Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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Memorandum (ISRP 2010-30) **August 27, 2010**

To: Tony Grover, Fish and Wildlife Director, Northwest Power and Conservation Council

From: Eric Loudenslager, ISRP Chair

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

Background

At the Council's July 9, 2010 request the ISRP reviewed Idaho Department of Fish and Game's (IDFG) 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 review follows below.

Recommendation

Response Requested

A few methodological issues need greater detail (see comments section below). In particular, the ISRP would like to see the following issues addressed in a response:

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

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

ISRP Comments

This project has the potential to contribute important information on the use of nutrient additions as an enhancement technique for steelhead. The evaluation of the logistical challenges of applying nutrients at large scales has not been previously addressed for streams in Idaho. The project also includes an assessment of steelhead response. The ideal salmonid response variable for these types of studies would be the production of smolts per spawner, with consideration of the number of spawners contributing to smolt recruitment, and detection of a recruitment difference caused by nutrients added to the stream. The ISRP recognizes that this type of analysis requires a level of effort and resources beyond that being requested for this study. However, the fish sampling protocols would be strengthened with some additional detail on how the effect of nutrient enhancement on juvenile steelhead density and length-at-age will be distinguished from responses in these variables caused by factors like flow, temperature or spawner density. Some additional consideration of how to assess feeding by steelhead on carcass analogs, should this method be the preferred option, should be included. Also some additional thought as to how to assess the effective treatment length should be incorporated into the proposal.

1. Technical Justification, Program Significance and Consistency, and Project Relationships

The high degree of interest in the Columbia River Basin in the use of nutrient augmentation as a method of enhancing trophic productivity in tributary systems clearly indicates that projects of the type described in this proposal are relevant to salmon recovery efforts. The ISRP believes that this proposal tends to portray the effectiveness of nutrient addition in a more positive light than supported by the scientific literature. Page 2 of the proposal states "nutrient additions have the potential to increase the recruits to the spawning population..." There currently is little evidence that nutrient addition benefits salmonid recruitment to rivers and streams, especially at low spawner densities. A more thorough review of the literature regarding large-scale fertilization of aquatic ecosystems elsewhere (e.g., in British Columbia) would better justify this project. The uncertainty of the effectiveness of this technique make the assessment of fish population response to nutrient treatments and coordination with the other nutrient

enhancement evaluations occurring in the basin a critical components of this project. The project proponents do indicate they intend to incorporate results generated by ongoing nutrient enhancement research projects. However, more detail is needed on coordination with other projects and how their results will influence decisions about this project. Table 2 indicates that they will interact with some of these studies during the project planning phase and with others for logistical support. If nutrient application methods and the response variables being measured are not compatible between this project and the research efforts, it may be difficult to apply or compare the research results to this study. More detail on these relationships should be provided. Ideally, a formal process of communication and coordination among BPA-funded nutrient enhancement projects should be established to ensure that maximum benefit is derived from these efforts.

The project proponents indicate that this project is intended more as an evaluation of the logistics of implementing a nutrient enhancement project at scale rather than a focused research effort to evaluate the water quality and biological responses to nutrient addition. Some understanding of the difficulties that may be encountered in scaling up from an experimental addition of nutrients to application at the watershed level would be useful information. Developing a close association with the water quality regulatory agencies in Idaho also could help to make permitting these types of projects much easier in the future (assuming the current studies indicate that this is a promising technique). However, the proposal seems to underestimate the potential problems that may be encountered in mounting a large-scale nutrient addition treatment. For example, public concern with the fertilization of Dworshak Reservoir caused EPA to reconsider the permit requirements for nutrient addition. As a result, the Army Corp of Engineers and Idaho Fish and Game had to postpone this project until an NPDES was obtained from EPA. This experience would suggest that this project should include an outreach and education component to help address public concerns about this project that may arise.

An improved understanding of steelhead response to nutrient addition also would be valuable, especially the measurement of survival from nutrient enriched sites to Lower Granite Dam. Although increased survival to Lower Granite Dam does not constitute an increase in the production of smolts (really the most informative parameter), the fact that there has been relatively little assessment of the effect nutrient addition on salmonid survival would make these data of interest.

The ISRP believes that the effectiveness of nutrient applications for increasing the productivity of salmon and steelhead populations in flowing waters is still very much in question. The multiple studies currently ongoing in the Basin will provide a much improved understanding of the ecological effects of nutrient addition. The monitoring elements associated with this project can also provide useful information about this technique. Therefore, while a better understanding of the methodological issues associated with application of nutrients at a large scale is valuable, the ISRP believes this method should not be broadly implemented until the research currently underway provides a more comprehensive understanding of effectiveness.

