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Review of the Snake River Basin Steelhead Kelt Reconditioning Facility Master Plan (Project #2007-401-00): Response Requested

Step One of the Northwest Power and Conservation Council's
Three-Step Review Process

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Background

In response to the Northwest Power and Conservation Council's March 29, 2016 request, the ISRP reviewed a draft *Snake River Basin Steelhead Kelt Reconditioning Facility Master Plan*. This Master Plan is a component of Project #2007-401-00, *Kelt Reconditioning and Reproductive Success Evaluation Research*.

As summarized in the Master Plan, "the 2008 Biological Opinion (BiOp) on the Federal Columbia River Power System (FCRPS) and the Columbia Basin fish Accords recognized the potential for kelt reconditioning to contribute to steelhead populations, and the FCRPS BiOp identified actions in the Reasonable and Prudent Alternative (RPA Actions 33 and 42) to fund reconditioning programs in the upper-Columbia River and Snake River (NOAA 2008[1])."

This Master Plan proposal is to modify the Nez Perce Tribal Hatchery (NPTH) and install six 20-foot and four 15-foot circular tanks to support the long-term reconditioning of up to 750 Snake River Basin steelhead kelts, supporting the annual release of 180 reconditioned kelts – "the equivalent of a 6% increase in B-run adult steelhead escapement relative to the base period considered in the Supplemental Comprehensive Analysis Steelhead Kelt Appendix (Bellerud et al. 2008[2])."

Kelt reconditioning is pursued through two Fish and Wildlife Projects, the Snake River Basin project, which is the subject of this review, and the Yakama Nation's upper-Columbia project, *Steelhead Kelt Reconditioning* (#2008-458-00), which was reviewed by the ISRP (ISRP 2014-9) and received a recommendation from the Council on November 4, 2014. A central scientific issue raised in the upper-Columbia kelt review and other past reviews of these projects concerns the potential contributions of reconditioned kelts to steelhead viability and recovery (also see ISRP 2010-44A [pages 37-38] and 2010-44B [pages 196-198]; ISAB/ISRP 2016-1). As stated in ISRP 2014-9, "Ultimately the efficacy of reconditioning and releasing kelts to spawn in nature will depend on the demographic and genetic effects the strategy has on targeted populations, MPGs [Major Population Groups], and ESUs [Evolutionary Significant Units]." The ISAB and ISRP's 2016 Critical Uncertainties Report summarized the status of the kelt work,

[1] NOAA (National Oceanic and Atmospheric Administration). 2008. Consultation on Remand for Operation of the Federal Columbia River Power System, 11 Bureau of Reclamation Projects in the Columbia Basin and ESA Section 10(a)(I)(A) Permit for Juvenile Fish Transportation Program [Revised and reissued pursuant to court order, NWF v. NMFS, Civ. No. CV 01-640-RE (D. Oregon)]. Endangered Species Act Section 7(a)(2) Consultation Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation. May 5, 2008.

[2] Bellerud, B., R. Graves, and G. Fredricks. 2008. Assessment of the likely survival improvement resulting from enhancement strategies for steelhead kelts (B-run kelts in particular). NOAA Fisheries Kelt Analysis Memorandum to Bruce Suzumoto, April 21, 2008.

"Ongoing efforts in the Basin have demonstrated the ability to recondition kelts in a hatchery setting and for the reconditioned kelts to reproduce in the river. However, the contribution of the reconditioned kelts to population viability has not yet been demonstrated. In some areas, density dependence stemming from relatively high abundances of natural and hatchery spawners may limit the survival of progeny produced by kelts" (ISAB/ISRP 2016-1 Appendix D, pages 150-152).

