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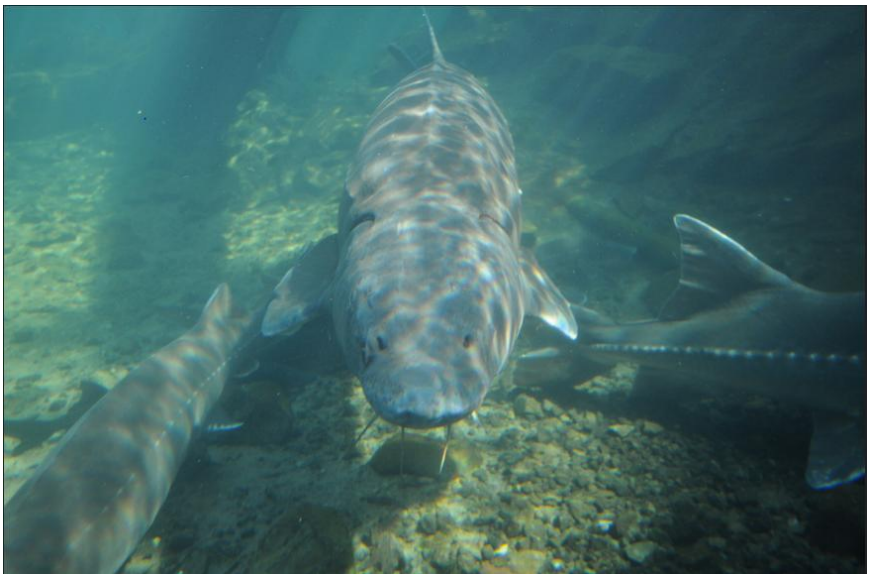
Step One Review of the White Sturgeon Hatchery Draft Master Plan: Lower Columbia and Snake River Impoundments – Response Requested

(Projects #2007-155-00 and #2008-455-00)



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Background

In response to the Northwest Power and Conservation Council's February 17, 2015 request, the Independent Scientific Review Panel (ISRP) evaluated the *White Sturgeon Hatchery Master Plan: Lower Columbia and Snake River Impoundments* prepared by the Columbia River Inter-Tribal Fish Commission (CRITFC). This is 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*.

In 2009, the ISRP reviewed a proposal for CRITFC's sturgeon project (ISRP 2009-10) and the Yakama Nation's sturgeon project (ISRP 2009-22). The Council approved these projects with the understanding that issues raised by the ISRP would be addressed as part of the Step process. In addition to those specific reviews, the ISRP made programmatic comments on sturgeon recovery and mitigation in the mainstem of the Columbia River (ISRP 2010-44A, pages 18-24) and reviewed a draft of the Columbia Basin White Sturgeon Planning Framework (ISRP 2013-5, see page 3 for comments about hatchery production). ISRP members have attended workshops related to the framework effort. All of these activities have informed the development of the Master Plan.

The construction and operation of dams on the mainstem of the Columbia River have created quasi-isolated populations of sturgeon as movements of fish from one reservoir to another have been impeded or blocked. Dam construction and operation have also altered areas traditionally used for spawning and early recruitment. Subsequently, natural recruitment of sturgeon has been sporadic and low in many of the reservoirs and now poses a problem for sustaining upriver sub-populations and fisheries. Thus, the sponsors determined that natural recruitment is inadequate for sturgeon conservation or enhancement in lower Columbia River impoundments. Additionally, limited alternatives for altering spawning flows, poor sturgeon passage at dams, and the likely high monetary and biological costs of transporting sturgeon from lower-river to up-river reservoirs reduced the viability of these possible enhancement options. At the same time, however, some of the reservoirs possess some habitat conditions and food resources that can support juvenile and adult sturgeon populations. Thus, the sponsors concluded that hatchery supplementation is the best management strategy in the near term to circumvent deficiencies in suitable spawning, incubation, and survival to the juvenile stage of sturgeon in lower Columbia River reservoirs.

CRITFC's January 9, 2015 cover letter to the Council for this review summarizes the intent of the Master Plan:

> The proposed facility and program provides fishery mitigation for the detrimental impacts of construction and operation of the Federal Columbia River Power System on white sturgeon in lower Columbia and Snake River impoundments. The program specifically addresses sturgeon measures in the Council's Fish and Wildlife Program as well as State and Tribal obligations and agreements under *U.S. v. Oregon*… Based on an extensive review of alternative sites throughout the Basin, the primary sturgeon production facility will be located at the Yakama Sturgeon Hatchery at Marion Drain near Toppenish Washington. The plan also identifies several alternatives for a satellite facility contingent on need and available resources. The proposed program will produce approximately 26,500 juvenile sturgeons per year for release in lower Columbia and Snake River reservoirs where natural production is impaired by hydro operations and significant amounts of under seeded sturgeon habitat are available. Initial releases will be focused in John Day Reservoir and the program will be managed adaptively based on a robust monitoring and evaluation program that will complement other existing sturgeon projects. Hatchery fish are projected to increase numbers of sturgeon available for harvest in affected reservoirs by 50-150% depending on survival. The program and facility design includes precautionary strategies for managing potential risks of hatchery operation to wild sturgeon production.

ISRP Response Request

Overall, the draft Master Plan is well organized and clearly written. However, the ISRP requests a written response to address the following 10 issues as part of the Step One review:

1. **Provide more comprehensive life history data in the Plan.** The Plan lacks sturgeon life history information that is needed to manage hatchery operations and the fishery. Although the sponsors indicate on Page 17 that research since 1987 has identified key life stages, no data are presented to indicate that this is the case. On Page 63, the State of Oregon referred to white sturgeon as a "data gap" species. For a species that has been studied in the basin for several decades, it is surprising that there does not seem to be data on the life stages of sturgeon, including size at age and the expected lifespan of sturgeon. More specifically, a framework is needed outlining the various stages of this long-lived species' life history, including sex-specific growth rates, sex-specific age and size at maturity, the life stage (by age and size) where the fish are growing relatively rapidly and also spawning, the prime spawning life stage (by age, sex and size) where growth has slowed and most energy is routed into reproduction, periodicity of gonadal recrudescence and spawning by age, sex and life stage, age at senescence, and total lifespan. No sex-specific age structure data of harvested fish are presented even though most Acipenseriform species are sexually dimorphic in size and in life stages by age. These life history characteristics all seem highly relevant to successful long-term harvest management and stock sustainability, and the characteristics have been described for other Acipenseriform species such as lake sturgeon

and paddlefish. The approach in the draft Master Plan is to stock fish, let them reach a length window, and regardless of origin, sex, age, or growth rate, harvest as many fish as concluded to be sustainable before they grow beyond the window. This harvest-centered approach will provide very limited demographic information on these fish. An alternative approach worth considering might emphasize long-term stock rebuilding, delaying harvest further into the future, and improving the management framework.

2. **Describe how sustainable harvest rates are presently determined for impounded populations (and how this may be modified after stocking).** It is not clear how sustainable exploitation rates are (or will be) determined for the impounded populations. It seems that the intrinsic productivity of the impounded populations must be lower than for unimpounded populations. If this is the case, it would be inappropriate to apply the same biological reference points (B_{40}) that determine optimal harvest rates for unimpounded populations. On Page 76, it is stated that "*system capacity for sturgeon is unknown and cannot be reasonably inferred from existing information. Aquatic food webs of impoundments can be qualitatively described … but production and trophic dynamics have not been quantified.*" What approach will be used to identify the carrying capacity and determine a realistic harvest potential in the system? Because of the migratory nature of the fish, historical harvest rates within a pool may not be indicative of what was actually produced at that location or that can be produced under existing conditions. It is not clear what exploitation rates are currently considered optimal for the impounded populations (i.e., before supplementation).

