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

Preliminary Review of the

Kootenai River Native Fish Conservation Aquaculture Master Plan

(BPA Project #1988-064-00)

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

Richard Alldredge
Robert Bilby
Peter Bisson
John Epifanio
Charles Henny
Colin Levings
Eric Loudenslager
Kate Myers
Tom Poe
Bruce Ward
Dennis Scarnecchia, PRG

ISRP 2009-40
October 13, 2009

ISRP Preliminary Review of the Kootenai River Native Fish Conservation Aquaculture Program Master Plan

Contents

Background 1
Review Summary and Recommendations 2
  Kootenai River White Sturgeon 2
  Burbot 5
  Format and Timeline 5
ISRP Comments on Step 1 Review Elements 6

ISRP Preliminary Review of the Kootenai River Native Fish Conservation Aquaculture Program Master Plan

Background

At the Northwest Power and Conservation Council's August 14, 2009 request, the ISRP reviewed the Kootenai Tribe of Idaho's Master Plan for the Kootenai River Native Fish Conservation Aquaculture Program. This is a Step 1 review in the Council's Three Step Review Process. Step 1 is the feasibility stage, and all major components and elements of a project should be identified. This review focuses on the Kootenai Tribe's responses to the Step 1 scientific review elements specified by the Council (Chapter 9 of the Master Plan summarizes the Kootenai Tribes approach to addressing the review elements).

Although this is a Step 1 review, the ISRP has reviewed *Kootenai River White Sturgeon Aquaculture Conservation Facility* (#1988-064-00) proposals in four project selection processes, most recently in the FY 2007-09 review.[1]

As described in the Master Plan, the goals of the Kootenai sturgeon aquaculture program are to prevent extinction of Kootenai sturgeon and restore a healthy age class structure to enhance demographic and genetic viability and persistence of the population. The burbot aquaculture program's goal is to re-establish a native burbot population in the lower Kootenai River capable of future sustainable subsistence and sport harvest. Through this Master Plan, the Kootenai Tribe is proposing to construct a new hatchery on Tribal-owned land at the confluence of the Moyie and Kootenai rivers.

The Master Plan further states, "The Kootenai Tribe has long understood that restoring Kootenai River habitat conditions capable of supporting all life stages of Kootenai sturgeon and burbot is critical to the long-term survival of both populations…in addition to this Master Plan and the Kootenai Tribe's ongoing habitat projects, the Tribe has prepared a Master Plan for the Kootenai River Habitat Restoration Project (BPA project 200200200) that presents a framework for a broad-scale ecosystem restoration effort designed to address factors limiting self-sustaining populations of Kootenai sturgeon and burbot." This habitat master plan was submitted to the ISRP to add context for the hatchery master plan but is not reviewed here.

Our review of the Master Plan for the Kootenai River Native Fish Conservation Aquaculture Program follows below.

[1] ISRP 2006-6 Final Review of FY 2007-09 Proposals: www.nwcouncil.org/library/isrp/isrp2006-6.htm (pages 306-313)

Review Summary and Recommendations

Response Requested (preferably as an updated draft of the Master Plan).

Kootenai River White Sturgeon

For white sturgeon, the Kootenai River Master Plan is generally consistent with using artificial production in ESA listed species management in the United States. That is, captive and artificial propagation is a recognized technique within the Endangered Species Act and is used as a tool to recover a number of species including black-footed ferrets, condors, razorback suckers, and Colorado pikeminnow. The plan recognizes the uncertainties in using artificial production and emphasizes the need for a parallel habitat restoration plan. The plan also recognizes that habitat restoration may be unsuccessful in re-establishing environmental conditions required for natural production of sturgeon. The Master Plan is well integrated into the Kootenai River Subbasin Plan, the USFWS recovery plan for Kootenai sturgeon, and the Libby Dam BiOp.

In general, the plan meets many of the requirements for the Step 1 process for artificial production of Kootenai River white sturgeon. The ISRP also appreciates and recognizes the critical need for expedience. However, the ISRP requests the following additional information and answers to a number of questions in order to complete the Step 1 review process. The ISRP recommends that this information be incorporated into a revised Master Plan, rather than provided in a memorandum.