ISRP Review Summary and Recommendations

Response Requested

The Master Plan is well written and contains an excellent summary of the extensive steelhead reconditioning work that has occurred in the Basin. Moreover, we compliment the proponents for investigating and addressing the many difficulties associated with steelhead reconditioning. Numerous challenges associated with fish culture had to be addressed, including establishing appropriate holding and rearing environments, formulating diets, and developing disease control protocols. The effects of long-term reconditioning on gamete viability, fidelity to natal streams, and ability to reproduce in nature were investigated. Comparisons that evaluated the potential benefits of various kelt treatments that ranged from simple direct transportation past downstream dams to long-term reconditioning lasting from 6 to 20 months were also conducted. In general, the results of these assessments indicated that long-term reconditioning of kelts appears to be a promising approach that might lead to a viable conservation strategy for steelhead.

The proponents acknowledge that the submitted Master Plan does not yet have all the necessary components for a Step 1 review. It currently lacks a Hatchery Genetic Management Plan (HGMP), and work is needed on the program's Research, Monitoring and Evaluation Plan and Comprehensive Environmental Assessment. Before producing these elements of the Master Plan, the proponents requested that the ISRP determine if the program's preferred location for a long-term reconditioning facility, for Snake River B-run steelhead, is appropriate**.**

More information is needed before a decision about the location of the proposed long-term reconditioning facility can be reached. Specifically, information on the following issues is requested in the updated Step 1 Master Plan. Additional comments below this list should also be considered in the revision.

1. The biological and ecological rationale for annually increasing B-run steelhead escapement by 180 reconditioned female kelts needs to be explained in the Master Plan.

2. Clarification on why male kelts are not included in the proposed reconditioning program is needed.

3. The biological escapement goals for B-run steelhead populations in the Snake River subbasin should be in the Master Plan along with a description of what project "success" entails. To what extent, for example, are reconditioned kelts expected to contribute to the rebuilding of natural steelhead populations and eventually to fisheries?

4. If available, information on the abundance and status and trends of B-run steelhead populations in the Clearwater and Salmon River subbasins should be provided in the Master Plan. Current spawning levels of B-run steelhead in the Snake River Basin should also be described with reference to numerical objectives for natural spawning steelhead. Additionally, a brief overview of the factors limiting each of these populations should be added to the Plan.

5. Substantial hatchery and habitat restoration actions affecting B-run steelhead are occurring in the Snake River subbasin. The Master Plan should briefly describe these programs and indicate how the proponent's goal of annually releasing 180 reconditioned kelts will be coordinated with ongoing habitat restoration and existing hatchery programs.

6. As it is currently designed, the kelt reconditioning program will recondition female B-run steelhead kelts without targeting specific populations. It would seem that capturing, reconditioning, and releasing kelts from populations that have the potential to accommodate additional spawners would be a more efficient and productive way of directing this strategy. The Master Plan should explain why a more focused program was not considered.

7. The Master Plan should discuss the infrastructural needs of a more focused and integrated reconditioning program. If the project, for instance, were to narrow its focus on B-run populations that could benefit from the addition of reconditioned kelts, would facilities at Dworshak National Fish Hatchery be adequate to meet these new escapement objectives?

8. The Master Plan should compare the benefits and drawbacks of increasing B-run steelhead escapements by modifying harvest regulations, by long-term reconditioning for adult release, and long-term reconditioning for captive breeding and smolt release.

9. Some discussion of the genetic risks that may accompany reconditioning (e.g., heritable epigenetic effects and domestication selection) needs to be added to the Master Plan or incorporated into the Plan's HGMP.

ISRP Comments on Step 1 Review Elements

The Council has emphasized that an important part of the Three Step Review Process includes an ISRP review of the responses to the technical elements listed below.

A. All Projects

Does the Master Plan:

1) Address the relationship and consistencies of the proposed project to the 2014 Fish and Wildlife Program's six scientific principles (Step 1)?

The Scientific Principles:
1. Healthy ecosystems sustain abundant, productive, and diverse plants and animals distributed over a wide area.
2. Biological diversity allows ecosystems to adapt to environmental changes.
3. Ecosystem conditions affect the well-being of all species including humans.
4. Cultural and biological diversity is the key to surviving changes.
5. Ecosystem management should be adaptive and experimental.
6. Ecosystem management can only succeed by considering people.

