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

Review of the

Mid-Columbia Coho Restoration Master Plan

Project # 199604000

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

August 9, 2006
ISRP 2006-5

Step One Review of the Mid-Columbia Coho Restoration Master Plan

Contents

Background 1
Recommendation 1
ISRP Comments on Step Review Elements 2
Additional ISRP Comments 17
ISRP Response to Sponsor's Fix-it-Loop for the FY 07-09 Solicitation 19
References 21

Step One Review of the Mid-Columbia Coho Restoration Master Plan

Background

At the Council's request, the ISRP reviewed the Yakama Nation's Mid-Columbia Coho Restoration Master Plan as part of the Step One process of the Council's Three Step Review. This review was conducted in conjunction with the fiscal years 2007- 2009 (FY 07-09) proposal for this project, 1996-040-00, Evaluate the Feasibility and Risks of Coho Reintroduction in the Mid-Columbia. The ISRP's recommendation for the FY 07-09 proposal is incorporated in this memo in advance of the ISRP's final report, due August 31, 2006. The ISRP has participated in numerous reviews of the feasibility study including annual reviews of proposals for funding through the Fish and Wildlife Program for fiscal years 1998, 1999, and 2000; a partial step review in 2000[1]; and a provincial review[2] for fiscal years 2003-2005 funding. These reviews have been constructive with improvement of the project's justification noted in each iteration, though not without debate on such issues as a change in the project's emphasis from the Methow to the Wenatchee basin. This Step One review marks the evolution of this project from a feasibility study to fuller implementation with increased production and releases of smolts (a peak of 2,155,000 in 2012) coupled with proposed investment in new facility development including a small adult holding and incubation site in the Wenatchee subbasin, two constructed habitats for rearing in the Methow subbasin, and a combination of five acclimation sites involve varying degrees of construction.

Recommendation

The ISRP finds the Master Plan to be a commendable draft and an excellent start to producing a final Master Plan for reintroducing coho salmon to the Wenatchee and Methow subbasins in the mid-Columbia River basin. The ISRP compliments the plan's team for their efforts. We were particularly pleased to see the recognition of the need for habitat restoration to accompany artificial production activities if self-sustaining coho salmon are to be reestablished in these subbasins. A further strong aspect is the use of the Entiat River subbasin as a reference site in trying to differentiate the effects of activities within the Wenatchee and Methow subbasins from the general effects of regional environmental and marine variation.

We believe there are a number of issues that should be resolved before proceeding to Step Two of the Three Step Review, and that these should be incorporated in a revised Master Plan before proceeding. These main issues are:

1. **Provide text that explicitly addresses the relationship and consistency of this proposal with the Council's eight scientific principles.** In the draft Master Plan sponsors include sections in which the headings apply to each of the eight principles and the text simply refer readers to further sections of the Master Plan by number (in at least one case, almost every section of the Master Plan). These sections do not provide the text that is needed under each of the principles to explain the association. In other words, the sponsors have presented no synthesizing discussion of how the plan embodies each of the principles. When the ISRP, or

[1] ISRP 2000-5: www.nwcouncil.org/library/isrp/isrp2000-5.pdf
[2] See the project under CBFWA's proposal finder: www.cbfwa.org/solicitation/components/forms/Proposal.cfm?PropID=223

anyone else, goes to the referred-to sections and tries to determine how the sponsor intends to meet the spirit of the principles, the result is only a rough interpretation of what the reader thinks the sponsors may think. Sponsors should provide text that explicitly identifies the elements of their work that establishes consistency with the Council's principles. The ISRP can then evaluate that association.

Below, under some of the eight principles, the ISRP provides information that sponsors should consider when developing their text.

2. **Provide more specificity and clarity on the habitat protection and enhancement portion of the Master Plan.** The artificial production plans are much more specific with respect to actions and projected timeline than are the plans for habitat restoration. The ISRP believes that at this time there is little evidence to conclude that existing environmental conditions are sufficient to sustain a coho salmon population in these subbasins. For that matter, it would be hard to argue that such conditions exist for steelhead or Chinook salmon either, which is why some component populations are listed under the ESA. The ISRP believes that habitat actions must precede the stocking of fish. If the habitat is unsuitable, reintroduction is unlikely to succeed.

   This theme is developed in more detail below.

3. **In the Master Plan, evaluate artificial production options with alternate PNI schedules, and variable production levels.** Sponsors evaluate (propose) a single artificial production option that has fixed smolt release schedules (albeit they decrease through time) that would maintain moderately high proportions of hatchery-origin adults both on the natural gravels and in the hatchery. Then the schedule abruptly switches to full natural production. The ISRP suggests one alternative schedule that they believe should be evaluated. Sponsors may think of others, and they should also be presented and evaluated.

   The rationale for considering (evaluating) this option is developed below.

The ISRP can make themselves available for discussions with the proposal sponsors during the Master Plan revision, to clarify our recommendations. Guidance to the sponsor for the revision can be found throughout the ISRP answers to questions from the Council.

ISRP Comments on Step Review Elements

The Council has emphasized that an important part of the Three Step Review Process includes an ISRP review of the sponsor responses to the technical elements listed below. The Council is looking for a full explanation of how the project is consistent with these elements. The Council revised the original review elements, developed in 1997, to better reflect and clearly refer to the 2000 Fish and Wildlife Program (e.g. artificial production and subbasin assessment protocols). The Council specified that the ISRP apply these elements or similar standards as a reflection of the current state of the science. The Step elements are outlined below in Arial font. The ISRP response follows each element in Times New Roman font.

Council Requirement 1

Does the Mid-Columbia Coho Restoration 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 of the Council's 2000FWP:

1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.
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.
8. Ecosystem function, habitat structure and biological performance are affected by human actions.

ISRP Comment: There was not a section that specifically addressed the relationship and consistency of the proposed project to the eight scientific principles. Section 1.4 (page 14) of the Master Plan directs readers to see other portions of the Master Plan for the relationship and consistency with Council principles. The example below is the Master Plan treatment of Principle 1:

> **Principle 1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.**
> See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2, 6.3, 7, Appendix A, B.1, B.2

The other sections provide a variety of text describing aspects of the proposal, but none of them directly addresses the Council requirement. Much of the text in these sections can be open to multiple interpretations. Consequently, what the ISRP might interpret as inconsistent with the principles could be a misinterpretation of the intent of sponsors. Sponsors should provide a succinct paragraph or two summarizing how the proposal is consistent with each of the principles. This will facilitate evaluation by the ISRP and provide a record of the views and understanding of the sponsors about the current state of the science bearing on the proposal.

Below are comments from the ISRP on specific principles that the sponsors should consider in developing the text for this step element.

