Independent Scientific Review Panel
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Memorandum (ISRP 2005-19) **December 16, 2005**

To: Doug Marker, Fish and Wildlife Division Director, Northwest Power and Conservation Council

From: ISRP

Subject: Review of Fiscal Year 2006 Proposal, Acoustic Tracking for Studying Ocean Survival (2003-114-00)

Background

At Bonneville Power Administration (BPA) and the Council's request, the ISRP reviewed Project 2003-114-00, Acoustic Tracking for Studying Ocean Survival. This project is part of the Action Agencies' effort to achieve specific goals identified in NOAA Fisheries' Biological Opinion and the Action Agencies' Implementation Plan for the Updated Proposed Action. It is an ongoing project that has been funded since 2004 and was built on the technical results of an earlier proposal funded in the Council's Innovative Proposal Category.

The ISRP last reviewed this project in the Province and Mainstem/Systemwide project selection cycle in 2002 and found the proposal to be "fundable in part (Qualified) at a reduced level of support." The ISRP commented that this research project could provide new and important insights into the early sea-life of salmonids and their use of the ocean environment. In 2003, the Council recommended that this project should not be funded. BPA, however, decided to fund this project albeit with a much smaller budget than originally sought by the sponsor. BPA funded this project for $200,000 in 2004, and $320,000 in 2005. The sponsor has requested $1.5 million for 2006; consequently, BPA and the Council are seeking ISRP review due to the increase in project scope.

Summary

The ISRP finds the project fundable in part at a reduced level of funding and deployment of the proposed acoustic tracking array. Deployment should be restricted to the Columbia River Basin and Plume with no deployment of benthic acoustic receivers until further evaluation. A response loop is requested to address ISRP comments and recommendations, which are provided below.

ISRP Review Comments on the FY06 Proposal

1. Is the Project based on Sound Scientific Principles?

This is a within-year proposal for an ongoing project that has not been reviewed by the ISRP since November 2002. The ISRP reiterates its 2002 suggestion that a reasonable process for this specific project would be to discuss the final acoustic array design with the proponents and to develop an incremental budget over the next few years. Coordination of the final design with other projects in the Columbia River Basin and Plume seems to be essential to this process. The ISRP also reiterates their previous (Nov. 2002) comment that the proposed acoustic tag may be suitable only for juvenile spring Chinook salmon and steelhead (and likely coho salmon), and not for smaller juvenile salmonids, in particular subyearling fall Chinook salmon.

a. Technical and Scientific Background

The ISRP has three major concerns about the technical and scientific background presented in this proposal, as follows: (1) data and interpretation of results from the first two field seasons are sparse, and references to specific reports or publications are vague, e.g., "the results from this project are just being published or prepared for publication (see references)," p. 7; (2) the text frequently implies accomplishment of tasks that are not likely to be met in the foreseeable future, e.g., "the array can be used to track up >250,000 tagged animals at once," p. 7; (3) there is no review of the scientific literature and full citations for most references cited in the text are missing (e.g., Muir et al. 2001a, Zabel et al. 2002, Hockersmith et al. 2003, Welch et al. 2000, Scheuerell and Williams 2005, Peters and Marmorek 2001, Deriso et al.2001, Shaller et al. 1999, Shreck et al. - no date; see pp. 3-8). The status of the Welch et al. (2005) paper on sturgeon is not given.

The ISRP considers the summaries of “proof of principle” studies in 2001 and 2002, and the larger demonstration project in 2004-2005 to be inadequate. The only specific result given is that 91% of individual tagged smolts were detected over individual listening lines. At a minimum, the proposal would be improved if the proponents could provide a more detailed summary that specifies (1) the total number of fish

detected, (2) the number of fish detected by multiple arrays, (3) how many times an array did not detect fish that were later detected by another array, (4) what kinds of estimates of survival and migration timing were made, and (5) whether these estimates have endured peer review. The background section mentions uncertainties related to estuarine residence and rearing of juvenile fall Chinook. That is, when a tagged fish is no longer detected by acoustic receivers in the estuary, it cannot be determined whether the fish died or migrated to the ocean. This section also alludes to the ability to detect returning acoustic-tagged adults. But these capabilities are not part of the proposed project, as fall Chinook salmon are too small for the type of acoustic tag to be used in the study. In addition, results from the proposed ocean array would pertain only to movements of fish within the range of arrays located over the continental shelf. An assumption critical to the success of this project is that juvenile salmon remain over the shelf during their 1st summer at sea. While this assumption may be reasonable, it is not adequately supported by a thorough review of the scientific literature.

