



Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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MEMORANDUM

April 8, 2004

TO: Doug Marker, Fish and Wildlife Division Director, Northwest Power and Conservation Council

FROM: ISRP

SUBJECT: Second Review of Proposal to Evaluate the Biological Effects of the Northwest Power and Conservation Council's Mainstem Amendments on the Fisheries Upstream and Downstream of Hungry Horse and Libby Dams, Montana (ISRP 2004-6 Final Review; see also ISRP 2004-3 Preliminary Review)

Background

On January 20th, at the Northwest Power and Conservation Council's request, the ISRP provided a preliminary review of the "Proposal to Evaluate the Biological Effects of the Northwest Power and Conservation Council's Mainstem Amendments on the Fisheries Upstream and Downstream of Hungry Horse and Libby Dams, Montana." The proposal was submitted by the Montana Department of Fish, Wildlife, and Parks, Brian Marotz, Principal Investigator.

The proposal was generated in response to the Council's mainstem amendments that directed the region to test, implement, and evaluate an interim summer operation, beginning in the summer 2004, that implements new drafting limits at Hungry Horse and Libby Dams. Summer drafting for flow augmentation would be limited to 10 feet from full pool by the end of September (elevations 3550 and 2449, respectively) in all years except the lowest 20th percentile water supply (drought years) when the draft could be increased to 20 feet from full pool by the end of September. The Council's hypothesis is that the proposed operations will significantly benefit listed and non-listed resident fish in the reservoirs and in the portions of the rivers below the reservoirs without discernible effects on the survival of juvenile and adult anadromous fish when compared to ordinary operations under the Biological Opinion.

This proposal is intended to test the first part of that hypothesis, whether resident fish will significantly benefit from the proposed operations. The proposal does not intend to evaluate physical and biological changes that occur in the Lower Columbia River from McNary Dam to downstream of Bonneville Dam that result from the modified drafting strategy at Libby and Hungry Horse Dams. That will require a separate, but presumably coordinated, study.

Specifically, the proposal intends to:

1. Evaluate the benefits for listed bull trout and resident fish of the Council's proposed reservoir drafting strategy.
2. Evaluate habitat changes associated with stabilized flows and velocities in the Flathead and Kootenai Rivers.

In the preliminary review, the ISRP found that the proposal (1) was pertinent to the current issues of balancing headwater ecological impacts with lower Columbia River benefits of flow augmentation, (2) was prepared by qualified staff with appropriate and unique background by virtue of previous studies at the sites, and (3) described an overall plan that was well suited to providing pertinent information on physical and biological effect on benefits to listed and non-listed resident fish as requested above.

However, the ISRP recommended that the project sponsors respond to the ISRP's concerns that key methodological details were lacking. Specifically, the ISRP requested a response that would better describe the several models to be developed and used. The ISRP suggested that it would be most helpful if the models were presented as syntheses of empirical data rather than merely theoretical and conceptual. These details on methods and models were needed for adequate peer review. Our second review focuses on these issues with advice concerning the need for more complete study of other issues.

This proposed study is but part of a broader question. The overarching issue is the tradeoff between the costs and benefits to resident fisheries in Montana/upper Idaho and the costs and benefits to anadromous fish in the lower river. The Council has identified the need to understand the biological and physical changes that occur in both places in the specific context of proposed 2004 (and beyond) reservoir elevations and river flows, both in the Hungry Horse and Libby reservoirs and tailwaters, and in the lower river from McNary Dam to below Bonneville Dam as a result of modifying the drafting strategy at Libby and Hungry Horse Dams. This project will address part of the information needed to answer that question. It will provide more detailed estimates of the habitat changes and population responses of so-called resident fish to proposed changes in reservoir operations, and monitor the effects when those operational changes are made. As the proposal clearly states, it will *not* address the downriver effects or provide a means to assess the tradeoffs among them. Taken alone, the results of this proposed study, are not likely to provide the Council with sufficient information to be confident in making the difficult policy decision whether the changes in reservoir elevations and river flows should be continued or not.

The Council is separately exploring the feasibility of a companion study of downstream reaches to approach the broader issue. At present, the ISRP is not aware of a feasible, statistically valid study design for the lower river that is adequate to detect physical and biological responses to the proposed changes in Hungry Horse/Libby reservoir operations. Thus, the measurement of changes in the Hungry Horse/Libby environs from dam operational changes is being undertaken separately. Our findings and

recommendations are presented in that context, although our detailed comments offer the Council some thoughts on the broader issues, as well.

Summary of Findings and Recommendation

As the ISRP recommended in the preliminary review, the project sponsors reorganized the proposal according to the normal BPA proposal guidelines. The proposal has been greatly improved through this reorganization and additional detail. The technical and scientific background section is quite clear and well presented. It effectively describes the context against which this proposal should be evaluated.

