



Independent Scientific Review Panel

for the Northwest Power & Conservation Council
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Memorandum (ISRP 2016-5)

March 16, 2016

To: Henry Lorenzen, Chair, Northwest Power and Conservation Council

From: Steve Schroder, ISRP Chair

Subject: White Sturgeon Hatchery Master Plan Step 1 Response Review

Background

At the Northwest Power and Conservation Council's request of December 18, 2015, the Independent Scientific Review Panel (ISRP) reviewed a revised *White Sturgeon Hatchery Master Plan: Lower Columbia and Snake River Impoundments* prepared by the Columbia River Inter-Tribal Fish Commission (CRITFC). The master plan was revised in response to the ISRP's April 15, 2015 review, which found the original master plan to be well organized and well written but needing clarification on 10 issues ([ISRP 2015-3](#)).

This is part of a Step One review for the Council's Three Step Review Process for artificial production programs. This Master Plan is a component of CRITFC's Project #2007-155-00, *Develop a Master Plan for a Rearing Facility to Enhance Selected Populations of White Sturgeon in the Columbia River Basin* and the Yakama Nation's Project #2008-455-00, *Sturgeon Management*. The program proposes to produce approximately 26,500 juvenile sturgeon per year for release in lower Columbia and Snake River reservoirs.

The ISRP reviewed the following documents:

- Cover Letter - <https://nwcouncil.box.com/s/bppuwl9479vzwf05he5xvesr4r23kxp6>
- Response to ISRP issues and concerns of previous review (ISRP 2015-3) - <https://nwcouncil.box.com/s/dg0iqdglxmtdsqn7pww5pvdrrpj7lux9>
- *White Sturgeon Hatchery Master Plan, Lower Columbia & Snake River Impoundments, Step 1 Revised, December 15, 2015* - <https://nwcouncil.box.com/s/cy4h34sfi3uh7cttrufp7pd067jj7imy>

Recommendation

Meets Scientific Review Criteria for Step 1 (Qualified)

Overall, the proponents' responses were detailed, comprehensive, and well-formulated. The additional information provided in the response to the questions greatly strengthens the Step 1 Document and clarifies the proponents' intent and the rationale for the proposed hatchery.

The Qualification is that, in Step 2, additional information is needed on the following topics:

1. *Management of the fishery.* Provide additional support and evidence for the assertion that management of a white sturgeon fishery, pursued over a wide area with long seasons and monitored as in the past, will provide the necessary outcomes for limiting harvest rates and protecting wild fish from overharvest.
2. *The ecological justification for the B40 biological reference point.* Its applicability to impounded white sturgeon populations is not clear.
3. *The fish ticket system.* Provide a more complete description and justify its adequacy for accurately quantifying harvest.
4. *Commercial catch.* Provide additional information on how biological data including lengths, weights, marks, and tags will be collected from subsamples of the commercial catch. Information should also be provided on the sampling design and the intensity of sampling.
5. *Tribal subsistence catch.* Provide additional information on how subsistence harvest will be estimated.
6. *Recreational catch.* Provide more information on the roving-clerk angler survey design, the accuracy of harvest estimates, and other biological data that may be obtained from the sport fishery.
7. *Catch-and-release mortality.* Provide a description of plans for quantifying post-release mortality.
8. *Illegal catch.* Provide a description of plans for addressing illegal harvest concerns.
9. *Sanctuaries.* Provide details on plans to create areas where harvest is prohibited.
10. *Carrying capacity.* Provide clear, justified benchmarks for survival, condition, and growth, which are based on literature and actual data, that can be used to determine if carrying capacity has been exceeded, thereby adversely affecting the viability of the natural population.
11. *Contaminants.* Provide a discussion of plans to assess contaminants in fish in the harvest slot as they relate to human consumption.

12. *Objectives.* Clarify how objectives will be quantified and their time frames (see closing section).

Comments

ISRP comments are categorized by each of the ten questions from our April 2015 review (Questions 1-10). The ISRP appreciates the attention given to the other 40 ancillary questions as well.