Master Plan Section 1.1 addresses the six scientific principles.

Even though the Master Plan lists the Fish and Wildlife Program's six scientific principles, explicit linkages between the project's proposed work and the Council's principles are not presented. Nonetheless, the proposed work is consistent with the intent of the Program's scientific principles. For example, the Master Plan implies that changes in tributary, mainstem, and estuary habitats, along with poor survival of kelts passing through hydrosystem dams, has decreased the occurrence of iteroparity in Columbia River steelhead populations. The kelt reconditioning program described in the Master Plan is designed to increase the occurrence of iteroparity in Snake River B-run steelhead. It is argued that augmenting iteroparity will increase demographic resilience, expand genetic diversity, and boost productivity. B-run steelhead are chosen for this program because of their high economic and cultural values. Additionally, their restricted geographic range and susceptibility to commercial fisheries has put them at risk of extirpation. The Master Plan indicates that the project values ecosystems that can support abundant, diverse, and broadly distributed populations; aims to maintain or increase biological diversity; and will be managed in an adaptive and experimental fashion.

2) describe the link of the proposal to other projects and activities in the subbasin and the desired end-state condition for the target subbasin (see 2014 Columbia River Basin Fish and Wildlife Program, Part Three, Section II) (Step 1)?

The Master Plan's Introduction Section covers this question.

The Master Plan provides a good summary of the kelt research that has taken place throughout the Columbia River Basin including studies that occurred in the Hood, Yakima, Omak, and Snake river subbasins. Part of this effort compared the ability of three kelt management approaches to enhance iteroparity. In two of these, captured kelts were transported and released below Bonneville Dam. In one approach, fish were transported without feeding whereas in the other approach, fish had been fed for several weeks (short-term reconditioning) prior to being transported. In the third approach, kelts were held in a hatchery environment, fed and treated with prophylactics for six to ten months, and were released and expected to migrate and spawn in natal streams. Marginal increases in iteroparity were realized by fish placed into either of the transportation strategies. On the other hand, the annual survival rate of fish exposed to long-term reconditioning averaged 47%. Some non-maturing fish were held for an additional year and achieved an overall survival rate of 22%. These results helped shape the proponent's decision to exclusively use the long-term reconditioning strategy in their B-run steelhead program.

NOAA Fisheries developed a suite of Reasonable and Prudent Actions to improve the productivity of interior basin B-run steelhead populations (BiOp 2008—sections 8.5.5.1-8.5.5.8). The kelt research briefly described above largely addresses the objectives of RPAs 33 and 42. The RPAs ask that conservation programs be developed to build genetic resources, serve as a "safety net" and promote recovery. Reconditioned B-run kelts are expected to serve both functions by providing a 6% increase (180 fish) in adult B-run steelhead abundance, assuming a population of 3,000 steelhead spawners. The Plan should describe the percentage increase in spawners represented by 180 kelts based on current spawner abundances of steelhead in the Basin.

Substantial hatchery programs for B-run steelhead occur in the Snake River subbasin. Most of the B-run steelhead hatcheries are operated as segregated programs and are managed to mitigate for lost harvest opportunities due to hydrosystem impacts on natural production. Recent (2012) HGMPs for the Upper Salmon and Clearwater B-run steelhead hatchery efforts, however, indicate that natural origin fish will be phased into the broodstock at these facilities. Additionally, plans are underway to create integrated B-run steelhead populations via supplementation in the East Fork of the Salmon River and South Fork of the Clearwater. For completeness, the Master Plan needs to briefly describe these programs and indicate how the proponent's goal of annually releasing 180 reconditioned kelts will be coordinated with ongoing hatchery programs.

Stock recruitment assessments performed on steelhead populations in the Snake River subbasin have shown that current habitat and hydrosystem conditions are limiting the productivity of many of these populations (Zabel and Cooney 2013; ISAB 2015-1). A variety of habitat restoration actions are occurring throughout the Upper Salmon and Clearwater watersheds. Several of them are designed to reconnect and expand spawning and rearing areas and may therefore increase existing carrying capacities. A brief overview of these actions should be included in the Master Plan as such areas could be targets for reconditioned kelts.