Principle 1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.

The plan is thorough and well reasoned with regard to freshwater characteristics (spawning and rearing habitat) of the ecosystems for coho salmon. The plan could provide additional attention to other ecosystem elements, specifically problems of the river migration route, estuary, and ocean

phase of their life cycle. The plan should emphasize that coho require proper serial habitats that offer the right resources at the right times all along the way.

Particularly, the plan's section 4.3.6: Why the Program is Expected to Succeed, would be improved by more thorough and accurate review of pertinent literature. In this, and past, reviews the ISRP has been supportive of the effort to attempt to reintroduce coho salmon to tributaries where they have been extirpated. The ISRP also recognizes the important progress that has been made during the feasibility studies. Even with this progress, a completed reintroduction is far from certain. The section's second paragraph begins with: "Previous efforts to transplant salmon populations to new environments show varying outcomes" and goes on to say there are "many examples of unsuccessful attempts." These are understatements. Actually, there have been hundreds if not thousands of attempts to transplant salmon, and, especially where an ocean (saltwater) phase is involved, only a handful resulted in self-reproducing populations that persist. Apparently, among these many tries, no coho transplantation involving a seagoing phase has ever succeeded in establishing a self-sustaining population.

The section states that "a number of successful introductions demonstrate the potential effectiveness of transplanting donor stocks over long distances . . ." and cites four examples. The first example (bulleted item), establishing populations of pink, coho, and Chinook salmon as well as steelhead into the Laurentian Great Lakes, did not involve an ocean phase, therefore, does not apply to the planned project. In the non-stream phase of their life cycles, the Great Lakes transplants do not contend with such vast distances (and perhaps complex current systems) as in the Pacific Ocean (more on this below). They also migrated in relatively short stream systems. (This item also contains a misreading of Quinn [2005]. The only 1956 "plant" of salmon in the Great Lakes was an inadvertent release of pinks from a hatchery. Quinn did not state when the other species were stocked. The steelhead were probably introduced well before 1956. The coho were successfully introduced first in 1965 or so, and the Chinook a few years later.) Other examples of "successful" salmon transplants into freshwater lake environments exist, which the plan does not review - and should not.

The second example of successful transplantation presented in the plan is that of Chinook salmon in rivers of the east side of New Zealand's south island. According to the review by McDowall (1988), this is a special - probably unique - case involving fortunate ocean currents, which bring the adult Chinook within detection range of their home rivers during the period when they need to ascend for spawning. Such ocean currents do not occur off the west coast of that island nor along New Zealand's north island, and few Chinook return from transplants in those places.

The plan would do well to use material from McDowall (1988). With regard to "transportability of anadromy," he emphasizes (p 197) that anadromy probably is "a highly adaptive phenomenon that involves close integration of the species and its life cycle with the environment in which that life cycle takes place." He points out that problems in developing the complete life cycle for such fishes could occur in one or more of the following phases: (1) in fresh water, (2) in migration to the sea, (3) at sea, and (4) in return from the sea to fresh water.

According to McDowall's (1988) review of the literature, providing suitable conditions for the freshwater phase seldom presents difficulties. The same may be true for the downstream migratory phase. He found little information about the sea-growth phase, but with regard to the return migration phase, he offers extensive discussion about apparent inability of transplanted salmon to navigate accurately enough to find their way back to the home river.

In the third example, the Baker Lake sockeye stock transplanted into Lakes Washington and Sammamish, it would be fair to point out that this is famous as a highly exceptional case, and that the transplanted population existed in only minor abundance for about 40 years before it suddenly developed substantial numbers (properly adapted?). The suitability of the transplantation environment may be attributable in part to the possible fact that the place where these fish pass the outer coast and enter the open Pacific Ocean may be the same as that of the parent stock, which departs from Baker Lake. In this respect, the proposed coho project would be similar, but would the timing of smolt entry into the sea be right (see below)?

The plan's fourth example involves Chinook, not coho.

Outside of the Pacific Northwest and the east coast of New Zealand's south island, few ocean currents may exist that favor transplanting Pacific salmon. Moreover, even within the Pacific Northwest, hardly any salmon transplantations have worked. Perhaps poor adaptation of transplanted stocks to new downstream migration distances (and other conditions of the route) puts smolts into the sea at the wrong time to "catch" the sequence of currents that will join them with the right marine food supplies and eventually bring them back within detection range of home streams when they mature. Salmon experts have said in seminar (this could be checked in literature) that upon entering the sea, some stocks of the same species turn left, others turn right, and others swim straight out—or dither around the river mouth. Timing of sea entry may also play a role in subsequent connection of the fish with the right sequence of ocean currents and feeding conditions. Will the project's coho (or enough of them) make the proper turn(s) at the proper time(s)?

The plan should treat the problem of adequate local adaptation of the transplanted salmon stock not just as a matter of stream habitat, but as encompassing the entire geographic route involved in its life cycle—a very extensive "local environment." The plan's literature review and discussion should be expanded to consider this.

Concerning the plans for artificially constructed rearing/acclimation facilities that simulate natural habitat, the statement that "supplemental hatchery food will be provided" raises the issue of potential over-enrichment of those facilities with plant nutrients. The plan should analyze the eutrophication risks for these systems, including the prospect of their becoming choked with submerged and emergent vegetation. Will excessive aquatic plant growths require artificial removal by herbicidal or mechanical means—and at what cost? Will the accumulation of live and decaying-dead plant material, in combination with fish feces, uneaten hatchery feed, and other oxygen-consuming organic matter, result in the summer-kill phenomenon (nighttime decline of dissolved oxygen to fish-killing levels) that typifies over-enriched ponds, lakes, and streams? This prospect is a matter of integral linking of coho rearing to characteristics of their ecosystem, including those characteristics that may be artificially constructed.

Principle 2. Ecosystems are dynamic, resilient and develop over time.

The plan helpfully acknowledges instances of adequate and inadequate "floodplain connectivity." Also implying some thought regarding stream dynamism are references to "channel migration zone." "Channel Migration Zone study" is mentioned for the Wenatchee basin (p 26) and in Table 2.4 for Peshastin Creek (p 61) but with no results described and no literature referenced. The term was also used on p 45 in regard to Peshastin Creek habitat status and on p 50 regarding Lost Creek habitat. These are, however, only brief locational meanings. They do not show consideration of channel migration as a process.