1. Comprehensive life history data

The life history overview presented in Section 3.3 is a welcome, and necessary, addition to the Step 1 Document. An effective review of available literature on the life history of white sturgeon has been included. While much remains to be learned about basic life history, such as the reasons for reproductive periodicities and sexual size and age dimorphism, the fundamentals of life history are known. The section also describes life history knowledge with reference to the history of white sturgeon harvest and current status in the various Columbia River pools. Differences in life histories among pools will be relevant in any future efforts at restoration. Because the slot limit harvest fishery will not provide sacrificed fish of different sizes and ages, fish killed from other causes (e.g., operations, heat stress, etc.) should be sampled for a range of attributes (e.g., age, reproductive state, fecundity, and other characteristics) to fill in knowledge gaps in life history.

2. Sustainable harvest rates for impounded populations

3. Management to avoid wild sturgeon overharvest

4. Harvest expansion justification

Responses to questions 2-4 are considered as a group. In partial response to these questions, the additional information regarding the biological basis of management (Section 9.6) is a very welcome, necessary, and beneficial addition to the Step 1 Document. It clearly describes the intent of the program and the rationale for the harvest management strategy. The proponents make it clear that the primary intent is harvest mitigation. The first quantitative objective in the revised plan is to *“Increase harvest of White Sturgeon in commercial, subsistence and recreational fisheries for impounded lower Columbia River subpopulations by 100% or more consistent with constraints of existing hatchery capacity.”*

From the response, it is clear that the present white sturgeon fishery management approach, with a harvest slot, is viewed as satisfactory by the proponents. Thus, few changes are being sought, other than producing more (hatchery) fish to harvest, with as long a season as possible over as wide an area as possible. However, the ISRP does have some concerns regarding current harvest management combined with the proposed hatchery supplementation effort.

The proponents' logic for the hatchery, in combination with slot limits on immature fish, can be justified as desirable conceptually. For Step 2, however, the ISRP requests additional support and evidence for the contention that management of a white sturgeon fishery, pursued over a wide area with long seasons and monitored as in the past, will result in the necessary outcomes of limiting harvest rates and protecting wild fish from overharvest.

The planned approach of using a percentage of the unexploited biomass (i.e., 40%) as a biological reference point for sustainability is an approach used for some marine fishes in the absence of productivity assessments. The ISRP is not convinced that the 60% exploitation rate (Effective Lifetime Exploitation Rate; ELER) based on a heuristic B40 reference point is appropriate for the populations being targeted. The ecological basis for that reference point is not clear. Under conditions of erratic recruitment, standard stock-recruitment assumptions might not apply. The rationale for B40 as sustainable for wild stocks in the Columbia River Basin should be clarified in Step 2.

Success of this approach is contingent on adequate, accurate estimates of population size and harvest rates. Managers must have accurate estimates of both the wild- and hatchery-origin populations and their rate of removal from the population. It was indicated that population estimates were reasonably accurate, but the ISRP has doubts about their adequacy for estimating sturgeon abundance in the slot size. Without accurate estimates, it will be difficult to protect natural fish from over-exploitation. Set lines and gillnets will be used and expected-confidence intervals are in the 15 to 30% range. The proponents should consider exploring new methods of estimating abundance in order to improve the accuracy and precision of their estimates.

Similar doubts remain in terms of the proponents' ability to actually maintain an annual harvest rate of $\leq 16\%$ (60% ELER). Meeting the objectives and effective monitoring of the fishery are dependent on an accurate assessment of annual harvest of white sturgeon. Are the methods used to estimate catch or harvest adequate to ensure that exploitation rates do not exceed 16% per year (60% ELER)? Will these harvest rates be estimated from mark-recapture methods of the PIT-tagged and scute-marked fish and counts of harvested fish? How much error is associated with estimation of actual harvest rates? Can the fishery actually be managed so that the maximum rate is not exceeded?

Total estimates of annual harvest will be summed from individual annual harvest estimates from three components of the fishery: (1) commercial, (2) subsistence, and (3) sport. The ISRP has concerns about the prospects for actually staying below or at the target harvest rate. There is a potential for exceeding the 16% annual harvest rate because of sampling inadequacies associated with fish tickets and creel censuses (see below), post-release mortality of fish outside the slot limit, illegal harvest, changes in effort due to increased abundance of hatchery fish, and difficulties in managing the open fishery as it is envisioned.