The long term desired end state for the targeted B-run populations is not described. For example, biological escapement goals for these populations are not mentioned. The plan would be improved by fully describing what "success" for the project entails.

3) Define the biological objectives with measurable attributes that define progress, provide accountability and track changes through time associated with this project (see 2014 Fish and Wildlife Program, Part Three, Section III) (Step 1)?

Biological objectives are covered in Master Plan Section 6.

The program has a biological goal of increasing the escapement of Snake River B-run steelhead by 6% (180 females) relative to its base period when annual escapements of natural-origin steelhead averaged 3,000 adults. The Master Plan states that this goal originated from RPA # 33. RPA 33 requires the Action Agencies to develop and implement, in cooperation with regional salmon managers, a kelt management plan. The 2008 BiOp states that this plan should be designed to increase B-run steelhead productivity by at least 6%. The Master Plan would be enhanced if the biological and ecological rationale behind this request were discussed.

The objective of annually releasing 180 reconditioned female kelts is clearly stated and can be tracked. Although not formally presented as biological objectives, the Master Plan presents a number of expectations that can be measured and tracked. Among these are:

- An annual goal of collecting 591 B-run kelts at Lower Granite (LGR) and Little Goose (LGO) dams.
- Successful identification of B- and A-run natural-origin kelts captured at LGR and LGO based on fork lengths and scale analyses.
- One hundred percent of the B-run kelts undergoing long-term reconditioning will be females.
- A 47% yearly survival rate of reconditioned kelts.
- A 33% rate of maturation after one year of reconditioning and a >90% maturation rate for skip spawners that are reconditioned for two years.
- Each annual collection of 591 kelts is expected to produce 93 first year repeat spawners and 87 mature skip spawners.
- No genetic or heritable epigenetic effects will be caused by long-term reconditioning.
- An increase in fecundity of 129% for first year repeat spawners and 151% for mature skip spawners.
- Maiden and reconditioned kelts will have similar egg viabilities.
- Harvest rates on reconditioned kelts will be low (<15%).
- Reconditioned kelts will successfully home to natal streams, and
- Reconditioned B-run female kelts and maiden natural origin females will have equal breeding and reproductive success.

When the RME plan for the project is developed in Step 2, provisions to measure and track these and other parameters will need to be described.

4) Define expected project benefits (e.g. preservation of biological diversity, fishery enhancement, water optimization, and habitat protection) (Step 1)?

Master Plan Sections 1.6, 2, and 6.3 cover project benefits.

The Master Plan contends that the proposed kelt reconditioning program will provide the following biological services: demographic resilience, maintenance of genetic diversity, and increased productivity of Snake River B-run steelhead populations. For these benefits to be achieved, however, it must be demonstrated that (1) it is possible to collect an adequate number of B-run kelts, (2) the collected fish can be reared to maturity after one or two years of reconditioning, (3) that reconditioned kelts mature at appropriate times and have fecundity and egg attributes that are comparable to maiden B-run steelhead, (4) reconditioned kelts have adequate energy reserves to home to natal spawning areas, and (5) reconditioned kelts can successfully spawn and produce adult offspring. Results of past kelt reconditioning studies that have taken place in the Basin are summarized in the Master Plan and show that methods currently being used to recondition kelts can meet most of these requirements. Some uncertainty still exists about egg viability and the ability of reconditioned kelts to reproduce in nature. Recently completed work at the Cle Elum Supplementation Research Facility has helped lessen these concerns. Reconditioned kelts established redds and produced juveniles in the facility's spawning channel showing that reconditioned females can reproduce under quasi-natural conditions.

