified at the outset of this subsection.

“The goal of the Local Adaptation Phase is to maintain or increase life history diversity of wild populations through local adaptation …until minimal levels of spawner abundance, productivity, and distribution are met.” Again, the target “minimal levels of spawner abundance, productivity, and distribution” should be identified in advance, as annual spawners Nb, returning NOR adults per NOR spawner, and outmigrating smolts per NOR spawner. The vague language of “minimal levels” needs to be replaced by specific numeric target levels.

Further, the quoted statement seems to erroneously imply that it can be known in advance what levels of “life history diversity” the Chinook population is capable of attaining. This appears to put the cart before the horse: what the hatchery program can legitimately claim to be able to assist with is to achieve minimum desirable, quantified levels of Nb in the wild, if necessary, and appropriately constrain pHOS to permit the recovering wild-spawning population to begin to adapt to local conditions. The diversity is likely to develop *after* the minimum level of Nb is attained for one generation. The goal of the hatchery program for this phase should therefore be stated simply as to help to secure annual levels of Nb that do not exceed specific levels and to have the hatchery meeting the requisite minimum levels of PNI.

“Hatchery program role”: The numerical target level of Nb and the number of years or generations that this level is to be attained (with hatchery support, if necessary) should be simply stated. The numbers of NOB and HOB associated with the target Nb and the target PNI and pHOS levels follow simply from these, and should then be stated.

Phase 4, “self-sustaining exploitable population”. The associated text implies that hatchery intervention will not cease until a recovered wild Chinook population, capable of sustaining harvest exploitation has been attained. This contradicts the concept of an “integrated recovery” hatchery program. There is likely to be a considerable lapse of time between the onset of the Local Adaptation Phase, when the requisite target level of Nb has been attained and the development of a wild population of sufficient size and productivity to sustain some annual level of *directed* harvest mortality.

The text also implies that prior to the attainment of this phase (phase 4) the hatchery will serve a harvest augmentation purpose in addition to a recovery purpose. But this is not a stated goal of the program, nor should it be. “The goal of the Self-sustaining Exploitable Population is to ensure that viable, self-sustaining and exploitable population levels continue once desired values for all VSP and habitat parameters have been met and hatchery program are no longer needed to provide for recovery *or exploitation*” (emphasis added). The words “or exploitation” should be deleted.

Moreover, given the habitat conditions in the majority of the Elwha basin it is very probable that the Elwha population will recover to this robust condition well before the rest of the Puget Sound ESU does. It will require a special decision by NOAA to permit directed harvest of a component of the listed ESU. This should not affect the description of the hatchery program as a recovery program.

We agree that ESA coverage can only be sought for the program for the first two phases. However, as discussed in General Comments, we think it better to request coverage for no more than 5 years with the intention to renew after the performance of the program in the first five years has been evaluated, keeping with a true “adaptive management” approach.

1.8. Justification for the program.

“This program enhances the survival of Elwha Chinook, whose existence has been limited…to the lower 5 miles of its historic range.” As noted in General Comments, the performance of the program as measured by the smolt-to-adult survival of the yearling and subyearling releases from the program cast serious doubt on this claim and should occasion a serious re-thinking about the nature and the scale of the program. The survival of individual hatchery yearlings and subyearlings has evidently not been enhanced. There is some reason to think that the scale and past conduct of the program has driven survival down. The continuation of the level of performance of the program during the recent past is undesirable and unjustifiable.

1.10. "Performance Indicators" addressing benefits: Here we simply note, again, the vagueness and lack of specific, quantitative targets and thresholds to the listed "hatchery program objectives" and "program indicators".

1.11. Expected size of program. We have already noted concerns regarding the proposed size of the hatchery program. "…up to 2,900,000 juveniles" appears unjustifiably large. In any event, assertions like "[t]he program is currently contributing to the Genetic Conservation phase …" are insufficient. Such assertions should be supported by quantitative data and relevant genetics argumentation.

Section 6 and in general. The HGMP fails to recognize and address the serious issue that fitness of the current hatchery-dominated stock has been driven extremely low. This makes continued release of large numbers of hatchery brood during phases 1 and 2 questionable as wild stock preservation.

Literature Cited.