It is stated that *"harvest in commercial fisheries is estimated from fish tickets, which are reported from fish buyers for all sturgeon purchased."* Based on experiences in other localities,

the ISRP has reason to doubt that the fish ticket approach is an adequate method for accurately quantifying all commercial harvests. No detail is provided as to how this system of reporting works or the accuracy of estimates based on the reporting by fish buyers. Issues that may lead to underestimates of commercial harvest include failure of commercial fishers to sell their catches to fish buyers who report their purchases. As in other localities, portions of commercial fish harvests may be diverted to subsistence, bartered, or sold to “underground” markets. Additionally, not all fish purchased by fish buyers may be reported on fish tickets. Full explanation of the fish ticket reporting system is needed in Step 2, with an explanation of how it is managed so that estimates of commercial harvest are reliable and accurate.

It is also stated that “*biological data including lengths, weights, marks, and tags*” will be collected from subsamples of the commercial catch. No explanation is provided as to how these samples will be obtained, the sampling design, or the intensity of sampling. This information is also requested for Step 2.

Furthermore, it is stated that “*subsistence harvest is estimated based on a survey program of treaty tribal fishers.*” No information is provided as to how the survey is conducted or the accuracy of estimates derived from the survey. Failure to report white sturgeon harvested for subsistence is likely to bias harvest estimates. Additionally, no biological data will be obtained from this component of the fishery and the catch composition may be substantially different from commercial or sport harvests. Additional information on how this harvest will be estimated should be provided in Step 2.

Also, it is stated that “*sport fishery harvest is also monitored in Zone 6 reservoirs during sturgeon retention seasons with a roving angler survey.*” No information is provided regarding the roving-clerk angler survey design, the accuracy of harvest estimates, or other biological data that may be derived for this component of the fishery. This information is needed for Step 2.

If fish in the slot size grow more slowly or rapidly than expected (2 inches per year), and increase or decrease their vulnerability to harvest as a result, what management revisions will be needed? This information is requested for Step 2.

The rationale for the slot limit approach was justified, especially in view of wanting long harvest seasons over large areas. However, the proponents state: “*It also ensures that harvest mortality is 0% for fish that have escaped the fishery and reached spawning age.*” This assumption needs to be evaluated. One of the risks of a slot fishery is post-release mortality. In practice, with this harvest management approach, a large fraction of the fish caught will be hauled in and then released. This sorting and release process will occur over large areas and long time periods, and will involve both wild and hatchery fish. Under these conditions, are there estimates of catch-and-release mortality, particularly in seasons with warm water temperatures (as was seen in 2015)? Effort should be directed toward determining the survival of sturgeon caught and subsequently released. Are, for example, gravid females able to tolerate catch-and-release? Evaluations should be conducted by size class. Radio and acoustic tags could be used to evaluate post release mortality. Also, some fish may be caught and released multiple times—

what effect does that have on their survival and growth? The ISRP suggests that there is a strong need to evaluate post-release mortality by size, reproductive stage, gear type, and water temperature. A higher than expected catch-and-release mortality will require steps to reduce the problem. It will also necessitate a lower exploitation rate for a sustainable fishery. For Step 2, the ISRP requests that the proponents more fully describe their plans for addressing catch-and-release mortality concerns.

The open fishery situation will undoubtedly increase the likelihood of illegal harvest. The ISRP shares the concerns of fishery managers about the impacts of illegal harvest and acknowledges the difficulty of enforcing regulations. These concerns need to be addressed and clarified in the Step 2 document. If managers cannot eliminate illegal harvest, they will need to incorporate that reality into management and reduce the legal harvest rate accordingly.

Compounding, and contributing to, concerns for the accuracy of harvest estimates and fishing mortality estimates is the expectation that the fishery will be pursued over as long of a season as possible and over as wide of an area as possible. Mention is made of creating sanctuaries, but no details are provided. Details on plans to create sanctuaries should be provided in Step 2.

We disagree with the proponents' statement that lake sturgeon and paddlefish fisheries have different characteristics from white sturgeon fisheries that necessarily demand different management approaches. Lake sturgeon and paddlefish fisheries also could be pursued over wide areas (i.e., large lake and reservoir areas) and long seasons. However, managers have recognized the stock assessment problems associated with such open fisheries and, in the interest of conservation and effective monitoring, have limited harvest areas and times.

