Project Sponsors ISRP Response Report

Date: April 30, 2009

Project Number	2007-155-00	
Proposer	Columbia River Inter-Tribal Fish Commission	
Project Title & Brief Description	Sturgeon Strategic and Hatchery Master Plan	
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ISRP Review History:

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ISRP Review results:

☐ Meets scientific criteria.

☐ Meets scientific criteria (qualified).

X *Response requested - meets scientific criteria (qualified).*

☐ Response requested – does not meet scientific criteria.

Response to ISRP Summary:

☐ The narrative will be revised and resubmitted.

X *A response to ISRP comments is provided below.*

Response to ISRP Comments:

ISRP Recommendation: Meets Scientific Review Criteria (In Part, Qualified)

- *Meets criteria for Objective 1, with the qualification that the sponsors address the questions and recommendations related to technical justification indicated below in section 1. The ISRP expects responses to our concerns be provided as part of the master plan submittal for the Council's Three-Step Process.*
- *Does not meet criteria for Objectives 2 and 3 at this time.*

Response: Questions and recommendations from the ISRP are addressed in the following sections. We agree that it is premature to draw conclusions regarding objectives 2 (hatchery master plan) and 3 (monitoring & evaluation) pending the completion and outcome of the strategic planning process identified in objective 1. Objectives 2 and 3 were included to show a comprehensive framework for implementation of any hatchery actions that might be developed based on direction in the strategic plan.

ISRP Comments:

1. ***Technical Justification, Program Significance and Consistency, and Project Relationships (sections B-D)***

   The technical background and justification are much improved since the FY 2007-09 proposal, including more detail and supporting references on the ecology and status of white sturgeon populations in the mid-Columbia and lower Snake above Bonneville Dam.

   However, the technical justification for the proposed project would be further improved by providing more specific data on several of the following points that would help the ISRP in future reviews:

   1. *How similar or different are the mid-Columbia reservoirs and their tributaries to the habitats in the Kootenai and upper Columbia? The sponsors are trying to make the case that methods successfully applied in the upper Columbia are applicable in the mid-Columbia. Although an adaptive management approach is to be taken in the reservoirs if the program proceeds (proposal footnote, page 9), more contextually explicit information about sturgeon habitat in the two areas is needed. References to the adaptive management approach are also required.*

Response: Sturgeon hatchery technology is a relatively new development in North America, without the long history and established methodologies of trout and salmon aquaculture. Methods developed for other sturgeon species were imported from the former Soviet Union during the 1970s and first adapted for white sturgeon in university and commercial grow-out facilities in California. The Kootenai and upper Columbia River white sturgeon programs were among the earliest conservation sturgeon programs and went through an extended developmental period during which time it was unclear whether basic hatchery activities, taken for granted in salmonid programs, would be successful for sturgeon. Open questions included whether and how best to collect broodstock, induce ovulation, spawn and fertilize significant numbers of embryos, incubate fish successfully, feed fish, and rear fish to desired sizes.

The narrative intended to make the point that many of these initial operational questions have now been solved. While successful sturgeon hatchery operations remain a combination of art and science, we now know that a well designed facility and carefully implemented program can successfully spawn, hatch, and rear significant numbers of sturgeon, and that a portion of these fish can be expected to survive following release under certain conditions.

We agree that project effectiveness will be case and area-specific. Habitat conditions in the upper basin and the middle-Columbia River reservoirs both contain common elements favorable to some sturgeon life stages but there are also clear differences that make any attempt to predict the outcome of any middle Columbia effort from upper Basin results somewhat speculative. For that reason, the sturgeon strategy contemplates an experimental approach firmly grounded in a robust monitoring and evaluation program. The details of that adaptive approach will be contingent on the mitigation and restoration objectives to be identified in the strategic and master planning processes.

