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Final Review of the June 2010 Revised

# Kootenai River Native Fish Conservation Aquaculture Master Plan and Response to the ISRP

(BPA Project #1988-064-00)

**Step One of the Northwest Power and Conservation Council's Three-Step Review Process**

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# ISRP Final Review of the June 2010 Revised Kootenai River Native Fish Conservation Aquaculture Program Master Plan

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## Background

At the Northwest Power and Conservation Council's June 25, 2010 request, the ISRP reviewed the Kootenai Tribe of Idaho's June 2010 revised Master Plan for the Kootenai River Native Fish Conservation Aquaculture Program. 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.

This is an ISRP response review as part of 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.[1] The ISRP reviewed the initial Step master plan submittal in 2009 and requested responses on specific issues regarding the white sturgeon and burbot components of the plan (ISRP 2009-40). The ISRP's preliminary report noted that, for white sturgeon, the Master Plan was well integrated with other regional recovery plans, was generally consistent with using artificial production in ESA listed species management, recognized the uncertainties in using artificial production, and emphasized the need for a parallel habitat restoration plan. The Master Plan also recognized that habitat restoration may not succeed in re-establishing environmental conditions required for natural production of sturgeon.

For burbot, the ISRP's preliminary review noted the need to proceed in a step-wise manner with a feasibility effort preceding a pilot scale effort, because relatively little is known about the ecology of burbot and factors needed for their survival once released. The preliminary review also raised issues about the Master Plan's timeline and format. Specifically, the state of knowledge and effort was more advanced on sturgeon than burbot, and the ISRP recommended that treatment of the two species be clearly separated in the master plan or, preferably, individual master plans be developed for each species. This would allow one major component of the plan to move forward (likely sturgeon) if the other component needed further work on scientific issues.

In June 2010, the Kootenai Tribe responded to the ISRP's preliminary review by revising the master plan based on the ISRP's comments and providing a point by point response to the ISRP's comments. The ISRP's review of the revised June 2010 Master Plan for the Kootenai River Native Fish Conservation Aquaculture Program and response follows below.

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

## ISRP Recommendations

**Kootenai White Sturgeon - Meets requirements for proceeding to Step Two (Qualified)**

The proponents have provided adequate responses to the majority of the ISRP's comments in the preliminary review of the Master Plan, and the ISRP appreciates the extensive detail provided in the response document and the revised Master Plan. However, the ISRP has identified several remaining issues for which we would like additional information/detail and qualify our review with expectations of seeing this information included in the Step Two Master Plan document.

The qualifications are that the proponents: (1) establish quantitative benchmarks (i.e. estimated population size, survival rates, adequate number of families, and age structure) and a decision pathway to adjust production goals based on monitoring data of hatchery fish in the wild, (2) refine the monitoring program to collect the necessary data to determine if benchmarks are being met or exceeded, and (3) provide additional details regarding the rationale and justification as to the need for additional hatchery capacity (see summary comments/questions below).

**Kootenai Burbot – Meets requirements for proceeding to Step Two**

The proponents responded adequately to ISRP recommendations by providing sufficient information and justification in the Master Plan to proceed to Step Two. A number of published papers cited provide guidance for moving forward with burbot conservation aquaculture. The ISRP further commends the proponents for providing the detailed burbot Hatchery and Genetic Management Plan (HGMP) and for their focus of the proposed program on the research aspects regarding burbot habitat requirements and limiting factors, as so little is known of their life history in the subbasin and elsewhere.

## Summary Review Comments

**Rationale/justification for a second hatchery** – Based on the Master Plan and Response, it is argued that hatchery capacity is limiting and that the rationale for the second hatchery is based on the needs for meeting several production targets outlined in Table 2, Page 13 of the Response document. Box 2, Page 8 in the Response also outlines some of the rationale for the second hatchery. The proponents want to "Release numbers consistent with family numbers and family release number targets designed to minimize genetic risks…30,000 to 40,000 sturgeon per year over 10 years." Despite these responses, it remains confusing as to exactly what aspect of hatchery capacity has actually, not just potentially, limited the program thus far from meeting production targets. The hatchery appears to have functioned well below production capacity thus far. Rearing capacity *per se* from the one hatchery plus B.C. contribution does not appear to be limiting. What aspect is limiting? This needs clarification as outlined below.