Studies performed outside of the Columbia Basin support the contention that iteroparity in steelhead populations can generate genetic diversity and demographic benefits. Investigations performed by Seamons and colleagues in a small coastal Washington stream (e.g., Seamons et al. 2004; Seamons and Quinn 2010) showed that many first-time spawning steelhead produced no adult offspring but were successful at producing adult offspring when they came back as repeat spawners. Thus, in this population, iteroparity helped preserve genetic diversity and productivity that might otherwise have been lost. Work performed by Moore et al. (2014) also showed that iteroparous steelhead helped dampen population fluctuations in two large British Columbian rivers, the Nass and Skeena. Contributions from multiple brood years helped to buffer these populations when fish from individual broodyears experienced episodes of poor freshwater or ocean survival.

The Master Plan suggests that artificially increasing iteroparity will offer several management benefits. First, reconditioned kelts can serve as natural origin captive broodstock in hatchery programs that are switching to local stocks. This would reduce some of the impact such programs may have through removing natural origin fish returning to these populations. Second, reconditioning can produce spawning adults in 6 to 20 months and therefore is a rapid way to create a demographic boost to depressed populations. Or, it may be used to quickly take advantage of recently opened habitat. Besides these possible benefits, the Master Plan should describe the potential benefit that the kelt program may eventually provide to fisheries if successful. Is it expected to contribute to abundance and stability of future adult returns?

Finally, it was hypothesized that reconditioning natural-origin kelts would produce fewer domestication effects than traditional hatchery programs. To our knowledge this has not yet been investigated. Consequently, evaluating genetic risks to natural populations posed by long-term reconditioning is something that can be included in the program's RME plan.

Seamons and Quinn (2010) and the Master Plan state that using fish culture to recondition kelts and utilize them to increase population viability will not work unless steps are undertaken to address the factors that are limiting the population in the first place. As it is currently being proposed, the project's goal is to improve the escapement of B-run adults in general without apparent regard to the factors that may be limiting the abundance of individual populations. In some cases new habitat is being opened up or habitat improvements have been made. It would seem that capturing, reconditioning, and releasing kelts from populations that could benefit from the infusion of additional adults would be a more efficient and productive way of using this strategy.

5) Ensure that cost-effective alternate measures are not overlooked and include descriptions of alternatives for resolving the resource problem, including a description of other management activities in the subbasin, province, and basin (Step 1)?

See Master Plan Sections 5 and 7.

The following four approaches to increase iteroparity in B-run steelhead were evaluated and compared (1) collection and transportation, (2) short-term rearing and transportation, (3) long-term reconditioning and subsequent release, and (4) passage improvements at mainstem dams. Data from the Yakima kelt reconditioning project and information obtained from studies performed on Snake River steelhead were used in these comparisons. The collection, transportation, and release of kelts below Bonneville generally increased the occurrence of repeat spawners. Yet, the survival gain realized by any of these approaches was substantially less than that obtained from long-term reconditioning because the latter approach spared kelts from having to experience challenging conditions in the mainstem, estuary, and ocean. Modifications to mainstem dams to facilitate upstream adult and downstream juvenile passage have occurred. How these changes may influence downstream kelt survival is not known, but they are not expected to increase iteroparity to the extent that transportation or long-term rearing have. Consequently, the use of long-term reconditioning by the proponents to increase iteroparity in B-run steelhead is likely the most cost-effective approach available.

Long-term reconditioning of B-run kelts has taken place at the Dworshak National Fish Hatchery. However, space, water, and effluent treatment capacities at this facility will not support the larger long-term reconditioning program envisioned by the proponents. The Master Plan describes the comprehensive list of attributes that were used to evaluate and eventually decide on a location for a long-term reconditioning facility. Factors considered included, location, acquisition cost, security, presence of three-phase power, quality and quantity of surface and ground water sources, and effluent treatment. A large number of prospective sites, even including the use of an Army Corps of Engineers fish hauling barge were considered and

ranked. Availability and cost narrowed choices down somewhat. The site that best met the criteria established was the Nez Perce Tribal Hatchery. Space exists at this site to hold and recondition up to 750 kelts. Security, power, reliable water sources and experienced fish cultural staff are also on site making it the best location among those considered.