2. *What are the specific data on limiting factors for white sturgeon for the various reservoirs – the sponsors make a strong case for lack of recruitment, but on the other hand spawning habitat is also apparently limiting? The sponsors point out that the population below Bonneville "continues to support a large diadromous population and excellent fisheries" but at the same time "no longer has access to thousand of miles of spawning and juvenile rearing habitat which has greatly reduced natural reproduction." On the other hand they point out (proposal, page 5) that some reservoirs have good spawning areas but that the reservoirs will not support juvenile production. It would be helpful to resolve some of these contradictions in this section of the proposal.*

   The apparent "healthiness" (blue zone) of the white sturgeon seems to decrease moving upstream with the reservoir populations between McNary and Bonneville dams doing the best (proposal, Figure 2). The proposal would be improved by a discussion of this phenomenon.

Response: Extensive research has been conducted on status and limiting factors of sturgeon populations throughout the basin and particularly in Bonneville, The Dalles, and John Day reservoirs. Recruitment success in these three reservoirs has been related to spawning habitat availability which is a function of the physical morphology of the dam tailraces where sturgeon spawn and the effects of river discharge on the suitability of velocity and turbulence patterns for successful spawning. The Dalles Dam tailrace provides consistently favorable spawning conditions under a wide range of flow conditions which results in consistent production of significant year classes of juvenile sturgeon. As a result, the Bonneville reservoir population is the most numerous and productive of these three impoundments. At the other end of the spectrum, the McNary Dam tailrace provides favorable spawning habitat conditions only during relatively high runoff years which are infrequent. As a result, year class strength in John Day Reservoir is sporadic and this population is substantially smaller and less productive. The mechanism and life stage of these reproduction/recruitment failures is unclear but it occurs in the interval from spawning, egg incubation, larval emergence, dispersal, exogenous feeding, and early young-of-the-year survival.

Sturgeon populations in each reservoir are also subject to a carrying capacity determined by the amount and quality of habitat available for juvenile, subadult, and adult sturgeon. Carrying capacity for sturgeon is unknown but reduced individual growth rates and condition factors in Bonneville Reservoir may be an indication of density-related food limitations in that area. Individual growth and condition are much higher in The Dalles and John Day reservoirs where sturgeon densities are much lower due to sporadic reproduction/recruitment success.

The population downstream from Bonneville Dam continues to have access to habitat conditions and food resources favorable to all life stages. Significant spawning habitat is available in the Columbia River gorge downstream the dam. Successful spawning, incubation, and early life history consistently produces large year classes each year. Abundant food resources support excellent growth and survival of juveniles, subadults, and adults which results in one of the largest, healthiest and most productive sturgeon populations in the world.

Upstream from McNary Dam, population status is variable and appears to depend on whether suitable spawning/incubation/early life history habitat conditions continue to be available in the area accessible to each population. In most cases, reproduction/recruitment success is

very low. In some cases where a large section of free-flowing river still exists(Hells Canyon in the Snake River and McNary Reservoir), limited but consistent recruitment is sufficient to sustain a sturgeon population. In most other areas, successful reproduction is rare and the population typically consists of a dwindling number of large, old fish that predate impoundment.

Considered in aggregate, the current Columbia basin white sturgeon population is substantially reduced from historical numbers because of the loss of production from many impounded portions of the system.

3. *What are the genetics of the "endemic" mid-Columbia white sturgeon? Are they considered separate populations or have no genetic analyses been done? In the next iteration of this proposal the ISRP would like to see a description of how fragmented white sturgeon populations (other than the Kootenai sturgeon) are in the Columbia and lower Snake rivers along with an analysis of overall population structure.*

Response: An extensive review and consideration of genetic questions will be a undertaken in the strategic planning process. A series of genetic studies using various indicators have provided a general picture of current population patterns throughout the Columbia River system. Genetic diversity is generally lower in inland sturgeon populations than in the unimpounded lower Columbia population but the same genetic types observed in inland populations also occur in the lower Columbia population. Differences in type frequencies are relatively small. This pattern is consistent with wide-ranging movements and mixing typical of white sturgeon life history. Differences in type frequencies among reservoir populations appear to be an artifact of the recent fragmentation of a more homogenous historical population.