2. Objectives, Work Elements, and Methods

The objectives focus on developing a process to deal with the operational challenges of large-scale nutrient addition and evaluation of the response of juvenile steelhead. The authors emphasize that they are not planning an exhaustive evaluation of aquatic ecosystem response to nutrient enhancement. However, they do plan to do a relatively complete assessment of the effect of nutrient addition on algal productivity and steelhead, so the assessment of macroinvertebrate response is the only major component not being evaluated. But omission of the invertebrate response is not a fatal deficiency. Enough is understood about the relationship of aquatic invertebrates to primary production and the utilization of invertebrates by fish to make an informed interpretation as to how the invertebrates are responding if altered algal and steelhead production are noted in response to nutrient addition.

Generally, the work elements are appropriate for the project objectives. Although, explanation of the sampling methodologies in the work elements section was not sufficiently detailed to enable a thorough evaluation of their adequacy, some of the required information was provided in the M&E section. There were work elements of the study, however, that were not adequately described. Determination of appropriate nutrient application rates will require an accurate measure of discharge. The work elements section indicates that staff gauges will be installed at the study sites but provides no information regarding how these staff gauges will be used. Will water height recorders be associated with the gauges to produce a continuous record of stage? How will the stage data be converted to discharge and how will nutrient additions be calibrated to discharge? There also should be some detail provided regarding the deployment of temperature monitors. This information should be relatively easy to provide.

Several possible nutrient addition methods are being considered for this project, including carcass analogs, fertilizer pellets, and liquid fertilizer. The proposal seems to indicate a preference for the fertilizer pellets, primarily because of ease of application. Nonetheless, it is commendable that a range of products will be evaluated before deciding on the most promising technique. Obviously, the application techniques will vary depending on the nutrient addition method selected and the proposal does provide an overview of some of the logistical pluses and minuses associated with each nutrient substrate option. One aspect of the feasibility of these application techniques that was not discussed was the availability of fertilizer pellets containing the appropriate concentrations of N and P. Are the pellets commercially available at this time? If not, is there a manufacturer who will produce pellets with the desired nutrient concentrations? The proposal should address the question of pellet supply. In addition, the proposal should provide some information on the procedures that will be employed to control nitrogen (N) and phosphorus (P) application rates given alternative nutrient addition methods.

The work elements described are generally suitable for assessing algae response to addition of inorganic nutrients. Some aspects of the methods to be used to measure steelhead response require additional detail. The methods also are incomplete if carcass analogs, or some other product that can be directly consumed by the fish, are added. It is conceivable that use of a

product of this type could cause an increase in steelhead density or size-at-age without having any measurable impact on primary production. If this is the case, basing product formulation on the perceived N or P deficiency makes little sense. In fact, properties of the added material such as energy density, fat, or protein content may be more related to steelhead response if consumption by the fish is an important process. Some discussion of how work elements might be modified if carcass analogs are used should be included in the proposal, especially a plan for determining the importance of direct consumption by fish.

3. M&E

Additional detail on how the fish data will be analyzed and interpreted should be incorporated into the proposal. A change in juvenile steelhead density following nutrient addition may or may not reflect a response to the treatment. Juvenile density will vary as a function of many factors, including spawner density and temporal (year to year) and spatial (control and treatment sites) variation in habitat characteristic like flow and temperature. Similarly, length-at-age is affected by habitat conditions and juvenile density. The manner in which these confounding factors will be addressed in data analysis was not addressed. In addition, a method for assessing the direct consumption of carcass analogs should be included in the study, if this method of nutrient addition is selected.

The plan to determine effective treatment length by using chlorophyll *a* accumulation as the primary indicator could pose problems. Algae will respond to factors other than nutrient concentration. Variation in light, water velocity, or invertebrate grazing intensity can cause spatial variability in chlorophyll *a* that would mask the influence of nutrient availability. The use of periphyton biomass or an ocular evaluation of the density of material on the foam sampler substrate would be even less reliable than chlorophyll *a*. Not all the material accumulating on the foam will be algae. The material encrusting streambeds contains fungi, bacteria, and deposited organic matter. Therefore, a denser layer of material or higher biomass may not represent greater algae growth. The best option would seem to be coupling an assessment of the downstream change in chlorophyll *a* with frequent (maybe weekly) water samples for N and P collected from each sample site. Care also should be taken to ensure that the foam algae samplers are exposed to comparable light levels and hydraulic conditions. Elevating the sampler a bit above the streambed may help to reduce invertebrate grazing, but spatial variation in this process may still present some problems. Useful discussions of this method of assessing nutrient effects on periphyton accrual can be found in Bothwell (1985; 1989).

References

Bothwell, M.L. 1985. Phosphorus limitation of lotic periphyton growth rates: an intersite comparison using continuous flow troughs (Thompson River System, British Columbia). Limnol. Oceanogr. 30:527-542.

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