One rationale for the second hatchery is that the proponents want to take advantage of any strong year class survival that may occur with released hatchery sturgeon. Several times it is mentioned (e.g., page 12) that there is a pressing need to front-load production while broodstock remain available. On page 16: "a front-loaded strategy requires maximum hatchery production rather

than average hatchery production. This is one of reasons (sic) the proposed new hatchery is needed at Twin Rivers." Is there any sense of how often these "strong year classes" would occur? One in 10 years might be optimistic under current river conditions, and that is about the predicted time period until wild broodstock begins to decline. Have any of those strong year class situations occurred thus far? We found no evidence presented that current hatchery capacity has thus far limited their response to any past strong year class situations. Is there any indication that it has?

Starting with Table 2, page 13 of the response document:

*Broodstock number/Families produced* – It is argued that the existing hatchery is inadequate, resulting in an inadequate number of families, and that the new hatchery will help.
The goal is 40 families per year. "Current production capacity of the combined Tribal sturgeon hatchery and the Kootenai Sturgeon hatchery in British Columbia is 12-18 families per year, with up to 5 families currently produced annually at the B. C. facility" (Page 16).

Our concern is that based on past efforts, it does not appear that total age 1+ rearing capacity or family capacity has been limiting (See Figure 4, page 20 of response), but rather there was a limit of how many brood fish were available. Current capacity is only 22,500 total age-1+ fish per year, or it can only accommodate between 15 and 22.5 families per year at 1,000 to 1,500 fish per family. See Table 23, Page 13. In recent years (2002-2009), though, even with many fewer fish per family, the number of families has varied from 9 in 2002 to 18 in 2007. There has evidently been a lack of available families (i.e., broodstock?) and not a lack of rearing capacity. Is this so? If so, how would this change with the second hatchery?

Can the proponents catch enough potential spawners to meet this family target? It does not *appear* that they have been able to do so thus far, so this point should be clarified. What are the plans for improved protocols for meeting this more ambitious goal? In seeking prime broodstock, it is possible that many mature Kootenai sturgeon do not migrate very far upriver of the lake. They *may* move a lesser distance upriver as they age and explore less, concentrating energy on feeding and reproduction. This may account for the larger population estimates in Beamesderfer et al. 2009 (as acknowledged) and may give a clue as to where to seek more broodstock. How much effort is Canada putting into this effort by catching brood fish in their waters?

On efforts to increase broodstock acquisition, it is not clear when during the year effort is made to acquire, maintain, and presumably inject broodstock for acquisition of gametes. The typical season for this is in spring. However, has it been considered that because these sturgeon, especially females, have a very protracted period of gonadal recrudescence (3-4 years between spawns), there are many phases of reproductive status occurring in these fish at any time of the year? That is, although natural spawning is in spring, fish are at many phases of reproduction and some are always "out of phase" for a narrow natural spawning window. Is it known if potentially useable females are or could be available for capture and use at any time of the year with injections and some temperature/photoperiod acclimation? Perhaps this is done now. This may be in the plan, but it was not clearly stated.

*Fish per family/size at release* – Targets for numbers per family are 1,000 to 1,500 per family at age-1 for genetic benefits. The proponents lay out the defense for the 1,000 to 1,500 fish per family in Figure 5, page 22. Is the 1,000 to 1,500 fish per family a genetically defensible and defended target? It seems instead to be based mostly on expected survival rates as related to size at release.

In using the 1000-1500 family size target as a justification, first year survival (i.e., of age-1 releases) seems critical in estimating the family sizes actually needed. The proponents base their estimates on the idea that age-1 fish (30 grams each) will survive at 15%. In preparing their Figure 5, it is not clear why they chose a first year survival of 15%. Is this based on a rate for fish released into the wild strictly as age-1 fish? Or does it include age-0 fish? This is very difficult to figure out from their presentations and from Justice et al. (2009). It would be very helpful if the projections were made based on a size of age-1 fish to be released and the best estimates of survival of those fish. What was the survival rate in 2005-2007 for fish comparable in size to fish released in earlier years? Was it as low as 15%? Were any similar sized fish released? Figure 10 of the response is not informative on this point either because it does not account for fish size. The basis of the 15% number needs to be clarified.

The expected survival is very critical to projections, as their Figure 8 shows. For example, for a slightly higher (25%) survival rate in year 1, and the projected rates of 88% in year 2, and 96% after that, the pattern would be:

| Year | Survival rate | Number of brood year fish per family at large (500 age-1 fish released) | |
|---|---|---|---|
| 2012 | (released) | 500 | |
| 2013 | .25 | 150 | |
| 2014 | .88 | 132 | |
| 2015 | .96 | 127 | |
| 2016 | .96 | 122 | |
| 2017 | .96 | 117 | |
| 2018 | .96 | 112 | |
| 2019 | .96 | 108 | |
| 2020 | .96 | 103 | |
| 2021 | .96 | 99 | |
| 2022 | .96 | 95 | |
| 2023 | .96 | 91 | |
| 2024 | .96 | 88 | |
| 2025 | .96 | 84 | |
| 2026 | .96 | 81 | |
| 2027 | .96 | 78 | |
| 2028 | .96 | 75 | |
| 2029 | .96 | 72 | |
| 2030 | .96 | 69 | |
| 2031 | .96 | 66 | |
| 2032 | .96 | 63 | |
| 2033 | .96 | 61 | |
| 2034 | .96 | 58 | |
| 2035 | .96 | 56 | |
| 2036 | .96 | 54 | age 25 fish (“Mature”) |