Early studies using allozymes identified significant differences in allele frequencies between the lower Columbia and Kootenai populations (Bartley et al. 1985). This result was subsequently corroborated by Setter and Brannon (1992), Anders (2002), and Smith et al. (2002). The difference reflects the genetic isolation of the Kootenai since the last ice age. Life history differences between Kootenai and Columbia river sturgeon have also been observed. For instance, Kootenai sturgeon spawn at colder temperatures than most other white sturgeon populations.

Allozyme analyses by Setter and Brannon (1992) found that genetic diversity is less in upper Columbia samples than in lower river samples but found no unique alleles in upper basin samples. Similar patterns of lower diversity of inland samples have also been reported in the Fraser system (Brown et al. 1992; Smith et al. 2002). Small genetic differences between mid-Columbia and lower Columbia, and mid-Columbia and upper Columbia samples did not represent enough genetic distance to base a strong argument for consideration as separate stocks (Setter and Brannon 1992).

Subsequent studies using mitochondrial DNA also found lower diversity in the Bonneville-McNary portion of the middle Columbia than in the lower Columbia downstream from Bonneville Dam (Brown et al. 1992). Differences were also reported by Brown et al. (1992) among samples from Bonneville, The Dalles, and John Day reservoirs although sample sizes were too small to determine if these differences were significant. Brown et al. (1992)

concluded that differences could be an artifact of dam construction that segregated certain genotypes in areas upstream and downstream of Bonneville Dam.

Anders (2002) analyzed mitochondrial DNA as part of the most comprehensive analysis of white sturgeon population structure at that time. His results corroborated findings of previous work that indicated a generally decreasing pattern of diversity between the lower and upper Columbia River but limited geographical substructure between lower, middle, and upper Columbia samples. Significant differences in mtDNA haplotype frequency distributions were revealed as a function of large geographic distances, often over 500 km, suggesting large-scale gene flow patterns, at least as supported my maternal lineage trajectories from mtDNA. Common haplotypes were widely distributed among sturgeon subpopulations from all areas. Pairwise comparisons of haplotype frequency distributions were generally not significant within the Columbia River system, except that the Kootenai population was distinguished by significantly lower diversity from other Columbia populations.

More recent analysis of microsatellite genetics also supported results of prior allozyme and mtDNA analyses (Rodzen et al. 2004). Rodzen et al. (2004) found that the number of alleles varies from population but estimates are to sensitive sample size which has been limited for many subpopulations.

Weak genetic differentiation among sturgeon samples from the lower, middle, and upper Columbia River is consistent with the lack of historically significant migration barriers to sturgeon in the Columbia River between the ocean and Canada, and the wide-ranging life history pattern of this species. White sturgeon historically had free range to move throughout the system. These big fish are strong swimmers and could negotiate fast current and rapids. Celilo Falls was only a partial, seasonal barrier to movements.

Interpretations of the historical genetic population structure from current samples is complicated by the confounding effects of extensive habitat alternation and potential founder effects. Impoundment has created a series of subpopulations that persist to varying degrees in reservoir and river segment habitat conditions unlike the historical free-flowing river which means that the historical genetic template may no longer be entirely adaptive. Genetic founder effects due to nonrandom population subsamples of fish trapped in each river segment and small population sizes due to limited natural production in many areas may have created local populations that are no longer representative of the historical genetic template.

Genetic evaluations of white sturgeon are also complicated by the unique genetic features of this species. Unlike anadromous and resident salmonids, the octaploid (8N) genetic condition of white sturgeon has hampered our understanding of population genetics.