It is difficult to understand Shreck's role in the project. Is he a co-proponent (p. 13)? Also, it seems that only 3 out of 800 fish that he tagged were logged passing Brooks Peninsula, which is very small proportion. If all Snake River Chinook salmon were bound for the Gulf of Alaska via the shelf, then the expected number would be higher if the technology were as good as described. Other explanations could be that the fish died before they got to the line or took a course further offshore – both conditions would not be detected with the present design. This would also be a problem for future deployments.

It is not clear how stream-type Chinook salmon with off shelf distribution could be detected with the present array design (p. 18, Section IV, paragraph 2). Some of the planned “curtains” exclude areas where the shelf is very wide (e.g., Fig 5, southwest Vancouver Island). The assumption seems to be that fish will be detected as they travel in a narrow band along the coast. Are there specific references that document this migration behavior? Will this project be limited in providing data on those salmon stocks that migrate along the coastal shelf?

Were the Dworshak smolts released in 2005 detected or are these data possibly in the Brooks Peninsula line that has not been recovered at the time of writing (see footnote, p. 18)?

What is the recent fieldwork which indicates that “by the fall Chinook salmon are concentrated in sheltered inside waters and not broadly distributed along the coast,” and to which stock of Chinook salmon does this refer? (p. 21, paragraph 3, last sentence)

b. Rationale and Significance to Subbasin Plans and Regional Programs

The relation of the proposed work to the 2000 Biological Opinion and Updated Proposed Action is clearly described in the administrative form. In particular, the relations to Action 187 habitat ("studies and analyses to evaluate relationships between ocean entry timing and SARs for transported and downstream migrants") and Action 193 ("investigate state-of-the-art, novel fish detection and tagging techniques for use, if warranted, in long-term research, monitoring, and evaluation efforts") are described. The proposal narrative would be improved if the significance to either the Estuary/Plume subbasin plan or the mainstem amendments/plan were described.

Regarding the proponent's rationale concerning uncertainty in the fraction of resident and transient populations (p. 20, 4th paragraph), have they considered periodic non-lethal sampling and genetic (DNA) stock identification methods as a less expensive and potentially more reliable alternative to acoustic tag technology?

Is there really evidence for the rationale concerning inter-specific competition or resource limitation involving juvenile Chinook salmon in the ocean (p. 21, paragraph 4, 1st sentence)? If so, a review of the scientific literature on this topic should be provided.

c. Relationships to Other Projects

The narrative describes several other ongoing acoustic research studies in the Columbia Basin, but only in general terms. There appears to be no contact with researchers working in the estuary, which would be desirable given some of the objectives of the proposed work. The proposal would be improved if attempts to collaborate or coordinate with these programs were described. The limitations of other projects, and how the 2006 project would fill-in those gaps are not clear.

The administrative form lists a substantial amount of current and pending financial support (> $4 million) from other organizations, including the Alfred P. Sloan Foundation, The Gordon and Betty More Foundation, VENUS, NSERC Strategic Grand, Pacific Salmon Commission, the Pacific Fisheries Conservation Council, and USACE (Walla Walla)/USGS. The narrative should include a clear description of relations between the proposed BPA-funded project and the scientific and management objectives and activities of projects funded by other organizations. The proposal narrative should address whether or not BPA funds would be used to support scientific and management activities of these other organizations. Is work under the proposed USACE (Walla Walla)/USGS funded project necessary to successful completion of the proposed 2006 BPA-funded study?

d. Project History

The project history is one of the weakest parts of this proposal. The ISRP assumes that annual progress reports have been provided to BPA, and if so they should be referenced and described along with any published peer-review papers in the proposal narrative. The proposal would be improved if the project history section included a discussion of whether or not the results to date have advanced our scientific understanding of the ocean ecology of salmon and have lead to changes in management or policy. Relevant tables and charts of results from the earlier studies should be included directly in the proposal narrative.