3. **Demonstrate how management will ensure that wild sturgeon will not be overharvested.** The draft Master Plan states that *"exploitation rates will continue to be limited by wild sub-population objectives and will not be increased in response to hatchery supplementation."* The plan also indicates that tribal fisheries will not be selective for marked hatchery sturgeon (Page 85), and because the hatchery program is an integrated one, separate management of hatchery and natural fish in the wild is not planned (Page 84). Increases in the harvest of put-grow-and-take hatchery fish without sorting may result in the equivalent of mixed stock overharvest of the wild fish. The potential for increased incidental, over-harvest of wild fish, especially wild females, needs to be addressed. A simulation model based on key life history information (see Response Request 1) would help to clarify how management would have to proceed to ensure that wild fish are not overharvested. Also, because this fishery is strictly a meat harvest, rather than a caviar harvest, the potential exists to develop some innovative, sex specific harvest plans that target male sturgeon. Has this opportunity been considered and have techniques (mainly genetic for immature fish) been investigated for real time sorting of the fish by sex?

4. **Provide better justification for expanding the harvest.** It is acknowledged that recruitment in many of the reservoir pools covered by the project is sporadic or episodic. The stock-recruitment relationships of populations in these pools are not known. Is it justifiable, in terms of conservation rebuilding, to focus on emphasizing a targeted fishery on mostly immature recruits, less than a fourth of the way through their life, preventing them from

reaching their prime spawning years? The Plan also needs to identify prime spawning years. The sponsors provide no examples of successful, long-term sturgeon management and do not describe what aspects of a harvest management program are necessary to maintain sub-populations or stocks. Globally, sturgeon of various species tend to be rapidly overharvested because of their long lifecycle and late maturity. There are some examples, however, where spatially and temporally structured Acipenseriform harvest fisheries, with harvest caps, have developed sustainable programs (i.e., lake sturgeon and paddlefish) that are efficiently monitored. Interest in the Plan seems to lie in providing more fish, more time on the water, and more areas in which to harvest fish. Can the sponsors provide some examples where this less controlled, more-difficult-to-monitor approach has been effective? The issue of effective harvest management needs to be addressed.

5. **Evaluate alternative strategies more thoroughly.** Some of the alternatives considered (Section 2.3) were dismissed without quantitative justification. In the Step Process review, *"All projects are expected to ensure that cost-effective alternative measures are not overlooked and include descriptions of alternatives for resolving the resource problem, including a description of other management activities in the sub-basin, province and basin."* It is noted on Page 65 that the 2014 U.S. v. Oregon Sturgeon Task Force supports use of hatchery production of sturgeon when it can effectively increase sturgeon numbers and harvest by supplementing poor or inconsistent natural recruitment upstream from Bonneville Dam. The Task Force also indicated that *"other alternatives for mitigation and restoration of naturally-produced sturgeon populations including flow management, habitat restoration, and passage, where appropriate"* will be pursued. These steps do not seem to be occurring. It is not clear to the ISRP why, for example, a combination of transportation of younger recruited fish (as has occurred in the past), the proposed opportunistic rearing of wild-caught larvae, and sustainable harvest rates would not be the most rational and cost-efficient program for maintaining the wild population without the potentially negative impacts of a hatchery program. Section 2.3.3, which describes the benefits and limitations of transportation, seems to dismiss this option without providing quantitative evidence. It would have been helpful to see statements such as "it is too expensive and here are the numbers to show it in relation to the costs of other alternatives." The same issue occurs when the fish passage alternative is discussed on Pages 19-20. Some sturgeon passage occurs at one of the ladders at The Dalles Dam. What is it about that site that enables passage, and is that a possible alternative to be considered (i.e., an easy fix or a more difficult or completely infeasible fix)? Another aspect worthy of consideration is that the proposed hatchery program will create a put-grow-and-take fishery. Such a fishery probably lessens the initiative to understand what needs to be done to improve sturgeon passage and natural recruitment success. This may be a hidden cost of a broodstock hatchery program, though not necessarily of a wild larvae hatchery program.

6. **More thoroughly evaluate long-term consequences and uncertainties of a hatchery program based on small numbers of brood fish.** It is not clear how the sponsors plan to evaluate the effects of 1) a small number of adults used annually as hatchery broodstock on the genetic diversity of the supplemented population, 2) the viability of adult offspring

produced by hatchery-origin adults, and 3) the long-term consequences of stocking hatchery sturgeon for a species that does not spawn initially for at least a quarter of a century, and then spawn for perhaps another quarter of a century or more. The few spawners used as broodstock and the anticipated low natural mortality rates of released sturgeon will result in relatively little natural selection. Even if the fish are in the wild over a period of many years, this could potentially lead to substantial, unintended domestication. They may grow and survive well in the reservoirs but not reproduce well. On Page 85, the sponsors justify the hatchery approach by stating, *"This approach now has decades-long history of demonstrated effectiveness."* However, the sponsors acknowledge that there are few spawners used in the typical hatchery programs. The location and other specifics of where this "effectiveness" was demonstrated, and how effectiveness in the long-term was evaluated, are not clear. Artificial spawning may have prevented or delayed extirpation of the Kootenai River white sturgeon, which essentially has had no record of natural recruitment for decades and is geographically isolated. That does not necessarily imply that this approach would be the preferred option for populations that still have some natural recruitment (and much more recruitment in lower pools), and that are less geographically isolated. What is the basis for assuming that a wild integration strategy, which will result in "natural" fish being derived from few broodstock (Page 84) is a good strategy for these populations? This issue should be addressed.

7. **Clearly describe how carrying capacity will be assessed by monitoring "post release responses to increasing density."** The method for assessing carrying capacity and establishing specific density criteria for project success is not clear. It is also unclear whether the design of the experimental releases and subsequent monitoring will be adequate to control for temporal changes in growth or survival unrelated to density effects, for example, due to trends in climate or flow. Perhaps a staircase design should be considered. Further explanation is needed to clarify how harvest monitoring and annual stock assessment data will be used to determine catch, sex-specific growth and growth trajectories, abundance, survival, age and size composition, and fish condition. Also, will these values be compared before and after supplementation? Will BACI designs be employed? Additionally, bench marks for detecting changes in demographic and harvest metrics will need to be established. Supplementation, for example, is expected to increase the harvest of white sturgeon by 50% to 150%. It is not clear, however, if this range of percentage increases will be utilized to assess the success of the program or if other values will be used.

