Independent Scientific Review Panel
for the Northwest Power & Conservation Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
www.nwcouncil.org/fw/isrp

Memorandum (ISRP 2012-7) **May 23, 2012**

To: Joan Dukes, Chair, Northwest Power and Conservation Council

From: Rich Alldredge, ISRP Chair

Subject: Snake River Sockeye Springfield Hatchery Step 2/Step 3 Review (Project #200740200)

Background

In response to the Council's April 27, 2012 request, the ISRP reviewed Step 2/ Step 3 documents for Idaho Department of Fish and Game's (IDFG) *Springfield Hatchery* project (#200740200, *Snake River Sockeye Captive Propagation*).

These IDFG documents are intended to address information requested by the ISRP (i.e., six qualifying issues) as part of our Step 1 review of the *Springfield Hatchery Master Plan* (ISRP 2011-2), and the requirements of Step 2 and Step 3 of the Council's review process.

The ISRP comments below are organized by the six qualifying issues identified in our Step 1 Review, which IDFG responded to point by point in their Step 2/Step 3 reply to the ISRP. Comments on the six key issues are followed by ISRP comments on the Step submittal appendices.

Recommendation

Meets Scientific Review Criteria (Qualified)

The Step 2/Step 3 submittal adequately addresses the facility, permitting, and construction plan requirements of Step 2 and 3, and the monitoring and evaluation (M&E) plan establishes a framework to acquire the required information for determining if the project is achieving its biological goals.

However, the following issues raised by the ISRP in Step 1 were not answered in sufficient detail:

- the transition from Phase 1 - Captive Broodstock to Phase 2 - Re-introduction Program Scale (1 million smolts)
- Redfish Lake broodstock collection
- experimental management

These Step 1 issues need to be addressed in a further response to the ISRP before fish culture at Springfield begins in December 2013. The plan represents a great deal of work, and with some additional consideration it can be made better. Construction initiation in July 2012 need not be delayed.

1. Production Transition

ISRP Comment 1. Please clarify the plan for using anadromous hatchery, natural, and captive reared adults for escapement to Redfish Lake, captive rearing, and Phase 2 production at Springfield Hatchery during the initiation of Springfield production. The Master Plan does not indicate how the transition from captive rearing to anadromous-based production will be executed.

The IDFG reply in the Combined Step 2/Step 3 Submittal did not address the question posed. The IDFG reply referred the ISRP to section 5.4 of the original Master Plan. Section 5.4.1.1 on page 64 of the Master Plan describes the production and release of fish by the Phase 1 – Captive Broodstock program, and section 5.4.1.2 describes general criteria to manage Phase 2 – Re-colonization, under a series of bullet points. Pages 65 through 76 provide a series of trigger points for scaling back the captive broodstock program, transitioning to Phase 3, and modifying release programs for specific lakes. This section of the Master Plan and the Step 2/Step 3 submittal do not describe the beginning years of implementing Phase 2. It is clear from the Master Plan and Step 2/Step 3 submittal that there is a desire to release 1 million smolts in the Redfish Lake watershed, and that it is anticipated that 1,150 adult brood fish are required to meet this target (Table 5-1 and Table 5-2, pages 66 and 67 of the 2010 Master Plan). What has not been presented is the number of captive broodstock currently being maintained at the Burley and Eagle facilities, and how adults and eggs from captive broodstock, anadromous hatchery returns, and natural returns will be allocated to Springfield Hatchery production, Burley captive-broodstock, Eagle captive-broodstock, and Redfish Lake spawning. The IDFG documents do not provide information on implementing Phase 2. Is there a plan to immediately propagate 1 million smolts, or is there a planned step-wise increase in production? Will eggs from captive broodstock be used in smolt production at Springfield?

Page 10 of the Step 2/Step 3 document states: “Because the program is producing large numbers of returning anadromous adults (1,215 in 2009, 2,201 in 2010, and 1,502 in 2011) the program is ready to be transitioned to Phase 2.” One of the decision points in the Phase 2 management is maintaining a pNOB of 10%. Table 1-1 on Page 8 of the Master Plan indicates that natural returns were 142 and 85 in 2008 and 2009 respectively, and that hatchery returns were 457 and 732 in those years. The total NOR and HOR returns for those years are not enough to implement a 1 million smolt program at Springfield. Plus, the Step 2/Step 3 Experimental Management Plan (3.1.5, page 20 and 21) allocates 250 adults to Redfish Lake when run-size is above 500 adult fish. At the bottom of the 1st paragraph on page 20 of Volume 1, IDFG states that natural escapement targets for runs less than 750 fish would be based on an evaluation of the productivity of natural-origin versus hatchery-origin spawners. This guideline is vague. Ultimately, it is not clear how these decision rules will be utilized when there is a conflict.