1. Provide a complete history of the sturgeon production and release program from adults collected and spawned, juveniles released, survival and current status of released individuals (for example, the repeat recapture history of individual brood fish). The purpose of this information and historical summary is to permit an adequate assessment of whether the captive propagation and release can work/is working toward recovery goals;
2. Justify the numerical biological objectives for genetic and abundance goals (the work performed by Kincaid (1993) and Paragamian et al. (2005) is a useful preliminary step, but may be superseded by information and changes to the state of the science since publication (e.g., Beamesderfer et al. 2009). A modeling exercise using a range of deterministic life-stage survival values and stochastic survival rates to establish the extinction risk and population abundance trajectory is needed.
3. Design a production plan to achieve the biological objectives. Here, the ISRP looked for linkages between the numbers produced, the breeding design, and other biological outcomes with the facilities expansion and programmatic strategy. These were not sufficiently transparent in the current document;
4. Design production facilities to achieve the production plan.

The ISRP provides the following questions/concerns/comments for context to the numbered points above that should be addressed in the Master Plan revisions:

A. Has it been concluded that culture of age-1 sturgeon is the preferred future method of rebuilding the stock as opposed to release of age-0 fish in spite of the lower survival rate of the younger release? What are the plans, if any, for the age-0 releases? (Age-1 release plans are broadly and adequately outlined). Holding young for extended periods of time in the captive environment, while elevating short-term survival carries risks to future natural recruitment. The logic path for these risk/benefit trade-offs need a concise presentation.

B. If both age-0 and age-1 releases are to be continued, how will those dual programs be managed and prioritized? That is, what is the proposed release schedule of age-1 versus age-0 fish? What are the ecological rationales for the proposed approach?

C. How many age-1 sturgeon of a defined, post vulnerability size can be effectively reared in the existing hatchery facility (a) in its present form, (b) with proposed upgrades of the existing hatchery, and (c) with the new hatchery?

D. Assuming survival rates of 60% in year 1 and 90% thereafter, how does (a) the current stocking capability with hatchery in its present form, (b) the current hatchery with proposed upgrades, and (c) the new hatchery (which can result in up to 1,500 fish per family for up to 40 families annually) translate into future numbers of 5, 10, 15, 20, 25, 30, 34, and 40 year old sturgeon? What do the numbers of adult sturgeon become when survival rates are raised to 70% (year 1) and 95% (thereafter) and lowered to 50% and 80%? The evaluation of a 95% survival seems appropriate because of recent information by Beamesderfer et al (2009) that annual mortality rates of (admittedly larger) wild fish appear to be about 4%. This is lower than the 10% originally reported by Paragamian et al. (2005). The point is, the larger sturgeon seem to have very high survival rates. If hatchery fish do nearly as well, there would need to be fewer stocked than would have been projected prior to 2009.

E. A few scenarios would better enable reviewers to evaluate the critical issue, namely, the importance and need of the proposed second hatchery.

F. In addition to examining the effect of different deterministic scenarios as mentioned above, an investigation of the predictions of stochastic modeling on estimated future numbers when variability in yearly survival, mortality, wild spawning, hatchery spawning, and hatchery stocking are needed. Included should be an evaluation of the probability of extinction under various stochastic scenarios. The questions to be answered are what is the likely range in the numbers in various age groups and what is the probability of extinction under the range of conditions likely to be encountered?

G. How do the proposed stocking rates under the scenarios and their resulting adult fish compare to (a) historical estimated numbers of fish and (b) current carrying capacity of the river system for the fish? That is, given the lowered productivity of the Kootenai River and limited prospects for major improvement in this area, can the river support the high numbers of sturgeon proposed to be stocked?

H. In addition, more thought should be provided on the desirability of “stocking and stacking” one-year class after another on top of each other in this comparatively unproductive environment. Justice et al. (2009) identifies the possibility that competition may be a factor affecting age-0 survival. It could also affect survival of older fish, but its main effects might be on growth and perhaps size and age at maturation. Studies on sturgeons in natural settings suggest that there may be wide differences in year class

strength, and that for a variety of reasons, it may not be optimal to have every year class be "strong" and of the same approximate size. Has this been considered?

I. How do projections of expected habitat restoration alter estimates of carrying capacity?

J. Please expand (from brief description in Chapter 6.5) on the alternatives for program termination if the production program is successful or fails.