Recent advances in polyploidy heritability studies and the development of new suites of microsatellite markers will enable more powerful analyses. Comprehensive white sturgeon population genetic analysis is ongoing at the University of California Davis' Genomic Variation Lab (Rodzen et al. 2004; Drauch and May 2007, 2008). Additionally, the proposed MOA sturgeon genetics project, "Experimental Sturgeon Genetics; Project No. 2008-504-00", will be collecting sturgeon genetic material to gain greater understanding of individual female spawning success using micro-satellite(nuclear) DNA analysis to more clearly define the role of supplementation to augment those populations in decline. This project, combined with the knowledge from the previously described studies, will ensure that the best possible science is being used to aid Columbia River white sturgeon populations. This work is expected to

provide additional insight into future designs and program development for white sturgeon aquaculture programs in the Columbia basin.

4. *It is not clear how all the hypotheses in Box 1 (mixture of null hypotheses and others) would be applicable to wild white sturgeon populations if hatchery white sturgeon were to be used in the experiments to test them (especially those relating to density dependence).*

Response: Hypotheses identified in Box 1 were intended to represent an inclusive list of significant questions regarding sturgeon status, limiting factors, and potential strategies for protection, restoration, management or mitigation. We agree with the ISRP that these include a variety of questions of various levels of applicability to wild sturgeon populations. Hypotheses were provided as examples highlighting potential research applications of hatchery sturgeon. More specific definitions and more explicit experimental designs will be developed in the strategic planning process.

The proposal states that the overarching goal is "restoring productive, viable sturgeon populations and fishery opportunities in FCRPS portions of the mid-Columbia and lower Snake river reservoirs." This proposal clarifies the dual goals of restoring white sturgeon populations and eventually fishery opportunities by using supplementation. The rationale is that supplementation may be (in the short-term) one of the only viable opportunities to restore white sturgeon populations above Bonneville Dam because the habitat restoration activities for improving successful white sturgeon spawning would involve (1) significantly altering mainstem dam operations in late spring for improved spawning conditions in dam tailrace habitats or (2) altering adult fish passage structures at mainstem dams to improve adult white sturgeon passage and movements among mainstem reservoirs. Both of these actions would be extremely difficult to achieve because they would be counter-productive for salmon and steelhead adult passage recovery actions related to upstream immigration.

Response: We agree with the ISRP's summary of the goals and rationale of this proposal, and the recognition of the need to consider potential trade-offs in effects of operations and passage of the hydropower system between salmonids and sturgeon. The passage tradeoffs between adult salmonids and adult sturgeon are clear-cut. Re-engineering upstream adult passage systems for sturgeon could substantially reduce their effectiveness for salmonids due to differences movement patterns of the two species. Tradeoffs in flow-related hydropower operations are less clear-cut. Higher spring flows appear to benefit both sturgeon spawning conditions and juvenile salmonid outmigration survival. However, water availability limitations can result in significant tradeoffs with needs in other areas and portions of the year.

The proposal explains links of this proposed project with several major regional programs including the NPCC 2000 Fish and Wildlife Program, the NPCC 2004 Subbasin Plan for the mid-Columbia mainstem, and the NOAA Fisheries BiOp. The one that specifically considers supplementation strategies for white sturgeon is mentioned in the 2004 NPCC Subbasin Plan for the lower mid-Columbia mainstem, which was: "3)

considering the use of hatchery fish to supplement The Dalles and John Day populations."

Response: None required

The proposal provides good descriptions of how this project is related with many past and current projects within the Fish and Wildlife Program and outside the Fish and Wildlife Program including the active supplementation projects in Canada. The sponsors also indicate that this project is closely affiliated with and complementary to the Yakama Nation sturgeon management project but provides almost no details of that project or how their actions will be coordinated. Details of how this coordination will be accomplished would improve this proposal.

Response: More detail on the Yakama Nation Sturgeon Management Project and it's relationship to this strategic and master planning project is described in a separate narrative that has been furnished to the ISRP. The Yakama project will assist in the development of the strategic plan, develop critical expertise and refine effective sturgeon culture methods for appropriate uses, and help identify facility and staff requirements and costs for consideration of hatchery potential in the strategic planning process. Future objectives and activities of the Yakama program are intended to be consistent and complementary to the strategic planning effort and plan.