Given the recent production of adult sockeye salmon, including HOR and NOR fish, how many would be used for artificial production broodstock and how many would be allowed to spawn in the lake? A retrospective presentation would be informative of what Springfield production would have been had the facility been available since 2008. Step 2/Step 3 Table 3-4 helps, compared to Master Plan Table 5.3, because it suggests Springfield smolt production may be less than half the 1 million target. But specific clarification and discussion of the options under consideration are needed.

The primary concern/issue is balancing the risks and uncertainties of domestication selection, population abundance, and re-adaptation using captive broodstock and anadromous hatchery fish in the recovery program. The Master Plan and Step 2/Step 3 documents adopt HSRG guidelines for pNOB during Phase 2 and PNI during Phase 3. But because these HSRG guidelines were established based on theory, rather than empirical data, it is unknown whether the guidance is too liberal or too constrained. The Snake River sockeye salmon propagation program and recovery plan need to consider options for smaller programs with more reliance on NOR production versus larger programs with more reliance on HOR production. It may be that achieving the recovery goals with a smaller program would ultimately have a shorter timeframe if re-adaptation to the natural environment improves productivity. These options need to be modeled as the program proceeds. Page 65 of the Master Plan states that the “primary objective of Phase 2 will be 1) gene banking and 2) providing adults to recolonize available habitat.” If this is the primary objective, why does “returning adults prioritized for broodstock” appear in a subsequent list in the report? What levels of production would be implemented if few NOR sockeye return to Redfish Lake? How is this consistent with the stated primary objective? For example, Table 3-2 (Step 2/ Step 3) suggests natural escapement would have priority over hatchery broodstock.

Finally, Redfish Lake trigger 1: Burley Creek captive brood program ceases when 1,000 anadromous hatchery and natural-origin adults return to Sawtooth subbasin (5-year geometric mean) appears as though it might be met in 2012, based on the returns in 2008 through 2011. The ISRP would appreciate learning about discussions to proceed with phasing out the Burley Creek component.

2. Comparison of Release Goals

ISRP Comment 2. Provide a comparison of the program with release goals across a range from the current 150,000 smolt to the 1,000,000 smolt preferred alternative, and explain the justification for the preferred alternative in terms of achieving the recovery and restoration goals of the anticipated Snake River sockeye recovery plan.

Justification for the one million hatchery smolt goal is never provided. The goal is attributed to a NOAA Fisheries analysis suggesting that this number of smolts may be an appropriate goal for the Springfield project. Justification requires a link between the Springfield Hatchery program size, full life-cycle survival of hatchery- and natural-origin sockeye salmon, and restoration and delisting criteria under the Snake River sockeye recovery plan and Fish and Wildlife Program goals.

Important assumptions about how values are derived in many of the tables are not presented or discussed. For example in Table 3.2 (page 18, Vol. 1), estimates of the number of adults produced under a range of smolt releases is presented, as requested by the ISRP. This table does not, however, provide a SAR value (it was apparently 0.47% across all release groups) nor does it explain why NOR escapement declines with decreasing numbers of released hatchery smolts. Understanding why NOR abundance declines in the fashion shown would help put the benefits and risks associated with different hatchery release numbers into perspective.

One observation is that total Redfish Lake natural spawning escapement of 2,695 is only producing 522 natural-origin sockeye salmon. This abundance is insufficient to trigger advancing to Phase 3 (requiring a 5-year geometric mean of 750 natural sockeye) and is well below the 1,000 NOR anticipated in the recovery plan. It appears to the ISRP that substantial improvement is needed in natural smolt production along with SARs. It is not clear how much resilience is gained by having 500 NOR sockeye over, for example, 400 NOR sockeye with a program of 500,000 smolts. The recruits per spawner ratio (R/S) is larger for the 500,000 smolt program than for the 1,000,000 smolt program (0.28 versus 0.19).

