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MEMORANDUM

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

FROM: Mike Edmondson, Program Manager, Office of Species Conservation

SUBJECT: Response to Memorandum (ISRP 2010-30) Response Request for Idaho Nutrient Enhancement Project (2008-607-00)

Background

On behalf of the state of Idaho and its agencies, the Office of Species Conservation (OSC) submits this response to Independent Scientific Review Panel (ISRP) Memorandum 2010-30.

The ISRP requested a response from project proponents after review of the proposal. The ISRP identified six methodological issues that need to be addressed in greater detail. These issues are:

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.

In the body of their review, the ISRP provided some commentary on these issues to explicate their questions. Following, we provide a response to each issue.

Response

1) The ISRP stated, '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.'

Response- These potential confounding factors were addressed in the proposal in two steps. As far as possible, they will be controlled by appropriate pairing of study streams. This is a vital first step to make a BACI analysis effective because the analysis depends on the assumption that the study streams are affected similarly in regards to environmental variability (e.g., differences in weather among years), making a treatment effect detectable. Insofar as is possible, stream pairs will be picked to maximize similarity within the pair in terms of physical proximity, parr density and growth, water chemistry, and instream habitat. These considerations should minimize the confounding effects of spatial variation. There will be 2 stream pairs in the study; each control stream will be located within 20 km of a treatment stream. Secondly, the proposal addressed inter-annual variation by the inclusion of covariates in the analysis. The basic BACI design is implemented in the basic analysis of variance (ANOVA) framework; the effects of annual differences in parental abundance, flow, and water temperature can be controlled for using analysis of covariance (ANCOVA). More detail is given on page 20 (second paragraph) in the proposal.

2) 'Some additional consideration of how to assess feeding by steelhead on carcass analogs, should this method be the preferred option, should be included.'

Response- Although of some interest to this study, dietary analysis is peripheral to our objectives to develop logistical expertise and confirm the steelhead population productivity increases following nutrient additions. One of the primary objectives of this study is increased productivity; whether the increase results from increased primary production or direct consumption is of lesser interest. Work completed by project 2007-332-00 shows that fish will eat carcass analog material (Felicetti et al. 2009). More intensive work by that project to describe the timing and importance of analog consumption to rainbow trout is currently pending (Scott Collins, Idaho State University, personal communication). Thus, we will conduct coarse confirmatory sampling and use Collins et al's results to estimate importance of direct consumption in our treatment streams. The equipment and time needed to collect diet samples is minimal, provided a crew is already doing field work. We will use the coarse approach documented in Felicetti et al. (2009), collecting stomach samples by gastric lavage from 10-20 fish from each treated stream when field crews are collecting fish to PIT tag (Work Element I). Proportion of individuals consuming analog will be computed. Samples can be stored and proportion of diet (by dry weight) can be determined later, as time, money, and facilities allow.

3) The third issue on which the ISRP requested a response concerned technical details of fertilizer specifications: '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.'

Response- One of the chief logistical problems in any nutrient addition project is the availability of a suitable product. In our view, this is part of the learning that must occur if nutrient mitigation is to be used as a management tool. The goal stated in the proposal is '... to test the feasibility of commercially available fertilizers for use as a nutrient mitigation technique...' Part of this testing is finding the product formulations available on the market that are suitable for use in Idaho. The fertilizer market is volatile and not static. During the initial planning stages of this project, carcass analogs did not appear to be commercially viable but now they are available. That could change again. We will review commercially available products for likely suitability to our study area (N limitation or N:P co-limitation) and test performance of samples under field conditions. Potential products will include inorganic pellet fertilizers as well as the organic options (carcass analogs and other fish meal products). A plethora of inorganic pellet formulations exist and are available from a wide variety of manufacturers (e.g., Sun Gro Horticulture, Vancouver BC; Florikan ESA, Sarasota FL; Haifa Chemicals Ltd, Altamonte Spring FL). Options for carcass analogs and fish meal are also numerous (e.g., Bio-Oregon, Longview WA; Welcome Harvest Farm, Van Anda BC; True Organic Products, Helm CA). Methods for product procurement are either 1) choose the most optimal commercial mix or 2) deal directly with a manufacturer to produce a custom product. If stock formulations are used, we can choose ones that fit a given stream chemistry because the treatment targets are a range of acceptable concentrations (see Ashley and Stockner 2003 for how to determine the appropriate N:P blend). In practice, products can be blended to reach any desired N:P ratio. Products will be ordered in bulk several months in advance of treatment (previous fall/winter), allowing alternative sources to be found if a manufacturer cannot supply the necessary amount. If stock formulations are not suitable, given that this project has a very finite budget, coordination with other nutrient enhancement projects will be necessary to get more leverage with supply companies. Such coordination is predicated on similarity in water chemistry among the various study streams that will be targeted. Due in part to the required adaptive nature of this project, this last detail cannot be fully known at this time. Given this uncertainty, we cannot answer the ISRP's question in any greater detail until the project begins.