In other regards, as well, the plan usually speaks of stream characteristics in primarily static senses with little or no cognizance of stream processes. The plan does not give enough thought to stream and landscape dynamism, resilience and development. Largely as a result of this, the natural capacities of streams for self-restoration of habitat for coho (and other organisms), once ongoing anthropogenic causes of harm are reduced or halted, do not receive due consideration. The plan needs more attention to broader ecosystem processes, as well. A team of fluvial geomorphologists and landscape ecologists is needed to bolster these aspects of the plan. The plan must analyze and discuss ecosystem processes (including those of the streams themselves) in order to meet Principle 2.

Principle 3. Biological systems operate on various spatial and time scales that can be organized hierarchically.

See comment regarding Principle 2.

Principle 4. Habitats develop, and are maintained, by physical and biological processes.

See comment regarding Principle 2, particularly with regard to considering stream and landscape capacities for natural self-restoration.

Principle 5. Species play key roles in developing and maintaining ecological conditions.

The plan is probably adequate in this respect. The plan focuses on a species, coho salmon, and shows consideration of its roles.

Principle 6. Biological diversity allows ecosystems to persist in the face of environmental variation.

The plan seems adequate in this respect.

Principle 7. Ecological management is adaptive and experimental.

The plan is presented as an experiment, seems well planned in that respect, and discusses various management options that could be undertaken, given different outcomes of the project. However, greater clarity is needed about objectives and potential adaptive management toward them.

In order to undertake rational adaptation of management toward the plan's primary objective -- restoring naturally self-sustaining populations of coho in the designated stream systems -- the wording of the primary objective should be made clearer, as also should subsequent statements concerning it and the possible needs for adaptive management. On p 2, the term "biologically sustainable levels" should be replaced by "levels self-sustained by natural reproduction." (See comments on Biological Objectives under Council Requirement 3.)

Also, on p 2, two statements in the main paragraph are inconsistent. The first statement is "After broodstock development goals are met . . . the natural production phases move towards a locally adapted integrated hatchery program where ultimately the percent of natural-origin fish in the hatchery broodstock will exceed the percent of hatchery-origin fish on the spawning grounds . . .". This is stated again in the first paragraph of p 6.

The second statement: "The coho restoration program is designed to be terminated when a self-sustaining naturally reproducing population is established (natural-origin return escapement of more than 1,500 coho to each subbasin, with a terminal and mainstem harvest in most years)." This is restated elsewhere in the plan, e.g., in Section 4.2.2 in the second bulleted item on p 80.

The first statement implies that the objective (ultimate) is a hatchery program of the "supplementation" type that will be ongoing, whereas, the second statement speaks of terminating the program.

Reaching the stage at which the coho population can sustain itself without inputs from the hatchery (while providing for significant harvest) is the important goal. The two statements should be melded to show a progression through increasing proportions of naturally reproduced fish in the population to a completely self-sustaining population, whereupon the hatchery program will be terminated.

The proposal often refers or alludes to recovery of the coho population as an objective or goal. The population cannot be considered to have undergone recovery until it is fully self-sustaining via natural reproduction and has no further hatchery input.

Also, see last paragraph of comments under Principle 1.

As an extension of feasibility project, the plan recognizes and has taken advantage of a formally monitored learning curve. Monitoring and design included statistical consultation. Use of the Entiat River as a reference stream is commended, but also needs to be examined for similarities and differences, even though there may be no better/appropriate options.

Principle 8. Ecosystem function, habitat structure and biological performance are affected by human actions.

The plan refers, particularly in Section 2.4 (Status of Habitat), to various anthropogenic influences and effects on the streams (occasionally on landscapes) involved in the project. These references are usually rather general. Few data are presented on extent of these influences. Because the most important thrust of habitat restoration should be to reduce or halt present anthropogenic harm, the plan's analyses of such harm should be made more specific in a revision of the Master Plan. In addition, specific steps of strategy and method to deal with anthropogenic harm to the streams and their catchment basins should be set forth.

Also, see last paragraph of comments under Principle 1.

Council Requirement 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.

ISRP Comment: The link between this proposed project and other planning documents and the subbasin plans is well done. The plan takes advantage of groundwork laid within the subbasin plans and their required elements (especially Ecosystem Diagnosis and Treatment (EDT) and Qualitative Habitat Assessment (QHA) [the All-H Analyzer (AHA) was not required as part of subbasin plans]).

If this project is to succeed, it will require the success of various habitat improvement projects and activities in the subbasins. Links to the desired end state condition for the two target subbasins is

buried throughout the document. Based on the adult-to-adult return rate from the feasibility studies, at this time survival is not sufficient to reintroduce and create a self-sustaining natural population.

As the sponsors and other reviews have pointed out, the remedy for this deficiency is improving survival – either through improvement in egg to smolt survival in the tributaries, improving survival through the migration corridor, or reducing harvest of older age class individuals. This project proposes habitat improvements in tributaries to improve the early life-stages. However, the treatment of habitat evaluation by EDT and QHA in section 2.4, and the summary of the Upper Columbia River Salmon Recovery Plan do not explicitly connect the best coho habitat to protect or recovery with the actions proposed in the Upper Columbia Salmon Recovery Plan (UCSRP), and the proposed actions in this proposal. A reader is left with the job of jumping between sections to determine if the primary coho habitat identified by EDT are covered by proposed habitat actions, and are in the vicinity of the proposed release sites, acclimation ponds, etc. A table and narrative text section explicitly establishing these linkages is needed.

Council Requirement 3

Define the biological objectives with measurable attributes that define progress, provide accountability and track changes through time associated with this project.

ISRP Comment: Biological objective 1 and 2 (section 1.2.2 page 7) are not appropriate.

The project's main emphasis, Biological Objective 1, does not embody the follow-through to complete self-sustainability of a naturally reproducing coho population—and resultant termination of the hatchery program—that was implied in Section 1.1.1.

Biological Objective 1: Develop locally adapted, naturally spawning coho stock in the Wenatchee and Methow river subbasins by 2026 is undefined. One could argue that this has already been achieved. No generally agreed on criteria exist for determining that a population has become "locally adapted." Goal 1 of this biological objective – 3 year mean escapement of natural origin returns in the Wenatchee above Tumwater and the Methow river subbasins exceeds 1,500 per subbasin could serve to develop a sufficient Biological Objective.

An appropriate Biological Objective would be "A population of coho salmon self-sustained by natural reproduction with a 3-year mean escapement of 1500…. The critical points here are self-sustained, natural, and 3-year mean escapement. This defines the biological state - self-sustained by natural reproduction, and a quantity (1500 per subbasin) that is unambiguous and can be used to track progress.

On p 2, and elsewhere in the Master Plan the term "biologically sustainable levels" should be replaced by "levels self-sustained by natural reproduction."

The numerical performance standards (1500 per subbasin), while ambitious, are not out of the realm of achievement for the subbasins, given historical run sizes (run sizes tend to be reported in terms of historical highs rather than ranges and the fluctuation of these).