The upper escapement target of 2,695 sockeye is within the reported (P. 69) pre-dam production potential of 3,800 sockeye in Redfish Lake. But new analyses are needed to justify

whether, given kokanee production and other fishes, the current lake can support this escapement level plus 1 million smolts released in the outlet stream.

The assumptions underlying the smolt number goal need to account for:

- survival effects of physiological stresses the fish will experience when they are trucked for approximately eight hours from the Springfield Hatchery to their release locations below Redfish Lake,
- the mortality they are likely to experience in the Snake and Columbia Rivers during downstream migration,
- the effects of variable ocean conditions on their marine survival, and
- the degree of mortality they will most likely experience as adults migrating back to Redfish Lake.

SAR survival rates cited for Oxbow smolts (smolts of about the same size as those planned for the Springfield Hatchery) ranged from 0.46 to 1.116%. If these survival values hold, a one million smolt program would produce between 4,630 and 11,160 hatchery-origin recruits, enough for them to meet Step 2/Step 3 plans. A rigorous exercise to establish smolt production numbers based on anticipated life-stage survivals and linked to restoration and delisting goals might alter this one million smolt goal, or more firmly validate it.

3. Characteristics of Produced Smolts

IDFG addressed the smolt size question sufficiently. The 170 mm, 58 g yearling smolts would be extraordinary large yearling sockeye smolts, in fact larger than any yearling smolts reported by Burgner (1991) in his review of sockeye. Large smolt size at age is known to reduce age and size at maturity in salmonids. IDFG's monitoring plan will evaluate whether this is occurring. So far they have not found evidence of a shift in age-at-return or sign of high jack frequency. As long IDFG continues to monitor size and age at maturity then corrections can occur as needed. IDFG states that smolt size would be adjusted downward if adult returns indicate survival is good from smaller smolts.

IDFG notes that larger sockeye smolts released from Oxbow Hatchery (10 fpp) had consistently higher survival (0.46%-1.1%) than smaller smolts released from Sawtooth Hatchery (20 fpp; 0.23%-0.38%). They conclude these large smolts, which are much larger than natural sockeye smolts, are necessary to achieve sustainable hatchery production. Ideally, the comparison would have used large and small releases from the same hatchery to test the size effect. Release of specific size groups should be part of the adaptive management/monitoring and evaluation program to determine the most effective size groups for the proposed hatchery.

4. Redfish Lake Broodstock Collection

ISRP Comment 4. Currently anadromous-hatchery and natural-origin adults are released to spawn in Redfish Lake. Recent return numbers are actually at or below the minimum run sizes in Table 5-3 (page 69 [Master Plan]) for allocating any escapement into Redfish Lake. It does not seem to be justified to collect all the returning adults (hatchery and natural) and use them in culture with no natural escapement. Consequently, some discussion is needed to elaborate and justify a plan for natural escapement when hatchery and natural adults are in the range of 800 to 1,200 fish.

In response to the ISRP query regarding spawning escapement into Redfish Lake, IDFG has modified the implementation schedule. Originally, no adults were allotted to lake escapement for spawning until combined HOR and NOR abundance reached 1,150 fish (Table 5-3, Master Plan). That schedule has been modified, and 250 fish will be allocated to spawning escapement when HOR and NOR abundance reaches 500 fish (Table 3-4, Step 2/Step 3). Table 3-4 needs further clarification. For run-sizes 500-750, there is allocation to hatchery broodstock of 450 HOR and 50 NOR, and allocation to Redfish Lake of 250 fish. This allocation of adults can only be achieved when adult abundance is 750, and only if there are 50 NOR. A description of the allocation from 500 to 750 is needed. There should also be a justified decision on apportioning the NORs to hatchery broodstock and spawning escapement. It would be preferable that the approach provides testable hypotheses regarding re-adaptation.

5. Experimental Management Plan

ISRP Comment 5. Develop an experimental management plan, with sufficient monitoring, to evaluate lake carrying capacity. This should be incorporated into the trigger points and decision framework for determining smolt release numbers, natural escapement targets, and PNI.