8. **Is stable annual recruitment natural or necessary for the ecological well-being of the sturgeon populations or is it just desirable for the fishery?** It is not clear that natural recruitment in sturgeon populations was ever highly stable or consistent over time. Available data from more natural populations of Acipenseriform fish suggest that recruitment is not stable inter-annually; strong and weak year classes often result. On Page 18, the argument is made that it is necessary to plug holes in depressed or irregular natural recruitment. This can make good sense for a short-lived species, but is it necessary or even natural for recruitment to be stable for sturgeon with their long lifespan? If not, is it

necessary to stock hatchery-origin fish every year? Or is it adequate to stock reared wild-caught larvae with some regularity as they become available? On Page 19 the sponsors seem to seek a stable fishery by using consistent annual releases of hatchery-reared juveniles. This stability is advantageous for human planning when harvesting immature fish in a narrow length window. But is it a necessary approach for rebuilding the natural sturgeon population? The need to stabilize annual recruitment with broodstock-produced hatchery fish might be reduced by opting for a less aggressive harvest management plan and a strategy not exclusively focused on juveniles and respectful of maintaining older spawners. This issue should be addressed.

9. **More fully consider effects of stocked hatchery sturgeon on other species and the fishery.** The hatchery supplementation program has the potential to create deleterious inter-specific interactions via competition and predation. How such interactions will be detected and appraised need to be further developed in the project's RM&E plan. A hoped-for outcome of the hatchery supplementation effort is to increase overall sturgeon harvest and extend fishing seasons. Some discussion in the Master Plan should be included to indicate whether by-catch of listed species (salmon, steelhead) is expected in the sturgeon fisheries and how it might be dealt with.

10. **Provide clarification on facilities.** The Master Plan indicates that the Yakama Nation's Marion Drain facility has been selected as the location for the project's primary sturgeon hatchery. Currently this facility is used to rear sturgeon, lamprey, and salmon. The site may also become the location of a summer Chinook and Coho hatchery. To accommodate this additional use, new wells, a hatchery building, rearing vessels, holding ponds, settling basins and other infrastructure are being proposed for the salmon effort. The Master Plan should indicate how the potentially competing needs for water and space created by the new fish cultural operations will be accommodated at the Marion Drain location.

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. In addition to the request for responses listed above, The ISRP has provided comments below on how the draft Master Plan addresses the Step Review elements. Additional questions by the ISRP are located within those comments and should be addressed in Step 2.

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 5.6.1 addresses the six scientific principles.

The draft Master Plan provides a conceptual description of an integrated hatchery effort designed to supplement white sturgeon in the Lower Mid-Columbia River (Bonneville Dam to Priest Rapids dam plus the lower Snake River to Lower Granite Dam) for the purpose of fishery mitigation. Longer term conservation benefits are also expected. The draft Master Plan adequately adheres to the Council's six scientific principles as they relate to white sturgeon, as well as could be expected for a hatchery program intended primarily to increase fishing opportunity. Sturgeon abundance is expected to increase assuming the fishery is adequately regulated and that hatchery-origin fish survive and become part of their reservoir's white sturgeon population. The program is intended to preserve the genetic resources, phenotypic variability and life history expressions of Columbia River white sturgeon. If growth and survival rates of hatchery sturgeon occur as expected, the program will contribute fish to tribal and non-tribal fisheries in 10-15 years, fulfilling a shorter term intention for increased harvest. A monitoring, evaluation, and research plan (RM&E) has been developed for the hatchery program. Metrics within the RM&E plan will allow the sponsors to test, evaluate, and change their proposed procedures in an adaptive fashion and are also expected to detect any deleterious impacts on wild-origin white sturgeon. The development of the draft Master Plan has involved extensive collaboration among tribal and non-tribal entities. All of these features are within the intent of the Council's six scientific principles.

Some clarification, however, of the following specific aspects of this section would be helpful.

First, the scientific principles are addressed by considering the role of sturgeon in the ecosystem but without considering how the addition of hatchery sturgeon will impact the ecosystem. One example of an element not fully considered is the potential impact, if any, on salmonids, other fish species, and other biota. Although a hatchery plan cannot be expected to conduct RM&E on all possible effects, some consideration of ecosystem impacts caused by an increase of sturgeon numbers would be useful. The RM&E plan for the project does, however, include some diet and food web investigations. Information on how data obtained from this work will be used to investigate possible competitive and predaceous interactions between sturgeon and other reservoir species needs to be added to the Master Plan.

Second, in Section 5.6.1, Principle 3, it is stated that "*Hatchery production levels and release locations are specifically designed to maintain sturgeon population levels within the range of densities documented within the region and to avoid substantial risk to other components of the ecosystem*." The draft Master Plan does not include specific information on production levels or release locations to maintain specific population levels or densities within John Day Reservoir or other impoundments in the system; these will need to be developed.

Third, further in Section 5.6.1, Principle 3, it is stated that "*A robust monitoring and evaluation is identified in order to continue to assess the potential for ecosystem risk*." Detailed descriptions of the monitoring and evaluation protocols are lacking and will need to be developed in Step 2. The challenge in monitoring and assessing white sturgeon stocks is substantial given the long life span, long period of time to sexual maturity, and sensitivity of long-lived species to over-harvest. The program appears to be dependent on monitoring that is conducted by agencies with oversight by the Sturgeon Management Task Force (see Section 9). The metrics used are limited in type and scope (Table 23). It is questionable if the current monitoring program is sufficient to provide a level of assessment necessary for effective scientific evaluation of stocking efforts or timely decisions in an adaptive management framework. The ISRP has seen reference to the draft White Sturgeon Monitoring Strategy, but could not find it on the Council website or a reference for it in the White Sturgeon Hatchery Master Plan. The draft White Sturgeon Monitoring Plan needs to be linked to the current Master Plan. This would help clarify whether appropriate monitoring and assessment actions for the program are in place.

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 Section 4 covers Programmatic Guidance and Section 4.7 covers Related Projects

The draft Master Plan provides a comprehensive overview of how the proposed white sturgeon hatchery program is linked to other sturgeon projects and activities in the basin. It adequately justifies the overall intent of this program in relation to other goals and activities in the region. The sponsors have satisfactorily considered all of the existing guidance including the Council's Fish and Wildlife Program Sturgeon Guidance, Program Strategies and Artificial Production Policy, among others. They have also considered state and Tribal positions on sturgeon management and guidance derived from overarching documents such as the U.S. v. Oregon decision and the ESA. The proposed hatchery program for white sturgeon appears to be guided by the 10 hatchery policies developed by the Council. Since the hatchery program is an integrated one, the Council's additional principles toward this type of hatchery operation also appear to be incorporated into the draft Master Plan (but also see ISRP comments on small broodstock population). The objectives of three subbasin plans (Columbia Gorge Mainstem, Lower Middle Columbia Mainstem, and Lower Snake River) to maintain sustainable production and harvest of white sturgeon also informed the draft Master Plan. Two of the plans, Columbia Gorge and Lower Middle Columbia Mainstem, suggest that hatchery supplementation be considered to achieve their abundance goals for white sturgeon. Tribal goals along with those of the states of Oregon and Washington also helped shape the draft Master Plan. Information from three associated BPA sponsored projects, Evaluating Sturgeon Populations in the Lower Columbia River (#1986-050-00), Sturgeon Genetics (#2007-155-00), and Sturgeon Management (#2008-455-00) also provided valuable information and procedures to the draft Master Plan. The sponsors also are to be commended for addressing previous ISRP suggestions and for conducting several inclusive workshops on white sturgeon. Information presented at the workshops was used to create the Columbia Basin White Sturgeon Planning Framework which was released in 2013. The workshops and development of the White Sturgeon Framework integrated all the white sturgeon projects in the Columbia Basin and also allowed interested parties to participate in the development of the Master Plan.