Biological Objective 2. Evaluate the efficacy of coho reintroduction in Mid-Columbia tributaries adds nothing beyond the first Biological Objective. It is simply the monitoring of whether Biological Objective 1 is achieved. Biological Objective 2 could be dropped.

Biological Objective 3. Increase the freshwater productivity of coho salmon in the Wenatchee and Methow subbasins. This Biological Objective is generally OK. Target values for the tributaries (that are in section 5.4) should be incorporated here, so it is explicit which tributaries and what productivity are going to serve as the benchmarks for success and to track progress. Technically, since many of these tributaries do not have natural populations of coho at this time, referring to "increase" the freshwater productivity may not be the best choice of wording. Consider "Achieve freshwater productivity (3 year average) of coho salmon as per Table 2-3 (page 55) in tributaries of the Wenatchee and Methow subbasins."

The evaluation of productivity needs to compare each generation's egg production. It should not be based on males and jacks. A female-to-female measure may, or may not, be entirely satisfactory because of differences in the body size and age distribution of females produced by eggs incubated and reared in artificial culture compared to those from streams. And within the same stream, the body size distribution of females will probably vary from year to year. Hence their total egg complement, may vary somewhat differently than the numbers of females vary. Estimates of each generation's egg production requires estimating the fecundity of females of different sizes and ages, and estimating the distribution of female size and age each generation.

Council Requirement 4

Define expected project benefits (e.g. preservation of biological diversity, fishery enhancement, water optimization, and habitat protection).

ISRP Comment: There is a section on benefits that focuses primarily on ecological conditions that would likely be enhanced by reintroduction of coho to the Mid Columbia. This portion is adequately done. This focus seems at odds with several portions of the Master Plan that emphasize the need to have coho production in the Mid-Columbia to fulfill U.S. v Oregon obligations. The section on benefits mentions little about the harvest expected. The section on AHA later in the plan identifies the number of fish to be harvested, and they appear to be modest. Elsewhere harvest is identified as a benefit…the IEAB report on the value of the coastal coho fishery is cited, and fish from this program are identified as likely to contribute to the fishing economy. Yet, in the harvest section of the M&E plan (Chapter 7), harvest rates outside of the subbasins are hoped to be low, and the program is planning on using tagging methods to avoid these fish be taken by troll commercial or sport anglers outside of the Columbia River. The role of this project in supporting meaningful harvest benefits should be clarified.

Council Requirement 5

Describe the implementation strategies as they relate to the current conditions and restoration potential of the habitat for the target species and the life stage of interest.

ISRP Comment: Sponsors identify that habitat restoration is needed in this project along with fish production. The ISRP concludes that under the current ecological conditions as represented by the egg to smolt, and smolt to adult survival in table 3-2 (page 71), coho reintroduction is unlikely to succeed and result in a population self-sustained by natural reproduction. Habitat improvement is as critical as appropriate use of cultured fish.

The ISRP recommends that as the plan unfolds and is executed, fish stocking should be contingent upon completion of habitat improvements. Section 1.2.3 (Guiding Principles and Mandates) of the Master Plan cites that Council's primary artificial production strategy (2000 Council FWP) states that artificial production can be used to "[complement] habitat improvement by supplementing fish

populations up to the sustainable carrying capacity with fish that are as similar as possible in genetics and behavior to wild native fish." This would imply recovering the ecosystem's habitat for coho before introducing these fish. It would be unwarranted to proceed with fish stocking in the out-years (say 2018 – 2024), if habitat actions have not been implemented by then, or if those actions have not resulted in sufficient recovery of habitat to support the desired coho abundance. The physical and vegetational responses of stream processes to actions intended to restore habitat often do not attain full effect until some years after the actions.

At this time the locations of habitat projects in these two subbasins are not sufficiently integrated with the production activities in this plan, which are quite specific as to which tributaries will be used as conduits for reintroduction. The plan needs much more detail on the habitat restoration. In Table 2-2, references to "conventional techniques and approaches" to be used in "restorable" assessment units (streams or sections of them) is uninformative. In each instance of this, the table should refer to the specific later section of the plan where the techniques and approaches are described for the particular assessment unit.

The "key actions" for the plan's habitat projects are listed in a cursory way in Tables 2-5 and 2-6. The list contains helpful information, obviously based on thorough analysis. The plan would greatly benefit by describing for the listed actions, their rationales, and their intended effects in detail in text, in a revised Master Plan. Discussion of the rationales and intended effects should include explanation of the relationship to stream process and to the habitat-use behavior of coho salmon. Much greater attention to reducing or halting the anthropogenic causes of habitat problems would be advisable.

Section 1.5.13 describes some ancillary activities toward recovering habitat. Much of this is indeed a plan to make a plan (providing a "project development coordinator") and does not commit to (or budget) specific habitat actions - although some degree of commitment can be inferred from the lists in Tables 2-5 and 2-6. Intermixed with this section's words about habitat are references to "coho acclimation" and "kelt reconditioning," which are artificial production procedures, not habitat matters.

Council Requirement 6

Address the relationship to the habitat strategies.

ISRP Comment: The plan contains no mention of "habitat strategy" per se, except in a quote of Council Requirement 6. The plan should set forth its habitat strategies explicitly. Strategies should not be confused with methods or procedures. See previous ISRP/ISAB or Council definitions of what a strategy is - essentially a plan for an integrated system of methods, performed in a specified logical sequence toward achieving a desired outcome. For appropriate flexibility, a strategy would often take the form of a decision tree.

Council Requirement 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.

ISRP Comment: Alternatives were presented. Ultimately, if recolonization is to succeed, issues such as mainstem and subbasin passage, appropriate flows, habitat availability, and so on must be continually and directly addressed.

Council Requirement 8
Provide the historical and current status of anadromous and resident fish and wildlife in the subbasin most relevant to the proposed project.

ISRP Comment: Adequately covered.

Council Requirement 9
Describe current and planned management of anadromous and resident fish and wildlife in the subbasin.

ISRP Comment: Adequately covered.

Council Requirement 10
Demonstrate consistency of the proposed project with NOAA Fisheries recovery plans and other fishery management and watershed plans.

ISRP Comment: Likely adequate. Various salmon recovery plans are mentioned throughout the Master Plan. In this review, the ISRP did not lay the plans out side by side to establish consistency.

Council Requirement 11
Describe the status of the comprehensive environmental assessment.

ISRP Comment: An environmental assessment for the early feasibility study was covered in a previous review, and attached to the Master Plan. It was not re-reviewed in this step 1 review.