In this case, the number of fish needed per family to achieve Ne, effective population size goal, is less than the proponent's target size, and the proponent's justification of the second hatchery is less obvious based on family size.

**Density dependence** – The proponents acknowledge that such front-loading could have negative impacts from density dependence. In the Response document, (P.9) "Recent analysis of post-release hatchery fish survival suggests there may be size-related density-dependent limitations during the first year of age." Also, "Current habitat capacity for sturgeon is unknown" and "it remains to be seen whether the larger fish will survive at similar rates to the like-sized fish groups released before 2004, given the density of hatchery-reared juvenile sturgeon in the river. In addition, as the habitat restoration program is implemented, the magnitude of the habitat carrying capacity limitation may be reduced." This evidently means that carrying capacity may increase.

The issue of carrying capacity in the plan in terms of its possible effects on the hatchery program is clearly acknowledged, but not effectively addressed. Not even ballpark estimates of carrying capacity are presented nor any calculations supporting them. Based on the available evidence of apparent density-dependent survival and perhaps growth with the comparatively modest releases thus far, it remains to be seen if the larger releases of larger fish into the river will show positive results. Has it been adequately considered that nearly all larger fish should be released into the lake or just above the lake, where carrying capacity limitations may not be as severe?

However, because of the importance of estimating carrying capacity and as the habitat restoration program planning moves ahead, it is strongly suggested that a workshop using trophodynamic models be convened.

## Specific Comments on Response Document

### Kootenai River Native Fish Conservation Aquaculture Program

The ISRP's review below is organized by the ISRP's preliminary comments.

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.

Good information was provided in the response, but it is still not clear if propagation and release can work. The carrying capacity of the Kootenai River remains unknown and may be insufficient to meet conservation goals.

2. Justification of 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.

Better justification for numerical objectives and abundance goals is needed (see summary comments above). Some basic life history models are provided, but the proponents may be relying too much on adaptive management (almost trial and error). The proponents declined the ISRP's request to use stochastic models because of a lack of information to parameterize them for Kootenai sturgeon. They insisted that this population is unique, and maybe it is, but it is troubling that the proponents did not provide much literature review and what they provided was focused on "their" population of upper Columbia white sturgeon.

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;

See above summary comments.

4. Design production facilities to achieve the production plan.

Adequate.

5. 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 needs a concise presentation.

Based on the proponent's responses, releases of both 0 and 1 fish are planned, and both are necessary because of the high risk of extinction. The proponents try to make the case there will be no "in-hatchery" evolution occurring if age-1 fish are reared. However, they do not adequately cover the literature of sturgeons elsewhere.

6. 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?

The ecological rationale is not well developed. If density-dependence is operating perhaps food is mediating, but the proponents have not provided any data on feeding differences between 0 and 1 age fish.

7. 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?

Mostly adequate response, but this is the crucial issue. If issues like density-dependence are really going to be tested they need to increase the number of fish in the river and monitor for years. However, there is still the lingering question of whether hatchery fish are going to behave in the same way as wild fish.

8. 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.

The proponents recognize that long-term issues of too many hatchery fish could arise but state that they are focused on the short-term risk of not capturing the genetic diversity. They are concerned with variation in survival rates and uncertainty in future availability of broodstock. The proponents seem reluctant to accept the Beamsdefer et al (2009) data.

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

See summary comments above – some scenarios were presented using models. On Page 40, the proponents state that, “Many sturgeon species around the world and in North America display specific homing fidelity to natal areas of native rivers.” No references are provided for this assertion, and none of us are aware of any studies testing this hypothesis. Please provide references and evidence/verification for this statement.

10. 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?

The proponents reject the idea of stochastic modeling because data on the Kootenai stock are not available for calibration. However, data from other white sturgeon populations could have been used, as the sponsors do comment that their stock is a typical "k" life history fish.

11. 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?

No estimates of carrying capacity were provided. The proposal would be improved by further information on particulars of the restoration work underway in the river. They state there are now "millions" more kokanee but give no reference for this statement. Nutrient addition experiments are also underway, but no specific information is given – the ISRP should not have to follow up on cited references.

