Response to the ISRP Preliminary Review of BPA Project 35012

Title of project

Spatial scales of homing and the efficacy of hatchery supplementation of wild populations.

BPA project number 35012

Business name of agency, institution or organization requesting funding
National Marine Fisheries Service/Northwest Fisheries Science Center

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The ISRP gave our proposal a careful and thoughtful review, and we appreciate the opportunity to respond to the their comments. Our responses and clarifications are given below (the ISRP comments are italicized).

This research is really more consistent with Yakima M&E type work…..

While this was not a comment for which the ISRP specifically requested a response, we would like to address this point. While our study will provide important M&E information about the efficacy of the Yakima Spring Chinook salmon supplementation program and will certainly be useful for "fine tuning" the YKFP program, we believe the scope of this study goes beyond this one program. Indeed, the results from this project will be relevant for hatcheries and supplementation programs in every subbasin and ESU within the Columbia River watershed. The integration of results from the three phases of this study (fine-scale spawning site determination, prespawning/spawning migratory behavior, and imprinting/homing physiology) will provide unique insights into the process of homing, straying and spawning site selection, interactions and success of hatchery and wild spawners, and the efficacy of supplementation in salmon recovery. Ultimately results from these studies should provide critical empirical data that can be applied to spatial and temporal models of salmonid population dynamics for recovery planning and for developing hatchery rearing and release strategies to minimize inappropriate straying.

Furthermore, this study will provide critical information about the impact and efficacy of satellite acclimation facilities for supplementation. The NMFS FCRPS Biological Opinion (2000) and the NWPPC Artificial Propagation Review (1999) have

advocated the use of these acclimation facilities to minimize straying by hatchery fish and remote acclimation sites have been developed or proposed as part of several BPA-sponsored supplementation programs throughout the Columbia River basin (e.g., Yakima/Klickitat Fisheries Project, Northeast Oregon hatchery program, the Nez Perce Tribal Hatchery, Omak/Okanogan Spring Chinook/Steelhead supplementation). However, the efficacy of off-site releases from acclimation facilities to minimize straying has not been demonstrated (Johnson et al. 1990; Savitz et al. 1993; Kenaston et al. 2001) and the ISRP itself has expressed concern/interest about the efficacy of acclimation sites in their recent comments related to BPA projects 29006 and 29038 (ISRP 2002).

At how fine a spatial scale can the redd mapping be conducted, and can it be related to the depth contours of the river?

One of the unique aspects of our proposal is the ability to map redds and carcasses accurately to within a few meters using differential GPS technology (Kojiro et al. 1999; Jeffrey and Edds 1997). Therefore, redd location could be directly related to depth contours of various segments of the upper Yakima River. While it is beyond the initial scope of this study to comprehensively survey environmental parameters associated with redd sites, the data from this study could ultimately be used to identify environmental parameters (e.g. flow, temperature, depth, substrate, cover, hyporheic exchange) that may be important for spawning site selection and reproductive success. Indeed, our comprehensive redd mapping data should complement a number of ongoing projects (Yakama Indian Nation, Washington Department of Fish and Wildlife, Bureau of Reclamation) currently being conducted to examine various environmental correlates of redd site selection for a subset of Spring Chinook redds within the upper Yakima River subbasin (M. Johnston, YIN, W. Larrick, BOR; personal communication) Furthermore, instream flow in the Yakima River is tightly regulated and managed for a variety of uses by manipulating flow at a number of storage and irrigation diversion dams throughout the watershed. Data from this study may be useful in predicting and monitoring the effects of flow changes and dewatering events on spawning success.

There seems to be a presumption that the distribution of spawners largely reflects homing or not (straying). How can homing be differentiated from simply selection of preferred spawning habitat and/or maintaining interaction with conspecifics?