e. Proposal Objectives, Tasks, and Methods

i. Objectives

The narrative does not seem to have a single clearly defined objective, other than a general objective of "getting an ocean array functioning in the northeast Pacific." The specific objectives for this part of this very large objective are spread among the subsections of Section f (beginning on p. 23). Specific comments by the ISRP on these objectives are listed below by the subsection numbers used in the proposal:

1a. Seabed deployment of acoustic receivers on the continental shelf:

The acoustic tag and receiver development seems to have gone well to date, but the ISRP is not convinced that putting the receivers on the seabed is in fact a good idea. For example, how will the proponents prevent trawlers from snagging them? Is a 10% loss per year a reasonable loss rate to assume? In a previous proposal with the floating array (reviewed by ISRP in 2002) a 20% loss was assumed. The 10% loss does not seem to be based on actual data. Loss rates could be much higher if the lines are in a heavily trawled area. Have these areas been mapped out and precautions taken to avoid these areas? Was this criterion used to position the lines? Are special permits required to make seabed installations of equipment? Is there a potential that seabed installation will disturb protected habitats? Dredging in the Columbia River also could be a problem, and mobile sand dunes are not only located off Washington and Oregon (e.g., there are some huge ones in the eastern Juan de Fuca Strait[1]). Generally, it is difficult to evaluate the vulnerability of the bottom receivers from the description given in the narrative. No description of the "extensive parallel R&D effort by the PIs" on the benthic receivers is given, and as

[1] Mosher, D.C., and R.E. Thomson. 2000. Massive submarine sand dunes in the eastern Juan de Fuca Strait, British Columbia. Marine Sandwave Dynamics, International Workshop, March 23-24, 2000. University of Lille 1, France, Proceedings, Trentesaux, A., and Garlan, T. (Eds.), p. 131-142.

a consequence the ISRP must take it on faith that they work. Is there any experience with deployment of other seabed instruments (e.g., geological work) that could be drawn upon? If so, these are not mentioned. This is a valid concern given that all the results to date seem to have been obtained with surface receivers.

2d. Why was a threshold length of 14 cm chosen for the smolts? Is that representative of the release size for Snake River Chinook salmon? Length-weight distribution data should be included for both stocks to be tagged.

2e. Is tag shedding rate in a tank representative of the field?

3b. It is difficult to understand the timing of the telemetering and the recovery of the instruments. The inclusion of a small table or time line plot would be helpful.

4d. The method proposed to calculate tag "efficiency" is not clear. It seems that the efficiency of the acoustic tags will be assessed relative to pit tags, but how will the efficiency of the pit tags be incorporated into this calculation?

ii. Methods and Tasks

The target species listed on the administrative form are *Acipenser transmontanus* (white sturgeon), *Oncorhynchus kisutch* (coho salmon), *O. mykiss* (steelhead), *and O. tshawytscha* (Chinook salmon), however, proposed monitoring and evaluation methods in 2006 are limited to tagging of only two stocks of Columbia River hatchery spring Chinook salmon (Hanford, Snake R.). The narrative should include at least a brief description of studies of other species planned for future years.

The choice of Carson stock spring Chinook salmon from Leavenworth Hatchery needs to be justified by coded-wire tag or PIT tag results that demonstrate this stock is equivalent to the listed Evolutionary Significant Unit (ESU) that is the subject of the Columbia versus Snake River contrast.

The proposed deployment of acoustic receivers in 2006 consists of eight Columbia Basin (freshwater) locations and ten "ocean listening line" positions. The arrays have been primarily tested in fairly narrow channels; more information is needed on how well the arrays have tracked or will track juvenile salmon on broader areas on the shelf. The lines on the open coast will extend to the 200-m depth contour marking the edge of the continental shelf (p. 11, last line), which is expected to cover the majority of the observed cross-shelf distribution of Chinook salmon. Does this statement refer to Chinook salmon in general or only to ocean-type fish? The arrays deployed in the Columbia River and along the outer coast are expected