A coordinated effort between upriver and downriver elements will be necessary if the broader issue is to be addressed, but that was not requested of this proposal. This proposed study might change somewhat if it is eventually closely coordinated with a downriver effort.

Despite our previous questions about the models, the Panel believes the proponents are highly qualified and they know the Hungry Horse and Libby systems well. They have an excellent track record and their work (especially the models that are proposed for update and use in this proposal) has had major impacts on management in the past. They are clearly the logical group to conduct this study.

The Panel recognizes that the project proponents are trying to make effective use of a decade or more of data and syntheses (in models) from research in the Hungry Horse and Libby environments. They want to add relevant additional new work (both updates and needed new information), and make and test predictions about effects on resident fish and biota from changing the dams' operations. The proponents' expectation is that the work would document biological improvements from the Council's operational plan. The Panel found this to be a good approach for the study of physical and biological effects on fish, but the models and their use in an experimental design still need to be better described, even after the proposal was revised.

The proposal does not present the architecture of the models or describe the input and output of the models or sensitivity to input parameters. The ISAB reviewed the model in 1996, but models are continually adapting to new data and techniques. Their present status is unclear. Some of the proposed new information seems of questionable importance for updating the models, whereas other work seems valuable. The Panel was unsure about how the team would use the models and the new data. In some places in the proposal it seems as if the new data would go into the models to update them. In other places, it seems as though the new data would be used independently to calibrate or validate the existing models. These are quite different uses. The Panel saw that elements of the research and monitoring plan need to be prioritized according to the questions and problems intended to be addressed. **We recommend that the strategy for using the existing data and models with updated data and models be more explicitly planned.**

The duration of the study and the use of biological indicators need attention. The Panel questioned whether the Council's new flow regime would be carried out long enough to give identifiable and meaningful biological results. The Council's flow regime will have to be continued for some time, perhaps decades, for fish and fisheries to fully adapt. This would necessitate incremental comparisons between the new field results and models' predictions to identify (verify) trends. It is unclear how the tendency to meet expectations might be judged without a long time series of empirical data sufficient to test the hypotheses. **We recommend that the principal investigators identify key indicators of trends in biological responses for early judgments about the nature and magnitude of biological effects. Such key indicators should be hypothesized (and their choice clearly explained) at the beginning of the study and should be carefully included in its design.**

The Panel senses that both an eventual upriver/downriver comparison and judgments about the success of the Council's proposed changes in dam operations for the Hungry Horse and Libby environs will involve social and economic judgments about resource uses as well as the biological ones requested of this proposal. In that sense, the physical and biological studies at the upriver locations may be insufficient, and elements of cost and benefit may need to be added. **We recommend that the Council plan for this study or a companion project to include a cost-benefit element, suitable for eventually making meaningful upriver/downriver comparisons.**

The Panel concluded that the proposal would provide useful information on upriver physical and biological effects on resident fish resulting from the Council's proposed changes in dam operations, despite some technical problems. We point out these problems to help make a better study. If the Council's flow scheme is to be implemented, physical and biological effects should be studied and evaluated, although obvious tradeoffs exist in funding of studies of physical/biological effects, the study of economic/social issues, and study of the tradeoffs between upriver and downriver objectives. We see no other group in the Montana/upper Idaho region that has the history, experience and capability to address the physical and biological issues in the Hungry Horse/Libby environs. **We recommend funding with the qualifications given above.**

Detailed Comments

Qualifications of Proponents

This group has extensive experience doing field studies of this reservoir-river system. It has an excellent track record, and its work has had major impacts on management in the past. The investigators did the right thing a few years ago by synthesizing their accumulated knowledge in a set of models for reservoir physical habitat and biological productivity, and downstream temperature and physical habitat and biological use. Then they applied the models. For example, the thermal modeling conducted by MDFWP helped justify the installation of selective withdrawal structures on the four penstocks on Hungry Horse Dam (Christenson et al. 1996 and Marotz et al. 1996). They propose to use these models again, along with data obtained before and after the flow changes. They propose to both make predictions about the possible outcome of the Council's new strategy and use statistical and regression approaches to compare before and after data (physical and biological). They are clearly the most qualified to do so, and the availability of their models is an essential part of their qualifications.

Adequacy of the Models

The Panel still had some difficulty understanding from the proposal the nature of the models, their suitability to the somewhat vaguely stated questions they are to address, and how the models would be used, validated, and interpreted. In general, a research proposal that will draw significant conclusions based on use of a model should clearly specify the model and the structure and size of "experiments" to be done with the model.

