



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

Memorandum (ISRP 2009-33)

July 27, 2009

To: Tony Grover, Director, Fish and Wildlife Division

From: Eric Loudenslager, ISRP Chair

Subject: Response Request for Accord Proposal, Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators (2009-004-00)

Background

At the Council's June 26, 2009 request, the ISRP reviewed the Columbia River Inter-Tribal Fish Commission's Accord proposal titled Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators (2009-004-00).

Recommendation

Meets Scientific Review Criteria (In Part)

- Objective 1, tasks 1.1 through 1.4 including the scoping, coordination, and planning tasks meet scientific review criteria
- Objective 1, task 1.5 and Objectives 2 through 5 do not meet scientific review criteria based on the information provided in the proposal – response requested

The ISRP requests a response to a number of questions regarding the methods used to measure habitat variables. We also request a more thorough explanation of how this study will associate improvements in habitat facilitated by restoration projects to improvements in the survival and production of various phases of spring Chinook life cycles in the upper Grande Ronde. Many of these questions are stated in 2. *Objectives, Work Elements, and Methods*, summarized below. The study objectives and methods are ambitious, and the ISRP requests answers to our questions so we can be confident that this important project will succeed.

Additional scoping planning is necessary to guide the selection of particular variables to be measured, sampling design, field installations, equipment to be purchased, and where and when it will be installed. The ISRP does not see how it can be determined what equipment should be bought without this additional scoping and planning. Equipment should not be purchased under one objective when under the same objective funding is requested for "planning to plan" on how much equipment will be eventually needed. Based on this rationale, and given that most of the planning and critical literature review has not been done, only those aspects of the objectives

involving actual scoping (i.e., “planning to plan”), planning, coordination, and literature review seem appropriate at this time. Following this scoping/planning phase when the project design has been more thoroughly formulated, the appropriate needs for equipment and facilities could then be identified and requested. Tasks 1.1 through 1.4 are thus appropriate and meet scientific criteria. Tasks 1.5 and the other Objectives (2-5) do not (yet) meet scientific criteria. A clearly articulated basis should be described for the necessary work elements under those objectives.

Overall Comments

The ISRP has stressed the importance of biological effectiveness monitoring and model verification. This proposal addresses both of these issues. Additionally, it focuses on a subbasin (Grande Ronde River) and major population group of spring Chinook that deserve attention. Because this project is both complex and ambitious, care should be taken not to over-promise what can be realistically delivered. There are limitations in how effectively some proposed variables can be measured, and how detailed measurements, such as sieving sediment, will be a step forward over simpler methods. Will the additional time and expense translate into useable information beyond what can be learned with simpler studies?

Both the modeling and limiting factor aspects of the study are worthwhile. With thoughtful planning and analysis during the initial scoping year, this project will likely benefit our understanding of factors limiting spring Chinook and possibly provide a more streamlined habitat assessment protocol. The goal of developing a robust model to project population sizes or population size changes based on water temperature, fine sediment, stream flow, and riparian condition, or their changes, is worthy. If successful it will provide an important planning tool in developing future habitat restoration projects.

Specific Comments

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

There is a clear need for effective quantification of habitat and a better understanding of how habitat can be improved to increase salmon production. The proposal describes an attempt to understand, quantify, model, and predict effects of habitat conditions and changes in habitat on the fish stock(s) from both top down and bottom up perspectives at the same time. This is an ambitious goal, especially the prediction aspect of the proposed study.

One focus of the proposal is on the development of a habitat-fish population modeling protocol that could be extrapolated to other watersheds and subbasins in the mid and upper Columbia. The project proponents state on page 12 of the proposal:

“The overall objective of this proposal is to develop a spatially-based system for modeling abundance, productivity, and growth rate for spring Chinook. The initial model will be a simple one based on water temperature, fine sediment (surface and depth), streamflow, and riparian condition in an attempt to create a robust alternative to EDT.”

Another focus of the proposal is a program of work for an intensively monitored watershed (IMW) analysis of the cumulative effects of multiple types of restoration on habitat condition and spring Chinook salmon in two medium sized watersheds in a single subbasin. The proponents note that there are differences in methods among ISEMP studies for habitat quality analysis and the implications of these differences to survival need to be more thoroughly evaluated.