A major advantage of restricted time and area fisheries for other Acipenseriform species (lake sturgeon and paddlefish) is that a much higher fraction of the harvest can be efficiently creel censused. Accuracy and precision of harvest estimates can be improved greatly if a substantial fraction of the harvest is monitored in a cost-effective way. Other benefits of restricted time and area fisheries include a reduced likelihood of illegal fishing and simplified enforcement. The ISRP has fundamental concerns that the proponents' open fishery approach will not be adequate to guarantee targeted maximum harvest rates. Judging from information centered in page 264, managers have constantly manipulated harvesters to meet desired harvest rates and still have considerable doubts that their efforts have been successful. In most years, target harvest rates have been exceeded and recruitment has been overestimated. At best, the proponents' open fishery approach will be substantially more expensive to manage and will likely result in less accurate harvest estimates than more scientifically defensible approaches involving time and area closures. Substantially more detail (or planning) is needed to provide assurance that accurate estimates of white sturgeon harvest are obtained for commercial, subsistence, and recreational fisheries. The ISRP asks if Tribal management could work with harvesters so that a large fraction of harvest could be monitored at peak harvest periods. The ISRP also suggests that the proponents consider and develop management strategies that can provide less variable estimates of abundance and catch. In addition, the proponents might

consider working with co-managers in testing some different fishery regulations in the interim years, as hatchery fish grow to harvestable size.

The proponents assert that if the exploitation rate of all fish (hatchery and wild) is based on the pre-supplementation rate (i.e., the rate does not increase), the wild component will not be over-harvested. However, given the nature of this mixed stock (i.e., hatchery and wild) fishery, it is not clear that overharvest (along with incidental catch-and-release mortality) of wild white sturgeon can be avoided. Because the hatchery-origin fish are marked, it may be possible to estimate separate harvest rates for wild and hatchery-origin fish for the commercial and sport fishery components. The harvest data for wild fish will have to be assessed in combination with other monitoring data to determine if wild white sturgeon are being overharvested.

The aversion of the proponents to mark selective fisheries for social reasons is well understood. However, in the mixed hatchery and wild harvest, any overharvest will increase the possibility that wild fish will be negatively affected, which is an important consideration for a sustainable fishery.

5. Alternative strategies

The response on alternatives was a very helpful and valuable addition to the Step 1 Document.

Table 2 provides a sound description and qualitative summary of alternatives. Table 2 also presents a qualitative assessment of benefits, costs and risks of the alternatives. Given that the intent of the program is to mitigate harvest in the shortest possible time over the widest area, the conclusion that hatchery supplementation is the best alternative is reasonable. Under the integrated approach of producing a hatchery program with consistent annual releases for a stable and expanded fishery with a specific harvest management approach (narrow slot on immature fish), the other alternatives would fall short. Neither passage nor transplants provides enough benefits in the desired time frame. If the primary intent is harvest mitigation, none of the alternatives considered would meet criteria for the expanded, controlled, put-grow-and-take white sturgeon fishery envisioned as emanating from this program.

The response to Question 9 (Page 23, revised Step 1 Document), regarding stable annual recruitment, was particularly insightful as to the intent of the proposed hatchery. The proponents viewed inconsistent recruitment as a potential problem, with the best approach to alleviate it being consistent stocking of hatchery fish to create a stable fishery, rather than managing around natural variability.

The proposal for the hatchery functions as an integrated unit involving specific goals for harvest management with specific regulations. The ISRP noted that alternative actions (i.e. trap and haul, improving fish passage, and flow augmentation) to improve recruitment are inferior to that of a hatchery program if the primary goal of the overall white sturgeon program in the Columbia River is to provide harvest with a stable annual stock over the shortest time frame, on immature fish, using the harvest slot approach. However, with other longer-term, less harvest-

oriented goals, the non-hatchery-alternatives in Table 2 would compare more favorably against hatcheries. Uneven annual recruitment would also be more easily tolerated.