K. A recent re-evaluation of the population status of the wild sturgeon (Beamesderfer et al. 2009) indicates that the adult population size is larger than previously thought, and that mortality rates after age-1 are lower than previously thought. A key reason for the discrepancy was the selective mark and recapture of fish in the river compared to the lake. Mark-recapture assumptions were violated, resulting in an underestimate of stock size. The implications of this re-evaluation, as indicated in the paper, are that the wild component stock will persist a few decades longer into the future than previously assumed. Although this paper is referenced in the Literature Cited section of the Master Plan, Volume 1, its results do not seem to enter into the rationale. For example, under the population status section (Page 3-10 *et seq*), no mention is made of this report or of its potential implications for sturgeon recovery and any changes in the rebuilding timeframe that may be called for. It also did not appear in the presentation at Astoria: The figure used was the older data of Paragamian et al. (2005), which suggested that the situation for wild fish was considerably more dire than projected in Beamesderfer et al. (2009). Do the results of Beamesderfer et al. (2009) affect the urgency of a rapid rebuilding effort? Does this revised population status make it less critical for an immediate second hatchery than if the demise of the wild component was more imminent? Can current stocking be spread out over more years to achieve the desired rebuilding status while seeking ways to improve wild reproduction? Under the situation outlined in Beamesderfer et al. (2009), would spreading out the stocking make more sense?

L. A significant influence on whether this program will work depends on the actions and approaches occurring/proposed in British Columbia. Much of the watershed, headwater, and compounding impacts are located north of the border. While the Master Plan outlines a number of cooperative actions north of the border (i.e., redundant rearing), a more thorough discussion of out-of-subbasin actions on program success would improve the plan.

M. The Monitoring and Evaluation component of the Master Plan needs to reflect the changes recommended above. For example, measuring post-release survival with marked fish has different design criteria than determining whether these releases ultimately led to or will lead to natural recruitment.

N. Supplemental information (including a memo and some pertinent sturgeon and burbot papers) was received from the proponents after receipt of the Master Plan. While this information was helpful in addressing some of the questions above, it is still incomplete. For example, it did not reconcile the "healthy age structure" and abundance targets, or reconcile the abundance targets and release of 40 families of 1500 progeny. The table that showed the mortality schedule was for a single cohort, but there would be several cohorts recruiting to reproduction and substantially more than 8,000 to 10,000 adults. Some of this is identified in the updated recruitment analysis (Beamesderfer et al. 2009). Much of this material should be included in an updated Master Plan or Appendix.

Burbot

The burbot component of the Master Plan is more difficult to justify on a full implementation basis before completion of a feasibility effort. Burbot have largely disappeared from the lower Kootenai River but are not listed because other independent populations within the distinct population segment are sufficiently abundant and productive. The ostensible goal of the burbot program is to reintroduce burbot and attempt to re-establish a self-sustaining population (presumably independent of artificial propagation and supplementation). It is not clear that the environmental conditions required for sustainable burbot production will be re-established – a precursor to the goal of self-sustainability. The program has yet to release fish on a study basis to determine the fate and likelihood of survival-to-maturity and participation in natural reproduction, let alone recruitment of any progeny into a wild population. No evidence of recruitment to reproduction or fisheries for other burbot culture programs is provided. This would provide a basic level of justification.

Although the rudiments of burbot genetics and culture are being discovered, relatively little is known about the ecology of burbot and factors needed for their survival once released. This is supported by comments at the bottom of page 9-1. At this time the ISRP feels that resources need to be allocated to gain an in-depth understanding of factors affecting burbot survival after stocking before development of a production-scale hatchery to rear and release burbot is initiated. Specifically, a deliberate step-wise approach proceeding from feasibility investigations to pilot studies is warranted prior to planning full implementation. In addition, a more thorough discussion of burbot culture by others is needed, that includes a summary or evaluation of the success of these programs toward re-establishing natural productivity. Ultimately, the ISRP recommends the burbot program should proceed on a feasibility scale primarily using existing facilities until sufficient proof exists to transition to pilot scale efforts.

Format and Timeline

Following acceptable revisions in response to the above questions and comments, the Kootenai River white sturgeon sections of the Master Plan will likely meet the requirements to proceed to Step 2. However, the required elements in several of the burbot sections of the Master Plan are incomplete/inadequate (e.g., missing HGMP, subbasin-wide risk assessment, and harvest plan). Additional background and technical justification are needed to be put into the Master Plan for burbot before Step 1 requirements are met.

Combining the two species into a single Master Plan when there are such substantial gaps in the understanding of limiting factors and development of culture technology between the species may slow down the process for white sturgeon. The ISRP recommends that the proponents either clearly separate the two species within the document (e.g., Parts I and II) or put into two separate documents. We recommend two separate documents, because they appear to be on two separate timelines for the step review and this may speed up the process for white sturgeon.

An adequate response would also indicate how the proponents wish to proceed regarding the dual structure of the proposal and format options.