The Upper Grande Ronde and Catherine Creek have been chosen as the basic study sites because of their current degraded condition and the importance of their restoration to the long term health of the spring Chinook population. The habitat enhancements that are expected to occur there over the next decade provide a natural experiment where habitat improvements may be tied to population changes. This project represents a departure from the build-from-strength philosophy often espoused in the region. However, the importance of restoring these basins is very high due to the interest in restoring key populations essential to the major population group.

The proposal appears to have components of three types of studies: fundamental ecological processes, modeling, and landscape ecology, all at the same time. This leads to some confusion in the data needs described in Appendix B (modeling) and the ambitious habitat sampling program described in appendices A1 and A2. For example, the modeling appendix described using pool frequency to characterize improvements in life-stage survival, yet pool frequency was not one of the assumed primary limiting factors in Appendix A1 or in the general project description. Using one of the major putative limiting factors of temperature, fine sediment, or flow would have made the Appendix A2 example more appropriate and relevant to the project's objectives. It was therefore difficult at times to understand what the overall goals of this project were. Is habitat/fish life cycle model development the primary goal, or is it to develop a better specific understanding of the effects of a suite of restoration actions on spring Chinook in the upper Grande Ronde?

Another inconsistency between the description of the population monitoring in Appendix B and the habitat assessment presented in Appendices A and C was the stratification of stream reaches. The description of the population modeling indicated that stream reaches would be stratified by land use. Habitat conditions for unsampled reaches would be assumed to be the same as those at the measured stream reaches in the same land use class. In contrast, Appendix C indicates that the reach-level stratification that will be used to extrapolate habitat condition to unsampled reaches will be based on physical characteristics of the channel and its valley, including channel size, gradient, and confinement. It is likely that both physical setting and land use will influence habitat. But assuming which stratification approach is best prior to collecting the data seems premature. The data collected in this study would enable a very thorough exploration of the relationships between landscape features and channel habitat conditions. These empirical relationships could then be used to predict habitat conditions at sites without data. It also was not clear how land will be associated with a stream segment. Will only the land use immediately adjacent to the channel segment be considered? What about land use upstream from the segment? This would seem to be especially important for attributes like sediment or temperature where the effects at one location can readily be transported downstream.

More importantly, while the proposal does a very thorough job of describing the approach that will be used to link various aspects of habitat condition to Chinook demographic response, it leaves many questions unanswered about how the relationship between habitat restoration and in-stream condition will be measured, and over what time frame. For example, will it be assumed

in the modeling exercises that stream habitat will respond immediately to restoration? This may be the case for some actions such as water rights transfers, tributary reconnection, or pushup dam removal but other actions such as riparian re-vegetation will show a delayed response. It is unclear how this delay would be factored into the models. The extent of these time lags can be influenced by quite subtle elements of spatial structure of the watershed and the population. These time lags may make it very difficult to tie specific improvement projects to particular population changes. It may also mean that the desired population changes may not occur within the time constraints of this project.

Other concerns:

1. Is there any way within the study design to determine which restoration efforts are most effective in achieving their habitat goals? Additionally, the proposal skirts the issue of natural disturbances and how their effects would impact study design. As an example, how would the impact of a severe wildfire be partitioned from changes related to restoration actions?
2. It is not clear that the proposed time schedule is realistic to develop a robust model. Normal temporal variation in environmental conditions could well obscure the response of the populations to habitat changes.
3. It is likely that the basic habitat characteristics of water temperature, fine sediment, stream flow, and riparian condition have a nonlinear impact on the spring Chinook population. For example, water temperature often has a nonlinear effect, as well as a threshold effect at the upper end of its range. This is also true for stream flow though this problem is substantially reduced by breaking the population model for the first year into several subclasses as the authors have proposed. How will nonlinear effects be incorporated?
4. There are implicit assumptions in the proposal that the proponents can select the most meaningful habitat attributes from a few key limiting factors, measure them accurately and precisely, and translate results via the model to an improved understanding of fish/habitat relationships locally and basinwide. Is there evidence in the literature to support these assumptions? The proponents need to review and evaluate the successes and failures in other studies and clearly identify what aspects of their particular study will allow them to succeed where others have not.
5. The use of the fine-scale relationships to construct the models and their expansion to mid-level and basinwide estimates could lead to a potential for propagation of error. That is, fairly narrow confidence intervals at the fine scale can lead to fairly wide confidence intervals at the mid-scale and to very wide confidence intervals at the large scale. How this issue will be dealt with needs to be addressed more effectively. An appropriate place to consider the effects of propagation of error would be Figure 2, where there is measurement error associated with each of the boxes depicted.
6. The proposal related the work to some existing restoration efforts elsewhere in the Grande Ronde and John Day Rivers. The proponents also connected this work to the Landscape Genetics project and the Climate Change project, both associated CRITFC Accord projects. However, there was not an adequate evaluation of how the results of those studies, some of which are in the Grande Ronde Basin, can and should be used in this proposed study. In addition, Van Dyke's (2009) field study in the Grande Ronde basin (conducted by ODFW), which involved very similar issues as this proposed study, albeit for one aspect of Chinook salmon's life history, was not included.