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 5.1.

Three biological objectives were presented in the draft Master Plan: (1) to enhance commercial, subsistence, and recreational fisheries for impounded white sturgeon subpopulations, (2) to conduct enhancement in such a manner that it protects and conserves natural populations of white sturgeon and ecosystems, and (3) to employ hatchery-produced sturgeon to answer questions related to limiting factors, habitat capacity, broodstock limitations, population parameters, and immigration/entrainment. These three objectives are actually conceptual goals. They lack quantification, temporal components, and measureable benchmarks for success. Quantitative production targets and fishery benefits are provided in Sections 5.4 and 5.5. Even so, Section 5.1 could be improved by providing more explicit criteria by which success

(or failure) of the program could be evaluated later, especially with regard to Objective 2 (protecting natural populations).

The sponsors also describe their strategies and the potential risks associated with pursuing these objectives. The RM&E plan for the project has four metrics (catch, harvest, proportion of hatchery marks, and size composition) which will be used to assess whether progress on objective one (fishery enhancement) is being met for individual fisheries. Data from an ongoing sturgeon harvest monitoring program will be used to estimate harvest. In Step 2, the sponsors need to describe how this information will be used to compare pre-project levels with those obtained once project fish recruit into fisheries. Will a BACI design be employed, for example? Secondly, as mentioned above, bench marks for success will need to be established for the program. The current expectation is that the program will increase harvest rates in the John Day reservoir by 50 to 150% based on expected survival and fishery exploitation rates. It is not clear if this range of percentage increases will be used to assess how successful the program has been.

The RM&E plan has 11 metrics that will be used to track the status and trends of wild sturgeon populations (objective two). Data from annual stock assessments that measure the abundance, size composition, growth, and condition factor of wild white sturgeon will be used to complete these metrics. As with objective one, the sponsors need to describe how these data will be used to compare pre- and post-project values in each metric category. Additionally, statistical methods designed to detect changes in natural white sturgeon abundance, growth, and survival due to hatchery supplementation will need to be described. The 11 metrics as listed on page 173 represent a very limited range of life history attributes of this species, so it is not clear if the RM&E portion will be adequate to monitor stock status. It also will be a challenge to disentangle environmental effects from those caused by introducing hatchery juveniles into a reservoir. Another difficult issue will be to determine what changes to the metrics being measured might be deemed acceptable and how the project would be altered in response to any perceived deleterious impacts on natural populations.

The third objective—using hatchery-origin fish to answer research questions related to carrying capacity, limiting factors, entrainment rates, and such—relies on several assumptions. First, it is assumed that hatchery- and naturally-produced juveniles behave in a similar manner (e.g., have similar diets, migration tendencies, susceptibilities to predators, and so forth). Second, it is assumed that sampling efforts will recover enough marked fish so that statistical results with relatively narrow confidence intervals can be produced. Some discussion should address how these two assumptions will be tested.

It is quite clear that the foremost objective is to enhance the harvest of fish by commercial, subsistence, and recreational fisheries. However, quantitative endpoints for the objectives are unstated. For Objective 1, for example, how will it be determined if or when the objective is achieved? What levels of abundance or harvest are to be achieved? What is the timeline for attainment of the objective? Biological reference points (BRPs) for assessing the effects of

harvest on stocks presented in Section 9.6 do not appear to be adequate for distinguishing the relative contributions of wild- and hatchery-origin fish.

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

Master Plan Section 5.5 covers project benefits.

Several expected benefits were identified in the Master Plan. Numbers of sturgeon are predicted to increase by 50% to 150% in the John Day Reservoir, contributing to fishing once hatchery fish reach harvestable lengths of 109 to 137 cm (43 to 54 inches). The sponsors clearly indicate, however, that there is a great deal of uncertainty as to how large the potential harvest benefits might be. It will take 15 or more years for hatchery sturgeon to recruit into fisheries if predicted growth rates of 5 to 8 cm (2 to 3 inches) per year occur. It will take longer if growth rates are less than anticipated. It is possible that with higher densities of sturgeon, growth trajectories will slow. Also the abundance levels of hatchery sturgeon will be strongly affected by their survival during the first two years of post-release residency in the reservoir. "Optimistic" and "pessimistic" estimates of what early survival rates might be in John Day Reservoir were made using survival data on sturgeon juveniles released from two upper Columbia River hatcheries. These estimates were used to predict the future abundance of hatchery-origin sturgeon over a fifty-year period under two different survival regimes. It is unknown if early survival of sturgeon released into mid-Columbia River reservoirs will be similar to what has been observed for Kootenai and transboundary hatchery sturgeon. How different environmental factors, including habitat features, may influence early survival is also unknown. Because early post-release survival of hatchery juveniles is such an important metric, details on how it will be estimated are needed. Such estimates may help clarify expected benefits soon after the project is initiated and are expected to affect where, how many, and when hatchery juveniles are released in the future.

The Master Plan acknowledges that the proportion of hatchery-origin fish in the John Day Reservoir could reach 50 – 75%. If this occurs it will be above the HSRG guideline of 30% for hatchery origin fish in a population. Eventually there is a strong likelihood that hatchery fish will make up the majority of the spawning population in the John Day Reservoir, which would reduce the PNI of the population below 0.67, in violation of a recommendation of the HSRG to keep PNI values in supplemented populations above or equal to 0.67. The ISRP notes that the HSRG guidelines were developed for salmon and steelhead. Nevertheless, the Master Plan should discuss how the program will respond to an overabundance of hatchery fish.

5) describe the implementation strategies as they relate to the current conditions and restoration potential of the habitat for the target species and the life stage of interest (Step 1)?

Master Plan Section 5.3 covers implementation strategies.

Overall, an adequate description of how the program's implementation strategies are related to current conditions is presented. The sponsors describe 11 strategies aimed at accomplishing the objectives while minimizing risks from intra- and inter-specific effects. The strategies are based on appropriate monitoring, evaluation, and adaptive management. Significant among these strategies is (No. 4) using both broodstock spawning in the hatchery and collection of wild larvae; (No. 5) collecting broodstock from the mid-Columbia Genetic Management Unit (GMU), the area where the releases will be made; (No. 7) minimizing disease transmission into the wild; and (No. 11) integrating hatchery operations with continued protection and restoration of habitat.

It could be noted in Strategy 6 (and Section 5.4.3) that the effective population size of the hatchery release groups would actually be *increased* significantly by culling to equalize family contributions. In a wild population, effective population size is typically much less than the census population size because family contributions tend to be more unequal than random (i.e., than the Poisson distribution assumed for the ideal reference population). In contrast, the effective population size of a hatchery population can, in principle, be increased to twice its census size by culling to equalize family contributions. In practice though, equal contributions are difficult to achieve, which is likely why the sponsors are only proposing to cull family contributions to within +/- 50%.

Strategy 4 identifies two production options: (1) conventional approach involving collection of mature adults prior to the spawning season and spawning the fish within a hatchery, and (2) collection of wild larvae for subsequent rearing in a hatchery. Substantial detail is presented in the draft Master Plan regarding hatchery protocols for rearing fish using the conventional approach. However, the draft Master Plan is lacking in description of methods for capture and transport of mature adults to a hatchery. More importantly, the conventional approach is contingent upon capturing sufficient numbers of adult males and females to achieve genetic management objectives. What are the probabilities of collecting the needed numbers of adult males and females on an annual basis from John Day Reservoir? That element of the strategy has not been addressed. Collection of wild larvae and subsequent rearing in captivity is an experimental alternative. The draft Master Plan does not present information on how experimentation will be conducted.