to provide most of all of the data on Columbia River spring Chinook salmon movements. Therefore, the ISRP advises that at least four of the proposed ocean array positions (nos. 3, 5, 6, and 7, Table 1, p.12; Fig. 5, p. 13) are not relevant to specific project goals in 2006 (measure relative survival and movements of Columbia R. spring Chinook salmon) or to the conceptual model of coastal ocean migration paths of juvenile Columbia R. salmon (depicted in Fig. 2, p. 10). Furthermore, the apparent lack of acoustic receivers to track downstream migrant spring Chinook salmon as they move through reservoirs behind the dams, freshwater tidal areas below Bonneville Dam, the Columbia R. estuary, and Columbia R. Plume limits the utility of the study to "evaluate relationships between ocean entry timing and SARs for transported and downstream migrants" (BiOp Action 193, habitat). The ISRP advises that ocean arrays should be concentrated near the Columbia River because migration pathways and associated uncertainties about ocean survival are key in this area.

The narrative needs to better describe tag effects. The size (22 mm x 9 mm diameter) and weight (2 gm in water) of the acoustic tag to be implanted in yearling spring Chinook salmon is still cause for concern. The tags are too large for small fish. Only large smolts (>14 cm) can be tagged, which would limit the utility of the acoustic technology to investigate ocean migration and survival of small salmon (e.g., subyearling fall or ocean-type Chinook salmon) that migrate to the ocean in their first year. Will results be biased because large smolts have different migratory timing and behaviors than smaller smolts? For a yearling Chinook salmon smolt (~ 140 mm FL and weighing ~ 20 g) the tag would be amount to ~10% the weight of the fish. A recent tag effects study (Perry et al. 2005)[2] indicates that reduced swimming performance of radio tagged juveniles occurred when tag weight relative to total fish weight exceeded 5%. As a result, the reliability of data on migration and behavior from the tagged fish is questionable. For birds, tags that weigh 3% of total body weight are the limit.

Another concern, which may be related to tag effects, is how long the tag will continue to transmit reliable data following release (up to 3.5 mos. ?). A study comparing migration rates and survival between radio-tagged and PIT tagged juvenile Chinook salmon concluded that radio-tagged juvenile Chinook salmon could provide reasonable estimates of travel rate and survival comparable to PIT tag estimates as long as the duration did not exceed approximately 6 days (Hockersmith et al. 2003).[3] What provisions have been made to ensure that

[2] Perry et al. 2005. USGS Presented at COE Annual AFEP Review, Walla Walla, WA, November 2005.
[3] Hockersmith et al. 2003. Comparison of migration rate and survival between radio-tagged and PIT tagged migrant yearling Chinook salmon in the Snake and Columbia Rivers. North American Journal of Fisheries Management 23:404-413.

released Snake River tagged fish are or are not transported on barges? Is there part of the study design that considers comparing transport vs. in-river options?

2. Does the Project have Provisions for Monitoring and Evaluation?

The project clearly has provisions for monitoring – as a research program this is how the data are obtained. The objectives of the proposed monitoring and evaluation are to "measure directly the comparative movement and survival of Snake & Upper Columbia R. spring Chinook salmon, and measure their: (1) relative migratory pathways; (2) survival by region; (3) duration of residence in various sections of the Columbia R/estuary and marine environment." However, if investigators are not able to identify fish when they return as adults, then how will uncertainties about migration or mortality be resolved? For example, if a juvenile fish is detected at array A and never arrives at array B, is the fish presumed to be dead, or still resident in the coastal ocean area between A and B, or did it migrate off the continental shelf to the open ocean?

Of 1000 fish to be tagged and released during this study, an estimated 50 fish would still be alive in August to assess the extent of ocean migration of the two stocks. Project sponsors do not fully discuss how analyzing and interpreting the data will be affected by the numbers of fish tagged and monitored by the array. The costs (50 fish @ $1.5 million) and risks of failure of the proposed pilot study seem high. The proposal states that only 50 fish per day can be tagged, which means that it will take 20 days to tag all of the fish for this study. The ISRP assumes the rate of tagging could be increased with additional workforce. Some new listening devices deployed in the 2004-05 demonstration project have already failed, and some already need to be updated and replaced. If some of these problems cannot be improved in the next couple iterations of this technology, it will have reduced applicability.