Beamish, R.J., R.M. Sweeting, C.M. Neville, K.L. Lange, T.D. Beecham, and D. Preikshot. 2012. "Wild chinook salmon survive better than hatchery salmon in a period of poor production". Environmental Biology of Fishes 94: 135-148.

NMFS Response to Comments Submitted on Behalf of the Wild Fish Conservancy, the Wild Steelhead Coalition, the Federation of Fly Fishers Steelhead Committee, and Wild Salmon Rivers d/b/a the Conservation Angler

1. Comment noted.

2. NMFS believes that 30 days was ample time to review the documents. For a NEPA review, neither the Council of Environmental Quality's NEPA regulations nor NMFS implementing regulations require a comment period on a draft Environmental Assessment; however NMFS often releases draft Environmental Assessments for public comment, such as this Environmental Assessment. Since the request was made within a comment document, NMFS assumes the commenter was able to fully assess the Environmental Assessment to prepare the comments.

   As to the "refusal to provide information," the commenter misrepresents the situation. This request for "all documents submitted as part of the joint plan" came from the litigation counsel to the Wild Fish Conservancy, plaintiffs in a lawsuit concerning the use of hatcheries in the Elwha River restoration. A discussion ensued between this attorney and the attorneys representing the United States, where it was determined that the counsel to the Wild Fish Conservancy already had the specific documents requested. Consequently, it is not clear why a delay in answering the request of the Wild Fish Conservancy's litigation counsel for documents already in his possession constitutes the "defeat of the spirit of the public comment process."

   It should be added that NMFS does not typically provide tribal plans for review, in accordance with its regulations, owing to the potential concerns that disclosing tribal plans would disclose the tribe's confidential information contained in its plan. In instances where a tribe agrees that its plan may be released, NMFS will honor the tribe's decision. This was communicated to the Wild Fish Conservancy's litigation counsel in a timely manner. At no point during the comment period was the commenter deprived of any documents to which it was entitled as part of the public notice and comment procedures under 50 CFR 223.203(b)(6).

3. Comment noted.

4. NMFS conducted a hard look assessment of potential effects by assessing impacts to all potentially affected environmental and human resources from four alternatives, including a No-action Alternative that represents the status quo condition. Further, NMFS assessed other

potential alternatives weighing their utility against the appropriate purpose and need for the Proposed Action and against other action alternatives, and provided meaningful rationale for eliminating these as a full alternative for review.

NMFS provided a meaningful and hard look evaluation of the expected effects (both beneficial and adverse) of a full range of alternatives on the human environment in its Environmental Assessment (Subsection 4.0, Environmental Consequences). Alternative 4 (no hatchery programs in the Elwha) examined the expected effects of terminating all Elwha River hatchery programs immediately. Best available science suggests that Alternative 4 would eliminate short- and long-term risks associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer from hatchery programs. However, benefits from the hatchery programs on population viability and nutrient cycling would be eliminated after hatchery-origin fish stop returning to the Basin to spawn (Subsection 4.4, Salmon, Steelhead, and Their Habitat). Because dam removal activities are already resulting in water quality conditions that are detrimental, and likely lethal, to all fish migrating and rearing in the lower Elwha River (Ward et al. 2008), Alternative 4 would reduce short-term abundance relative to Alternative 1, placing native salmon and steelhead population at a high risk of extirpation. It is unclear whether the Elwha River steelhead population would endure without supportive breeding provided by the hatchery program; if extirpated, it is unclear how long it would take the species to recolonize the Elwha River Basin from other watersheds and achieve a viable abundance level, or what the relative fitness of the recolonizing population would be compared to the extirpated native populations which have evolved in the Elwha River over thousands of years. Any salmon and steelhead that survive dam removal activities would have access to high-quality habitat throughout the Elwha River Basin but, because abundance levels would be expected to be critically low (with possible extirpation of the population), the spatial structure, productivity, and genetic diversity status of the species would be markedly reduced.

In addition, NMFS incorporates by reference the National Park Service EISs on Elwha River Ecosystem Restoration and Elwha River Ecosystem Restoration Implementation for a robust analysis of direct, indirect, and cumulative effects (Section 5, Cumulative Impacts). The Environmental Assessment analyses are consistent with the analyses in these EISs.