The ISRP wonders, however, if the kelt reconditioning program being proposed can be reduced and yet still provide the benefits envisioned by the proponents. If the project were to identify the factors limiting B-run populations and narrow its focus on B-run populations that could benefit from the addition of reconditioned kelts, would existing facilities at Dworshak meet these new escapement objectives? The Master Plan should discuss this possibility.

The ISRP recognizes that substantial difficulties may exist in capturing kelts from targeted populations. Consequently, the program may wish to consider shifting to a long- and short-term reconditioning program. Genetic tools developed by the proponents could be used to identify the regional group of B-run kelts collected at Lower Granite and Little Goose Dams. Those kelts returning to streams in need of additional escapement would be incorporated into the program's proposed long-term rearing effort. B-run kelts from other populations could be placed into a short-term rearing program and transported downstream after 3 to 5 weeks of reconditioning. A discussion of the feasibility of such an approach and its possible infrastructural requirements would enrich the Master Plan.

Lastly, kelt reconditioning is not the only method that can be employed to increase adult steelhead escapement numbers. For example, could harvest reduction provide an immediate 6% boost in escapement (and productivity) more cost effectively and with less risk of domestication selection? If not, and hatchery intervention seems justified, at least in the short term, would it be more cost effective to recondition a smaller number of kelts and hold them as broodstock for a more significant boost in productivity (i.e., captive breeding)? The latter option is listed at the end of Section 3 in the Master Plan but is not discussed. The pros and cons of these approaches should be discussed in the Master Plan.

6) Provide the historical and current status of anadromous and resident fish and wildlife in the subbasin most relevant to the proposed project (Step 1)?

See Master Plan Section 4.

Some general material is provided about the location of B-run steelhead populations in the Snake River subbasin. It would be useful, however, if information on the abundance and status and trends of B-run populations in the Clearwater and Salmon River subbasins was provided. Current spawning levels of steelhead in the Snake River Basin should also be described with reference to numerical objectives for natural spawning steelhead. Additionally, a brief overview of the factors limiting each of these populations and descriptions of any habitat or supplementation efforts designed to help recover these stocks would also enrich the Master Plan.

7) Describe current and planned management of anadromous and resident fish and wildlife in the subbasin (Step 1)?

See Master Plan Section 6.

The ultimate management goals for Snake River B-run steelhead are to lessen short-term extinction risk and stimulate recovery. As the Master Plan points out, long-term kelt reconditioning; regulation of commercial, tribal, and sport harvests; hydrosystem alterations; habitat restoration; predator suppression; and hatchery supplementation are tools that are being used throughout the Basin for steelhead recovery. Excellent summaries of the kelt transportation studies and extensive kelt reconditioning research are provided. As noted previously, long-term reconditioning of kelts appears to have the potential to provide demographic and genetic benefits to depressed steelhead populations if suitable spawning and juvenile rearing habitats are available. However, the Master Plan currently lacks information on the extent that reconditioned kelts are expected to contribute to the rebuilding of natural steelhead populations and to fisheries. Are hatchery-origin steelhead expected to supplement these populations as well? This information should be included in the Master Plan.

The Master Plan also indicates that existing harvest regulations will not be changed; reconditioned fish will not bear external marks and are expected to escape harvest and contribute to natural populations. The effects of hydrosystem alterations are also briefly touched on—mainly as they relate to downstream survival of kelts. Nonetheless, the extensive alterations made to mainstem dams to facilitate adult and juvenile passage have most likely provided some benefits to B-run steelhead. For completeness, brief descriptions of ongoing hatchery and habitat actions occurring in the subbasins containing B-run steelhead should be added to the plan. It is important to understand how all of these efforts will be coordinated so that they can complement one another.

8) Demonstrate consistency of the proposed project with NOAA Fisheries recovery plans and other fishery management and watershed plans (Step 1)?

See Master Plan Introduction Section.