It is therefore not clear that the proponents' preferred option is necessarily "best" from the perspective of conservation biology or the long term sustainability of the sturgeon populations. Table 2 suggests the long term risks from the hatchery option are low to moderate and that they heavily favor shorter term benefits related to mitigating for lost harvest opportunities. The ISRP is not yet convinced that the risk for the hatchery option is "low to moderate" as is indicated in Table 2. Although the proponents' ranking is plausible, other rankings are also plausible. Whereas the status quo is simply ruled out under the harvest mitigation strategy, a conservation biology perspective might continue to work within the status quo option, fine tuning/rationalizing the harvest rate and fish management policy first, while researching ways to improve natural recruitment and maintaining or bolstering genetic diversity.

6. Long-term consequences and uncertainties of a hatchery program based on small numbers of brood fish

A reasonable presentation of potential genetic consequences and uncertainties of the hatchery program is included in the revised Step 1 Document. An argument is made that an "*effective population size of at least 500 white sturgeon adults per 25-year generation*" for the hatchery broodstock will be achieved to avoid undesirable genetic effects of propagation. Ten males and ten females will be used to create two 5x5 factorial matings to produce a total of 50 families/year. Plenty of eggs (~1 million, 100K per female) will be collected. Family size will be regulated (a good strategy) so that similar numbers of juveniles from each family will be released. This in theory helps reduce unequal family representation at maturation.

Autopolyploidy will be assessed and families with an incidence greater than 10% will not be released. Hatchery juveniles will only be released into the John Day Pool and a few (~5K) will be annually placed into Snake River reservoirs. All hatchery juveniles will be visually marked and tagged. Genetic samples will be taken on fish collected during annual surveys. Currently microsatellites are being used. The ISRP suggest that single nucleotide polymorphisms (SNPs) would provide a more robust tool to assess possible genetic effects and provide a better tool for future pedigree analyses. Moving forward, careful assessment of the potential adverse genetic effects is critical. The issue should be readdressed as more information from various species becomes available. Effects, if any, may not be detectable for more than a quarter century. That is a major reason why supplementation has a significant risk associated with it.

The proposed hatchery mating approach seems much riskier than using wild larval fish in the hatchery program, as is occurring upriver. The response indicates that a strong effort will be made to use natural origin juveniles. The challenge is keeping these fish alive and starting them on artificial foods. That will take experimentation. The ISRP supports the proponents' efforts to capture and use naturally produced larvae in their hatchery program. We recognize that research and experimentation will need to take place to determine where, when, and how to capture these fish and on how to culture them once they are introduced into a hatchery

environment. Conserving the apparent genetic diversity of these fish is highly important and solving such issues would greatly benefit the program.

Any negative effects of hatchery-reared fish on long term fitness of the Columbia River white sturgeon are especially concerning since the proposed hatchery program is designed for pools above Bonneville Dam. The last remaining successful stock of wild white sturgeon in the basin will be affected, for better or worse, by fish migrating or flushed downriver. The proponents indicate that there will be little downriver movement. However, the basis for this claim is not supported and needs to be clarified in Step 2. Since all hatchery fish will be PIT tagged, it would be important to check for PIT-tagged fish in all stock assessment and harvest sampling programs so that migrants could be identified and quantified.

A question arose about the calculation of effective population size (20 fish per year X 25 years = 500). This requires that a fish be used only once as broodstock. As brood fish will be released after spawning, the ISRP assumes that will they be PIT tagged or otherwise marked for future identification to avoid their reuse. Is this the case?

The introduction of hatchery fish in upriver areas (e.g., the lower Snake River) may help maintain genetics of the declining populations, although it is uncertain where fish that were historically caught there may have successfully spawned. In the past, many fish could have spawned farther downriver and migrated upriver during high flow years, to be caught there.

7. Carrying capacity assessment by monitoring “post release responses to increasing density”

This concern was not adequately addressed within the revised monitoring plan. It is stated that *“reservoir carrying capacity for sturgeon will be empirically determined by monitoring changes in survival, growth and condition of juvenile and sub-adult sturgeon in response to increasing density produced by hatchery releases over time.”* Task 4.1 (page 234) may provide data for addressing this concern, but specific analytical procedures to determine if, or when, carrying capacity is reached or exceeded are only broadly described. For Step 2, the proponents should provide clearer, justified benchmarks for survival, condition, and growth based on literature and actual data, which can be used to determine if carrying capacity has been exceeded. It would also be worthwhile to evaluate if relative weight (W_r), annual growth rates of tagged juveniles (both hatchery and wild), and survival will be useful in assessing the effects of hatchery fish on wild cohorts.