4) The ISRP questioned the proposed methodology for determination of effective treatment length. '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).'

Response- There are pitfalls and pluses to any methodology. A robust water quality sampling protocol can be expensive in terms of personnel time and laboratory costs. If N or P is limiting, they are taken up almost immediately, making detection with water samples much harder. In our proposal, water sampling is mostly for permitting requirements and detection of treatment effects will focus on the biotic response. Ashley and Stockner (2003) state that qualitative assessments of relative periphyton abundance can be surprisingly informative and reliable, whereas Bothwell (1989) suggests that chlorophyll a is a potentially biased measure of periphyton biomass. In support of the former point, in the Kootenai River, algae and diatoms responded immediately to treatment and the difference between above and below the treatment site was visible to the eye (Vaughn Paragamian, IDFG, personal communication). In support of the latter point, heterotrophic response may also be an important component. The goal of this assessment is to determine the zone of impact for the purpose of adaptively managing the number and locations of treatment sites. The results need to be approximate, not exact, so our intent was to reduce costs by assessing the periphyton. Certainly, monitoring sites should be standardized as much as possible for important factors affecting algal growth beyond nutrient levels: light, temperature, flow. Grazing invertebrates could be excluded but that may be at the expense of other practical considerations (e.g., rendering samplers vulnerable to debris accumulation or damage). Given sufficient algal concentration, grazing is irrelevant to determining whether there is a treatment effect. Evidence of grazing is a good indicator that energy is being transferred up the food chain. The alternative is to assume grazing pressure is roughly equivalent among sites. That may be reasonable, given the approximate nature of this assessment and a scale of 5 km within a stream reach of similar habitat. Assessment can be made more accurate by the use of two controls (new substrate and substrate placed above all treatment sites). The comparison of the two controls corrects for passive settlement (as recommended by Bothwell 1985) and the base level of autotrophic and heterotrophic productivity in the treatment stream. Laboratory costs can be reduced by using ash-free dry mass or visual evaluation rather than chlorophyll a. We will test visual evaluation against quantitative measures in a side-by-side comparison before relying on them.

5) The ISRP advocates, '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.' They also request more detail about coordination with other nutrient enhancement projects and how results from other projects will be incorporated into this project.

Response- To date, all coordination activities with other projects have been the result of informal contacts. We certainly agree that a formal coordination forum would be a good idea but it is quite beyond the scope of this project to organize such a meeting. The International Kootenai/y Ecosystem Restoration Team meets annually and we have been invited to attend. Note that Project 2007-332-00 has the objective of coordinating a regional synthesis of the results of nutrient mitigation projects (Objective 7 in their proposal). They further have proposed to hold a symposium on nutrient additions at the 2011 American Fisheries Society

national meeting in Seattle. We would certainly attend and participate. The results from other projects would feed into this project primarily during the nutrient product testing and logistical planning phases (2011-2013). For example, by coordinating with other projects we could obtain appropriate nutrient formulas at better prices (see issue 3 above), which would be part of our logistical planning. Recent work by project 2007-322-00 on nutrient release by a commercial product under field conditions (Florikote, Scott Collins, Idaho State University, personal communication) is an example of nutrient product testing that we will use to evaluate treatment options without conducting tests ourselves. Information from these two examples would be used to develop the initial treatment plan to be used in 2014. The only negative results that might cancel treatments would be excessive eutrophication. Previous work in Idaho streams show there is a reasonable expectation of a positive treatment effect to the stream biota (including fish) at smaller scales; this effect may wash out at the population level, but it is difficult to determine how this may translate into a detrimental impact to steelhead production.

6) As a result of recent events with the Dworshak mitigation project (2007-003-00), the ISRP recommends addition of an outreach and education component.

Response- This is always a good idea, whether it is handled formally or informally. In the Idaho Department of Fish & Game, public contacts are usually handled by the relevant regional office, in this case the Clearwater regional office in Lewiston. Regional office staff are much more familiar with the area and already do education/outreach there. Personnel from this project will work with regional staff to develop the most appropriate form of outreach concerning project activities. We will be proactive in holding public meetings or news releases as well as appropriate interpretive signage at field sites to explain project activities to the public. The Kootenai River Ecosystem Restoration project provides a useful model and we will interact with them to develop effective outreach tools (e.g., brochures for local distribution).