Apart from these concerns the ISRP agrees there is a strong need to relate biological response to restoration work, and the Grande Ronde subbasin has been identified as a place where such research is especially needed. The project is important not only to the Upper Grande Ronde and Catherine Creek but also to larger Columbia River Basin. Having a robust model based on water temperature, fine sediment, stream flow, and riparian condition, would provide an important planning tool in developing future habitat restoration projects.

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

The proposal included the main project narrative and three separate appendices – habitat, modeling, and experimental design. Some details were presented in Section F of the narrative, but many others were presented in the appendices.

The project is based on the concept that it is feasible to construct a habitat database using fewer variables than typically used in EDT analyses. Furthermore, a spatially extensive stream monitoring program, aimed at key limiting factors, can be used to estimate the effect of current and future habitat condition on salmon productivity. This proposal emphasizes applying more spatially and temporally extensive analysis of water temperature distribution to predict potential survival.

Project Organization and Timelines

Many questions remain unanswered regarding objectives and hypotheses and the appropriateness of the proposed sequence of tasks. The proposal calls for an initial year “*to develop and test sampling procedures, develop a long-term coordination plan and design successive phases,*” followed by a five-year period “*to implement full sampling in two damaged watersheds supporting key TRT Chinook populations; continue development of sampling procedures and protocols; develop a set of models representing the relationship between watershed conditions and fish responses at the individual and population scales,*” succeeded by a second five-year period that would entail “*continuation of lower intensity monitoring of trends in the two initial study areas and implementation of monitoring in a second set of streams to represent contrasting intensities of disturbance and development of additional models representing habitat/fish interactions for all life stages.*”

Given the breadth of the environmental and fish population parameters included in the plan, the ISRP believes that the initial year’s development and testing phase represents the absolute minimum time period that will be needed to arrive at a final set of variables to be measured. We believe that many of the habitat variables could be labor-intensive to inventory, depending on the final number of sampling sites selected for study. Some candidate elements of the study plan, such as food availability estimates, will be very expensive and time-consuming to process. We do not wish to discourage the project proponents from exploring these options but rather caution them that significant sampling questions may still remain after the initial scoping year.

It was not clear in the proposal why a five-year evaluation period was selected for habitat analysis, Chinook population analysis, and model development in the upper Grande Ronde River and Catherine Creek. The ISRP needs information concerning why five years are believed to be sufficient: (1) to detect the life cycle-specific impacts of changes in temperature, fine sediment, and streamflow on overall demographic response; (2) to demonstrate the relationship between

restoration projects and habitat improvement or continued degradation; and (3) to test the hypothesis that temperature, fine sediment, and limited streamflow are the principal limiting factors for spring Chinook in this subbasin.

The timeframe is especially short if a BACI design at multiple spatial scales is to be employed for the study. A BACI design requires the collection of pre-treatment data that ideally consists of three or more years for the fish data. Were this to occur, followed by treatment application in year four, post-treatment data collection would be limited to a single year.

The relatively short timeframe of the study also will make it difficult to address interannual variations in climate. Large storms or droughts can impact the relationship between habitat condition and survival. The BACI design, preferred in this study, does help to address this problem assuming that a reference watershed is established (see comment below). But these factors can cause large variations in survival making it difficult to accurately determine the relationship between habitat conditions and population performance. Ideally, this problem could be resolved by an understanding of how habitat conditions affect salmon under various climate regimes but developing this information would be a long-term effort.