2. Objectives, Work Elements, and Methods (section F)

Objective 1 "Complete, in conjunction with regional, tribal, and state management entities, a collaborative and comprehensive strategic plan for sturgeon conservation, restoration and management to include specific objectives, strategies, actions, milestones and schedules for habitat protection and restoration, natural production, hatchery production, fishery management, research, monitoring, and evaluation." This objective is a reasonable beginning for development of a Hatchery Master Plan and if widespread regional participation in the proposed workshop (WE #189) and the outcome from the workshop is general agreement in the direction and drafting of the regional plan (WE#174), then this would form the basis for initiation of the three-step review process. Overall, the sponsors are proceeding in a logical rational way for a three-step review realizing that as stated "hatchery-related actions (if any) may not prove the way to go."

Response: We agree with the ISRP on the need for a workshop with widespread regional participation in order to clarify appropriate restoration and management strategies and measures. This is a critical element of the project as proposed.

The ISRP commends the sponsors for the collaborative way that Objective 1 is framed, placing the initial priority on a regional workshop - the initial focus on a workshop is very necessary step in building a regional plan. However, the ISRP has one question about the workshop: are two days enough to achieve a successful outcome? It seems that by adding one or two additional days would allow more thorough development of the regional plan and the setting of priorities for implementing the plan.

Response: We agree with the ISRP that collaboration will be key to developing an effective and acceptable strategic plan, and that this outcome will require more collaboration than can be achieved in a two day workshop. We are proposing use of the workshop organize participation, provide a common understanding of the available information, and begin to articulate alternative objectives and strategies. We envision that completion of a comprehensive strategic plan will require a continuing process involving follow-up reviews and meetings of a sturgeon strategic planning group. This process will be clarified in the project work statement.

The sponsors have indicated (in Work Element # 183) that they will produce a peer reviewed journal article based on the results of the workshop and this is an excellent way to widely disseminate information. However, as it sometimes takes a long time to get something published, we would expect to see some written documentation on the results of the workshop and a draft plan shortly following the workshop.

Response: A workshop proceedings will be completed and distributed soon after the workshop. This product will be clarified in the work statement. This is in addition to a related journal article that will be provide a broader dissemination and peer review.

Objectives 2 and 3 are conditional on completion of Objective 1, and the ISRP finds that these objectives do not meet scientific review criteria at this time.

Response: We agree that it is premature to draw conclusions regarding objectives 2 (hatchery master plan) and 3 (monitoring & evaluation) pending the completion and outcome of the strategic planning process identified in objective 1. This does not mean that they are not appropriate or scientifically supportable objectives – merely that their implementation is conditional on the completion and results of the strategic planning process.

3. M&E (section G, and F)

No specific M&E information provided – to be developed later.

Response: none required

4. Overall Comments - Benefits to F&W (all proposal)

Have the potential benefits to white sturgeon populations basinwide been weighed against the risks from potential hatchery effects? Even though this proposal centers on the mid-Columbia and lower Snake region, a wider range of white sturgeon population segments may be affected by releases of supplementation or hatchery-reared fish. For example, the wild sturgeon stock below Bonneville Dam, the only viable population segment capable of significant harvest, and its important fisheries may be affected by many activities suggested and implied in this proposal. There is concern from peer-reviewed literature on salmon and other species that putting large numbers of hatchery fish on top of wild fish is a detriment to wild fish. There is also strong evidence (presented in the proposal) that hatchery-reared fish move downriver into lower pools. There will thus be impacts not only on the wild stock below Bonneville but also on the

fishery. Short-term positive effects may be more fish, but long-term consequences should be considered. Any negative impacts to wild fish, whether through loss of genetic diversity, fitness, diseases, etc. will affect the key white sturgeon population segment remaining in the Columbia River. There is valid concern, based on scientific precedents, for the wild stock concentrated below Bonneville Dam, which is the lynchpin of the Columbia River Basin stock and provides important fisheries.

