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 2010-24) **July 9, 2010**

To: Bruce Measure, Chair, Northwest Power and Conservation Council

From: Eric Loudenslager, ISRP Chair

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

Background

This is a final review of 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). On July 27, 2009, the ISRP reviewed an initial proposal and found that it met scientific review criteria (in part) (ISRP 2009-33).

Specifically, we recommended:

- 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 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, we recommended that care should be taken not to over-promise what can be realistically delivered. We requested a response to a number of questions regarding the methods used to measure habitat variables. We also requested 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.

On May 21, the Council forwarded CRITFC's response to us and requested our review, which follows below.

Recommendation

Meets scientific review criteria in part – Our July 2009 recommendation has changed somewhat due to clarification provided by the extensive CRITFC response:

- Objective 1, tasks 1.1 through 1.4 including the scoping, coordination, and planning tasks *meet scientific review criteria*
- The ISRP recommends that project staff develop models as specified in the proposal abstract, specifically in the scope of the first five-year module, items 3 and 8:
  3. Develop models of the relationships between habitat conditions and Chinook salmon responses:
     a. At the reach and watershed scale in detail;
     b. For the entire life cycle
  8. A theoretical biological model will be developed that will express spring Chinook abundance and survival as a function of a set of sub-models based on *scientific literature, specifically (ISRP text inserted)* (a) known relationships between fine sediment in spawning gravel and survival to emergence, (b) summer water temperature and juvenile summer rearing survival, (c) streamflow (d) spawning gravel availability for adults, and (e) riparian vegetation canopy structure and height; topographic shading; streamflow vs. water temperature.

- Objective 1, task 1.5 and Objectives 2 through 5 *do not meet scientific review criteria* based on the information provided in the proposal and response.

- A revised proposal for Objective 1, task 1.5 and Objectives 2 through 5 may be appropriate after tasks 1.1 through 1.4 and development of models are completed. Any revised proposal should consider the ISRP comments presented below.

Comments

The ISRP thanks the proponents for the detailed, lengthy response provided to our preliminary review comments. The two-column organization of the response helped to organize the extensive comments and responses from the initial ISRP review. Inclusion of two appendices in the response provided further information on the sample design, the connection between effectiveness and status and trend monitoring, as well as an example to display overall objectives.

This is a multi-faceted, multi-variable post-hoc modeling approach to address sediment, flow, and temperature variables related to the survival and abundance of Chinook salmon at all life stages in freshwater, over 5 to 10 years. The sampling and analysis proposed is stratified by landscape conditions of gradient, hill slope, upstream habitat, riparian condition, land use, and more, to detect the benefits from several habitat restoration efforts, in-stream and on land. However, there appears to be a lack of control over implementation of what may be limited and unspecified restoration activities within areas of study, and thus small treatment replicate numbers, which may constrain the magnitude and detection of restoration effect. As such, detection of a treatment response seems difficult, if at all possible, given time constraints and inherent environmental and sampling variability. Instead of the current study design, an experimental adaptive management approach is suggested, where modeling is conducted a priori,

and then used to select appropriate response variables (e.g., smolt recruitment as a function of spawners) and subsequently to develop the test design. Model construct on the suspect limiting factors should follow from a thorough literature review. For example, Roper et al. (2010) assessed the performance and comparability of seven different methodologies for quantifying stream habitat in the Pacific Northwest. After examination of current models available, and perhaps a workshop-based collaboration with others in similar studies, development of a new broadly applicable simulation model could follow. The next phase, in a subsequent proposal, would be to experimentally test restoration treatments using the model in the field once sites have been selected, possibly over several watersheds.

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, if successful, would provide an important planning tool in developing future habitat restoration projects. That said, the initial proposal and the response to the ISRP review do not provide evidence that enough consideration has been given to previous work in the region, the fundamental difficulties of collecting adequate data for the tasks at hand, the limitations of the proposed statistical methods of analysis, and the immense challenge to reaching general conclusions from data limited in time, space, and quantity. The goal of explaining variation in Chinook productivity and abundance at various life stages using stratified monitoring of several variables and multivariate models is in contrast to Walters and Collie (1988), who commented on the futility of relating environmental parameters to salmon recruitment. Strong justification for modeling efforts is therefore necessary.