Council Requirement 12
Describe the monitoring and evaluation plan.

An issue remaining from the earlier ISRP review and Council decision was for the project sponsors to "Modify monitoring and evaluation procedures to clarify how time-limited objectives will be measured."

ISRP Comment: See comment above under Council Requirement 3. As already noted in previous ISRP review, the criterion of adult-to-adult production should be changed so that it is based on females and egg production. The sponsor should plan on being able to partition production into sex and age classes to confirm that the number of eggs being laid in one generation are being replaced (or exceeded or falling short) in the next.

Greater specific detail on statistical design and field methods for M&E should be shown in the Step 2 document. For example, the procedures and equipment for electrofishing and snorkeling estimates of fish abundance should be described, and, in view of the fact that these measurements have been underway for years, the results to date should be shown and discussed.

The M&E as proposed will cover much of the information needed upon which to make decisions. There is a little bit of the "measure everything" presentation here (which is better than measure nothing or the wrong thing). Perhaps all of the proposed elements are needed, but perhaps not. A more compelling case for including such measured elements would be made by conceptually describing the connectedness of variables and how they contribute to understanding the populations.

For example, survival through each life stage contributes to total productivity and ultimately to population strength. So, if survival and productivity are sufficient at most stages, but fail at a key one, this would inform future management decisions. This may be in the plan, but it was not obvious.

The ISRP provides these additional comments on M&E and the project.

Point 1) 4.3.3 "M&E needed to answer key questions such as when the program in each basin can move into a new phase."

The Mid-Columbia Coho Restoration Master Plan anticipates five phases to reach the point where coho salmon will perhaps be self-sustaining by natural production: two broodstock development phases (I and II, referred to as BDP1 and BDP2), and three natural production phases (an implementation phase followed by support phase 1 and support phase 2). In the plan there are projected timelines for these phases, anticipated smolt release numbers, and projected returns of adult fish of both hatchery-origin adults and naturalized adults. The approach is reasonable, but note the ISRP suggestions for modifying these phases under Council Requirement 14 below.

The ISRP is concerned by the sponsor's statement that the decisions to move from one phase to the next will be decided upon by data collected by the M&E, and this is based largely on the performance of fish released from artificial production. The ISRP acknowledges the statement by the sponsors in section 4.3.3 that if the program is not achieving its projected return numbers they will evaluate the possible reasons why, and modify the program, including transitioning to a harvest augmentation program. The framework of the plan is encouraging, but the repeated reference to options to continue early phases if the returns are not sufficient is counterproductive, in the ISRP's view. The timelines for the phases should be established by the plan, and adhered too. If the returns of hatchery or natural fish do not live up to expectations, the numbers of fish spawned, reared, and released should be adjusted. The time period for the phases should not be extended. The program should move through to the next phase with a reduced stocking level. In Council Requirement 14 we argue that the production should be guided by the numbers of hatchery fish returning to the upstream collection sites in Broodstock Development Phase 2 and the Natural Production Initiation phase, and by PNI in the Natural Production Support phases. The M&E should enumerate fish to establish numbers of fish to be collected for broodstock in the hatchery phase, and escapement to the natural spawning grounds for the natural production phase. Data collected by the monitoring should be used to inform the managers of whether their projected capacity and productivity is realistic. The data from M&E should be used to test hypothesis on capacity and productivity and evaluate EDT and AHA.

Point 2) Page 159. Adult redd counts. Consider coordinating with other survey groups to cover streams not stocked, rather than, or in addition to, radio-tagging. While radio-tagging adults could identify spawning areas not previously identified, it is cost-prohibitive to actually cover a large area using that method. Consider using a probabilistic/randomized sampling scheme to look for redds outside of the traditional spawning reaches.

Point 3) SARs should be estimated separately for jacks and adults. Adult SARs should be partitioned by sex and year of return.

Point 4) 7.1.9. Adult-to-adult ratios should not include males and jacks. See additional description of the appropriate evaluation under Council Requirement 3, Biological Objective 3.

Point 5) 7.1.10. Harvest. Since the fish are going to be tagged in such a way that they will not be identified if they are part of incidental catch or release mortality in the ocean, this becomes the weakest link in understanding why this project will have succeeded or failed. Ocean harvest is planned to be minimal and avoided (so it can't be a benefit – see above), but if it occurs then it will be missed, and "ocean conditions" will tend to be blamed for poor returns—without adequate justification for doing so.

Point 6) 7.3. M&E for adaptation. The crucial data for evaluating adaptation will come from monitoring life-stage survival and abundance. 7.3.1. Life history and morphometrics along with changes in productivity should be sufficient to evaluate adaptation. 7.3.2. No clear need exists to evaluate genotypes at neutral loci. At this time the ISRP considers this the least important of the monitoring. It would not hurt, but there would be no useful interpretation, regardless of whether or not allele frequencies changed. If concerns develop about population bottlenecks, or other specific questions arise that have clear hypothesis that can be addressed with this data, then genotyping fish can be reconsidered. It would be appropriate to collect tissues from representative individuals for DNA extraction and genotyping in the future, should the need arise. 7.3.3. Cryopreservation is not necessary. If the program is not producing enough males for a breeding program, then the sponsors can conclude that reintroduction was unsuccessful.

Point 7) The sponsors adopt the Entiat subbasin as a reference for evaluating the reintroduction on Non Target Taxa. This adoption, along with identifying the Entiat as a subbasin that will not undergo a variety of artificial production initiatives, is acknowledged by the ISRP as a positive development.

Council Requirement 13

Describe and provide specific items and cost estimates for 10 Fiscal Years for planning and design (i.e. conceptual, preliminary and final), construction, operation and maintenance and monitoring and evaluation.

ISRP Comment: Cost estimates are given. We have no basis for judging their adequacy.

Council Requirement 14

Address the relation and link to the Council's artificial production policies and strategies.

ISRP Comment: Sponsors did not explicitly link and discuss their actions and strategies with the Council's artificial production policies. As with the Council Scientific Principles, sponsors should develop text for the Council's artificial production principles (policies).

Some of the comments and approaches in the plan seem at odds with the artificial production principles.

Point 1) Page 81. "The program is designed to be discontinued after 5 generations of supplementation unless it can be clearly demonstrated that continued supplementation is needed to prevent extirpation from once again occurring."

The reintroduction program should be designed with a phase-out timetable. If after this period the population is not self-sustaining, the sponsors should be willing to conclude that reintroduction was not successful.