5. NMFS does not assume that the Elwha River hatchery programs would continue regardless of what action NMFS takes. NMFS provided a meaningful evaluation of the effects of the proposed hatchery programs by assessing potential impacts on the human environment from a No-action Alternative and three action alternatives. Alternative 4 specifically addressed impacts if the hatchery programs were terminated. It should be clarified that the

environmental baseline in Chapter 3 reflects current conditions, which appropriately includes ongoing hatchery program effects on the current environment. Alternatives analyzed included:

a. Under Alternative 1 (No Action), NMFS would take no action on the submitted HGMPs, and for this Environmental Assessment, we assumed no changes would be made to the existing hatchery programs.
b. Under Alternative 2, NMFS would approve the proposed HGMPs and they would be implemented as proposed.
c. Under Alternative 3, NMFS would approve HGMPs that have been revised to include a sunset term, and the Elwha River hatchery programs would be terminated in approximately 2019.
d. Under Alternative 4, NMFS would find that the proposed plans do not meet the criteria of the 4(d) Rule, and, for this Environmental Assessment, we assumed the existing hatchery programs would be terminated.

The effects of each one of these alternatives is considered in Subsection 4.0, Environmental Consequences. Please see the analysis of effects of Alternative 4 (no hatchery programs in the Elwha) for a comparison of effects of the Elwha River hatchery programs as compared a scenario without hatchery production in the Elwha River Basin.

6. Because this is an overview statement, NMFS will not respond here, but instead respond below to specific issues raised by the commenters.

7. NMFS does not make a determination on the significance of a Proposed Action in an Environmental Assessment. A determination of significance is made in the NEPA decision document. National Oceanic and Atmospheric Administration Administrative Order 216-6 (NAO 216-6) (May 20, 1999) contains criteria for determining the significance of the impacts of a Proposed Action. In addition, the Council on Environmental Quality regulations at 40 C.F.R. 1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity."

   After meaningful evaluation of the effects of the Proposed Action (both beneficial and adverse) on the human environment, NMFS has determined that the Proposed Action will not have a significant effect on the environment (see attached Finding of No Significant Impact). Further, all pertinent and best available information was fully analyzed in the Environmental Assessment or incorporated by reference from the NPS EISs. NMFS properly concluded in its FONSI that the potential effects of the Proposed Action would not be a significant impact to resources analyzed in the Environmental Assessment based on CEQ criteria for context and intensity.

8. NMFS used the best available science in assessing effects on the human environment from the Proposed Action. Each of the impacts listed by the commenter (e.g., genetic interactions, ecological interactions, predation, etc.) were fully analyzed in the Environmental Assessment. Additional clarification of potential impacts has been added to Subsection 3.4, Salmon and Steelhead and Subsection 4.4, Salmon and Steelhead. NMFS hereby notes the comment, including the citation to the Declaration of Gordon Luikart. NMFS's rationale for disagreeing with the commenter's conclusions are addressed in detail in the Environmental Assessment and in the Biological Opinion, which represents the best available science and which contradicts the opinions offered by the commenter.

9. Consistent with Council of Environmental Quality NEPA regulations, NMFS incorporates material by reference "when the effect will be to cut down on bulk without impeding agency and public review of an action" (1502.21). Consequently, NMFS briefly described the general mechanisms through which a hatchery program can affect salmon, steelhead, and their habitat to provide baseline information for the impact assessment (Subsection 3.4, Salmon and Steelhead). The Environmental Assessment then refers the reader to the draft EIS to Inform Columbia River Basin Hatchery Operations and the Funding of the Mitchell Act Hatchery Programs (NMFS 2010) strictly to provide a more detailed discussion on these general mechanisms (Subsection 3.4, Salmon and Steelhead). The analysis of the effects of the Proposed Action and its alternatives is found in Subsection 4.0, Environmental Consequences, of the Environmental Assessment, and no part of the analysis of effects relies on NMFS's draft EIS to Inform Columbia River Basin Hatchery Operations and the Funding of the Mitchell Act Hatchery Programs (NMFS 2010).