Multivariate models may help describe instantaneous distribution and abundance in streams, but are unlikely to explain population variation in the long term. It is more likely that catastrophic events (e.g., mass wasting, extreme climate-induced flooding or heating, or pollution events) and limits from harvest or ocean life stage are key factors. Key to the evaluation of rehabilitation efforts is the selection of appropriate response variables that are closely linked to the overall subbasin goals. This was not evident in the response, but one suspects that smolt yield per spawner, as a function of the number of spawners is the critical issue. A lack of attention to these fish density issues in the stream sampling and modeling efforts will seriously jeopardize the value of the results. Some consideration of density impact to issues of food assessment, egg-to-fry and parr-to-smolt survivals, and carrying capacity is necessary. One additional issue that needs to be considered more carefully is the assumption that habitat condition and spring Chinook abundance and distribution will necessarily be linked. In systems where the stock is greatly depressed, some upriver habitat may be of very high quality but still not contain many (or any) fish. Such problems may be difficult to assess with many traditional approaches. The study design does not adequately account for these issues.

In the interest of advancing scientific communication, a brief outline of the initial ISRP review comments, the corresponding CRITFC response, and ISRP review follow.

- The confusion caused by using pool frequency to characterize improvements in life-stage survival, when pool frequency was not an assumed primary limiting factor, was acknowledged by responding that water temperature would have been more appropriate.

- A new figure in the response provides a conceptual diagram of the planned workflow to aid in communicating the overall goals of the project. The proponents state that a linkage is

assumed between habitat condition and biotic response, and they note that the biotic response may have a lag time. They further state that the first goal is building a conceptual model relating abundance and productivity to water temperature, fine sediment, and streamflow. Next the model would be applied on a spatially extensive scale. The ISRP recommends that the initial model trial be limited to a smaller area, where different sampling and environmental monitoring techniques can be evaluated. The third goal is then to use the model to estimate at a watershed scale the impact of various levels of habitat restoration as illustrated in the new figure.

- The response states, "We have developed a new surface fine sediment method that we maintain is far superior to the Wolman pebble count method." Details are needed to support this assertion.

- An inconsistency among descriptions of stratification of stream reaches in the proposal and appendices was corrected in the response.

- The response to the question of how land use will be associated with a stream segment mentioned that a goal is to test whether a limited buffer strip or total watershed restoration has a stronger influence on fish response. The response states that it is anticipated that the model will be able to differentiate these two strategies, but more justification is needed to support this anticipated outcome.

- A question about the time frame for relationships between habitat restoration and instream conditions prompted a response stating that the model will allow investigation of hypotheses about the effects of restoration over multiple time lags and spatial scales. Additional explanation of how the model will incorporate time and space should be provided.

- The response notes that because only cumulative effects can be assessed using the proposed methods of analysis, only the largest contributors to habitat changes including both restoration efforts and natural disturbances can be identified. What is the probability that meaningful changes can be detected with the proposed sample sizes and methods of analysis?

- The response asserts that the model should be able to predict the response of Chinook in the proposed time schedule, despite population changes due to normal temporal variation in environmental conditions. Will this proposed 10-year project allow sufficient time to factor in the effects of *El Niño/La Niña* and PDO cycles? It is stated on page 10 of the response that climate change scenarios will be incorporated into the model framework, but the ISRP would like more detail on how this will be accomplished and how scenario assumptions can be field-tested.

- The response asserts the proponents have the expertise to incorporate non-linear effects of water temperature, fine sediment, stream flow and riparian condition in models. A discussion of the nature of expected non-linear effects, based on the literature, should be provided.

- The concern about assuming that the most meaningful habitat attributes can be selected, measured accurately and precisely, and modeled to provide an improved understanding of fish/habitat relationships resulted in reference to the 2005 subbasin plan for identification of key limiting factors. The response noted that other habitat factors such as pool frequencies

and stream bank stability will be explored at other times. Given the recent interest in food webs, trophic processes should be considered as limiting factors as well. Macroinvertebrate sampling is part of the proposal, but should not be limited to only detecting water quality impairment.

