



Independent Scientific Review Panel

for the Northwest Power & Conservation Council
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Memorandum (ISRP 2011-5)

February 18, 2011

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

From: Eric Loudenslager, ISRP Chair

Subject: Final Review of Idaho Department of Fish and Game's Accord proposal, Idaho Nutrient Enhancement Project (2008-607-00)

Background

At the Council's January 13, 2011 request, the ISRP reviewed Idaho Department of Fish and Game's (IDFG) response to a preliminary ISRP review of the Accord proposal, Idaho Nutrient Enhancement Project (2008-607-00). This pilot project's objective is to introduce selected nutrient sources to Idaho streams with the goal of providing benefits to Idaho steelhead populations. A paired treatment/control approach is proposed to evaluate the effectiveness of the nutrient enhancements. The ISRP's preliminary review requested greater detail on six methodological issues related to the design and potential implementation of the project ([ISRP 2010-30](#)). The ISRP's review follows below, organized by the six issues.

Recommendation

Does Not Meet Scientific Review Criteria

Four of the six issues raised by the ISRP in their first review of this project were adequately addressed in the response. However, the ISRP remains doubtful that the statistical power of the study and the proposed methods are adequate for monitoring fish response. As a study "to develop the expertise and experience with commercially available products to conduct large-scale nutrient enhancement projects in Idaho," the project could yield useful information. However, as the biological effectiveness of fertilizer application still remains unclear, it seems premature to be devoting considerable effort and resources to operational considerations. As a study "to confirm that the addition of such nutrients can measurably increase steelhead population productivity in central Idaho streams," the project lacks statistical power to achieve such an extrapolation. As this study is designed, the results obtained could be used to draw conclusions only about the four streams included in the study; it will not confirm whether or not other streams selected for nutrient enrichment would respond in a similar manner.

Although the assessment of biological response to stream nutrient addition in this project is of limited value because of the inability to extend these results to other systems, as a case study, it has the potential to provide some insight as to an appropriate design for a more comprehensive study of steelhead response. However, the ISRP believes that the design and methods proposed are not adequate to evaluate steelhead response. At a minimum, accurate estimates of spawner abundance (at each study reach) and smolt production are required. Enhancements to the measurement of nutrient concentrations and primary production also would strengthen the study.

The ISRP recognizes that the proposal states that this project is not intended to be a rigorous assessment of the effectiveness of nutrient addition. However, until enough information has been generated to ascertain where and when this technique will be beneficial to salmon and steelhead recovery, all nutrient additions should be treated as experimental and include sampling rigorous enough to determine if the fish respond. If the funding for this project precludes the inclusion of a more appropriate sampling strategy, the ISRP suggests reducing project scale to enable biological response to be measured or utilizing the resources requested for this project to expand one of the ongoing nutrient addition evaluations in Idaho. If these options are not feasible, we would propose that the project be postponed until other studies in the basin provide information on effectiveness of this method. Should the technique be proven effective, an evaluation of the operational logistics of implementing large-scale stream nutrient enrichment in relatively small, occasionally remote streams would be appropriate.

The comments above emphasize the need for close collaboration among the various projects investigating fish response to nutrient addition in the basin. Such collaboration could greatly enhance the compatibility among projects in experimental design and methods and eventually provide data from enough locations to provide a general indication of the effectiveness of this technique.

There are several recent papers from outside Idaho that might be useful in providing context and refining the design and methods for this study:

Harvey, B.C. and Wilzbach, M.A. 2010. Carcass Addition Does Not Enhance Juvenile Salmonid Biomass, Growth, or Retention in Six Northwestern California Streams. *North American Journal of Fisheries Management* 30:1445–1451.

Martin et al. (2010). Aquatic Community Responses to Salmon Carcass Analog and Wood Bundle Additions in Restored Floodplain Habitats in an Alaskan Stream. *Transactions of the American Fisheries Society* 2010; 139: 1828-1845.
<http://afsjournal.org/doi/abs/10.1577/T09-096.1>

Philip Roni, George Pess, Tim Beechie, and Sarah Morley. 2011. Estimating Changes in Coho Salmon and Steelhead Abundance from Watershed Restoration: How Much Restoration Is Needed to Measurably Increase Smolt Production? *North American Journal of Fisheries Management* 2010; 30: 1469-1484. <http://afsjournals.org/doi/abs/10.1577/M09-162.1>

Comments

1. *Describe the analytical approach that will be used to account for the effect of variation in spawner density and habitat conditions on juvenile steelhead density, length at age, and survival.*

This concern was not adequately addressed in the response. The two streams receiving nutrients and the two control streams constitute the experimental units for the study. Observing multiple sites in each stream and measuring individual fish responses in each stream are subsamples, not replicates of the experimental units. Observations repeated over a period of years in the same streams do not create more experimental units for comparing the effect of the treatments. They are merely repeated measures. Results obtained from this study as it is proposed could be used to draw conclusions only about these four particular streams when treated as specified. That is, the power calculations presented apply to these particular streams, not all streams that could be selected for nutrient enhancement.