The proponents mention that a quasi-experimental before-after design will be used to assess carrying capacity. The ISRP ([2005-14](#)) stated that this approach may be the most useful type of study design for determining effectiveness of management decisions in large systems. The proponents also state that white sturgeon in non-supplemented pools will be sampled in an effort to tease out possible effects of density-independent effects on growth and condition. The ISRP suggests that it would be useful to collect information on sturgeon currently residing in the John Day Pool as it will take a few years before the hatchery will be releasing any juvenile sturgeon. Data collected now might be amenable to a more formal BACI design. The ISRP would also recommend collecting biological information on sturgeon in non-supplemented pools as

this could help the program understand how density-independent factors affect the parameters they may use to assess carrying capacity.

8. Stable annual recruitment: natural or necessary for the ecological well-being of the sturgeon populations or just desirable for the fishery

A reasonable argument is made that relatively stable annual recruitment of hatchery-origin fish will not be detrimental to the fishery. However, it remains unclear if consistently high densities of small stocked sturgeon will be detrimental to growth and recruitment of wild sturgeon when strong cohorts may occur. The proponents outlined a monitoring program designed to evaluate this concern, but the effectiveness of the planned monitoring program is uncertain.

9. Effects of stocked hatchery sturgeon on other species and the fishery

The proponents adequately addressed the issue. A reasonable discussion of possible effects is provided.

10. Clarification on facilities

The proponents adequately addressed the issue. Substantially more detail regarding the hatcheries is provided in the revised master plan. The level of detail is sufficient for a Step I review.

Comments on other CRITFC responses and the revised Master Plan

An additional important issue that needs to be addressed in Step 2 is the role of contaminants in implementing this proposed hatchery program. The Washington Department of Health has fish consumption advisories for white sturgeon (either “do not eat” or “limit consumption to one meal per week”) in Zone 6 fishing areas (above Bonneville Dam). How are these consumption advisories to be reconciled against the desire to increase harvest and consumption?

While quantifiable objectives have been added to the revised master plan, additional work is needed to make them fully quantifiable and understandable. At least two objectives have not been quantified. One of these is Objective 2.1: *“Limit sturgeon biomass to enhance subpopulation to levels consistent with those of productive impounded subpopulations in order to ameliorate risks of significant ecological impacts on wild sturgeon demographics and sensitive ecosystem components.”* This is a very complex objective. Procedures for carrying it out along with metrics to assess success or failure are not evident in the revised master plan. The objective aims at addressing several of the concerns listed above, but it is not sufficiently quantitative to be of use in assessing future success or failure. A second is Objective 3.1: *“Increase precision and reduce bias in estimation of limiting factors, habitat capacity, broodstock limitations, population parameters, and immigration/entrainment of natural sturgeon subpopulations.”* Again, this objective seems to aim at addressing several of the

concerns listed above. However, the inability to identify specific elements of the revised master plan that address each of the components, along with methods and specific metrics to measure each of the components of the objective, make this a vague, unquantified objective.

Elements of some other objectives lack sufficient detail to make them fully quantified or understandable. For example, Objective 1.1: *“Increase harvest of White Sturgeon in commercial, subsistence and recreational fisheries for impounded lower Columbia River subpopulations by 100% or more consistent with constraints of existing hatchery capacity.”* What is meant by “or more consistent with constraints of existing hatchery capacity”? Does this mean the inability to produce and stock 26,500 annually? Similarly, Objective 1.2: *“Increase abundance of White Sturgeon in lower Snake River reservoirs by 100% or more to enhance fishery quality and potential harvest opportunities consistent with constraints of existing habitat capacity.”* Why does the objective differ from the lower Columbia River (Objective 1.2) regarding fishery quality and potential harvest, and what is meant by “constraints of existing hatchery capacity”?