The ISRP asked that plans be developed to evaluate lake carrying capacity for juvenile sockeye and for spawning adults. A comprehensive limnological sampling design is described, but how this information will be used to determine juvenile carrying capacity is not mentioned. The M&E plan also mentions how adult spawning areas are identified. However, the size of these locations, their environmental characteristics, for example gravel composition, presence of up-welling flows, and temperature regimes, and their estimated adult carrying capacities are not. In regard to these two questions, IDFG states that adult and juvenile productivity and capacity values are based on an analysis of habitat quality and quantity and not empirical data (p 32 Vol 1, Step 2/Step 3 document). The relationships between the habitat variables being measured and juvenile and adult carrying capacity need to be assessed to verify the appropriateness of this approach and to help determine the size of the program. Monitoring should include an

evaluation of the relationships between juvenile abundance and the resulting smolt size at age and smolt age composition. Additionally, the impacts of predators such as rainbow trout and potential competitors such as kokanee need to be considered when estimating natural production in Redfish, Pettit, and eventually Alturas lakes. Finally no mention is made on how or if natural spawning areas might be improved via gravel cleaning or whether artificial spawning beaches or channels using lake tributaries might be employed. Improving the capacity of the natural environment to produce smolts is a pivotal need for the project, and part of the Step 2/Step 3 process should address this issue.

Performance Standard 3.4.4 indicates that IDFG has included in the HGMP a performance standard that annual release numbers do not exceed estimated basinwide and local habitat capacity. However, it is not clear from the IDFG response whether the release of up to 1 million smolt size sockeye salmon will be modified, for example, if natural production has already produced high numbers of juvenile sockeye in the lake. This issue will depend, in part, on the degree to which hatchery smolts interact with natural production. The release of 1 million large sockeye smolts may cause reduced survival of smaller natural sockeye during downstream migration.

6. Exclusive Sockeye Production

The response provided adequate clarification.

Step 2/Step 3 Comments

ISRP Summary comment A. IDFG states that R/S was above 1 for brood years that incorporated return years 2009-2011. This information should be displayed in a table that shows parent escapement and adult returns from the brood by age. IDFG states that this information indicates that recovery of Snake River sockeye is possible under current conditions. It would be worthwhile to identify current conditions that led to the R/S exceeding 1. To what degree was the relatively high R/S related to conditions in freshwater versus the ocean? For the freshwater component, to what extent were conditions in freshwater related to actions controlled by management? The Step 2/Step 3 submittal identifies that parentage analysis concluded that natural spawning by captive reared adults in the 2006 brood year achieved replacement. Monitoring trends in smolt production and subsequent survival are necessary to determine if the program is making progress, and for refining breeding, production, escapement, and harvest plans. At this time the goals and triggers for Phase 2 and Phase 3 are below the delisting abundance anticipated in the recovery plan. The Springfield Hatchery program is warranted under the Fish and Wildlife Program and BiOp only to the extent that there is a companion

effort to further define the limiting life stages and a plan to implement actions to improve survival at some life-stage such that VSP parameters indicate a low likelihood of extinction and that abundance and productivity support harvest.

Key ISRP Recommendation No. 3. The IDFG response states that hatchery production will decrease as natural production increases, but Table 3-4 shows that hatchery production (broodstock collection) would remain constant as overall production increases. The response did not address the issue of using natural rearing methods.

Appendix A. HGMP

The presentation of performance standards (p. 75) gave no indication of an inclination to evaluate and fine-tune the size of smolts at release (the issue in ISRP comment #3). This seems an oversight.

Appendix D. Redfish Lake Sockeye Monitoring and Evaluation Plan

In general the M&E plan represents a good starting point. A framework is laid out for Phase 2 (re-colonization) and the intent is stated to defer M&E plan development for Phase 3 until later, because Phase 3 (local adaptation) is decades away. This approach is reasonable. A number of issues need to be addressed:

a. How can minimum hatchery production be "not applicable" for Phase 2? If pNOB is 10%, then the minimum would be zero, if no NOR adults returned. There is a need to further develop the rule set when NOR is small and the total escapement is above 500, but below the threshold that permits 250 adults to escape for natural spawning (see comments above under answer to comment 1).

b. Table 3-4 on page 19 is a copy of Table 5-3 from the Master Plan. It seems it should be a copy of 3-4 from Step 2/Step 3.

c. P. 13, paragraph 1. The statement that a minimum escapement of 500 NOR adults is a goal is misleading in light of Table 3-4, which indicated hatchery brood stock has priority at low abundances.

