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Northwest Power Planning Council
Attention: Kendra Phillips - Response to ISRP
851 SW 6th Avenue, Suite 1100
Portland, OR 97204

Dear Ms. Phillips,

This letter is a response to the Independent Scientific Review Panel (ISRP) comments on our research proposal for the Middle Snake Solicitation from Bonneville Power Administration, entitled

"Effects of culverts on fish population persistence: tools for prioritizing fish passage restoration projects in the Middle Snake Province" (Proposal 32004).

We appreciated the comments from the ISRP and welcome the opportunity to respond. We have identied four separate questions from the review and answered them individually below.

1. *Is there a demand for this by managers in the Middle Snake Province?*

Yes. This proposal was developed in close collaboration with Idaho Department of Fish and Game (IDFG). When we were considering a range of potential research projects for this province, we met with IDFG staff to solicit their input on information needs. A better means for prioritizing culvert restoration projects was by far the most important need identified. In particular, we have worked very closely with Scott Grunder of the Natural Resources Policy Bureau, who is listed specifically on the proposal as a key player in this project. We also met with managers representing several local agencies (FS, NMFS, DEQ) to discuss this project. They agreed the products from this work would be directly useful to culvert restoration activities. We have also been in contact with forest hydrologists and biologists throughout the country in developing these ideas. We would be happy to provide more specific contact information to verify the management interest in products from this proposed research. The proposal contains numerous references to assessments in the province identifying culvert restoration as an urgent need.

2. Will the proposed research provide new information?

Yes. The ISRP review specifically mentioned the WDFW culvert prioritization manual. That product is an excellent tool, but it does not address the issues outlined in our proposal. The WDFW protocol provides methods for assessing the value of a fish passage restoration project to fish production. Our proposal is focused not on production, but on population persistence upstream of a passage barrier.

The WDFW protocol is focused on anadromous fish passage, whereas our project is focused on resident species. On page 29 of the WDFW protocol, it is stated "In those portions of a watershed that only support resident salmonids, barrier removal may not result in a net gain of habitat upstream because resident fish populations can exist both up and downstream of a human-made barrier." Our proposal is focused on resident fish, accounting for the fact that persistence of resident fish in isolated habitats is *not* guaranteed. This has been highlighted by our own research on the effects of isolation and habitat fragmentation on population persistence for resident fishes (see proposal background).

The WDFW protocol uses information from a variety of ground surveys to determine habitat suitability. The amount of information varies, and includes "full physical surveys," "reduced sampling physical surveys," and "expanded threshold determination." There is not enough space here to describe these methods, but they rely primarily on ground-based habitat surveys and assumptions about the value of measured habitat characteristics to anadromous fish. There is no reliance on direct quantitative models, as we have proposed.

The utility of quantitative models is as follows: 1) they are based directly on the response of fish populations, not assumptions, expert opinion, or extrapolations about habitat quality; 2) they provide probabilistic model predictions that can be used in decision support models; 3) they allow identification of a key subset of variables that are important to fish populations – thus economizing the amount of information needed for prioritizing fish passage restoration projects; 4) modeling responses directly from the fish may reveal new or unexpected relationships that cannot be understood through other means.

We do not wish to unduly criticize the WDFW guidance. We support their excellent efforts in the face of limited resources and information. Our point here is to clearly demonstrate the differences between the WDFW guidance and our proposed work, as requested by ISRP. Our objective is to extend guidance offered by WDFW and FishXing.

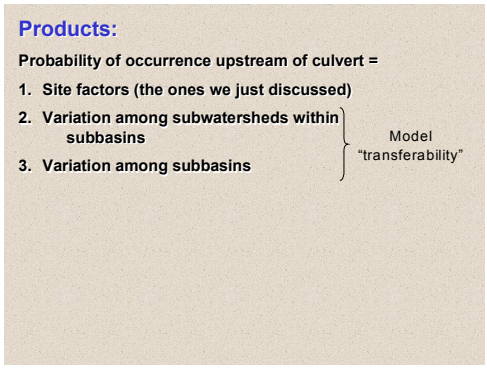
3. *What is the model to be developed? What is the response variable? What are the predictors?*

We outlined the model components in Table 1 of the proposal…

Table 1. List of key factors and predicted responses (probability of occurrence upstream of culverts).

Stream culverts: Key factors and predicted responses	
Factor	**Predicted Response (probability of occurrence upstream of the culvert)**
Area of suitable habitat upstream of culvert	Probability of occurrence increases with increasing suitable habitat area above culvert. Can look at total watershed area above a culvert, or total length of stream available, given constraints posed by natural barriers and other culverts upstream.
Time since culvert was installed	Probability of occurrence increases with shorter time since culvert installed (less time for local extinction to occur).
Degree of fish passage impairment	Probability of occurrence increases with increasing fish passage (e.g., not a barrier, partial barrier, complete barrier, no-culvert "control"). Fish passage impairment will also be measured in terms of number of culverts downstream of the "focal" culvert.
Presence of nonnative trout	Probability of occurrence increases in habitats without nonnative trout present.
Presence of focal species downstream of culvert	Probability of occurrence increases in habitats with a potential source of immigrants from downstream. Applies only to culverts that are not complete barriers.
Presence of focal species in adjacent suitable habitats	Probability of occurrence increases in habitats that are adjacent to other streams with potential sources of immigrants. Applies only to culverts that are not complete barriers.
Degree of human or natural disturbance	Probability of occurrence increases in habitats that are less subject to increased human disturbance as indexed by road densities (e.g., Rieman et al. 1997; Dunham and Rieman 1999). Probability of occurrence is less likely in habitats that are more subject to the effects of fires (link with RMRS-fire research).