As in other matters, the proponents are reluctant to extrapolate data from other white sturgeon stocks, or, for example to use bioenergetics models to forecast food needs. There is excessive reliance on adaptive management.

12. 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?

The issue was discussed in some detail – but always refers back to adaptive management.

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

The response to this question was very general and consisted mainly of narrative of planned work. Nutrient addition has stimulated food production for whitefish in the Kootenai River but the proposal does not tie these results to white sturgeon feeding ecology (also see comment in # 11 above).

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

Alternatives are adequately described.

15. 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?

If spreading out the stocking was to occur, detailed carrying capacity monitoring would be required to account for inter-annual variation (and presumably progressive improvement) if the habitat restoration program goes ahead.

16. 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.

Partially addressed. The proponents acknowledged that water from upstream flows from north of the border into Kootenai white sturgeon habitat. However, the implications were not discussed. Have the tribes and B. C. considered pen-rearing or some sort of grow-out of fish in the lake? Can sturgeon be effectively pen-reared up to post predation size in a lake? There seem to be very few references in the literature on this possibility.

The response clearly outlined the long-term cooperation at some level between Canada and the Tribe. It is not clear, though what Canada plans to do in the future to complement this proposed program. A specific letter from Canada would help and perhaps be appropriate.

17. 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.

The proponents have provided the key elements of a comprehensive monitoring plan. However, statistical aspects were not included (e.g., power analysis and strategy for spatial sampling (probabilistic, stratified or?). We assume this will be developed in Step Two.

18. 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.

Most of the new information is tabulated or graphed in the response document and updated Master Plan.

## 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.

*ISRP 2009 Comments: 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.*

ISRP 2010 Comments: Some new food information is provided but the sponsors declined the idea of trophodynamic models. Generally they provided a good response for burbot, using best available scientific literature. However, only inferential comments were provided on the role of burbot's "key regulatory role."

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)?

*ISRP 2009 Comments: 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.*

ISRP 2010 Comments: No change.

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)?

*ISRP 2009 Comments: 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.*

ISRP 2010 Comments: Carrying capacity issues were not well described. The proponents prefer to use an adaptive management approach to this problem but do not describe the details of what they would do to estimate carrying capacity with this technique.

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

*ISRP 2009 Comments: 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)).*

ISRP 2010 Comments: Adequate.

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)?

ISRP 2010 Comments: Yes, the implementation strategies were adequately described in the 2009 Master Plan (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)?

ISRP 2010 Comments: Yes, those relationships were addressed in the 2009 Master Plan (Chapter 9.6).

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)?

*ISRP 2009 Comments: 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.*

ISRP 2010 Comments: Considerable progress has been made since the original proposal was written. A number of published papers provide guidance for moving forward with burbot conservation aquaculture.

Canadian officials are monitoring the burbot in Moyie Lake to prevent overharvesting of the species for brood stock. However, the proposal does not describe a back-up plan for another source of brood stock should this supply be terminated. No response was given to the ISRP comment, “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?"

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)?

*ISRP 2009 Comment: 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?*

ISRP 2010 Comment: Adequate response.

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

ISRP 2010 Comment: Yes, in the 2009 Master Plan the proponents 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)?

*ISRP 2009 Comment: 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.*

ISRP 2010 Comment: No change.

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

*ISRP 2009 Comment: 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?*

ISRP 2010 Comment: According to Section 7 of the Master Plan the comprehensive environmental assessment will be prepared in Step 2.

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)?

*ISRP 2009 Comment: 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?*

ISRP 2010 Comment: Some agreements are in place and others are still 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)?

*ISRP 2009 Comment: 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.*

ISRP 2010 Comment: This will be addressed during Step Two.

## 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)?

*ISRP 2009 Comment: 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.*

ISRP 2010: The burbot material added was adequate considering that not much is known about burbot in the subbasin.

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

*ISRP 2009 Comment: 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.*

The HGMP for white sturgeon has been updated and is adequate. An HGMP was also prepared for burbot and was well done. Risk assessments were not provided. See also above regarding comments to Question A.7.

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

*ISRP 2009 Comment: 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.*

ISRP 2010 Comment: The sponsors assume a "wild" population of burbot will eventually develop from hatchery releases but no harvest goals for the former are provided.

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

*ISRP 2009 Comment: 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.*

ISRP 2010 Comment: See above.

5) provide a preliminary design of the proposed facilities (Step 2)?

ISRP 2010 comments: 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)?

ISRP 2010 comments: Not applicable for this review; this is a Step 3 issue.