- A comment concerning propagation of errors, when models built using fine-scale relationships are expanded to mid-level and basin-wide estimates, elicited the response that fine sediment concentrations could be related to channel gradient or stream power with the hope of extrapolation to entire spawning stream network. What evidence is available in the literature that this hope is justified?

- The comment that there was not adequate evaluation of how results from other CRITFC Accord Projects would be used in the proposed study resulted in a response stating that landscape variables can be used to hypothesize small scale changes in genetic variation. Climate scenarios can be used to identify constraints in models. Additional explanation of the connections among projects is necessary.

- The original proposed 5-year evaluation period has been changed to study both treatment and control sites for 10 years.

- The response states that the BACI design will not be used due to the relatively short time frame. The proponents should consider the use of a staircase design to account for environmental variation (Walters et al. 1989), as reiterated by Marmorek et al. (2004).

- Some index sites will be assessed for habitat change but changes in fish densities will rely on fish-habitat models. Note that by intensively studying a geographically limited site, once the model prototype is developed, it might be possible to include natural fish census data to compare to model predictions.

- A proposed option suggested in the response is to measure a response such as fish density, relate this response to habitat variables at each site, and then to account for differences as a function of habitat restoration work. Reference to studies where this approach to relating fish response with habitat restoration work in non-experimental situations should be cited.

- A concern about whether the level of fish population response would be sufficient to be detected remains although the BiOp assumption is that the level of restoration will be sufficient to see improvement in Chinook productivity. The ISRP suggests that a worthwhile strategy might also be to examine instances of environmental degradation (through either natural or anthropogenic causes), as well as restoration, to test limiting factor assumptions in the model. Examining sites of habitat degradation can increase the knowledge gained from field studies in a limited area.

- The response acknowledges that although key limiting factors were identified by experts there may be other limiting factors that should be considered.

- There is no direct connection between locations of stream temperature monitors and habitat restoration projects. The reason for this was unclear.

- This project does not engage in any restoration actions, so the location of restoration projects is up to others. This project monitors habitat and fish population response to identify changes in habitat quality and Chinook productivity. This is why there may be value in looking for degraded sites as well as restored sites.

- The response to the question, "How many fine-sediment samples will be taken during the initial scoping year?" is five. Justification of the adequacy of this sample size for project purposes should be provided before initiation of data collection.

- The location of existing stream gauging stations has been difficult, so the location of additional stations is unknown. Proposed locations for additional stations should be provided and justified as part of a scientific review of the project.

- Plans for obtaining cross-sectional data are vague in the response except that LiDAR will be used to survey riffles and pools. The technology for this is still under development. What evidence exists that this approach is feasible?

- Gross vegetation mapping will be done by LiDAR and aerial photos then used as input into models related to habitat and productivity.

- The comment that a better understanding of the mechanisms relating road density, sediment, and temperature levels to habitat changes elicited the response that an investigation of fine-scale mechanistic explanation of sediment dynamics is beyond the scope of this generally broad-scale study.

- Concerns about the difficulty in estimating food availability including both terrestrial and aquatic invertebrates were acknowledged in the response without a specific commitment or plan to investigate food resources. As stated above, the ISRP feels that food webs should be considered as potentially important limiting factors.

- The comment about missing details regarding life cycle specific survival determinations elicited some details on methods along with the statement that instream estimates of survival to emergence is beyond the scope of the project.

- Questions about estimating the carrying capacity of stream segments were not fully answered. In any case, it is unlikely that carrying capacity will remain constant over time so repeated estimation should be considered.

- The response provided a discussion of the hierarchically nested stream classification system in answer to why representative reaches were selected as they were.

- The response acknowledges that separating temperature effects from the effects of other environmental factors is not possible with field-based evidence that is correlative in nature.

- Questions concerning the Shiraz model resulted in the clarification that this model would be evaluated along with others when deriving model relationships for this project.

- The response justified purchasing equipment at this stage by noting that equipment is justified in subbasin plans and EDT analyses as identifying factors that have been listed as most limiting. Nevertheless, the limiting factor assumptions in the subbasin plans and the EDT outputs remain unverified hypotheses. Purchase of the McNeil core device is based on the literature and the selection of GIS options is based on the required precision.

References

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