This is an excellent question because, as the ISRP notes, the choice of spawning location within a watershed involves complex tradeoffs between homing to the natal site, spawning habitat selection and mate choice (Dittman and Quinn 1996). This is one reason we are particularly excited about this project because the extensive pre-supplementation data on spawner distributions, the comprehensive tagging of all hatchery fish and the use of several acclimation sites for release provides a unique opportunity to differentiate between homing to the site of imprinting and spawning site selection based on habitat or demographic factors (e.g., mate choice, density of conspecifics, competition). Quinn (1993; 1997) defined homing as the return to the natal stream where a salmon incubated, hatched and emerged. For a wild fish, therefore, homing success might be measured

relative to the natal redd. Over the last several decades, wild Spring Chinook in the upper Yakima River have consistently and selectively utilized only a small subset of the available habitat for spawning (YKFP 2002) but as noted by the ISRP, the studies outlined in this proposal will not allow us to distinguish whether this reflects homing to the natal site or spawning site selection because the natal site of any individual wild fish within the upper Yakima subbasin won't be known. Future studies may utilize otolith microchemistry to identify wild fish from specific natal incubation sites with distinct water chemistry (e.g., Ingram and Weber 1999) but these studies are beyond the scope of this proposal. However, we may gain some insights about the relative importance of homing vs. demographic factors and habitat if wild fish alter their spawning distribution in response to the introduction of supplemented fish. For example, in 2001, the first year that hatchery-reared adults returned to spawn, a higher percentage of wild spawners were recovered in the vicinity of the Cle Elum hatchery (where a number of supplemented fish spawned) relative to pre-supplementation distributions.

For supplemented fish, that are fertilized and reared in the hatchery and acclimation sites, we will be able to distinguish between homing to the site of imprinting and spawning site selection. Hatchery fish will only have experienced the homing cues from the Cle Elum hatchery and the acclimation sites for imprinting prior to their out migration. If the imprinting site is the primary factor driving spawning location within a subbasin, we would anticipate that hatchery fish will be recovered in the vicinity of the acclimation sites or the Cle Elum hatchery. On the other hand, if habitat or interactions with conspecifics are ultimately more important in deciding spawning location, supplemented fish may be recovered more often in traditional spawning areas. The radiotelemetry assessment of prespawning movements relative to the ultimate spawning location will also provide important insights regarding the tradeoffs involved in spawning site location.

The proposal comments on the aggregation of hatchery fish. Will this aspect of behavior be routinely monitored? Some aspects of aggregations will be lost possibly by sampling carcasses only, will it be possible to sample groups of live fish (e.g., males are unlikely to remain in a group following spawning)?

We will routinely assess and analyze the spatial patterning of hatchery and wild fish using the *Ripley's K* clustering analysis (Ripley 1981). While it is certainly true that some aspects of the aggregation patterns will be lost by sampling only carcasses (e.g. mate choice), our initial feasibility studies established that carcasses were recovered in the vicinity of their redds and carcass sampling will allow analysis of hatchery/wild aggregation patterns on 50-100 meter scale. We anticipate that this will hold true in all study years because flows in the upper Yakima River are maintained at a relatively constant level during the spawning season by the Bureau of Reclamation. To further validate that carcasses are retained in the vicinity of spawning, we will map the spawning and carcass recovery location of all radio tagged fish that are recovered. Comparative residence time and movement patterns of representative males and females over the spawning season will also be assessed by radiotelemetry but sampling groups of live fish without radiotags will not be possible.

The budget includes sub-contracting with Dr. T. Quinn, U of Washington and support for one MS student and one Ph.D. student, plus hourly field assistants. The subcontracting is not noted in the proposal. Who would actually be conducting this research?

We apologize for not clarifying this point in the initial proposal. The project has been developed and will be conducted by the NMFS Principal Investigators in collaboration with Dr. Quinn and his graduate students. Dr Quinn is internationally known for his expertise on the behavior, ecology and evolution of salmonid fishes and will make major contribution towards the success of this project. The two graduate students will work in collaboration with the NMFS research to provide long term, motivated and cost-effective contributions to the data collection and analysis.

Section 9g Facilities does not comment on the source of the fixed radio-tag receivers?

The fixed radiotag receivers will be purchased from Lotek Wireless Inc. to insure compatibility with tags and equipment currently being utilized by Yakama biologists and Corps of Engineer funded projects that radiotag Yakima River spring Chinook for dam passage studies.

The ISRP's comments are consistent with the RME group comments about the potential value of this study. The RME group comments will be useful in documenting the relationship of the project to the RPAs and BiOp.

In response to the RME groups comments on our proposal and their indication that results from this study will be relevant to RPAs 182 and 184 of the BIOP., we have initiated discussions with the RME hatchery workgroup to examine our proposal in the context of implementation of the RME BiOp RPA action items.

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Yakama Klickitat Fisheries Project website 2002 : http://ykfp.org/