Even for the four streams included in the study, detecting a fish response would likely require many years of repeated measures to compile sufficient data. The ISRP agrees with the response that the BACI design of the study would enhance the ability to detect a steelhead response at the study sites. The proponents also would improve their ability to detect a fish response by selecting study reaches as similar as possible and treating variables other than nutrient enrichment as co-variates. Selecting reference and treatment stream reaches as similar as possible and within 20 km of each other would help address variation in some physical habitat variables, although locating stream reaches with comparable physical features often can be a challenge.

The issue of availability and accuracy of the parameters to be included as co-variates was not adequately discussed. The ISRP believes that this issue is especially of concern as it relates to the effect of differential spawner abundance on parr density and growth rate. The response indicates that spawner abundance would be represented by an "index" of abundance based on counts at a nearby weir. It is unclear whether or not this weir would be downstream of the control and treatments reaches. But even if it is, there is no assurance that the spawning fish would distribute themselves uniformly through the tributaries above the weir and thus provide similar initial juvenile densities. Thus, there can still be a considerable difference between the reference and treatment section in spawner abundance, even with a weir count of adults somewhere in the system. This problem could make it very difficult to assign any changes observed in fish density or growth-rate (if growth-rate is density dependent) to the application of the treatment. This problem would be exacerbated if the duration of the study is relatively

short or if for some reason steelhead or other salmonids were supplemented at some but not all sites. The ISRP recognizes that counting steelhead redds is very difficult, given typical water conditions at the time they spawn. But developing some method to estimate spawner abundance at the study reaches is necessary to reduce uncertainty related to this parameter.

- 2. Include a methodology for determining the extent to which carcass analogs are directly ingested by juvenile steelhead.*

The authors have added post-analog placement stomach-sampling to the study. They plan to sample stomach contents from 10-20 fish in the treated stream during PIT tagging. Assuming the PIT tagging effort occurs while analogs or carcasses are still available in the stream for the fish to ingest, this method should provide sufficient evidence of direct consumption. Understanding how analog or carcass placement impacts fish growth is an important consideration for implementing stream enrichment projects. Optimum timing of analog or carcass addition might differ considerably depending on the mechanism by which the fish are responding to the treatment.

- 3. Discuss the availability of nutrient pellets at appropriate N+P ratios. Describe the methods that will be used to ensure that N+P levels achieved prescribed levels given the alternative application techniques (pellets, carcasses, analogs).*

This concern was adequately addressed in the response. The project plans to use commercially-available fertilizer products, presumably selecting a formulation that has an N:P ratio appropriate for the treatment streams. The project sponsors also indicate that if an appropriate product is not commercially available, they may be able to team with other nutrient enhancement projects in the basin to amass an order large enough to convince a manufacturer to produce a custom product. This possibility is another good reason for the development of a more formal process of coordination among the various nutrient enrichment projects being conducted in the basin.

- 4. Address the issues raised about the reliance on algal abundance to determine effective treatment length, and consider incorporating a more robust water chemistry sampling protocol to supplement the algae measurements.*

The ISRP feels that this element of the project design needs improvement. We recognize that a comprehensive nutrient monitoring program would be expensive and that N and P uptake can be rapid. Nonetheless, the primary zone of response, especially with the addition of inorganic nutrients, will be the section of stream where nutrient availability is measurably enhanced. Nutrient analysis of water samples is a reasonable method of determining the length of this section. We agree that algal accumulation also might be useful in determining the extent of the affected this zone. Although an increase in algal growth sufficient to detect visually may occur near the location where nutrients are added, it seems very unlikely that this monitoring method would be sensitive enough to determine the downstream extent of the effect. We suggest that a combination of chlorophyll *a* and algal biomass be employed. The inclusion of both metrics

may require the use of separate substrates (foam for chl. *a* and a hard substrate (tile) for biomass). As noted in the response, locating the substrates at sites in the stream with comparable conditions of light, flow velocity, depth and temperature also may help alleviate variability due to factors other than nutrient availability. But the inherent variability in monitoring algae may make it difficult to accurately estimate the length of stream channel affected by treatments. Additionally, algal accrual rates on artificial substrates can be confounded by invertebrate grazing; therefore, grazer densities should be taken into account.

5. Describe the process of coordination with other nutrient-addition research projects, including a decision plan and time lines that are based on the results of these research efforts. Especially indicate how negative results from these studies (i.e., lack of response or detrimental impact on steelhead production) would alter the design of this project (including the possibility of cancelling nutrient application).

The ISRP recognizes that the establishment of a formal collaboration among studies involved in nutrient addition research in the Columbia Basin cannot be the responsibility of any one project. The response does indicate that there are some planned interactions with the other nutrient enhancement projects in Idaho. These activities should help promote coordination of efforts. However, given the uncertainty regarding the effectiveness of nutrient addition as a restoration technique and the fact that this project will not appreciably add to our understanding of this topic, the ISRP would encourage the project sponsors to use these planned interactions as a basis to jointly develop a linked network of projects in Idaho.

6. Consider incorporating a public outreach/education component into the project.

The response indicates that the infrastructure to execute an effective outreach program is available with current IDFG programs and can be utilized by the project sponsors.