Results generated from addressing RPAs #33 and 42 guided the development of the long-term reconditioning effort described in the Master Plan. Consequently the proposed work of creating a long-term kelt reconditioning program for B-run steelhead is consistent with NOAA recovery plans. Uncertainty does exist, however, on how large an effort this should be and how it should be implemented. The Plan should justify why a general aggregate increase of 180 B-run adults per year would be superior to more focused efforts directed toward B-run populations that could benefit from an infusion of reconditioned adults.

No mention of any possible watershed plans is provided. If any exist they should be briefly described along with how reconditioned kelts might be incorporated into them.

9) Describe the status of the comprehensive environmental assessment (Step 1 and 2)?

See Master Plan Section 1.2.

The Plan states that a comprehensive environmental assessment will be prepared as part of Step 2 when the hatchery location has been finalized.

10) Describe the monitoring and evaluation plan (Step 1, 2 and 3)?

See Master Plan Section 1.2.

An RM&E plan will be completed once a final location for the proposed long-term reconditioning facility has been determined.

11) Describe and provide specific items and cost estimates for ten fiscal years for planning and design (i.e. conceptual, preliminary and final), construction, operation and maintenance and monitoring and evaluation (Step 1, 2 and 3)?

See Master Plan Section 8.

The Master Plan adequately addresses costs, design and operating expenses at the Step 1 level. RME costs have not yet been included. Has any consideration being given to using Fiberglass circular tanks rather than aluminum? A considerable cost savings could be realized if such tanks met project requirements.

B. Artificial Production Initiatives

Does the Master Plan:

1) Address the relation and link to the artificial production policies and strategies (see 2014 Fish and Wildlife Program, Part Three, Section IV, B and C1, 2, 4, 5, and 6) (Step 1)?

Primary strategy: Use hatchery programs as tools to help meet the mitigation requirements of the Northwest Power Act.

The APR standards:

- The purpose and use of artificial production must be considered in the context of the ecological environment in which it will be used. (See Step Elements A.1 and A.6)
- Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties. (See A.12)
- Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors. (See A.1)

- A diversity of life history types and species needs to be maintained in order to sustain a system of populations in the face of environmental variation. (See A.1)
- Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics.
- The entities authorizing or managing an artificial production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of those purposes for each population of fish addressed. (See A.3)
- Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels. (See A.2)
- Appropriate risk management needs to be maintained in using the tool of artificial propagation.
- Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations. (see B.3)
- Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed. (See A.10)

See Master Plan Section 1.3.

In its current stage of development, the Master Plan does not provide sufficient consideration of the APR standards relevant to managing risk to natural populations. This comment is covered more fully under the next technical element (HGMP).

2) Provide a completed Hatchery and Genetic Management Plan (HGMP) for the target population(s) (Step 1)?

See Master Plan Section 1.2.

An HGMP is not provided. The proponents suggest that the HGMP will depend on where a facility is developed and should be deferred pending the decision to develop a specific facility. However, an adequate conceptual review and evaluation of the genetic risks posed by the kelt reconditioning proposal is needed before approval to proceed with construction of a reconditioning facility. Iteroparity clearly has a genetic basis, as evidenced by differences among species reared under common conditions, and theoretical knowledge of the conditions favoring the evolution of iteroparity is well developed. The proponents describe how hydrosystem development has made the downstream migration of kelts more challenging, and current conditions are likely decreasing the strength of natural selection for iteroparity in steelhead populations above Bonneville. Therefore, the intention to reverse this process by enhancing kelt survival seems to have merit.

The proponents demonstrate that long-term reconditioning can increase survival of kelts by a factor of ten relative to un-reconditioned kelts. The success of this intervention is comparable

to rearing smolts from eggs in a hatchery, and it seems possible that the scope for domestication selection will be similar. This issue requires further scrutiny and should be presented in the plan. Presumably the reconditioned kelts are much more likely to survive than un-reconditioned kelts because they are spared the hazardous anadromous migration (and all of the opportunities for natural selection that entails). In addition to experiencing relaxed natural selection, reconditioned kelts may also experience directional artificial selection associated with their size, condition, ability to survive chemical treatments for fungus and gill parasites, or to prosper on new foods, etc. It's also worth noting that only about half of kelts retained for reconditioning survive, so considerable scope for artificial selection exists while they are in captivity.