Reference/treatment pairs are required to interpret fish response at all spatial scales that will be investigated in this study. However, the proposal indicates that there will be no reference or control at the watershed scale. Appendix A lists restoration actions will be occurring during the study period in both the Upper Grande Ronde and Catherine Creek. As a result, it will be very difficult, or impossible, to evaluate the impact that multiple restoration actions within the watershed will have on egg-smolt survival and watershed-scale carrying capacity. To have a reference site at the watershed scale demands that restoration activities be suspended in one watershed for the duration of the study.

The ISRP agrees with project proponents that coordination between cooperating organizations, accompanied by a review of the scientific literature in the first year, is a worthwhile effort to enhance the likelihood of project success.

Data Collection

There are a number of aspects of data collection that need clarification. The ISRP notes that some of the work elements such as 1-m resolution LiDAR including vegetation interpretation and Forward-Looking Infrared (FLiR) analysis of streams in the study sites are likely to be quite costly. Have qualified subcontractors been selected to do the work? Likewise, the fish tracking research involving PIT-tagged individuals will involve fairly large numbers of marked fish including small fish that are carrying dye markers and both the tagging and mark census efforts will be time consuming and expensive. Application of restoration treatments also will present a challenge. In order to alter habitat condition sufficiently to cause a detectable fish population response, multiple treatments will be required, applied over a very short period of time as noted in the discussion of the project timeline above. Application of these treatments will be very expensive and require a huge amount of planning and coordination. This problem was not addressed in the proposal. Sample size determination, based on the targeted CV and signal to noise ratio, provided on page 27, is not adequately justified.

The study will focus on a few limiting factors that are assumed to constrain Chinook salmon production at the study sites. The reduction in assessed habitat factors to those few considered to

be critical is an improvement over the approach used in EDT. But it also is important to include measures in the study to determine if key limiting factors have been omitted. Perhaps some exploratory sampling or small-scale experiments could be incorporated into the study to ensure that potential issues, like chemical contamination, are not preventing responses to the improvement in other habitat factors.

a. Water temperature

Locations of stream temperature monitoring sites are shown in Figure 3 of Appendix A1; however, it was not clear how these locations related to the locations of habitat restoration projects. Will the recording thermographs be able to detect the signature of habitat improvement efforts?

b. Habitat restoration treatments

Tables 1-4 in Appendix A1 give lists of restoration priorities and specific habitat improvement actions for the *entire* Grande Ronde subbasin, but they do not highlight the projects that will take place within the proposed study areas of Catherine Creek and the upper Grande Ronde River. Where are the existing restoration projects located within the study areas? Will they affect enough length of the streams to have a reasonable chance of being measured in terms of fish response?

c. Fine sediment

It would helpful to give some indication of how ambitious the fine sediment sampling regime would be. Sieving many samples and weighing the fractions takes considerable time. Do the proponents have the facilities and staff to carry out the sediment sampling program? Approximately how many samples will be taken during the initial scoping year? If a comprehensive sampling program cannot be implemented, how will subsequent sampling be stratified to reduce costs but still achieve project objectives?

d. Streamflow

It was unclear how many stream gauging sites will be installed in this study or if the project will simply make use of existing gauging stations and attempt to draw discharge inferences from correlations between study sites and locations with gauged flow. In addition, the methods used to relate flow improvements in reaches receiving restoration treatments were not described in adequate detail.

e. Channel parameters

There did not appear to be any surveys of habitat unit (riffle and pool) frequency. How will cross-sectional data be translated into habitat parameters that can be related in a quantitative way to spring Chinook abundance or survival?

f. Vegetation (including in-stream large wood)

How will riparian vegetation surveys be related quantitatively or qualitatively to fish habitat quality and productivity? Appendix A2, beginning on page 6, describes the process, but what

will be done to verify the assumptions given in Appendix A2, Table 4 and Table 5, about habitat composition and Chinook abundance? The Bjorn data are a good starting point, but additional field verification is needed.