ISRP Comments on Step 1 Review Elements

A. All Projects

Does the Kootenai River Master Plan:

1) address the relationship and consistencies of the proposed project to the eight scientific principles (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section B.2) (Step 1)?

The eight Scientific Principles: 1. The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystem. 2. Ecosystems are dynamic, resilient and develop over time. 3. Biological systems operate on various spatial and time scales that can be organized hierarchically. 4. Habitats develop, and are maintained, by physical and biological processes. 5. Species play key roles in developing and maintaining ecological conditions. 6. Biological diversity allows ecosystems to persist in the face of environmental variation. 7. Ecological management is adaptive and experimental.

The eight Scientific Principles overall:

Yes, Chapter 9 provides a narrative explanation of the consistency of the Master Plan with the Fish and Wildlife Program's eight scientific principles. The treatment of each principle and the relationship of the Kootenai Sturgeon and Burbot Master Plan to these Program principles is not exhaustive. Yet, the plan conveys the important message that the Kootenai Tribe understands the limits of artificial production as a recovery/restoration strategy and the need for essential features of the ecosystem to be re-established if the activities pursued within the Master Plan are to contribute to sturgeon and burbot restoration. Additionally, the proponents have produced numerous reports and scientific publications over the past decade that demonstrate a thorough knowledge of the Kootenai River ecosystem.

One area in which the proposal could be improved is in explaining the importance of the food web in the Kootenai River ecosystem. The proponents state on page 9-3 concerning the white sturgeon "This apex predator species plays a key role in the food web of the Kootenai River ecosystem." This statement is provided as support for Principle 3. However, the proposal would be improved by adding more information on this point – the document does not provide any insight into white sturgeon feeding habits at present (when presumably important forage species are in low abundance). There is also a lack of information on feeding of the hatchery-reared white sturgeon once released. Are they going to be able to switch to natural food quickly, or is there a period of acclimation needed? Are food supplies sufficient to support them? Perhaps a trophic model such as ECOSIM or another model would help in this regard.

The proponents also state (as support for Principle 3) that burbot played a "key regulatory role" in the river ecosystem, but no information is provided as to what that role was.

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 (Step 1)?

Yes, the KTOI has a good team of biologists working on this important project, and they are working closely with numerous state, federal, and provincial researchers and managers to achieve many of their goals. The proponents document this extensive history of working closely with many other projects and agencies (Chapter 3). This has important implications for response monitoring as well as the KTOI's adaptive management plan.

3) define the biological objectives (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section C.2 (1) and (2), and Technical Appendix) with measurable attributes that define progress, provide accountability and track changes through time associated with this project (Step 1)?

The objectives are defined for white sturgeon and burbot in Chapters 4 and 6. However, additional development of the biological objectives is needed. The final biological objective(s) should be used to design the fish production program, and the fish production program should be used to design the scope and scale of production facilities.

The ultimate biological objectives for the sturgeon program are two of the five elements of the Post-release Kootenai sturgeon conservation aquaculture program biological objectives on pages 4-9 and 4-10: "Ensure genetic diversity with and among progeny groups" (The target is an effective population size of greater than 20 spawners and over 200 fish per generation); and, Achieve a sustainable adult population target" (The abundance target is 8,000 to 10,000 adults)".

The Master Plan needs to justify the 20 spawners and over 200 fish per generation. And also explain it. It is not clear what these targets refer to and how they will be measured. The Master Plan needs to justify the abundance target of 8,000 to 10,000 adults. Elsewhere in the Plan reference is made to establishing a healthy age class structure. It is not clear how the 8,000 to 10,000 adults fit with the 20 spawners and 200 fish per generation. This needs to be reconciled and explained.

Additionally, on page 4-8 production targets of 1,500 age 1 sturgeon from 40 families is identified, and on page 4-9 a bullet point has a target of spawning up to 18 females.

One objective of the sturgeon program is appropriately conservation of the remaining genetic variation in the extant declining adult population. A genetic breeding design based on the number of remaining fish and the goals of retaining variation (what percent over what timeframe) needs to be developed and incorporated into the Master Plan. This will establish one component of the needed size for the propagation plan. Monitoring should probably include molecular analysis of current and ongoing effective population size.

A definition needs to be provided for "healthy age class structure." Based on the abundance goals for viability, "healthy age class structure," and gene conservation, a production plan can be developed. In other words, there are theoretically established conservation and genetic production and abundance requirements. To achieve those production levels a specific breeding and culture program can be designed. Once the program is designed, then facility designs can be completed.