Point 2) Do not set fixed production releases. This is not consistent with Artificial Production Principles 1, 3, 4, and 5. Rather, set sequential pNOB and pHOS for each generation in each phase, and then let the underlying productivity of the natural subcomponent of the integrated population determine the level of fish production. Consider employing a strategy similar to: during the Broodstock Development Phase 2; 1:1 collections of broodstock at Dryden and Tumwater (lower and upper sites). If this does not produce sufficient broodstock to meet effective population guidelines try two cycles with the fist at 1:1, and the second at 1:2 (lower:upper collection sites). During the Natural Production Initiation Phase (Generation 1) pHOR > 90% / pNOR <1 0%. During the Natural Production Support Phase (Generation 2) pHOR = 75% / pNOR 25%, then (Generation 3) pHOR = 50% / pNOR = 50%, then (Generation 4) pHOR 25% / pNOR 75%, and finally (Generation 5) pHOR = 0.00% / pNOR = 100. These would be the pHOR and pNOR ratios in both the hatchery and on the natural spawning grounds. Run the program using this or similar guidelines, let the numbers of coho salmon spawned for artificial production and numbers released fluctuate based on the NORs returning, and sit back and see what happens. This will provide the selection for adaptation and will provide information on the capacity and productivity of each tributary. If our understanding of the life history is correct, there would be three lines (years) running this protocol.

Point 3) Page 96/97. AHA modeling. Output from the AHA model can be used to generate hypotheses to be tested by the implementation of the program. Also, AHA should help identify critical parameters expected to influence the success of the program, which need to be measured in the M&E component. Because the values used in the AHA model – heritability, and selection pressures, habitat capacity and productivity - are unknown, little predictive value should be attributed to the model results.

Point 4) 5.1.2. Shortfalls - if adult coho salmon returning from the ocean are below expectations, the production levels should be reduced. It is unwise to exchange broodstock between subbasins. If the sources are from sufficiently divergent genetic lineages, or the populations are starting to adapt to the subbasin environmental conditions, mixing/interbreeding will convey an outbreeding cost (lowered fitness).

Point 5) Page 105. Set the broodstock collection at 50:50 above/below Tumwater Dam to “select” for upstream migration. If the numbers of broodstock collected from the lower are greater than the upper sites because adults are not returning to Tumwater and above, it will counteract the adaptation that sponsor wishes to generate by releasing fish in the upper tributaries.

Point 6) Page 108. Coho smolt production and capacity should be viewed as a hypothesis to be tested.

Point 7) 5.17. The rational for the disposition of some of the broodstock is not clear. Specifically, if NORs are 5,000 and HORs are less than or equal to 100, why would 70 HORs be allocated to broodstock and 30 to natural spawning! Why not harvest them and rely 100% on NORs for spawning in both environments. If that outcome were realized, why not declare success and discontinue the hatchery program as unnecessary?

Point 8) Page 130. The explanation of why Dryden Dam site is a good location for holding adults is not clear. This location is downstream from both Tumwater and Icicle Creek.

Council Requirement 15

Provide a completed Hatchery and Genetic Management Plan (HGMP) for the target population(s).

ISRP Comment: A Hatchery and Genetic Management Plan (HGMP) is attached (attachment G) that was originally produced in 1999 and updated in 2002.

To establish a record for the future, and for the benefit of new ISRP members and the public that are just now becoming interested in this coho reintroduction would the sponsors please briefly explain why the lower Columbia River stocks were selected to begin the program. Ultimately, given absence of a remnant native population in either Subbasin, there had to be a decision as to founding source. It seems that a Lower Columbia River Basin source has been used for brood and has been/is being transitioned to more upriver source stock. On the surface, this appears reasonable, but it begs the question as to what is the most appropriate source for brood that are a good match evolutionarily (including genetic relatedness, behaviorally and ecologically similar, etc.) and that can withstand "brood mining." These matters should be discussed.

Council Requirement 16

Describe the harvest plan.

ISRP Comment: A harvest plan is included. At this point in the plan's development, it is very general as to the location of fisheries, their exploitation of the fish produced from this project, and especially how fish caught in the ocean will be estimated. This needs to be further developed in revision. The ISRP understands that the project sponsors will not be monitoring harvest in the lower Columbia/Estuary and ocean. Those monitoring activities are the responsibilities of other management agencies. However, evidence that estimates of harvest are actually going to take place and have reasonable precision should be discussed. Ocean harvest certainly contributed the original extirpation of this stock of coho and could affect the success of establishing a self-sustaining population that can be exploited at the 23% rate proposed in the harvest plan.

Council Requirement 17

Provide a conceptual design of the proposed facilities, including an assessment of the availability and utility of existing facilities.

ISRP Comment: The project proposes a variety of volitional release acclimation ponds. This takes advantage of spatial complexity and variation in behavior (over other point in time and single site forced release).

The ISRP acknowledges that the project sponsors have attempted to develop a program that does not include new major hatchery construction. However, it should be a concern that most of the smolts will be reared for several months at lower Columbia River hatcheries before transfer for acclimation in the subbasins. This is probably the preferred option under the circumstances. The cost to return rates from this practice remains an uncertainty however.

1.4.2 Partial Step 2 Review

From the Mid-Columbia Coho Restoration Master Plan: "*This section discusses where the Master Plan addresses the information needs identified in the Partial Step 2 review. As stated in the July 12, 2002 memorandum: "The results of Phase I will be used to address program areas pertaining to master planning as well as other aspects including National Environmental Policy Act documents. Before initiation of Phase II, this information will be*

used for a Step 2 review." (M. Fritsch, NPPC, memorandum to Council, July 12, 2000). The following four categories of information (in boldface type) were requested for the next Council review of the Mid-Columbia coho project. The location of this information in the Master Plan follows each category (in regular typeface)."

1) Provide a specific statement of goals in terms of numbers of coho adults and/or of smolt to adult return rates that are expected to constitute success in reestablishment or at least to render unnecessary further hatchery plants or supplementation with artificially reared coho.

ISRP Comment: See comment above under Council Requirement 3.

A discussion of the return rates from the feasibility study, and the return rates (egg to smolt, smolt to adult) required for program success is sparse. Sponsors should address this topic more explicitly.

The program they have planned is an excellent framework for reintroducing coho into the Mid-Columbia. However, it still is a very long shot. Success will ultimately depend on ecological conditions that support survival of coho, not long-term releases of cultured fish. It is worth the effort to try the reintroduction. It is important to be transparent about the existing environmental challenges that limit coho distribution and about the low likelihood that the reintroductions will succeed.

2) Modify monitoring and evaluation procedures to clarify how time-limited objectives will be measured.

ISRP Comment: See ISRP comments under Council Requirement 12 above.

3) Discuss the possibility that further facilities may not be needed and the conditions that would enter into making that decision.

