Independent Scientific Review Panel
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Memorandum (ISRP 2009-27) **July 10, 2009**

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

From: Pete Bisson, ISRP Vice-Chair

Subject: Review of the Yakama Nation's Accord Proposal, Upper Columbia Nutrient Supplementation (2008-471-00)

Background

At the Council's June 17, 2009 request the ISRP reviewed the Yakama Nation's Columbia River Fish Accord proposal titled Upper Columbia Nutrient Supplementation (2008-471-00). The project is intended to assess and characterize nutrient availability. If needed the project proponents will perform controlled experimental addition of limiting nutrients to enhance natural production of anadromous salmonids and their supporting ecological functions and limnological conditions in rivers in the Methow Subbasin.

Recommendation

Response Requested

This proposal includes some methods that are not appropriate and does not provide sufficient detail in other areas to enable an evaluation of scientific merit. The ISRP requests a response to the following items:

1. Provide more detail on the process that will be used to determine nutrient limitation. How will the information on nutrient concentration, trophic processes, etc. be used to determine whether there is a nutrient deficiency and, if so, what element is constraining production? Consider the use of nutrient diffusing substrates to augment this portion of the study. Additional background information on current carcass abundance in the system also would be useful.
2. Consider enhancing the methods to be used for measuring primary production. At a minimum, total periphyton biomass should be measured along with the measure of chlorophyll content. A measure of whole-system metabolism would considerably improve this aspect of the study.
3. The invertebrate sampling protocols are not fully described and in some cases appear to be inappropriate to answer the questions being asked. Indicate how the Hess samples will be processed and approximately how many samples will be taken, given the significant costs inevitably associated with sample processing. Why is there no measure of invertebrate density and biomass included? How will the information on invertebrate

community composition be related to nutrient status and productivity? Fully describe how the Hess samples and kick-net samples will complement each other.

4. More fully describe the methods to be used in evaluating juvenile fish populations. Will density and biomass be measured? If so, how will these population attributes be measured?
5. Describe how adult abundance and smolt production will be measured at the Methow study sites. Without this information, determining the effect of nutrient addition on the productivity on salmon and steelhead will be either very difficult or impossible.
6. Describe how potential density-dependent effects of fish population response to food limitation will be addressed. How will the effects of water temperature, flow, and changes in other habitat attributes be accounted for when assessing the responses to nutrient addition?
7. Consider the application of a bioenergetics model to identify appropriate hypotheses and design experiments.
8. Include a more detailed description of the adaptive management process that will be used in moving this study forward.
9. Describe how the evaluation will deal with the presence of and confounding effects of hatchery fish and the role of hatchery fish carcasses in the study design and evaluation, including the identification of their marine-derived nutrient contribution.

Overall Comments

The ISRP appreciates the approach of assessing nutrient concentrations and potential trophic enhancement; however, a more complete understanding of the benefits and risks associated with nutrient additions to streams in the Columbia Basin is a critical need as these projects are being widely proposed and implemented. The proposed study lacks details of study design that may make the results difficult to interpret and apply to other tributary systems in the basin if critical information needs (e.g., adults in, smolts out) are not addressed. More detail on some aspects of this study and incorporation of more appropriate methods for other aspects are required to make the proposed approach technically sound.

Specific Comments

1. Technical Justification, Program Significance and Consistency, and Project Relationships (sections B-D)

This proposed project would establish baseline nutrient and trophic productivity for two tributaries in the Methow River watershed. Nutrient addition would then occur if the initial studies indicated a deficiency. The approach proposed to determine nutrient status appears to be overly intensive. Water samples collected at multiple, randomly-selected locations in the watershed would provide sufficient information on background nutrient levels to determine whether or not nutrient enrichment is warranted. However, a detailed assessment of water quality and trophic system processes would provide the background information necessary to determine the manner in which the system responded to nutrient addition. Unfortunately, as detailed below, the methods and work elements presented in the proposal would not provide appropriate information on several of the key attributes that would be expected to respond to elevated nutrient levels.

The project proponents should provide a stronger rationale for why the Methow River subbasin was selected as a potential candidate for nutrient supplementation. This tributary may not have contained the large number of fall spawning Pacific salmon that were present in tributaries lower in the Columbia River system, and species that spawn at high densities (pink, chum, and sockeye) did not historically occur in the Methow in appreciable numbers. Granted, naturally spawning salmon populations at present are severely diminished relative to populations that existed before development, but applying carcass loading targets to the Methow that are used elsewhere in the basin where spawning densities were historically greater, regardless of the perceived extent of nutrient limitation, may lead to a departure from natural conditions. Of the species that are identified as focal species in this proposal (spring Chinook, steelhead and bull trout), only Chinook would likely have contributed significant quantities of marine-derived nutrients to the watershed. Coho salmon may have also contributed marine-derived nutrients historically, but coho re-establishment efforts in the Methow are in the early stages.

Because suitable Chinook spawning reaches are somewhat limited in the upper Methow River and Twisp River, extrapolating the Mullen estimate of 125 carcasses per mile to target carcass loading for the entire watershed could be inaccurate (it is not clear if this was an objective; clarification is needed). The project proponents are appropriately cautious in stating "One example provided in the Methow Subbasin Plan was to: 'Achieve 125 salmon carcasses/mile as an interim target, based on estimates of historic run size' (Mullen et al. 1992 distributed in areas of current spawning and rearing; WDFW unpublished data). However, no empirical linkage currently exists between the relevance of this 125 kelt [carcass?]/mile estimate and current nutrient availability in the proposed study area. NOTE: For this project it is currently unclear whether or the degree to which project waters are nutrient limited, and/or unbalanced. Therefore, kelt [carcass?] addition is currently unwarranted due to this lack of quantification." The ISRP feels the justification for assessing the extent of nutrient limitation is reasonable, and performing this assessment before launching into a full-scale nutrient supplementation project is very admirable, but it seems prudent to place any nutrient addition goals in the context of historical salmon escapements to this part of the Columbia Basin.