The proponents could have provided better background information on the type and architecture of their models. What do the current models look like? The proposal mentioned two models but the models' different scopes and applications were not clear. It would have helped the Panel (and other readers) if more of the model structure descriptions had been put in the background section. A spreadsheet illustrating what the model(s) can (might be able to) do and their sensitivity to various types of input would have been useful.

The proposal did, however, include some such details in the information under each task. References to reports and papers were given for details on the past models and methods. The proponents referenced their model reports and the ISAB and ISRP reviews of them. Statistical information was not presented fully, but the proponents gave general information that is appropriate (e.g., hypothesis testing for identifying differences, and regression analyses for quantifying trends). They note that they will have to evaluate their ability to detect differences by examining the precision of their data.

Enough information was given to understand the basic logic of the models, though not yet enough for the ISRP to provide direct feedback on the uses to which the models may be put in the proposed work. Most of the principal investigators' models appear to be based on multiple regression analyses. For example, in the Hungry Horse Dam

(HRMOD) and Libby Dam (LRMOD) models, they report “Differing dam operation strategies will be contrasted using time series analyses of historic reservoir surface elevation data, correlated with seasonal measurements of biological productivity (phytoplankton and benthic dipteran production).” And, they give a better indication than in the version reviewed previously of how the models are to be used, as in “Specifically, the two reservoir models estimate zooplankton production and washout, the deposition of terrestrial insects on the reservoir surface and body growth of major game fish. We will compare these model outputs for alternative operational strategies.”

While the ambitiousness of a comprehensive model is desired, the Panel was not sure about the "power" that multiple-variable models have for this real-world case. Given that there has likely been a limited range of variation in discharge rates and patterns in the past, does the model have a reasonable chance at accurately predicting what will happen? Can it be used to predict better/more-desired outcomes for ecological response variables of interest?

There also is some question about how the principal investigators will use the models in conjunction with the new data. In some places the proposal stated that new data would go into the models to update them. In other places, it seems as though the new data would be used independently to calibrate or validate the existing models. A clearer distinction between these two uses would have been helpful and seems necessary for research planning. The Panel suggests that a bioenergetics model that looks at feeding habits and rates of the species of interest might be more appropriate than some of the current approach.

In addition, a workshop approach might be useful for updating and applying the models. The Panel noted that Carl Walters and Ray Hilborn previously ran workshops with real-time modeling to help develop experimental management designs for situations similar to this one. The Panel suggested that someone with similar skills (e.g., LeRoy Poff at Colorado State University [who models naturalizing flows on the Colorado River] or Ken Rose at Louisiana State University [a fish population modeler], or others) might be enlisted to run a similar workshop for the Hungry Horse and Libby operations experiment, if this approach were desired.

Linking Models and Research

The linkage between models and research was seen as too diffuse and lacking in focus. The Panel felt that the team ought to use their models, augmented with a better review of the world's literature, to predict what biological (e.g., fisheries) effects are likely to be the greatest results from changes in the pattern of lake elevation or tailwater changes, then design a study to focus on those parameters. As it stands, the proposal tends to simply list as tasks everything that the principal investigators have measured in the past, with the apparent hope that something will turn up in the results.

The proposal did not provide as much information as the Panel would have liked for the ISRP to confidently judge whether the right research was proposed at the right times and

places, in a way that would provide key input to the analysis, and would result in key outputs. The proposal was not fully convincing that many of the proposed studies could be used to address the basic question, "What is the effect of a modified pattern of changes in lake elevation on the fisheries." Effects on the fisheries (not just fish) are a crucial bottom line, in the Panel's opinion. The sponsors seem to have made a tactical decision to focus upon fish that may be rare or endangered, but that is only one approach that might be taken among several. Nonetheless, the Panel concluded that a linkage between the models and the proposed studies could be made and that the planned project is likely on the right track. More explicit linkage will likely be needed as the project develops further.

The Panel was concerned about the duration of the study. Is there assurance that the Council's new flow regime would be carried out long enough to give detectable and meaningful biological results? The Council's flow regime was not well spelled out in the proposal and directly tied to the research, although the Panel referred to the Mainstem Amendments in our review. Whatever new operational scheme is agreed upon for the two dams, it will have to be continued for some time, perhaps decades, for fish and fisheries to fully adapt. Can data be collected for a sufficient duration to allow conclusions about effects? This may necessitate incremental comparisons between the new field results and model predictions to identify (verify) trends. It is unclear how the tendency to meet expectations might be judged without long-term empirical data sufficient to test the hypotheses. Are there key indicators that could be used? And can validity of such indicators be tested as part of the work?

Specific Work

In the objectives and tasks, it was not always clear whether the work was in the reservoirs or in the tailwaters. This could have been written more clearly.