An appealing part of the reconditioning plan is that kelts have already survived one anadromous migration and thus have already been subjected to rigors of natural selection. Another reassuring argument is that these kelts have likely already spawned; thus, even if reconditioned kelts survive to reproduce a second time at ten times the rate (say 30% versus 3%), and are inadvertently selected to be genetically different than non-reconditioned kelts, their lifetime contribution of gametes is likely only 26% higher than non-reconditioned kelts [i.e., (1 + 0.3)/(1+0.03) rather than 0.3/0.03)].

Releasing the kelts to spawn naturally mitigates against further artificial selection, but at the cost of a potentially much larger demographic boost. Retaining the kelts for use as broodstock might be much more cost-effective, albeit with considerably more genetic risk to the natural population; still that risk might be deemed worthwhile if limited to one generation and other measures were taken to foster recovery and prevent a "collapse scenario" (see Waples and Do 1994). To conclude, considerations of genetic risk are not likely to be fatal to the proposal but must be given further scrutiny within the plan.

3) Describe the harvest plan (see 2014 Columbia River Basin Fish and Wildlife Program, Part Two, Section II) (Step 1)?

See Master Plan Section 1.4.

The proposed kelt reconditioning program will not change any existing harvest policy and is unlikely to have any significant impact on existing commercial, tribal, or recreational fisheries. The kelt reconditioning program will result in the release of approximately 180 reconditioned natural-origin B-run kelts annually. These individuals are intended to contribute to natural production in their natal population and will not bear external marks that would make them eligible for recreational harvest.

4) Provide a conceptual design of the proposed facilities, including an assessment of the availability and utility of existing facilities (Step 1)?

See Master Plan Sections 6-8.

The Master Plan provides a conceptual design of a long-term reconditioning facility and a comprehensive assessment of the availability of existing facilities. Additional details will be provided in Step 2.

5) Provide a preliminary design of the proposed facilities (Step 2)?

See Sections 8 and 1.2.

Not applicable for this review; this is a Step 2 issue.

6) Provide a final design of the proposed facilities, including appropriate value engineering review, consistent with previous submittal documents and preliminary design (Step 3)?

See Section 1.2.

Not applicable for this review; this is a Step 3 issue.

Literature Cited

Independent Scientific Advisory Board (ISAB). 2015. Density dependence and its implications for fish management and restoration programs in the Columbia River Basin. ISAB Document 2015-1. Prepared for the Northwest Power and Conservation Council, Portland, OR.

Moore, J.W., J.D. Yeakel, D. Peard, J. Lough, and M. Beere. 2014. Life history diversity and its importance to population stability and persistence of a migratory fish: steelhead in two large North American watersheds. Journal of Animal Ecology. 83:1035-1046.

NOAA Fisheries FCRPS Biological Opinion. 2008. Endangered Species Act Section 7(a)(2) Consultation Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation. www.salmonrecovery.gov/files/BiologicalOpinions/2008/2008%20BiOp.pdf 991pp.

Seamons, T.R., P. Bentzen, and T.P. Quinn. 2004. The mating system of steelhead, *Oncorhynchus mykiss*, inferred by molecular analysis of parents and progeny. Environmental Biology of Fishes. 69:333-344.

Seamons, T.R. and T.P. Quinn. 2010. Sex-specific patterns of lifetime reproductive success in single and repeat breeding steelhead trout (*Oncorhynchus mykiss*). Behavioral Ecology and Sociobiology. 64:505-513.

Waples, R.S. and C. Do. 1994. Genetic Risk Associated with Supplementation of Pacific Salmonids: Captive Broodstock Programs. Canadian Journal of Fisheries and Aquatic Sciences. 51:310-329,

Zabel, R. and T. Cooney. 2013. Recruits-per-Spawner in Base Versus Current Time Periods—Do they differ? Appendix C of the 2014 FCRPS Supplemental Biological Opinion, NOAA Fisheries.