Strategy 8 calls for one primary facility and one companion facility. It makes sense not to put "all your eggs in one basket." However, the draft Master Plan is quite vague in identifying the importance of a companion facility and a timeline for bringing a second facility on line.

Strategy 9 calls for "established benchmarks for evaluation of benefits and risks" and "a clear decision structure for future adaptive management." These two items are clearly needed and should be emphasized in the draft Master Plan.

6) address the relationship to the habitat strategies (Step 1)?

See Master Plan Section 5.6.2.

This proposal is not directly relevant to habitat strategies but may be viewed as an interim step to mitigate loss of habitat quality until other restoration actions can be implemented. Discussion regarding habitat relationships is, therefore, limited within the draft Master Plan. The sponsors point to the Basinwide Sturgeon Planning Framework with which the draft Master Plan is integrated. The lower mid-Columbia reservoirs identified in the Plan are not currently candidates for habitat restoration activities because of the uncertain benefits and the large scale of the reservoirs. The proposed hatchery operations are described as interim mitigation until the habitat is restored. This approach seems reasonable; however, the timeframe of hatchery operations (50 or more years) makes it likely that hatchery operations will become a permanent fixture in sturgeon management.

The Fish and Wildlife Program mentions the importance of protecting and maintaining species strongholds or areas where species are relatively abundant and self-sustaining. Three such areas exist for white sturgeon: (1) the Columbia River below the Bonneville Dam, (2) the Bonneville Reservoir, and (3) the Snake River between Lower Granite and Hells Canyon dams. Two strategies in the draft Master Plan were established to protect these areas from stray hatchery sturgeon. The first strategy is to only release hatchery sturgeon into the John Day Reservoir. This restriction is expected to isolate hatchery sturgeon from each of the strongholds. Secondly, to test this assumption, juvenile sturgeon passage over The Dalles and Bonneville dams will be monitored, so that if hatchery sturgeon are seen moving downstream, the number of hatchery sturgeon being released upstream can be reduced appropriately.

The effects of climate change on fish and wildlife resources in the Columbia Basin are another habitat concern raised by the Fish and Wildlife Program. The sponsors hypothesized that reductions in winter snow pack would diminish water flows and therefore reduce the occurrence of natural recruitment. Hence, the hatchery supplementation program is expected to become more important with continuing climate change.

7) 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 sub-basin, province and basin (Step 1)?

See Master Plan Section 2.3.

The sponsors provide a summary description of six alternatives that were considered for sturgeon conservation and recovery: (1) no action, (2) passage (3) transplanting (4) flow augmentation (5) habitat restoration and (6) hatchery supplementation. It is pointed out that these are not mutually exclusive. While the sponsors make plausible conclusions about the viability of the alternatives, they do not thoroughly evaluate the alternatives nor present any

cost-benefit analyses of the alternatives. It is not clear to the ISRP why, for example, the transportation of younger recruited fish (as has occurred in the past), in combination with the proposed opportunistic rearing of wild-caught larvae, with less emphasis on fishing, would not be the most rational program for maintaining the wild population without the potentially negative impacts of a hatchery program. Section 2.3.3 describing the benefits and limitations of transportation seems dismissive without providing quantitative evidence in support of those conclusions (e.g., "it is too expensive and here are the numbers to show it in relation to costs of alternatives"). The sponsors say: "capture and transplanting of meaningful numbers of juvenile fish from Bonneville Reservoir *may* [our italics] not be cost effective and removal of juvenile sturgeon are *unlikely* to be sufficient in number to stimulate an improvement in growth and improve conditions for remaining sturgeon in the in (sic) Bonneville Reservoir. Further, growth benefits of transferring individual sturgeon to underseeded reservoirs *may* be partly offset by handling mortality that might occur, and movements of fish among areas within the current tribal fishery zone does (sic) may not substantially increase net harvest yields." This defense is not rigorously written, and none of the conclusions that lead to the exclusion of transportation are ecologically or economically supported in a systematic way. The same argument could be applied to evaluating the fish passage alternative. Some passage does occur at one of the ladders at The Dalles Dam. What is it about that site that enables passage, and is that a possible alternative? Can passage problems be dealt with in some places? The arguments regarding each of the six alternatives, including cost effectiveness, do not seem to have been explicitly evaluated.

8) provide the historical and current status of anadromous and resident fish and wildlife in the sub-basin most relevant to the proposed project (Step 1)?

See Master Plan sections 3.2 for aquatic ecosystem, 3.3 for sturgeon history, and 3.4 for current sturgeon status.

The sponsors provided an informative presentation of the historical and current status of the aquatic ecosystem and the sturgeon's role in it, including reservoir-by-reservoir sturgeon abundance, size, and harvest. The sponsors also provided a succinct, but comprehensive, summary of the major ecosystem changes the dams and their reservoirs have had on this portion of the Columbia River Basin. These new conditions also altered the aquatic species composition in the river, shifting it from a lotic or riverine system to a lentic or lacustrine system. The sponsors suggest this shift from a periphyton and detrital based food web to one founded on phytoplankton reduced the food available to juvenile sturgeon.

The Plan also includes a concise and ample chronological history of white sturgeon abundance, management history, research efforts, and artificial culture in the Columbia Basin. A commercial fishery established in the 1880's led to a population collapse in the 1890's due to overfishing. Gear restrictions and size regulations instituted in the early 1900's prevented extirpation but sturgeon abundance remained at very low levels for the next 50 years. This was attributed to two factors, the lengthy period of time required for sturgeon to reach maturity

(up to 25 years) and changing environmental conditions in the river due to dam development and operation. The establishment of a slot length fishery in the 1950's helped protect adult sturgeon from overharvest. Sport and commercial catches increased from 1970 and peaked in the late 1980's. However, after 2000, overall catches began to decline and the standing stock of sturgeon in the reservoirs between Bonneville and John Day dams were significantly reduced due to recreational and commercial fisheries. Catches below Bonneville Dam also declined and beginning in 2014 fishing was curtailed in this previously productive part of the Columbia River. The sponsors hypothesize that sea lion predation in the Bonneville Dam tailrace may be a major cause of the loss of sturgeon in this part of the lower Columbia; however, no specific research supporting that hypothesis is cited in the draft Master Plan.

The loss of fishing opportunities and the precarious abundance of sturgeon prompted the region to fund and perform research on white sturgeon. A research plan for white sturgeon was completed in 1985 which led to annual stock assessments in the reservoirs and in the area below the Bonneville Dam. Additionally, methods to protect, mitigate, and enhance sturgeon were also evaluated by researchers from multiple agencies and tribes. The results of these efforts are the foundation of the sponsor's hatchery proposal. At the same time, several sturgeon hatchery programs began in the Columbia River, starting with the Kootenai Tribe of Idaho and Idaho Department of Fish and Game's sturgeon hatchery on the Kootenai River. Additional hatchery programs for sturgeon in the upper Columbia and mid-Columbia operated by various agencies, tribes, and PUDs have provided the region with sturgeon culture experience and expertise.