In addition, more thought should be provided on the desirability of "stocking and stacking" one-year class after another on top of each other in this comparatively unproductive environment. Justice et al. (2009) identifies the possibility that competition may be a factor affecting age-0 survival. It could also affect survival of older fish, but its main effects might be on growth and perhaps size and age at maturation. Studies on Acipenserids in natural settings suggest that there may be wide differences in year class strength, and that for a variety of reasons, it may not be optimal to have every year class be "strong" and of the same approximate size. Has this been considered?

The measures that define progress must be viewed in relation to carrying capacity and desired numbers of fish in the river, preferably in relation to historical numbers and 20th century reductions in carrying capacity.

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

The proposal describes expected project benefits in Chapter 9 in terms of a direct and well-defined goal – preservation, in perpetuity, of the Kootenai River populations of white sturgeon and burbot. The goal, however, has a lot of uncertainty. More explanation and specificity are needed to understand the basis of the goals for genetic conservation and for abundance goals (see above comments in (3)).

5) describe the implementation strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.2) 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)?

Yes, the implementation strategies are adequately described in Chapter 9.

6) address the relationship to the habitat strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.3) (Step 1)?

Yes, Chapter 9.6 lists those relationships.

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 subbasin, province and basin (Step 1)?

Alternatives are presented and generally described in Chapter 4.

The alternatives for Kootenai white sturgeon are well presented and discussed; however, the basis for selecting the Expanded Aquaculture Alternative needs to be supported with additional information, as indicated above.

For Burbot, three alternatives are listed: status quo (do nothing), a new facility, and use of an existing facility. Evidently because of concerns for the stock concept and escape of fish, the alternatives included only rearing fish within the Kootenai subbasin. Few alternatives thus exist. However, ongoing research at the University of Idaho identified in the plan suggests that there are no clear rules as to where (i.e., in which basin) the fish may be reared, at least for experimental purposes. Stronger scientifically based rationale needs to be articulated as to why the listed alternatives are limited to within the subbasin. Restricting considerations for rearing burbot to within the subbasin clearly limits options. Such within subbasin considerations may be ecologically sound and favor a new hatchery. However, because of the cost of a new hatchery, it should be clearly discussed why rearing of all types must remain in the subbasin and other production facilities could not be used. It would also be worthwhile to contact regional agencies with hatcheries to assess their restrictions and limitations. The proposed approach may indeed be the most appropriate one, but better justification for the limited range of alternatives considered would improve the plan.

As part of this justification, the burbot genetics, as far as are known, need to be clearly described, including ranges and locations of the fish of the different clades (Columbia, Missouri, Mississippi; Powell et al. 2008). Is it not so that both Mississippi and Columbia clades are found in the Kootenai basin? How well are different clades and stocks delineated? How different are they in life histories? Does the evidence suggest strong selection has occurred for stock-specific traits, as in salmon? Because so few burbot remain in the lower Kootenai (less than 50), a remnant neighboring stock is proposed. Are there clearly enough fish from this neighboring stock for the proponents to be sure that they will be a viable egg source?

Although the rudiments of burbot genetics and culture are being discovered, relatively little is known about the ecology of burbot and factors needed for their survival once released. This is supported by comments at the bottom of page 9-1. At this time the ISRP believes it is premature to initiate development of a production scale hatchery to rear burbot. Resources need to be committed to developing a better understanding of factors affecting their survival after stocking before full-scale hatchery is initiated.

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

The proponents have provided a thorough review of historical and current status of resident fish and wildlife in the Kootenai River subbasin. While the current status is well described for both sturgeon and burbot, it would be very useful to provide a clearer picture of the historical abundance of burbot in the river. Additional information needs to be provided regarding the

historical importance of the burbot fishery. Were they a significant part of the fish community in terms of number and biomass?

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

Yes, the proponents have provided a fairly thorough review of the management of resident fish and wildlife in the Kootenai River subbasin.

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

Yes, for white sturgeon the Master Plan demonstrates adequate responses to the USFWS recovery plan, BiOp, and the Kootenai River Subbasin Plan. The proposal would also be improved by more discussion/consideration of the major initiatives regarding upper Columbia sturgeon hatchery releases on the Canadian side and in Washington. For example the Upper Columbia White Sturgeon Recovery Initiative has been underway since 2000 (see webpage for UCWSRI) but this work is not mentioned in the Plan. For burbot, the plan indicates responses to the Kootenai River Subbasin Plan and the Kootenai Valley River Initiative conservation strategies.