For Task 4 of Objective 2, what is the evidence that fish using the mainstem below Hungry Horse Reservoir (where the modified discharge flows will have their effect) actually spawn in the upper tributaries of the North Fork? This evidence seems like a major omission in making the case for studying these streams.

The proposal to examine scale chemistry to identify potential elemental signatures that represent the environmental history of recaptured fish seems to be a little too "research" oriented. But the Panel supports the work, partly because of questions like the preceding one. There are indications that the technique works elsewhere. Application here could resolve many uncertainties about where in the system these "resident" fish originate and the various habitats they occupy in their lifetimes.

The proponents responded to our earlier comment about density affecting growth by just admitting it, without any solution for their study. On the face of it, this would seem to be a fatal flaw, but we see no reason why abundance cannot be used as a predictor variable in the multiple regression models to help account for density dependence in the study of,

e.g., growth rates. That is, measures of abundance could be used, at least as an indication of density dependence on growth.

There is an indication that dam discharges will be gradually ramped down from a normalized spring freshet and stabilized, so that flood plain function will be restored, reducing deleterious effects on biological production. However, Tables 1 and 2 indicate ramping rates both up and down, we assume during the season. What are the criteria by which flow rates can be “ramped up” or “ramped down?” Do the criteria allow the dam operators to “follow the load” on a periodic schedule? If so, will the study be able to meet basic objectives?

Advice to the Council Concerning Eventual Upriver/downriver Comparisons

The downstream effects of changes in Hungry Horse and Libby operations on anadromous salmon need to be studied, but the Panel appreciates that this was not requested of this proposal. Nonetheless, the Panel offers the Council some thoughts that may be useful in planning such a comparison.

A study of downstream effects is called for in the Council’s Mainstem Amendments. At present, the ISRP is not aware of a feasible, statistically valid study design for the lower river that is adequate to detect physical and biological responses to the proposed changes in reservoir operations. The present inability to design a study to satisfactorily identify downstream effects may be indicative of the small magnitude of the effects. The Panel advises the Council that planning should continue, despite obvious analytical problems. In the course of this review, the Panel raised several analytical approaches, which will be shared with the Council separately.

If there are measurable, detrimental effects downstream, what are the offsets? How would the region mitigate for decreases in downstream anadromous fish survival? What level of benefit (and to what aspect of the Hungry Horse/Libby physical/biological/social environs) would need to be attained upriver to compensate for any downstream losses? Although these questions go beyond the present proposal, they are the crux of an evaluation of the Council’s proposed modified operations. As such, they affect what should be studied and evaluated in the upriver area.

Anticipating an eventual upriver/downriver comparison, the Panel suggests to the Council that the proposal would be stronger if it or a companion proposal presented a cost/benefit analysis to identify the biological, physical, economic and social tradeoffs under various operational scenarios. Perhaps the Council should include additional objectives in the current request for a proposal, or issue an additional request for a companion project to address the economic and social tradeoffs, perhaps in both the upper and lower river sections. What drives this issue is people -- people who want access to the lake to fish and boat and stroll out on their docks - with water under them. It is people who want to fish for species now damaged in dam tailwaters and farther downstream. In its broader context, we asked why not include some aspects of that sort in

the present study? Cost/benefit decisions get made indirectly in the policy/management arena, but this proposal provides an opportunity for a more direct analysis. Such a cost-benefit analysis seems needed if there is to be an upriver/downriver comparison.

The proposal was apparently not requested to justify a level of funding needed to update estimates of physical and biological effects in the Hungry Horse/Libby environs for the purpose of answering the broader upriver/downriver question. The emphasis is on monitoring changes (hopefully improvements) in the biological features after implementing the Council's new operations. The Panel did not review the budget in detail, but we wondered whether the proposed approach to the upstream analysis is the most effective allocation of funding resources to address the underlying problem of upriver/downriver tradeoffs. The current level of understanding of upstream effects is probably sufficient for justifying the Council's proposed changes in reservoir operations. The separate issue of monitoring upstream physical and biological changes that result from modified operations would entail a study like the one proposed.

It seems that the critical question before the Council is to understand and document the upriver/downriver tradeoffs. A real need exists to develop a methodological framework within which to address the resident fish/anadromous fish tradeoffs. We agree that the physical and biological information base on Hungry Horse and Libby can be improved, and that it is necessary to monitor changes in the Hungry Horse/Libby environs as a consequence of the modified dam operations. But, it is hard to see how putting resources into only one component of the question is going to answer the underlying question of what tradeoffs are embedded in this policy and how they can be assessed. This is particularly important, when it is done under the assumption that someone else will address the second component but without any indication how additional projects would be coordinated or how they would be combined to analyze tradeoffs.