The draft Master Plan provides a synopsis of the white sturgeon populations residing below Bonneville Dam, and in the Bonneville, The Dalles, John Day, McNary, and Lower Snake River reservoirs. Information on recruitment frequency, size composition of the fish, annual growth rates by fish size, age at fishery recruitment, annual exploitation rates, harvest numbers per year, and an overall fishery exploitation rate for each population is provided. This information is used by the sponsors to indicate which of these areas would be good candidates for hatchery supplementation. They conclude that the John Day Reservoir will provide the best location for their hatchery supplementation effort. This reservoir appears to be recruitment limited but provides ample food for its resident sturgeon population. Their analyses indicated that the McNary Pool and the reservoirs in the lower Snake River were also good candidates for supplementation. However, these locations, unlike the John Day Reservoir, are not open to tribal commercial fisheries and were thus not chosen as initial sites for supplementation.

Despite all of the aforementioned information, the section is noteworthy for what is not presented. Specifically, there is no life history framework for white sturgeon outlining the various life stages of this long lived species, including sex-specific growth rates; sex-specific age and size at maturity; the age and size of each sex at which fish are both growing fairly rapidly and spawning; the age and size at prime spawning, at which growth has slowed and most fish energy is routed into reproduction; the age at senescence; the periodicity of gonadal recrudescence; spawning by age, sex and life stage; and the expected lifespan of each sex. Those factors are all highly relevant to successful long-term harvest management and stock

sustainability. It is suggested by the sponsors, without a reference in the report, that sturgeon can live to 100 years, but no life history framework is laid out to support this statement, as is available for some other Acipenseriform species such as lake sturgeon and paddlefish.

Size distributions (shown as pie diagrams) are used to show that recent recruitment has been insufficient to maintain current or desired population abundance in many reservoirs. However, it would have been helpful and informative to indicate what the size distribution would look like at the desired stable equilibrium. Such a metric could be listed as part of a quantitative objective for the program.

Within Section 3.4, Table 4 is a presentation of characteristics of sub-populations among impoundments. No information is presented regarding the source of the data. What is the time period represented by the data? Many of the values are means, but no measures of variance are presented to provide insight into the variation among years.

Figures 9, 13, 17, and 21 provide information on recruitment over several years in different reservoirs using a "Recruitment Index." No information is provided as to how the recruitment index is computed or the source of the data.

Figures 10, 14, and 18 provide abundance estimates over several years in different reservoirs. Yet, no information is provided as to how the abundance estimates are obtained or the source of the data. No measure of precision of the estimates is provided, such as the 95% confidence intervals. Measures of precision of abundance estimates are as important as the point estimates when evaluating temporal trends in a population or making comparisons among populations.

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

See Master Plan sections 9.2 for fishery regulation, 9.4 for management process, and 9.5 for management objectives.

The sponsors present sturgeon fishing regulations and management and how the hatchery production will fit into the fishery. The description of current and planned management focuses on harvest management in Section 9. A good summary of length limits, annual harvest guidelines, seasons, sanctuaries, and catch limits is presented. The draft Master Plan indicates that Columbia River white sturgeon are currently managed with two objectives in mind. The first objective is to maintain a significant and stable population of adult sturgeon to support natural spawning and recruitment. The second objective is to optimize fishery values for both tribal and non-tribal fishers. These same management objectives will be in place after hatchery supplementation occurs. Management tools specific to each reservoir, including stock assessments and harvest goals, regular adjustments to slot limits and changes in annual and overall exploitation rates, plus closed seasons, the use of sturgeon sanctuaries, and daily and

annual bag limits for recreational fisheries, are being used by tribal and state managers to meet both objectives.

Three types of gear are used in the white sturgeon fisheries, hook and line, setlines, and gillnets although a few sturgeon are also taken in hoop nets. Non-Indian fishers use hook and line only. Lacking in the draft Master Plan was the abundance and species composition of by-catch with each gear type, particularly gillnets.

The harvest plan and its biological rationale are clearly described in Section 9. Fishing regulations based on a length slot are designed to provide a desirable tradeoff between the number and size of fish caught and to maximize yield per recruit while avoiding recruitment overfishing. Because so little is known about the stock-recruitment relationship in sturgeon the sponsors have assumed that a maximum fishery yield will occur if 40% of the sturgeon susceptible to a fishery survive to reproduce. This assumption is based on experience with other self-sustaining populations of long-lived species. However, it seems unlikely that this assumption about productivity is reasonable for populations that are declining (or have declined) because of inconsistent natural recruitment associated with degradation of conditions or habitat for spawning. It seems more likely that overall productivity (averaged over years of favorable and unfavorable conditions) is much lower for impounded Columbia River sturgeon populations than for the populations on which the biological reference point (B_{40}) is based. It is not clear what exploitation rates are currently optimal for the impounded populations (i.e., without supplementation). What evidence is there that the B_{40} reference point is appropriate? How do the sponsors plan on assessing the consequences of annual and overall exploitation rates on the supplemented population? Details about how annual and overall exploitation rates will be determined should be included in future Step documents.

In the opening paragraph of Section 9 (page 167), the sponsors state that "*exploitation rates will continue to be limited by wild subpopulation objectives and will not be increased in response to hatchery supplementation.*" As stated, the policy of not increasing exploitation rate despite hatchery supplementation could increase yield over levels that are currently sustainable, because overall abundance would increase.

This section of the draft Master Plan also provides a summary of those involved in the Sturgeon Management Task Force (SMTF). However, it does not explain how the SMTF will be involved in monitoring, assessment, or adaptive management relative to the White Sturgeon Hatchery Master Plan. This section should be clarified.

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

See Master Plan Section 10.2 ESA.

The sponsors indicate that NOAA has completed recovery plans for the listed salmonids present as adults and juveniles in the Lower Mid-Columbia River. How the proposed sturgeon supplementation plan may potentially affect these species is not examined. It would be helpful if discussion were directed toward expected levels of harvest or catch and release on listed species caused by increasing sturgeon fisheries.

The proposed site for the primary hatchery is Marion Drain. This location is currently being used for some sturgeon, salmon, and lamprey culture by the Yakama Nation. The Yakama Nation submitted a Master Plan for summer- and fall-run Chinook and Coho in 2012. A part of this proposed program (incubation and rearing of summer Chinook and Coho) is expected to take place at the Marion Drain location. To accommodate the addition of these fish, new infra-structure, including, wells, a hatchery building, settling basins, adult holding ponds, and rearing vessels were proposed for the salmon project. Because this project and the planned sturgeon hatchery are both projected to be built at Marion Drain, it is important to know how water and space will be allotted to the two projects.

The attached HGMP provides a comprehensive overview of how the proposed sturgeon program has been influenced and coordinated with subbasin plans and addresses tribal and state conservation and harvest objectives.

11) describe the status of the comprehensive environmental assessment (Step 1 and 2)?

See Master Plan Section 10.

The environmental assessment is not yet completed, which is appropriate for this stage of the Step Review. The sponsors list the various assessments that they will perform as the hatchery plan proceeds: NEPA, ESA, Clean Water Act, National Historic Preservation Act, and state approvals.

12) describe the monitoring and evaluation plan (Step 1, 2 and 3)?

See Master Plan Section 8.