10. Comment noted.

11. The historic issue of dam removal and Elwha River restoration was evaluated in three EISs whereby the NPS took a hard look at impacts of dam removal and restoration of the Elwha Basin. See the Elwha River Ecosystem Restoration EIS (NPS 1995), the Elwha River Ecosystem Restoration Implementation EIS (NPS 1996), and the Elwha River Ecosystem Restoration Supplemental EIS (NPS 2005). Furthermore, implementation of the Elwha Restoration Plan is ongoing separately from the Proposed Action under review, which is limited to determining whether the proposed hatchery programs satisfy the ESA and associated regulations. To suggest that the current Proposed Action requires an EIS to examine the effects of dam removal dismisses the hard look analyses of this issue presented in the NPS EISs. Further, NMFS does not have the authority to review the NPS's Elwha

Restoration Plan through the request to approve HGMPs submitted by WDFW and the Lower Elwha Klallam Tribe.

12. NMFS provided a meaningful evaluation of the expected effects (both beneficial and adverse) of a full range of alternatives on the human environment in its Environmental Assessment (Subsection 4.0, Environmental Consequences). Although the Proposed Action would be expected to have some adverse effects on species listed as endangered or threatened under the ESA, NMFS found that the degree to which adverse effects may occur would not be significant (1508.27(9))(see attached Finding of No Significant Impact). CEQ significance factors are not limited to whether an action may have an effect on listed species, but the degree to which this impact may occur. All pertinent and best available information was fully analyzed in the Environmental Assessment or incorporated by reference from the NPS EISs (40 CFR 1502.22). After applying best available science to the analyses, NMFS concluded that the degree of effect from the Proposed Action on listed species was not significant.

13. NMFS provided a meaningful evaluation of the expected effects (both beneficial and adverse) of a full range of alternatives on bull trout, eulachon, and Southern Resident Killer Whales in its Environmental Assessment (Subsection 4.5, Other Fish Species; Subsection 4.6, Wildlife). In summary:
    a. Bull trout may be affected by predation, competition, marine-derived nutrients, fishing, and interception at the Elwha weir, but these effects are not expected to be substantial for the following reasons (1) bull trout would largely benefit from having hatchery-origin salmon and steelhead released into the Elwha River Basin because they eat juvenile salmon and steelhead, (2) based on 2011 and 2012 data, few bull trout would be expected to be intercepted at the Elwha weir and no mortalities would be expected, (2) although bull trout would be expected to be periodically encountered in the Tribal subsistence fishery, incidental mortalities would be expected to be low, and (3) bull trout are not found exclusively in the Elwha River Basin or nearby marine waters, and in fact, the Elwha River Basin is a very small percentage of their total range, so any mortalities as a result of the Proposed Action would not be expected to impact the overall size, health, or status of the species.
    b. Despite the occasional presence of eulachon in the Elwha River, the relatively small numbers of straying fish are not likely to be successfully contributing to the annual recruitment of juveniles that would substantially support recovery of the DPS (Gustafson et al. 2010). Therefore, any adverse or beneficial effects on Eulachon as a result of competition, predation, or marine derived-nutrients associated with the Proposed Action are not expected to impact the overall size, health, or status of the species.

c. Southern Resident Killer Whales may intercept Elwha River salmon and steelhead when feeding in marine waters, but because Elwha River salmon and steelhead co-occur with many other hatchery-origin and natural-origin salmon and steelhead populations from the Puget Sound, Fraser River, Columbia River, and Washington Coast while in marine waters, Elwha River salmon and steelhead are not expected to be a substantial component of their diet, and the Proposed Action is not expected to change the size, health, survival, or listing status of the species,

The Environmental Assessment has been modified to specifically describe expected impacts on the size, health, and survival of these ESA-listed species.

14. The Environmental Assessment has been modified to include information on critical habitat within the Analysis Area (Subsection 3.4, Salmon and Steelhead; Subsection 3.5, Other Fish Species; and Subsection 4.0, Environmental Consequences).

15. The proposed hatchery programs are not likely to establish a precedent for future actions with significant effects or to represent a decision in principle about a future consideration because the proposed hatchery programs are similar in nature and scope to similar hatchery actions over the past several years. Other HGMPs involving captive breeding or supplementation (e.g., Snake River fall Chinook salmon and Hood Canal Summer Chum) in the Pacific Northwest have been analyzed through similar ESA determinations and NEPA reviews.