ISRP Comment: The sponsors appear to have made a concerted effort to avoid new construction. See comment under Council Requirement 17 above.

4) Respond to the general and specific comments relating to:
• harvest rates as limiting factors

ISRP Comment: See ISRP comments under Council Requirement 14 above.

• the monitoring and evaluation plan

ISRP Comment: See ISRP comments under Council Requirement 3 and 12 above.

• issues (i.e. ecological interactions, quality of rearing habitat and case studies of successes in similar endeavors).

ISRP Comment: Chapter 3. Summary of feasibility study results and resolution of critical uncertainties is not well prepared and editing this chapter would improve the Master Plan appreciably. The summary of the fish culture activity that served as the feasibility study is not presented in sufficient detail. Most of the information is in table 3-1. What is needed is an accounting of how many eggs were transferred from lower river hatcheries to which Methow or

Wenatchee hatchery, how many smolts were released, how they were tagged, and where smolts and adults were encountered from these releases. In chapter 3.1.2, a table summarizing the location of spawning redds in the Wenatchee is provided. Unfortunately, it is difficult to interpret the table without knowing the sites and numbers of smolts released. Do the large number of fish returning to Icicle Creek reflect releases there, or is there another explanation? Is the Wenatchee River above or below Tumwater Dam? A map of the distribution of spawners would help.

Additional ISRP Comments

The following are general and specific comments that did not fit into the template framework. The first paragraph or so arose during review of the plan's text under its heading for Principle 1, but it may be of broader applicability than to any one category.

1.1 Purpose of this Plan

p 6, paragraph 3—"We believe the proposed mid-Columbia coho reintroduction plan presents a unique opportunity to test some of the assumptions of the AHA model, as they pertain to domestication and local adaptation, in the absence of genetic risk to a native coho population." The ISRP should examine whether this test is properly designed.

1.1.4 Habitat Degradation (p 6)—This section should refer by project number to the projects under which the pertinent habitat work is being (or to be) done.

2.2 Status of Coho (*Oncorhynchus kisutch*) in the Subbasins

p 36, top—"Spawning ground surveys are used to enumerate the numbers and distribution of naturally spawning coho in the Methow Subbasin." What are the results?

p 36, section on "Productivity"—The sponsor's concept of productivity is not defined. It seems muddled—partly synonymous with abundance (covered in the immediately preceding section) and partly synonymous with habitat conditions. Essentially, the subject of this section seems to be suitability of habitat for supporting natural production of coho. Changing the heading to that would help make the section more useful. It would help also for the sponsor to define the section's terms "habitat diversity" and "development." The latter is a particularly ambiguous term. What constitutes "habitat diversity," and what are the aspects of it that promote coho production? Which of these are degraded or missing? What might be done about the deficiencies? What are the various kinds of "development" that the sponsor refers to, and how does each of them affect coho habitat and production? By properly dealing with the most destructive forms of "development," the project would reduce human causes of damage rather than fall into the short-term-activity-trap of just treating symptoms.

2.4.1 Habitat Descriptions from Subbasin Plans

This section contains a better description of habitat problems. There are some aspects to clarify.

p 44, section on Lower Wenatchee River—More information on "channel confinement" is needed. All channels are confined. Do the sponsors mean diking or something else?

p 45—Vague descriptions. “Mission Creek is considered the most polluted water body in the Wenatchee River subbasin. Cumulative disruption of both stream channel and upland habitat throughout the watershed, except in the Devils Gulch reach of Mission Creek, has resulted in a declining population of salmonids . . .” What is (are) the source(s) of pollution? What is “cumulative disruption”? Please explain and discuss.

4.3.5 Contingency Plans and Decision Processes

p 98—“iv. Supplementation may be required in some years, and local adaptation could be protected by releasing moderate numbers of coho smolts to hedge against catastrophic events. All populations have lows and highs. In the low years, supplementation might be needed as an insurance policy against a second extirpation. Alternatively, a small supplementation program may be needed at the end of the proposed 20-year program (5 generations after beginning the NP phases). For example, 150,000 coho smolts could be produced at LNFH for a number of years (maybe 10) until we are sure the naturally spawning populations can survive for the long term. In both cases, the fish would come from the naturally spawning population, and in both cases, the program could be funded under the PUDs’ compensation program, not by BPA.” Is such “supplementation” really warranted? Would it be consistent with the overall experiment? Might it disrupt natural production?

4.3.6 Why the Program is Expected to Succeed

p 100, second bullet—“Improved fish culture techniques (rearing at low densities, acclimation in natural conditions, improved feed, following natural growth profiles) have been shown to increase adult return rates and provide a higher likelihood that enough adults will return to satisfy local broodstock development needs.” Literature references and discussion of the evidence therein is needed here.

p 100—“Evidence that this approach is working comes from data collected during the feasibility phases of the mid-Columbia and Yakima River coho reintroduction programs. An important measure of the effect of local adaptation is smolt-to-adult return rate. The results presented in Section 3.1 show that this rate is increasing rapidly for all coho programs above McNary Dam (mid-Columbia, Umatilla River and Yakima River) after implementation of the fish culture techniques described above.” Does this assertion account for improved ocean conditions?

ISRP Response to Sponsor's Fix-it-Loop for the FY 07-09 Solicitation

Recommendation: Fundable (Qualified) with the qualification being that the sponsors revise the Master Plan before proceeding to Step Two, and that they fully address the ISRP concerns about clearly establishing unambiguous biological objectives.

Comments: The sponsors sufficiently respond to the queries posed in the ISRP's preliminary review of the project. Most of the questions are dealt with in greater detail in the ISRP Step One review, above. For completeness brief ISRP responses to this follow-up are provided here.

The sponsors responded to the ISRP recommendation for Fundable-in-part, for completing the Three Step Process, by identifying that funding for 07-09 was for continued feasibility level fish culture operations and completing the Three Step Process. No funds for construction or expanded fish culture operations are in the FY 07-09 budget. The ISRP thanks the sponsors for this clarification. The final funding level is a matter for Council and BPA, but the ISRP notes that the Fundable-in-part recommendation in fact includes all the activities that they are requesting support for.