d. The plan states (P. 16) that the quality and quantity of adult and juvenile habitat are high priority. It was not clear how a release of up to 1 million hatchery smolts is justified if the capacity of the natural habitat is so low (78,125 smolts). Will the interaction of these hatchery smolts and natural sockeye be evaluated? Is the estimated capacity based on limnological data and sockeye growth data? The assumed value of 63 smolts

per spawner seems a bit high, and an R/S of 4 is unrealistic (for this natural stock, on average). But it is good that monitoring will be in place to examine smolt and overall productivity from natural spawners. Will release of eyed-eggs and pre-smolts (Phase 1) be eliminated? If not, how will these fish be accounted for in the monitoring plan?

The monitoring and evaluation plan appears to identify the critical uncertainties and appropriate data and derived estimates needed to evaluate the Snake River sockeye natural and hatchery production in Sawtooth valley lakes. There is no overview provided to indicate how well existing M&E has been functioning and what aspects of it are adequate and what are not.

An ISMP (In-Season Management Procedure) is developed for Phase 2 that is intended to facilitate transition to Phase 3. Presumably the ISMP is an original "innovation" and is unique to this project. If there are any new features to an ISMP, they were not apparent. Details were sparse, and examples were not provided to show how it might be implemented to modify the Snake River sockeye salmon restoration program in general or the Springfield Hatchery program specifically. One might think that it is intended to better track annual performance of project sockeye, but if so there was no indication how data would be provided in a more timely manner to enable more enlightened management. It is a four-step procedure "formalized in a (spreadsheet) database and a set of management tools" that "assure consistency and accountability" as part of the traditional Annual Project Review (APR). One feature involves evaluating and adopting new assumptions within the ISMP review. However, expecting an evaluation of updated assumptions to make changes to decision rules a day after presenting new information is unrealistic. More likely, decision rules would be updated with a year time lag.

The four "highest M&E priorities" are listed on page 16. It is not clear what these really are, as they are not just the issues/topics most in need of assessment or monitoring. They seem more like assumptions, and if so should be so labeled. The four are:

1. Quality and quantity of Sawtooth Basin habitat – spawning and rearing habitat assumed to be in close to pristine condition.

2. Natural population fitness – actions are expected to increase natural smolt "productivity" by 78% and increase the fitness factor from AHA by 80% as shown in Table 3-1.

3. Hatchery population fitness – assumes HOS fish are less fit than NOS.

4. Survival rates of adult and juvenile fish – assumes they can be increased by 39 and 48%, respectively, but the basis for any such beliefs (and the way to achieve them) are not given. They should be.

A substantial opportunity appears to exist to take better advantage of the PIT tags to be placed into some undescribed subset of NOR and HOR juveniles (Section 5.1.1.2). In addition to the other types of data generated, reviewers suggest the analysis of survival and travel time to Lower Granite Dam would be valuable if it can be designed to assess differences due to fish size and relative time of outmigration (as well as NOR vs. HOR performance). Such use of PIT-tagged fish to evaluate overwinter survival and outmigration success is vaguely mentioned at the end of the M&E Plan (p. 52) but needs to be expanded and strengthened. PIT tags will be an important tool, but sockeye are fragile and more susceptible to handling and tagging stress compared with Chinook and steelhead. Efforts will be needed to ensure the fragile nature of sockeye will not compromise the tagging results.

Will age composition be monitored in the returning adults so that returns can be assigned to the parent year for calculation of R/S?

How are juvenile sockeye distinguished from juvenile kokanee when attempting to relate juvenile data in the lakes to parent spawners and smolt production?

Of the metrics listed in the plan, it would be useful to indicate which have been measured to date.

Appendix G. 60% Design Documentation Report

Section 3 – Biocriteria. Table 3-1 summarizes the fish production program and provides assumptions on growth, rearing densities, water requirements, and tank and incubator requirements. All these are reasonable. IDFG is using best practices for culture assumptions (growth rates, densities, and flow). If the water is of the quality and quantity described in the appendix the proponents should have the necessary facilities to meet the production targets.