We also outlined the model structure in the ISRP project presentation:



The "response" variable is presence or absence of a given fish species (e.g., bull trout, rainbow trout, mountain whitefish, largescale sucker, nonnative brook trout, brown trout) upstream of a fish passage barrier (culvert). This binary response (0 = absent; 1=present) can be modeled as a function of the predictor variables described in Table 1. The response (presence-absence) is modeled as probability of occurrence.

Models can be structured to test for variability at different spatial scales, which is a key component of model "transferability." In other words, does a model developed in one area apply to another area? This is a key question for management applications. Models that prove to be "transferable" are most useful for general applications, including standardized methods to prioritize management alternatives at multiple spatial scales.

The specific modeling approach will be dictated by the data. We have used a variety of methods, ranging from logistic regression (Dunham and Rieman 1999) to classification and regression trees (Rieman et al. 1997) to nonparametric discriminant function analysis (Dunham et al. 2002). (Note: All references are cited in the proposal and are available in full-text on our website: www.fs.fed.us/rm/boise)

4. *Specifically how will model predictions be used to prioritize fish passage restoration projects?*

We added this question and answer to clarify how the products from this work will be used in practice. Information on probability of occurrence is the key indicator of risks to populations isolated upstream of culverts, and for assessing the quality of unoccupied habitats. Isolated populations with a low predicted probability of occurrence should be considered to be at risk. To avert local extinction, fish passage restoration should be a prioritiy in these habitats. In the case of unoccupied habitats, it would be most beneficial to restore passage to habitats with a high predicted probability of occurrence. These are the places where fish are most likely to show a positive response to management. We do not know for sure which of the factors listed in Table 1 will be most important, and how many of them need to be considered in prioritization. Furthermore, the "transferability" of model predictions is unknown. That can only be revealed through direct modeling of fish responses.

Model predictions can be used directly in prioritization, as described above, or the modeling exercise could be viewed more simply as a screening process to objectively identify the key factors that need to be considered in assessing the biological benefits of a fish passage restoration project. The alternative is to measure everything that could be important, or to adopt an expert opinion or "consensus" process to identify key factors. In our experience, there is tremendous variability in expert opinion. We do not question the value of local expertise, but it is also helpful to have a more quantitative perspective to back it up.

5. *ISRP suggests incorporating an experimental design to test model predictions against best professional judgement.*

We agree with this suggestion, and it is something we have thought of. The way to do this would be to test model predictions against culvert restoration projects that have been completed in the past. It would be possible to compare the predicted biological value (as indexed by probability of occurrence) of past activities, and potential opportunities to see if professional judgement is already working to get the biggest biological benefit. It would also be important to consider other constraints (e.g., social, economic, legal, logistical) in assessing past fish passage restoration activities. We believe this assessment would provide an invaluable perspective on management activities. We will incorporate this suggestion into the project, if it is fully funded.

6. *What will be the cost of prioritization if the results from this research are used for management? Will it be too difficult or expensive to implement?*

Numerous documents (e.g., ISAB, Return to River, ISRP project reviews) reviewing management of fisheries in the Columbia River basin call for better prioritization and evaluation of management activities. In practice, however, the response has been slow. On one hand, there is a strong push for doing things on the ground, and a frustration with planning, assessment, and prioritization that appears to delay progress. On the other hand, there is a growing concern that projects on the ground are often ineffective, and that effects on fisheries are not adequately assessed. Each perspective carries some merit.

The value attached to prioritization must incorporate real-world concerns, including relative cost and difficulty of implementation. The reason for conducting the research proposed here is to make *biological* prioritization less difficult by identifying a key subset of factors that contribute to the value of habitats to fish populations upstream of culverts. The issue of cost is not directly addressed, and is beyond the scope of this project. This could be incorporated using existing protocols (e.g., WDFW).

We are confident the cost of developing prioritization tools is extremely minimal in relation to the magnitude of fish passage problems posed by culverts. For example, the GAO report on federal lands in Oregon and Washington revealed costs exceeding $375 million for restoring fish passage through culverts, and estimated a timeframe of several decades to complete the work. Costs for fish passage restoration through culverts in the Columbia basin, which spans five states and two countries, probably exceeds $1 billion dollars in the U.S. alone.

Culverts and other small fish passage barriers are repeatedly identified as high priority management issues throughout the region, and we have cited numerous examples in the proposal. Fish passage restoration through these structures is one of the most straightforward activities for enhancing fish populations in the Columbia basin. Given the tremendous cost of restoration and the long time frames for implementation, we believe it is urgent to develop a stronger sense of the priorities, and a stronger framework for prioritization. We hope to have the opportunity to begin this process in the Middle Snake Province.

A final, local example that should suffice to drive this point home. The Boise River problem assessment has identified approximately 607 culverts in the Beaver-Edna subwatershed and about 500 in the Pikes Fork subwatershed. Which of these 1100 culverts poses a risk to existing fish populations? Where would be the best place to restore passage to benefit fish populations? This example represents only two of the over 100 subwatersheds analyzed in the Boise River drainage bull trout assessment. What type of problems do we have in the rest of the Middle Snake Province, or the other 58 bull trout key watersheds across in Idaho, or across the Columbia basin as a whole? As data from culvert inventories begins to accumulate across the region, the magnitude of the problem is becoming increasingly clear.

We hope our responses to the ISRP concerns have substantially strengthened the justification for funding our proposed work on nonnative trout invasions. We feel their call for additional clarifications will also help others assess the practical significance of this work. Please contact me at the above address if you need further information.

Sincerely,

Jason Dunham