    Like other similar hatchery programs already reviewed, implementation monitoring is a key element of the proposed hatchery programs, which would inform co-managers of the effects of the program. The proposed hatchery programs would support precedents already set for monitoring and adaptive management, which reduce any risk of significant effects occurring now or in the future.

    Further, this NEPA process and these hatchery programs will not set important precedent about the level of analysis that NMFS provides to hatchery programs and the types of hatchery programs that meet the ESA requirements. NMFS reviews each HGMP ESA approval request independently and is preparing two programmatic NEPA assessments of hatchery effects in the Columbia River Basin and Puget Sound action areas, independent and unrelated to the Proposed Action reviewed in this Environmental Assessment.

    See response to Comment Number 3 and response to Comment Number 8 regarding the hard look review.

16. This comment begins with an incorrect premise: that any action that is "highly controversial" must be accompanied by an EIS. The Council on Environmental Quality regulations contain no such requirement. An EIS is required for major Federal actions significantly affecting the human environment. In determining significance, agencies analyze the context and intensity of an action and its effects. Among other factors, the "degree to which the effects on the quality of the human environment are likely to be highly controversial" is one of 10 factors that "should be considered in evaluating intensity" (40 CFR 1508.27). Thus, whether an action is likely to be highly controversial is one factor to consider in the determination of whether an EIS is warranted.

    In making its significance determination NMFS has considered the likelihood that the Proposed Action could be highly controversial (Section 8.0, Finding of No Significant Impact). The use of hatcheries can be controversial, and NMFS must carefully consider potential adverse effects of hatchery programs on listed fish. However, the controversy surrounding the Elwha hatchery programs is related to whether or not hatchery fish should be used as part of the Elwha River Ecosystem Restoration. This issue was fully analyzed in one NPS EIS and one supplemental EIS on Elwha River Ecosystem Restoration and Elwha River Ecosystem Restoration Implementation (NPS 1996; NPS 2005). The effects of the proposed hatchery programs as described in the Environmental Assessment are not highly controversial because their effects are minimized and adequately mitigated to the point that the benefits of hatchery programs outweigh associated risks.

    Four comment letters were received in response to the Proposed Action and draft Environmental Assessment, one criticism by the party currently in litigation over the matter and three comment letters in support of the Proposed Action. In considering whether the Proposed Action is likely to be highly controversial, NMFS acknowledges the disagreement contained in this comment letter and recognizes the unsettled science and potential risks applicable to hatcheries generally. However, NMFS applied best available science and information to the analyses of impacts resulting from each alternative, including the Proposed Action.

17. The historic issue of dam removal and Elwha River restoration was evaluated in the Elwha River Ecosystem Restoration EIS (NPS 1995) and the Elwha River Ecosystem Restoration Implementation EIS (NPS 1996; NPS 2005). Furthermore, implementation of the Elwha Restoration Plan is not the Proposed Action under review, and NMFS does not have the authority to review the NPS's Elwha Restoration Plan through the request to approve HGMPs submitted by WDFW and the Lower Elwha Klallam Tribe.

Regarding impacts to the Olympic Wilderness Area, releasing fish into a wilderness area is not incompatible with the goals, objectives, and policies of the Wilderness Act. There is no information to suggest that commercial harvest would occur in the Wilderness Area as a result of the release of hatchery fish; such activity is likely illegal under the Wilderness Act and would be under the regulatory purview of the NPS. The Environmental Assessment has been modified to address the Wilderness Act.

18. See response to Comment Number 4, Comment Number 7, and Comment Number 12.

19. The characterization of the environmental baseline is incorrect. See response to Comment Number 4 for clarification and for information on the analysis of effects between program closure (Alternative 4) and continued hatchery operations.