The sponsors acknowledge that key uncertainties about their sturgeon supplementation program exist. The RM&E plan is designed to address those, including 1) the feasibility of using wild larvae in the program, 2) the best ways to reduce early mortality, especially from yolk absorption to active feeding in the hatchery, 3) the best time, areas, and size for releasing juveniles into reservoirs, 4) understanding the factors responsible for high mortality rates during the first year after release, 5) estimating the carrying capacity of sturgeon in each reservoir and how it may change by life stage, 6) assessing genetic changes caused by supplementation, 7) evaluating the ecological effects that hatchery sturgeon may have in

reservoirs, and 8) testing and evaluating methods that can be used to improve inconsistent natural recruitment.

More consideration is needed of quantifiable objectives of the RM&E Plan with thorough explanation of monitoring and evaluation protocols to assess objectives. Each objective includes a number of hypotheses to be tested and metrics to be evaluated. Many of the RM&E Plan objectives have explicit metrics which need to be measured and expectations about the values of some of the metrics are presented in the plan. The objectives as stated, however, are more like tasks. The reference values are not, as acknowledged by the sponsors, objectives to be met "*but rather representative or baseline values consistent with production targets and planning assumptions.*" The meaning of this statement is unclear, as are the ecological consequences of not meeting reference values. For an experimental or adaptive management framework to be applied, it is critical that quantitative objectives be developed, effective monitoring take place so that progress toward objectives can be assessed, and that objective protocols for utilizing monitoring data be established for the adaptive management process. As it currently exists, Section 8 falls short of describing an effective monitoring and evaluation plan. For example, Section 8.2.1, Hatchery Effectiveness – Broodstock & Larval Collection, addresses the question of hatchery effectiveness. The four subjective hypotheses that are presented would benefit from quantification. The first hypothesis, or "*H1*", in this section states "*Wild broodstock collection is sufficient to meet hatchery production objectives*." It is illustrative of a hypothesis (or objective) lacking quantification. Specific numbers as to how many adult males and females are needed annually for the breeding protocol that are presented in other portions of the draft Master Plan. These numbers should be inserted into hypotheses (or objectives). The second hypothesis "*H2*" states that "*Extending holding of wild broodstock collected in developing condition one-year prior to spawning can significantly reduce effort and costs of broodstock collection*." In order to measure progress toward achievement of this objective, the second hypothesis needs to be altered to something like: 80% of the adult females collected one-year prior to spawning will yield viable eggs by the 10th year of hatchery operation.

Table 23 provides a list of metrics for monitoring and evaluation. Although this is a start in the development of a monitoring and evaluation plan for broodstock and larval collections, it is far from comprehensive in assessing progress. Further identification and definition of the metrics is needed, including which metrics apply to specific hypotheses (or objectives), how they will be measured in the hatchery or field, how sampling can be done in a manner to test hypotheses (or achievement of objectives; i.e., experimental design), and how much sampling is needed to achieve reasonable estimates and power for statistical evaluations. As the project proceeds additional metrics and tasks will undoubtedly be added simply because newly acquired information often spurs additional questions and concerns.

The seven objectives of the RM&E plan address uncertainties. Additionally, a work plan was developed for each of the objectives and an implementation schedule was presented. Thus, the RM&E plan associated with the project has defined but unquantified objectives, some meaningful metrics, and a series of tasks outlined. For example, one of the important

information gaps the project faces is what might be causing 75% or more of newly released hatchery juveniles to perish during their first post-release year. Currently the sponsors plan on quantifying early survival and examining the diet of hatchery-origin and wild sturgeon. Both are good steps. However, there does not appear to be any effort directed toward developing methods that could be used to increase early survival. The investigators might consider exposing hatchery juveniles to a mixture of natural and artificial foods for several months prior to release to see if early exposure to natural foods increases survival. Similarly, Juvenile Salmon Acoustic Tags (JSAT) could be applied to hatchery juveniles to discern their distribution and habitat preferences in reservoirs. That information coupled with the diet data the project expects to obtain may suggest release times and locations that could lead to higher initial survival rates. Comparable ideas such as these are sure to arise as the project progresses and they would fall under Objective 7, Conduct Research to Address Critical Uncertainties. The project plans to use hatchery-origin juveniles to answer research questions related to carrying capacity, limiting factors, entrainment/immigration rates and other issues. It is assumed that hatchery fish behave in a manner similar to natural-origin fish and that sampling efforts will recover enough marked fish to make meaningful statistical comparisons. Some discussion about the validity of these assumptions or how they will be tested should be added to the Master Plan.

A hypothesis should be added to Objective 3 to ask the question whether wild-caught larvae survive better or worse than sturgeon from broodstock when released from the hatchery. The true cost/benefits of collecting wild larvae need to be determined based on survival to the fishery and recruitment to the spawning population. A similar comparison should be made under Objective 5, which addresses harvest.

One issue that is inadequately addressed is how carrying capacity will be assessed by monitoring “post release responses to increasing density.” A particular concern is whether the design of the experimental releases and subsequent monitoring will be adequate to control for temporal changes in growth or survival unrelated to density effects, for example, due to trends in climate or flow. Perhaps a staircase design should be considered.

A significant unknown is how many adult sturgeon may be present in each reservoir. Have the sponsors considered the possible use of hydroacoustic methods to estimate adult abundance or the abundance of fish in the harvestable size range? This method has been used effectively for other sturgeon species and populations. It could be a valuable tool that would provide the sponsors with an independent method of estimating abundance.

Sturgeon hatchery programs in Europe apparently have been reasonably successful in re-establishing populations. Have the sponsors made good use of the information coming out of these programs? No indication was provided to indicate that the sponsors reviewed international literature on sturgeon in preparing this draft Plan.

13) 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 11.

Preliminary cost estimates and construction drawings for the project were developed and presented. The sponsors present cost estimates for the next 10 years, should the project go forward. The cost estimates provided insight into the cost of the Marion Drain Hatchery.

In the RM&E section (and elsewhere), the sponsors mention disease control measures, which include pathogen screening. Will this require a fish pathology lab at the hatchery or will they use existing labs?

The HGMP for the project mentions that a water recirculating system will be used at the sturgeon hatchery. It would be useful to have separate drawings for this system along with a cost breakout for the hatchery's water re-circulating system.

In Section 11.3, costs for one or two additional wells, or alternative water sources, are not found. These could be substantial cost items.

It appears that capacity for holding adult sturgeon may be limited. Is the number of circular tanks sufficient to hold adult brood fish captured in the spring as well as brood fish captured the previous year and held over the winter?

It is noted that there is no cost element for equipment needed to capture either adult brood fish or larval fish. This raises the question if hatchery personnel or personnel from other agencies will be responsible for capture and transport of adult brood fish and larval fish. Explanation is needed with appropriate sections of the draft Master Plan.

Section 11.4 addresses operations and maintenance of the Marion hatchery. There is no budget for monitoring and assessment. It is recognized that monitoring is conducted by fisheries management agencies, but identification of additional costs specific to hatchery supplementation is a relevant component of a draft Master Plan.

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)?

See Master Plan Section 5.6.3.