Information on how the data will be analyzed statistically to test the hypothesis of Schaller et al. (1996? or is this an error? p. 27), as well as to estimate migratory movements, rates of mortality, and areas of ocean residence, is not provided. The design of the data analysis is deferred until the numbers of fish that are actually detected is known. The proponents could provide a more thorough appraisal of what can be interpreted from the evaluations as a function of the detected history of the project.

f. Facilities, Equipment, and Personnel

Facilities are not adequately described in the proposal narrative.

The principal investigator and program manager are well-qualified scientists in the field of fisheries-oceanography. The descriptions of their roles in the project should be moved from the attached resumes to the proposal narrative. Because of the substantial amount of current and pending funding from other organizations, the ISRP requests a breakdown of the percentages of time that key personnel will devote to the proposed BPA-funded portion of the study in 2006. The team could be improved by the addition of an expert on hydroacoustic engineering. The ISRP requests specific information on the roles John K. McKern and Erin Rechisky in the project, including information on the name of the university where Erin Rechisky is enrolled for her Ph.D. work.

The ISRP lacks the engineering expertise needed to evaluate whether the proposed benthic acoustic equipment is adequate to accomplish the proposed study and recommends further review of engineering specifications, calibration, and performance. The ISRP is also concerned about whether these heavy (500 lb) devices can be successfully deployed and retrieved along the outer continental shelf. Use of a ROV and side scan sonar (SSS) to find a lost unit may be like "looking for a needle in a haystack" unless a failed unit also sends a signal. The assumption seems to be that it will send a signal, but no statement to that effect is given. ROV and SSS are expensive technologies, and would add significantly to the overhead of full-scale implementation.

g. Information Transfer

Provisions for information transfer of data from the POST tracking array are clearly stated on the administrative form, but need to be described in greater detail in the narrative.

3. Benefits to Fish and Wildlife (Proposal as a whole)

There could be major benefits to Columbia Basin salmon from this project if funding is sustained over the next 5 years. Over the short term, however, the only benefit is incremental information and experience toward the long-term goal. The ISRP advises that full benefits would require oceanographic forecasting or simultaneous surveys in order to synchronize fish release with optimal oceanographic conditions. This would have to include routine examination of environmental conditions in the northeast Pacific and Gulf of Alaska. This is a concept somewhat similar to the plankton watch program that was used in Japan to time chum salmon fry release from hatcheries to

coincide with maximum plankton biomass in the coastal zone. Is this the long range plan? One immediate benefit is that mortality of salmon from traditional ocean survey methods (e.g., surface trawls) will be avoided with the acoustic tag approach.

4. Consistency with Power Act Amendment Criteria:

1. Sound Science Principles	Yes (qualified)
2. Consistent with Program	Yes (qualified)
3. Benefit to Fish and Wildlife	Yes (qualified)
4. Clearly defined Obj. and Outcome	Yes (qualified)
5. Provision for M&E	No (qualified)

The "No" score on provisions for M&E reflects the lack of consideration of confounding of mortality and undetected migration paths, and statistical rigor if few smolts are detected. This might be dealt with in a "fix-it loop."

ISRP Recommendation

The major rationale for this project is the need for information on ocean movements and area-specific estimates of marine survival of juvenile salmon. The ISRP concludes that the proponents have a somewhat simplistic view of the problem when they state that they "should be able to provide testable scientific results on whether the different survivals of Upper Columbia and Snake River Chinook salmon stocks is due [to] these stocks residing in different regions of the coastal ocean" (p. 2). The ISRP advises that it will take a comprehensive ecological program to show any cause and effect or relation beyond a geographic correlation. The length of time an organism spends in a habitat or water mass may or may not be directly proportional to its survival. The ISRP agrees, however, that establishing residence time of various Chinook salmon populations in different water masses is a key piece of data to obtain. This is the type of project that will require constant heavy funding in the future in order to show that it is indeed based on good science (i.e., improve understanding/prediction of Columbia salmon production). To date, however, the project seems to be based in good technology at least in the initial phases.

The ISRP finds the project fundable in part (for 1 year) at a reduced level of funding and deployment of the proposed acoustic tracking array (restricted to the Columbia River Basin and Plume). A response loop is requested to address ISRP comments and recommendations. The ISRP does not recommend funding for the proposed deployment of benthic acoustic receivers until further details are given on this method.