    The Environmental Assessment provides a factual analysis of expected conditions under the No-action Alternative compared to the factual baseline condition that includes past operation of hatchery programs. The No-action Alternative analysis did not preclude the analysis of the Proposed Action, and did not foreclose any analysis outcome under the Proposed Action. Further, CEQ regulations and the 40 Most Asked Questions do not preclude the analysis of an illegal alternative (CEQ 40 Most Asked Questions, 2b), and CEQ regulations support the description of the affected environment to illustrate existing conditions for the best impact assessment of alternatives against these conditions (40 CFR 1502.15, 40 CFR 1502.14, 40 CFR 1502.16). As stated in the 40 Most Asked Questions at 2b, "An alternative that is outside the legal jurisdiction of the lead agency must still be analyzed in the EIS if it is reasonable. A potential conflict with local or Federal law does not necessarily render an alternative unreasonable, although such conflicts must be considered. Section 1506.2(d). Alternatives that are outside the scope of what Congress has approved or funded must still be evaluated in the EIS if they are reasonable, because the EIS may serve as the basis for modifying the Congressional approval or funding in light of NEPA's goals and policies. Section 1500.1(a)." NMFS was thorough in its decision to include the possibility of continued hatchery operations as one alternative and closure as another alternative with a comparison between the two potential outcomes.

20. See responses to Comment Number 5 and Comment Number 19.

    A true no action alternative was analyzed in the EA. The No-action Alternative was not meaningless because it represents NMFS' best estimate of what would happen in the absence of the proposed Federal action – NMFS approval of the HGMPs. The scope of the No-action Alternative is consistent with CEQ's 40 Most Asked Questions. Specifically, "There are two distinct interpretations of "no action" that must be considered, depending on the nature of the proposal being evaluated. The first situation might involve an action such as updating a land management plan where ongoing programs initiated under existing legislation and regulations will continue, even as new plans are developed. In these cases "no action" is "no change" from current management direction or level of management intensity. To construct an alternative that is based on no management at all would be a useless academic exercise. Therefore, the "no action" alternative may be thought of in terms of continuing with the present course of action until that action is changed."

NMFS has defined the No-action Alternative in other NEPA reviews as resulting in hatchery closures or termination of fisheries (e.g., NMFS 2012a and NMFS 2012b), which differs from the No-action Alternative description in this Environmental Assessment. However, this does not represent arbitrary or inconsistent decision making by NMFS. The scope of the No-action Alternative is a matter confined to the specific actions being reviewed. Hatchery and fisheries programs differ greatly in their management and surrounding circumstances, which can require varying approaches under NEPA to provide a meaningful analysis of the Proposed Action. Each analysis requires NMFS to apply the applicable NEPA standards to the specific major Federal action.

In the case of the Elwha Environmental Assessment, the Proposed Action is to make a determination that both the submitted HGMPs and the submitted Tribal Harvest Plan meet the requirements of the 4(d) Rule. Although Elwha River hatchery programs currently operate, the submitted Tribal Harvest Plan would change current harvest management. Therefore, if the No-action Alternative did not include the operation of existing hatchery programs, existing fisheries would also need to be excluded from the No-action Alternative (i.e., there would be no fish to harvest). Consequently, NMFS would not be able to compare the proposed harvest plan with the existing harvest plan, and the Environmental Assessment would omit meaningful information needed to make a decision on the submitted plans. Therefore, the scope of the No-action Alternative provided NMFS with the most reasonable and understandable condition to make robust and meaningful analyses comparisons with action alternatives.

Including a continued hatchery operations alternative as the No-action scope does not fail to meet the purpose and mandate of NEPA and does not harm the analysis because (1) it is a reasonable alternative that is both "practical" and "feasible" regardless of potential ESA legality since the activities have been ongoing and are interrelated (CEQ 40 Most Asked Questions, 2a, 2b; See also 40 CFR 1508.25 regarding connected actions), and (2) a hatchery program closure alternative was analyzed against these ongoing programs to assess differences in environmental effects. While NMFS does not believe that program closure meets the purpose and need for action (Subsection 2.4, Alternative 4), NMFS recognized that two possible outcomes – continued operations and closure - would be beneficial to analyze and would be of interest to the public.

Finally, the Chambers Creek steelhead program was terminated in 2011. The No-action Alterative does not include the operation of this hatchery program, but it does recognize that fish released from the Chambers Creek hatchery program would continue to return to the Elwha River Basin as adults for several years. It is unclear why the commenter states that this is a “false” assumption.