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

No, there is no separate section in the plan as the comprehensive environmental assessment. Do subsections 3.1, 3.2, and 3.3 serve this function? Seems like this information was taken directly from the Kootenai River Subbasin Plan?

12) describe the monitoring and evaluation plan (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.9) (Step 1, 2 and 3)?

Yes, adequate for white sturgeon Step 1, but lacking adequate detail for burbot. Once the biological objectives are clarified, Step 2 and Step 3 need to provide specifics on the monitoring to establish that both the production and post-release phase monitoring is reasonable and feasible. The ISRP is concerned that post-release survival monitoring, which obviously is very important to the KTOI aquaculture plan goals, depends on the cooperation of agencies outside the KTOI. The links are supposed to be made with other agencies, but the proposal would be improved by providing more explicit information. For example, are agreements in place or firmly proposed?

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)?

Yes, they are provided in Appendix D. The conceptual facility designs need to be verified once the biological objectives are justified. Until they are better established, the need for additional facilities is pending.

B. Artificial Production Initiatives

Does the Kootenai River Native Fish Conservation Aquaculture Program Master Plan:

1) address the relation and link to the artificial production policies and strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.4 and Technical Appendix) (Step 1)?

Primary strategy: Artificial production can be used, under the proper conditions, to 1) complement habitat improvements by supplementing native fish populations up to the sustainable carrying capacity of the habitat with fish that are as similar as possible, in genetics and behavior, to wild native fish, and 2) replace lost salmon and steelhead in blocked areas.

The APR standards: [Most of these elements are covered by questions in the template, but the two elements in italics are not as redundant.]

- The purpose and use of artificial production must be considered in the context of the ecological environment in which it will be used. (See A.1 and A.6)
- Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties. (See A.12)
- Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors. (See A.1)
- A diversity of life history types and species needs to be maintained in order to sustain a system of populations in the face of environmental variation. (See A.1)
- *Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics.*
- The entities authorizing or managing an artificial production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of those purposes for each population of fish addressed. (See A.3)
- Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels. (See A.2)
- *Appropriate risk management needs to be maintained in using the tool of artificial propagation.*
- Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations. (see B.3)
- Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed. (See A.10)

See the 2000 FWP for details on Wild Salmon Refuges, Harvest and Restoration Hatcheries, and Experimental Approach. [Delete this box after comments are synthesized?]

The Master Plan addresses each artificial production principle/standards. The standard "Naturally selected populations should provide the model…." states that attributes of sturgeon and burbot life history and evolution are incorporated into the breeding and culture plan. The Master Plan also cites a manuscript "Don't save sturgeon with salmon hatcheries" to indicate

they have recognized the special features of sturgeon and burbot life histories that make the requirements for programs different from salmon programs. However, they have not actually summarized these points. It would be good to include more in depth discussion of how the breeding, culture, and release programs have been guided by the life-history attributes of the species.

For the white sturgeon material the Master Plan appears to address basinwide artificial production standards and strategies adequately, although no risk assessment to white sturgeon populations out of subbasin was done.

For burbot, the plan does not present enough detail on the current naturally existing population of burbot to provide a model to guide artificially reared fish production to the point of release. There is scientific literature available to draw on, that could/should be incorporated into the plan. A risk assessment of potential impacts from artificially produced burbot to other burbot populations in the subbasin is needed.

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

Yes, a HGMP for white sturgeon is included in Appendix A, but it is dated 2000. It is the only source for some of the history of fish production of sturgeon by the program. While the HGMP doesn't require updating if it is not required for permitting under the ESA, additional presentation and summary of the production, release, and evaluation program is needed early in the Master Plan.

No HGMP is provided for burbot.

3) describe the harvest plan (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.5) (Step 1)?

Yes, but just explanations are given that this is pre-mature for species on the verge of extinction and they may be correct on this. More could be provided on the potential to harvest both sturgeon and burbot produced by artificial production in the medium term even if natural self-sustaining populations are not being reestablished by the restoration of required environmental attributes through the habitat Master Plan (to be reviewed in the future). Also, for burbot, one of the expected benefits is to "restore and maintain a viable and harvestable burbot population…" so a future harvest plan should be projected with some estimated goals.

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

Yes, the conceptual designs appear adequate for this stage (Step 1) of the review, but this needs to be revisited once the production goals are clarified and justified based on the conservation needs of the species.

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.