Response: We agree with the ISRP that potential risks of hatchery actions to the healthy lower Columbia River sturgeon population will need to be carefully evaluated in the strategic planning process. These evaluations must explicitly consider both sturgeon population and fishery effects including loss of diversity, fitness, diseases, etc. Decisions would involve explicit qualification of the significance of each risk. A precautionary approach to uncertainty would be prudent given the value of the lower Columbia River population.

A "vision" for white sturgeon in the Mid-Columbia is required before proceeding into supplementation or artificial production. Certainly, the proposed workshop as indicated in Objective 1 would facilitate finding the "vision." The workshop discussions would involve a facilitated planning process to identify and discuss potential alternative conservation, restoration and management objectives, strategies, etc. These discussions would form the basis for development of an initial draft of a strategic plan for further review and consideration. Overall, as stated above, the sponsors are proceeding in a logical rational way for a three-step review realizing that as stated in the proposal that "hatchery-related actions (if any) may not prove the way to go."

Response: We agree with the ISRP that definition of a shared vision for white sturgeon is the mid-Columbia will be a requisite before proceeding into any consideration of management, restoration, or mitigation alternatives. Developing a shared vision will be a key focus of the strategic planning workshop and process.

A useful reference for the sponsors:

Smith, C. T., R. J. Nelson, S. Pollard, E. Rubidge, S. J. McKay, J. Rodzen, B. May, and B. Koop. 2002. Population genetic analysis of white sturgeon (Acipenser transmontanus) in the Fraser River. Journal of Applied Ichthyology 18: 307-312.

Response: Genetic information like that discussed in the above reference will be a critical element in the strategic and master planning process. This is one of a series of genetic evaluations of Columbia River white sturgeon based on ever-advancing methodologies. White sturgeon genetic studies began with allozymes in the 1980s (Bartley et al. 1985; Setter and Brannon (1992) followed by a series of mitochondrial (mtDNA) studies from the mid-1980s until the early 2000s (Brown et al. 1992; Anders 2002; Smith et al. 2002). More recent genetic analyses are focused on developing microsatellite methods which hold even greater potential for clarifying genetic population structure and providing new insights into historical patterns (Rodzen et al. 2004; Drauch and May 2007, 2008).

References

Anders, P. J., and M. S. Powell. 2002. Population structure and mitochondrial DNA diversity of North American white sturgeon (*Acipenser transmontanus*): An empirical expansive gene flow model. Doctoral dissertation, Chapter 2. University of Idaho.

Bartley, D. M., G. A. E. Gall, and B. Bentley. 1985. Preliminary description of the genetic structure of white sturgeon, *Acipenser transmontanus*, in the Pacific Northwest. Pages 105 to 109 in F. P. Binkowski and S. I. Doroshov, editors. North American sturgeons. Junk, Netherlands.

Drauch, A., and B. May. 2007. Genetic monitoring of the Kootenai Tribe of Idaho white sturgeon conservation aquaculture program. University of California Davis Report to the Kootenai Tribe of Idaho.

Drauch, A., and B. May. 2008. Continued genetic monitoring of the Kootenai Tribe of Idaho white sturgeon conservation aquaculture program. University of California Davis Report to the Kootenai Tribe of Idaho.

Rodzen, J. B. May, P. Anders and S. Ireland. 2004. Initial microsatellite analysis of wild Kootenai River white sturgeon and subset brood stock groups used in a conservation aquaculture program. Report prepared for the Kootenai Tribe of Idaho and the U.S. Department of Energy, Bonneville Power Administration, Portland, OR. Contract No. 88-64. 36 pp.

Setter, A., and E. Brannon. 1992. A summary of stock identification research on white sturgeon of the Columbia River (1985-1990). Report by the University of Idaho to the Bonneville Power Administration (project 89-44, contract DE-AI79-89BP97298).