2. Objectives, Work Elements, and Methods (section F)

The overarching objective of the proposal, to determine baseline nutrient and trophic conditions at the study sites, is appropriate. However, as noted above, simply identifying nutrient limitation could be accomplished with considerably less effort. Water samples, in many cases, can provide a good indication of nutrient status. Nutrient diffusing substrates also can provide a very good indication of the nutrient, or combinations of nutrients, limiting primary production. This technique is not mentioned in the proposal but should be considered. The detailed evaluation of trophic processes proposed for this project are not necessary for determining nutrient limitation but would be very desirable for measuring responses to nutrient addition, should this occur at a later date. However, the parameters that are proposed for measurement, in many cases, are not the most appropriate for detecting responses to nutrient addition.

Consideration should be given to sampling year round. The current study design calls for sampling from April to October; however, no water samples would apparently be collected from November to March. This time period is important because it generally represents the window when carcasses and their decomposition products are present in the streams and are being processed by the aquatic community. If nutrient supplementation proceeds and if carcasses are added to the Methow drainage system, it would be useful to have a strong baseline of nutrient

concentration, and other information relative to the trophic status of the streams, when carcass or carcass analog supplementation would take place.

One of the primary responses anticipated from nutrient addition is an increase in trophic system productivity. An indication of increased production may be an increase in biomass of primary and secondary producers. The proposal indicates that the only measure of primary production that will be collected is chlorophyll biomass. This measure may not be sufficient to determine changes in primary production. Increases in biomass at one trophic level may be masked by corresponding increases at higher trophic levels and the consequent increase in grazing or predation. For example, an increase in primary production may not be reflected in an increase in algal biomass or chlorophyll content if an increase in the population of invertebrates that feed on this material keeps biomass low. In this case, an actual measure of primary production would be required to determine if algae had responded to nutrient addition. Measures of whole-stream metabolism using very sensitive oxygen sensors have been used successfully for a number of years to determine rates of primary production. Applying this technique, in conjunction with the measurement of biomass and chlorophyll, would provide a more thorough evaluation of primary production and be less likely to suffer problems due to changes in populations of grazing invertebrates after nutrient addition.

The invertebrate sampling methods do not appear to be sufficient to detect a response to nutrient addition, or even to provide an indication of background conditions. The methods described include Hess samples and kick net sampling (referred to as “drift sampling” in the proposal). The manner in which the Hess samples would be processed and analyzed is not adequately described in the proposal. The method to be used in processing the kick-net samples appears to be one developed for assessing biotic integrity of a macroinvertebrate community. This method is not the most appropriate for addressing the objectives of this study. Assessing the availability of food items for fish requires a good estimate of invertebrate density and biomass. The sample analysis protocol described in the proposal is designed to provide an indication of community composition, not abundance. Composition may give some indication of the nutrient status of a system. But direct measurement of attributes of the invertebrate community most closely linked to trophic productivity (density, biomass, secondary production) are much more appropriate for this study.

The methods for fish sampling also are not sufficient for determining productivity of these populations. Food limitation on fish populations would best be determined by examining and comparing size-at-age, density, and growth rates several times a year. However, the description of the methods to be used in examining the fish populations does not provide enough detail to determine whether or not these metrics are included; there is no mention of density or biomass, a key component of the fish community from the standpoint of trophic productivity. More detail on what fish populations’ attributes will be measured, how this information will be collected and how it will be interpreted needs to be included in the proposal.

One of the greatest needs of this project is the lack of information on smolt production at the Methow River study sites. The proposal indicates that WDFW is conducting adult counts and collecting smolts on the Twisp. But there is no mention of these data being collected for the Methow study site. Nutrient enhancement in the Columbia Basin is being done, primarily, to increase survival of juvenile salmon and steelhead. Without very good data on the number of adult salmon spawning and number of smolts leaving the study sites, this assessment cannot be

made. This deficiency constitutes a significant flaw in the current design and needs to be addressed before proceeding with this project.

The proposal proponents might consider using a bioenergetics model to conceptually explore how nutrient addition might contribute toward rebuilding wild salmon runs. Data on fish production from WDFW could initially be used to parameterize such a model and evaluate expectations of system response to nutrient addition (combine the trophic dynamics, bioenergetics, and recruitment models). Plausible hypotheses derived from the modeling could then be examined with adaptive field experiments then expanded to watershed-scale studies with controls and treatments. Adaptive management gets lip service here, but is not truly applied, where objectives need to be clearly defined, dynamic models developed to predict responses, then appropriate response variables selected and tested with field experiments, in a feedback loop.

There are a number of other areas where insufficient information was provided to enable an assessment of the technical merits of the proposed work.

1. What is the current availability of hatchery carcasses at the study sites? Is there any need for additional carcasses and/or inorganic nutrients, or salmon carcass analogs if hatchery fish are already delivering sufficient quantities of marine-derived nutrients? The proposal should include some indication of the amount of marine-derived nutrients already being delivered by the return of hatchery salmon.
2. Hatchery fish are unlikely to provide adequate seeding of fry and juveniles to achieve carrying capacity for the study sites. If this is the case, the evidence for food limitation will be weak, and the need to add nutrients will be similarly weakened. The proposal should indicate how they will address density-dependent effects on food limitation.
3. Limits to salmon production in the study area may be more related to stream flow and temperature conditions than to trophic productivity and food availability (although all these factors interact). More detail on how the effects of factors other than nutrient availability will be assessed and interpreted should be included.

3. M&E (section G, and F)

The entire proposal is M&E. See comments above.