g. Anthropogenic impacts

Spatially referenced maps of grazing pressure, as outlined in Appendix A1, should be very helpful. A simple correlation approach between road density and sediment and temperature levels may be fine for routine watershed assessments, but for this project a better understanding of the mechanisms driving habitat changes is needed. This may be accomplished by an inventory of road crossings, direct-entry culverts, length of stream channel directly impacted by road-related riparian shade removal, and other more causative metrics.

h. Biota

Estimating food availability to drift-feeding fishes is one of the most difficult measurements in aquatic ecology. Considerable resources can be expended with few conclusive results to show for the effort. An invertebrate sampling program, if implemented, should be carefully reviewed by an aquatic entomologist. Care should be taken to estimate the contribution of terrestrial invertebrates as well as aquatic invertebrates to Chinook diets.

There appear to be some inconsistencies between the proposal and Appendix A in the approach that will be used to evaluate food availability for Chinook salmon. The proposal document indicates that the macroinvertebrate community will be evaluated with one of the widely used indices of community integrity. Available indices are mostly focused on water quality and these may not provide a reliable indication of invertebrates that are of greatest significance to juvenile Chinook. The methods described in Appendix A are more compatible with the objectives of the study in that they will provide an indication of macroinvertebrate density in the drift, a parameter more indicative of the food resource for the fish. It might also be worthwhile to compare the composition of the drift with Chinook dietary preferences derived from literature information, possibly augmented with evaluation of gut contents at the study sites.

i. Fish populations

Some of the details regarding life cycle-specific survival determinations seem to be missing. For example, how will intragravel egg-to-fry survival be measured? Will redd capping, as recommended by Chapman and McLeod be used? Because of the ESA status of spring Chinook in this subbasin, will it be possible to get a permit to handle enough fish for PIT-tagging, electrofishing, stomach pumping, blood withdrawals, and other activities to achieve sufficient sample sizes for the study? The PIT-tag antenna array is a good idea and should provide useful information, by tracking movements of individuals, on whether spring Chinook in the upper Grande Ronde all conform to a single life cycle strategy.

Appendix B indicates that carrying capacity of various stream reaches will be determined empirically. It would seem that an empirical estimate of capacity would require fully-seeded conditions, which seems unlikely to be achieved at very many of the study sites given the current abundance of spring Chinook salmon in the watershed. The authors indicate that they will use a sensitivity analysis to account for underseeding in estimating carrying capacity, but the proposal

does not explain how this approach would enable carrying capacity of a stream segment to be estimated.

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

It is not clear why representative reaches were selected by channel gradient, watershed area class, and valley width class, as opposed to the more commonly-used stream segment classification system of Montgomery and Buffington, with reaches selected from a “rotating panel” EMAP-type design. However, if site access in the area is as difficult as the proposal suggests, perhaps selection of study reaches will be dictated more by land ownership than by valley and channel morphology. The ISRP agrees this is not an easy task.

It appears, at least initially, that many of the modeled outcomes will be based on information from the scientific literature. For example as stated in Appendix C, page 1, “the potential impact of summer water temperature regimes on summer rearing survival will be assessed from available literature”. While such assumptions form the basis for testable hypotheses, the most critical assumptions will need to be field validated at some point. The proposal acknowledges this problem but does not explain how the study will separate temperature effects from the effects of other environmental factors. With regard to sediment monitoring, Appendix C does not explain how surface fines can be substituted for sub-surface fines in the context of inferring quantitative impacts on Chinook egg survival. Appendix C provides few details on the habitat monitoring and evaluation design.

Appendix B provides many modeling details taken directly from Sharma (2005) without clearly demonstrating how that reference will be applied to this project. Some questionable statistical approaches are included such as using a dummy variable regression approach in place of paired and unpaired t-tests and claiming that the finite population correction can be ignored when sample size increases sufficiently. A reference to Scheuerell et al. (2006) that describes the Shiraz model is included, but this model is not explicitly discussed in the proposal. More details concerning the application of the Shiraz model should be presented.

References:

Van Dyke, E., D. L. Scarnecchia, B. C. Jonasson and R. W. Carmichael. 2009. Relationship of winter concealment habitat quality on pool use by juvenile spring Chinook salmon (*Oncorhynchus tshawytscha*) in the Grande Ronde River Basin, Oregon. *Hydrobiologia* 625:27-42.