The draft Master Plan adequately describes how the 10 policies developed by Council in its Fish and Wildlife Program will be used to guide the use of artificial production. This program is primarily intended to produce fish for harvest, but it has been designed to emulate the conservation hatchery for the Kootenai River sturgeon population. The sponsors have clearly given considerable attention to potential risks and identified culture and release practices that should reduce these risks to acceptable levels. The proposed experiments with different sources (wild adult broodstock versus wild larvae) and different ages at release, the intensity of marking and tracking, and monitoring of growth and survival, could provide valuable information about factors that are limiting recruitment in natural populations. The sponsors have also considered ways to minimize potential risks to the natural population in the lower Columbia (below Bonneville Dam). The downstream movement of hatchery fish into the lower Columbia remains a serious concern with this program, but the proposal to limit releases to upstream of John Day Dam and to track movements downstream of John Day Dam over time are essential actions to control and evaluate this concern.

In the Plan, the sponsors indicate an understanding of the population structure, mating behavior, and general biology of sturgeon in the wild. They also describe how this knowledge has been integrated into the design and operation of the proposed hatchery. For example, they propose to use a 5 x 5 factorial spawning design in which eggs from each female are fertilized with milt from five males. In the wild, a female will spawn with numerous males. The sponsors also demonstrate an awareness of the risks of using artificial production. Several sections in the Plan explicitly state potential risks and uncertainties. For example, the implementation plan includes 11 strategies for accomplishing the Plan objectives while minimizing risks. In addition, the RM&E plan lists a number of key uncertainties followed by objectives, hypotheses, and metrics for addressing the uncertainties.

There appears to be a conflict in the Plan between the goal of re-establishing wild populations and optimizing harvest of white sturgeon through stocking of hatchery-origin juveniles. Nothing in the draft Master Plan appears to address the idea of establishing a population with a demographic structure that mimics a naturally reproducing population or what might be called a "*healthy age structure*." The unstated goal of the draft Master Plan appears to be to maximize the biomass of harvestable-size white sturgeon with annual harvest. In Section 9.6, Biological Basis of Management, the Biological Reference Points (BRPs) and the Optimum Yield Objective provide little attention to population structure. Assuming successful recruitment of fish released from hatcheries, the harvest plan and associated slot limit are likely to result in large numbers of sub-adults just under the harvestable length with high mortality upon achieving harvestable length. This resulting age structure would differ substantially from a naturally selected, unexploited population.

The use of wild adults collected within the project areas as broodstock (local genetic stock) is intended to preserve the native, area-specific characteristics of local populations. It is unclear, however, whether the current genetic composition is representative of the historical type or if it has been unintentionally altered by overexploitation and population fragmentation.

Risk management has been addressed relative to loss of genetic diversity and disease, but many other risks have been neglected or minimally addressed. Some of the more obvious risks include:

- Risk of not obtaining sufficient numbers of adult males and females annually in order to maintain the spawning protocol;
- Risk of stocking too many juvenile white sturgeon and exceeding the carrying capacity of the reservoir with subsequent impacts on survival, growth, and reproduction of naturally spawned white sturgeon;
- Risk of inadequate monitoring data from which to make adaptive management decisions; and,
- Risk of inadequate (or timely) actions by those entities contributing to adaptive management decisions.

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

See Master Plan Section 13.2.

An HGMP for the project is attached as an appendix to the draft Master Plan. It largely recapitulates previous sections of the draft Master Plan, although unlike other elements of the draft Master Plan, quantifiable production targets (or objectives) are provided (see Table 40). However, systematic assessment of performance is not well described. Table 41 lists an array of metrics to evaluate broodstock and larval collection, operations, post-release monitoring, wild stocks, and fisheries. However, there is no discussion of experimental designs, sampling intensity, and statistical analyses; all are necessary components of evaluation. The evaluation could benefit from greater discussion of potential problems associated with autoploidy, a common occurrence in white sturgeon (e.g., Gille et al. 2015, Aquaculture 435:467-474). The draft Master Plan noted a goal of keeping incidence of autoploidy <5%.

Earlier in the draft Master Plan the sponsors mention that a randomized culling procedure will be used to create equal family sizes in their cultured fish. The HGMP indicates that "*…malformed or exceedingly small fish will be removed*" (p 283, section 13.2.10.7). This seems like a reasonable thing to do, but might be inconsistent with the plan to cull randomly to equalize family contributions within a specified range. How important this might be depends on the abundance of such fish. It would be useful to report what the occurrence of malformed or stunted fish has typically been in other sturgeon hatchery programs.

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

A description of the harvest plan and its objectives are presented in Chapter 9 of the draft Master Plan. The sponsors describe the fishery and fishing regulations and project how the hatchery releases will fit into the future fishery. As they intend to tag all hatchery releases, they will be able to monitor the fishery contributions of the program. The Plan's description of the expected fishery on the hatchery releases appears inclusive.

However, it does not appear that there has been extensive coordination between the sponsors of the Marion Drain hatchery and the fisheries management agencies responsible for monitoring and assessing white sturgeon stocks in the reservoirs. Collaboration to ensure sufficient monitoring of both hatchery-origin and wild fish is important for an integrated adaptive management process involving both hatchery and monitoring interests. Thus, there is a substantial need to link the draft White Sturgeon Hatchery Master Plan and the draft White Sturgeon Monitoring Strategy.

The sponsors should ensure that the quality of the fish flesh is suitable for human consumption. The Washington Department of Health has a website that lists a series of health advisories for fish consumption (www.doh.wa.gov/CommunityandEnvironment/Food/Fish/Advisories#LowerColumbiaRiver). In the project area, or middle Columbia River, the Departments of Health for Washington and Oregon advise fishers not to eat sturgeon along with many other resident species due to mercury and PCB accumulations. The ISRP recommends that the sponsors perform assays on fish within the current harvestable sizes to ascertain their contaminant levels. These assays could be used to determine if the project would be producing fish that are problematic or not suitable for human consumption.

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 7 for conceptual design and 13.1 for existing facilities.

Conceptual designs at the Step 1 level were provided. An appendix to the plan offered a survey of existing facilities that could potentially be used in the project. Twelve different sites with varying degrees of infrastructure were considered by the sponsors. In the Plan each of these is described and opportunities and constraints are considered. In the end, the sponsors selected the Yakama Sturgeon Hatchery at Marion Drain as the primary facility location and suggest a number of others as secondary/satellite sites. The selection criteria seem appropriate; however, the Marion Drain site is surrounded by agriculture. Is there any concern that agricultural chemicals could enter the hatchery either by air or water?

Several additional uncertainties regarding the Marion Drain site are identified in Section 7.3.3. They include capacity of new wells, ability of the aquifer to sustain the water needs, ability to

manage water temperatures, waste water treatment needs, and the electrical power system. These uncertainties should receive immediate priority in future planning associated with Step 2.

A sufficient water supply is critical to any hatchery operation. In Section 7.3.3, it is stated that additional wells or recirculating systems will be needed. An additional well with a 600 gal/min capacity has been investigated and is believed to be feasible. The feasibility of an additional well that meets the needed capacity needs to be determined before further hatchery design work occurs. Alternatives to wells will likely add substantial developmental effort and costs to hatchery expansion.

Section 7 (Conceptual Design Facility) contains an in-depth site plan for the Marion Drain site, and it appears that the sponsors have considered all contingencies.

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

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

Editorial Comments

The draft Master Plan has small typographical errors and short text omissions that could be easily fixed after a careful review. In addition, a mixture of metric and United States customary units are used throughout the text. The document could be improved by using metric equivalents with customary units following in parentheses, e.g. 109 to 137 cm (43 to 54 inches).