21. The purpose and need for this action was not drawn too narrowly. The purpose and need statement properly captures NMFS’s purpose and need for action, in addition to noting the applicants’ need, which includes treaty reserved fishing rights and achieving substantial progress towards fish restoration in a 20- to 30-year period. This purpose and need enabled detailed consideration of a range of alternatives. Of the 10 total alternatives considered in the Environmental Assessment, only two alternatives were eliminated from detailed consideration in part because they did meet the purpose and need to action. Although Alternative 3 (Proposed Hatchery Programs with a Sunset Term) and Alternative 4 (No Hatchery Programs in the Elwha River) would not meet every aspect of the applicants’ need, they were nonetheless evaluated in detail and fully considered by NMFS’s decisionmaker. NMFS analyzed these alternatives in detail to assist with a full understanding of management options and their potential effects on the human environment.

22. The Environmental Assessment has been modified to discuss the option for implementation of a smaller hatchery program. However, the environmental effects of a substantially smaller hatchery program would not be meaningfully different than the effects of Alternative 4 (No Hatchery Programs in the Elwha River). In addition, this alternative would not be expected to meet the applicants’ purpose and need because substantial progress toward fish restoration in the Elwha River would not be expected to occur in a 20- to 30-year time frame under this alternative. Additionally, this alternative would not fulfill treaty-reserved fishing rights or provide fishing opportunities for citizens of Washington State. See Environmental Assessment Subsection 2.5.5, Hatchery Programs with Decreased Production Levels.

23. The action area (or project area) for this Environmental Assessment is the geographic area where the Proposed Action would take place (Subsection 1.4, Action Area). However, because the effects of a Proposed Action can occur outside of the action area, an analysis area is determined for each potentially affected resource (Subsection 1.4, Action Area). For some resources, the analysis area may be larger than the action area, since some of the effects of the alternatives may occur outside the action area. For example, Alaska is not in the

action area, but because fish produced in the Elwha River hatchery programs may be intercepted in Alaskan fisheries, Alaska is included in the analysis area for socioeconomics.

24. NMFS applies best available science and information in its NEPA analyses, and employed this practice in making all assessments (e.g., Alternative 3 and Alternative 4 conclusions) (40 CFR 1502.22). The commenter's disagreement with NMFS's conclusions is noted. The Environmental Assessment contains the rationale for all conclusions with supporting science.

    It should be noted that NEPA does not require the action agency to dismiss from its analysis any mitigation measures (or monitoring and adaptive management components) included in the Proposed Action simply because such implementation relies on future funding. NMFS considers mitigation measures, future funding notwithstanding, in its analyses as long as they are part of the Proposed Action and there is a reasonable expectation that funding will occur.

    Finally, the commenters claim that NMFS will be using the analysis of Alternative 3 to provide "carte blanche" for hatcheries to continue past 2019. NMFS does not understand this interpretation. As described in Subsection 1.2, Description of the Proposed Action, NMFS's determination would apply only for the duration of the preservation and recolonization phases of fish restoration in the Elwha River Basin, as defined in the HGMPs. These phases would encompass the periods during removal of the two Elwha River dams, and for a period following that removal as river habitat, and the productivity of salmon and steelhead populations, recover from dam removal effects.

25. Comment noted.

26. Genetic risks are a direct effect and are appropriately discussed in Subsection 4.0, Environmental Consequences.

27. NEPA does not require the action agency to dismiss from its analysis any mitigation measures (or monitoring and adaptive management components) included in the Proposed Action simply because they rely on future funding. NMFS considers mitigation measures, future funding notwithstanding, in its analyses as long as they are part of the Proposed Action and there is a reasonable expectation that funding will occur.

    The inclusion of adaptive management and monitoring programs as a means to track and mitigate long-term effects from climate change is a reasonable approach given the unknown outcomes of future conditions on the landscape.

28. The effects of other Puget Sound hatchery programs is appropriately captured in the baseline conditions in Chapter 3, Affected Environment, since they are ongoing programs and have resulted in current conditions in the action area. There are no ESA applicant proposals at this time that would increase straying into the Elwha River Basin. If such proposals are presented to NFMS for future ESA approval, NMFS will consider the ongoing effects from this Proposed Action and its adaptive management success in conjunction with other proposals within the same action area or vicinity.

29. Documents noted.