The ISRP recommended in the preliminary proposal review and in the Master Plan Step One review that the sponsors alter the primary biological objective from "biologically sustainable" to "naturally self-sustaining population." Sponsors provide an adequate summary of the history of the development of the primary objective and use of the term "biologically sustainable." They provide their rationale for using the term:

> *"Our use of "biologically sustainable" does not make any assumptions about whether future hatchery supplementation will be required. Very early versions of the Master Plan included the term "self-sustaining" in the vision statement. The term was eliminated after much consideration by the Mid-Columbia Coho Technical Work Group because no other species of anadromous salmonid within the upper Columbia currently is self-sustaining. All other species of salmon and steelhead receive supplementation of some kind. Inclusion of the term "self-sustaining" may unintentionally predispose the project for failure in terms of whether or not a realistic vision is achieved."*

This rationale is exactly the reason the ISRP continues to recommend changing "biologically sustainable" to "self-sustaining by natural reproduction." The ISRP recognized that biologically sustainable could be interpreted to mean supported indefinitely by hatchery-origin adults. In the present case, however, the project proponents have clearly designed a program that implies it is going to proceed to entirely natural production. It is the hedges that appear occasionally in the Master Plan and in this reply that back away from the schedule to attain self-sustaining status that is of concern to the ISRP. It is worth attempting to reintroduce coho and achieve self-sustaining status. If that is the goal, a production and habitat restoration plan needs to be designed to accomplish that task. If it does not work, then the program can be altered at the end of the experimental phase. This might be a harvest augmentation program, as the sponsors identify in the Master Plan, or it might be some other integrated hatchery program.

The ISRP emphasizes that integrated hatchery programs that include a goal of keeping the artificial and natural components genetically similar, and adapted to the natural environment, require the natural population to be self-sustaining, require the proportion of natural-origin adults in the hatchery broodstock to exceed the proportion of hatchery-origin adults in the wild. Finally, the total

number of salmon used for broodstock (NOR plus HOR) cannot exceed the natural-origin escapement that spawns in streams.

In response to the ISRP comment that the project was ambitious and it did not appear that the sponsors had given themselves much time to address unanticipated challenges, the sponsors provided a verbatim copy of section 4.3.5 Contingency Plans and Decision Processes from the Master Plan. The ISRP acknowledges this contingency plan. In the ISRP Step One review we do not explicitly address the contingency plan but do suggest when addressing the consistency of the Master Plan with Council's artificial production principles, that the ISRP recommends adhering to a rigid schedule of transition through the broodstock development and natural production phases of the reintroduction. The contingency plan is appropriate in that it poses questions of whether the difficulties encountered can be surmounted, but it is of concern to the ISRP that it extends the phases or exits to a harvest augmentation program fairly early in the reintroduction effort if not successful at achieving that stage's goals. In our more lengthy step review we recommend establishing a schedule of pNOR, and pHORs in the hatchery and natural rearing sub-components, and following it strictly through the generations of this experimental reintroduction. If the reintroduction is ultimately determined to be infeasible, options for a harvest augmentation program, whether integrated or segregated will not be lost.

If this reintroduction experiment focuses on release numbers and relaxes the fish culture practices to maintain high production, then the reintroduction itself could be compromised. The broodstock management protocol for the pHOR and pNOR in artificial culture and in the streams will provide the "selection" that will lead to the hoped for adaptation of the lower river stock to the mid-Columiba tributaries. In the broodstock development phase 2 releasing fish in upper areas of the watershed and then use of the returns of these fish for broodstock is suppose to provide the opportunity to select parents that have exhibited the stamina and other behaviors to migrate to the release sites. If these fish are spawned with individuals from families that have not exhibited those capabilities, and these fish predominate in the pool of parents, you could actually be selecting against the genotypes that you hope to increase in proportion in the population. The same rationale holds for the natural production initiation and support phases.

The sponsors indicate that they will use standard metrics to evaluate the productivity of their program. The ISRP recommended that adult replacement rate would be based on female to female and certainly not include jacks. The ISRP points out that even the female-to-female replacement rate may not be sufficient under all circumstances, if the age structure of the female offspring differ across generations or between eggs incubated in the streams versus those incubated and then reared in a hatchery. Under these circumstances the appropriate measure would be each generation's egg production. This requires estimating the fecundity of females of different sizes and ages each generation, and estimating the proportions of females in body size (and age) categories. The data to estimate the egg production should be available since fish will be collected for hatchery spawning and fish released for natural spawning will be enumerated at weirs. The sponsors indicate that the data that is collected is sufficient to calculate the female-to-female or egg-to-egg metric. The ISRP is satisfied that these metrics can be evaluated.

Finally, the sponsors clarify the plan to construct acclimation ponds. In general the ISRP was encouraged that expanding hatchery facilities within the subbasins to produce smolts was not necessary. The ISRP thanks the sponsors for clarifying the construction schedule. The ISRP remains concerned about the environmental conditions that may develop from feed and feces that could accumulate in semi-natural acclimation ponds that are not as easily cleaned as traditional

raceways. Additional discussion of the specifics of this type of fish culture issue would improve the Master Plan.

The ISRP encourages keeping program termination as one decision option, including demolition of acclimation ponds at the end of the experiment, even though we realize that public pressure tends to prevent decommissioning hatchery facilities.

Once the program establishes a coho population sustained by natural reproduction, the sponsors propose retaining an option of employing supplementation in years of low swings in salmon abundance: "*supplementation might be needed as an insurance policy against a second extirpation.*" In practice, this seems impractical and unlikely to the ISRP. How would managers be able to predict each low year far enough in advance to get the hatchery system to ramp up production for it? Will significantly "supplementing" a severely reduced population with less fit hatchery-produced fish inordinately risk damaging the well-adapted gene pool of the self-reproducing population? Natural fluctuation in salmon abundance tends to be inconvenient for humans, but it has ecological benefits. For example, occasional lows may reduce competition (e.g., of residualized smolts) with overlapping generations of offspring, may allow recovery of populations of food organisms, and may prevent inordinate proliferation of predators that may depend on the fish species as a food source.

The response brings in the aspect of "carrying capacity" confusingly and probably unnecessarily. It sounds almost as if the sponsor thinks that trying to achieve a self-sustaining coho population might mean that the fish should persist at some "carrying capacity" level of abundance, but that the population will violate this concept by fluctuating. Involved also may be the common misconception that a population's fluctuation in abundance closely represents a fluctuation (which may indeed exist) of a stream system's carrying capacity for that organism. It may really be influences other than stream carrying capacity that enter into the population's variation in abundance. It may be more nearly the case that populations of stream-dependent organisms fluctuate with relatively high amplitude about a stream carrying capacity, which varies with less amplitude. In other words, populations may occasionally overshoot carrying capacity for a short time and due to "external" factors may often decline below it. The plan might benefit by omitting mention of carrying capacity unless the sponsor discusses the interactions of habitat, nutrient supply, competitor organisms, predator organisms, etc. that are involved in setting the carrying capacity.

References

McDowall, R. M. 1988. Diadromy in fishes: migrations between freshwater and marine environments. Timber Press, Portland, Or.

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. American Fisheries Society, Bethesda.