IDFG plan to use “Heath Tray” stack incubators. This is fine, but sockeye, like pink and chum salmon, are vulnerable to a host of problems including loss of yolk material, lower jaw deformations, and other maladies, if their alevins are allowed to incubate on bare screen (e.g., Fuss and Johnson 1988; Leon and Bonney 1979). Some type of rugose substrate has to be inserted into the trays to stop the fish from continuing to swim and or attempt to right themselves. Typically, ½ inch vexar screening is folded onto itself four times and tied together with metal clips or nylon ties. These vexar mats can be easily cleaned and inserted into trays

and fry will not lose 20% of their yolk material due to needless activity. If IDFG have not planned on doing this, they need to do so.

It looks like the incubation room does not have any windows, which is good. Whenever possible, eggs and alevins should be incubated in darkness. This will increase yolk efficiency and reduce the chance for visual impairments. Also it appears that a water chiller with the capacity to chill about 70 gpm of 10 degree water down to 4.5 degrees will be part of the Springfield Hatchery's infrastructure. Because the incoming water has such a constant temperature it makes this hatchery an ideal setting for thermal marking. In this case, every fish could be marked with a thermal code in its otolith during the incubation period. This offers a non-stressful way to mark 100% of the hatchery's production (Volk et al. 2005). Additionally, they should try some innovative things with their culture methods. Not at Springfield, but, perhaps at Manchester while it is still being used to grow fry. One of these would be to compare the effectiveness of underwater feeders versus standard hand or surface feeding methods to start newly ponded fry on their food. One of the many challenges a culturist has is starting young salmon to feed. Salmon fry have an innate startle response to surface shadows and movements, which make it difficult for them to start feeding on food thrown onto the surface of the water. Underwater feeders eliminate this response as food is delivered to them in the mid-water column, fry and juveniles do not become surface oriented or habituated to overhead movements and therefore their post-release vulnerability to avian predators may be reduced. Researchers at Manchester have built and used underwater feeders in the past and would be well suited to carry out this type of experimentation.

Other Comments

An analysis of the captive sockeye breeding program by Kalinowski *et al.* has been completed and is in publication. It would have been beneficial to have attached it to the current proposal.

As it is planned, it is difficult to see how it is possible to meet a PNI goal of 67% and also have more NORs on natural spawning grounds than hatchery origin fish. To meet this goal natural origin smolts would have to have SARs higher than have been recorded to date.

The assumptions made are very optimistic regarding fitness increases as the fish are allowed to reproduce under natural conditions and presumably become less domesticated and more adapted to natural conditions. A more conservative approach is one that assumes that fish originating from the hatchery and under natural conditions will have similar fitness values—at least in the early days. This assumption can be revised as empirical data are obtained.

There is a 750 NOR trigger for Redfish Lake to initiate Phase 3 according to Figure 3, page 16 of the Step 2/Step 3 submittal, but Table 3-1 on page 17 identifies a NOR escapement of 500 as a decision rule. How these triggers and rules will be applied needs to be reconciled.

Finally, in Table 3.4 natural escapement targets based on run size (page 21 Vol 1) are presented. This table indicates that when escapement (HOR + NOR) reaches 5,000 they will plant 50 adults into Pettit Lake. Fifty adults seems very low. It may be worth considering introducing more adults into Pettit and fewer into Redfish Lake. In this approach, there would be a chance that some Pettit Lake adults might produce some adult offspring. It might also provide valuable information on factors limiting natural production in this lake. The numbers of adults released for spawning in each lake should be based on a designed experiment.

Citations

Burgner, R.L. 1991. The life history of sockeye salmon (*Oncorhynchus nerka*). Pages 3-117 *in* C. Groot and L. Margolis (eds.), Pacific Salmon Life Histories. Univ. British Columbia Press.

Fuss, H.J., and C. Johnson. 1988. Effects of artificial substrate and covering on growth and survival of hatchery-reared coho salmon. Prog. Fish-Cult. 50:232-237.

Leon, K.A., and W.A. Bonney. 1979. Atlantic salmon embryos and fry: effects of various incubation and rearing methods on hatchery survival and growth. Prog. Fish-Cult. 41:20-25.

Volk, E.C., S.L. Schroder, and J.J. Grimm. 2005. Otolith thermal marking. Pages 447- 463 *In* S.X. Cardin, K.D. Friedland, and J.R. Waldman (ed.s) Stock Identification Methods, Elsevier Press.