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November 2, 2006

MEMORANDUM

TO: Council Members

FROM: Jim Ruff
Erik Merrill
Steve Waste

SUBJECT: Council decision on Comparative Survival Study (CSS) review

SIGNIFICANCE

At the October Council meeting in Helena, Montana, the Council deferred a final FY 2007-09 funding recommendation for the Comparative Survival Study (CSS) project, formally known as PIT-tagging spring/summer Chinook Salmon (Project No. 199602000). A majority of the Council members agreed to the idea of a comprehensive scientific and policy review of this project during FY07-09, and then asked the staff to frame a discussion for the Council at the November meeting as to how to undertake that review and how to proceed with the project in the interim. That is the purpose of this memorandum. It includes a staff recommendation for interim funding for this project in FY 2007 with out-year funding contingent on the results of a review by the Independent Scientific Advisory Board and the Council of a CSS retrospective summary report and the project's analytical approach.

RECOMMENDATION

1) Prepare a CSS Summary Report. The staff agrees with the direction that the Council was already heading -- that the CSS project sponsors prepare a ten-year retrospective report on the CSS study. This is consistent with one of the major ISAB/ISRP comments on this project in past reviews. This retrospective summary report should include an in-depth description of the project's methods, analytical approaches used and interpretation of all the project's past data. The project's total budget to prepare the retrospective report and the 2007 annual report is about \$182,700. Staff is confirming that the cost for completing only the retrospective report could be less than \$100,000.

The project sponsor reported that May 2007 would be the earliest they would be able to complete a draft of the summary report. The sponsor's usual practice with CSS reports is to seek public review and comment before finalizing a report, and staff recommends that they follow this practice with the retrospective report. The sponsor would thus post the draft on the web and make it available to the region for a 30-day review and comment period. The project sponsor would then consider and incorporate (or respond to) comments and prepare the final ten-year retrospective report, which the sponsor indicates could be completed by July 2007.

2) Review of the CSS retrospective report by the ISAB and the Council. The ISAB would then review the CSS retrospective report. The staff estimates that the science review could be completed by September 2007. One ISAB member familiar with the 2006 CSS review indicated to staff that there is little, if anything, new for the ISAB to review and consider prior to getting the summary report, which is expected to address many of the earlier ISAB and ISRP review comments and recommendations on this project (pers. communication, Tom Poe). The ISAB review of the CSS retrospective report is expected to include a science review of "an in-depth description of methods and data analyses" used by the CSS and "interpretation of [all] the [past CSS] data in a retrospective style." Over the next few months we will be able to sharpen the precise nature of the scientific review that the Council is after, including framing a set of questions for the ISAB to answer, and do so in consultation with the other members of the ISAB oversight committee.

Once the ISAB completes its review, the Council will then take up its review of the project, the retrospective report, the ISAB review report, and other relevant material and frame a recommendation for this project for FY08 and beyond. Staff anticipates that the Council will decide on the future years' funding, objectives and approach based largely on the outcome and recommendations of the ISAB in its review of the CSS retrospective report.

3) PIT-tagging for 2007. One point discussed but not resolved at the October Council meeting concerned CSS PIT-tagging in 2007. Would the tagging continue? Which groups of fish would be tagged? Who would do the tagging? While the project sponsor is preparing the CSS retrospective report and the report is under review, the staff recommends that the PIT-tagging and releases continue as in past years, that is, that similar numbers and groups of fish be tagged in 2007 as were marked in 2006. The project sponsor has indicated that the cost of tagging similar numbers and groups of fish in 2007 is \$1,026,130. In the course of our review of the CSS project, we learned that some of the planned PIT-tagging had been funded through another project in FY2006. This causes the total cost of the planned tagging program in 2007 to be higher than the Council's draft recommended budget of \$765,000. If the CSS project is held to the Council's draft recommended budget level, the project sponsor has commented that the project "would not be able to maintain the long-time series of marking for the Snake [River] and down river Chinook hatchery programs." Staff is undertaking additional analysis for discussion at the Council meeting.

This cost estimate includes the cost of all PIT-tags, cost of PIT-tagging, and all tagging coordination, data collection and data dissemination efforts. The tagging (or more precisely, the information gained from the fish tagged in the CSS study) is important not just to the CSS study itself but also to various other projects, as briefly discussed below.

4) Analysis of the results of the tagging in 2007 and subsequent work. The CSS project proposal includes work elements and project budgets not only for the reporting, tagging, collection and data dissemination work discussed above, but also for analysis based on the results of the tagging. It is the sense of the staff from the Council's discussion in Helena to defer any commitment of funds for analysis next fall by the project sponsor of the results of the 2007 tagging -- that all aspects of the project beyond preparing the retrospective report and the tagging and data dissemination in 2007 is contingent on the results of the review. Is this a correct assumption? If so, the staff recommends continuing to hold the rest of the proposed funding for this project in the CSS placeholder until that final resolution.

BACKGROUND

The Comparative Survival Study (CSS) was initiated in 1996 as a multi-year program of the fishery agencies and tribes to estimate survival rates over different life stages for spring and summer Chinook salmon produced in major hatcheries the Snake River basin and from selected hatcheries in the lower Columbia River.

The major objectives of the CSS include: (1) develop a long-term index of transport smolt-to-adult return rates (SARs) and in-river SARs measured at Lower Granite Dam for Snake River hatchery and wild spring/summer Chinook smolts; (2) develop a long-term index of survival rates from release of smolts at Snake River hatcheries to return of adults to the hatcheries; (3) compute and compare the overall SARs for selected upriver and downriver spring and summer Chinook hatchery and wild stocks; and (4) begin a time series of SARs for use in hypothesis testing and as part of a regional long-term monitoring and evaluation program.

In recent years the CSS PIT tags and annually releases more than 200,000 smolts from Snake River hatcheries (e.g., Dworshak, McCall, Rapid River, Catherine Creek and Imnaha) and currently 15,000 smolts from a downriver hatchery (Carson NFH). In addition, the CSS provides over 27,000 PIT-tags for wild Chinook and wild steelhead to augment various on-going trapping and tagging operations in the Snake River basin. Beginning in 2002, and based on the recommendation of the Council's Independent Scientific Review Panel (ISRP), the CSS increased releases of PIT-tagged wild Chinook in the Snake River basin and coordinated with other researchers to route more detected wild Chinook into transportation for subsequent use in the CSS. These PIT-tagged smolts from the Snake River basin are detected in the bypass and collection systems at mainstem Snake and Columbia River dams and either diverted into transportation or bypassed to the river according to the annual study design.

To augment the downriver mark groups, the CSS also provides 12,000 PIT tags for wild Chinook and steelhead tagging in the John Day River. This study is designed to be cost-effective by coordinating each year with other PIT-tagging efforts and utilizing other mark groups wherever possible. As noted above, this tagging was previously funded through another project in the Columbia Plateau province.

Data from the CSS mark groups of fish are used for many other applications. For example, state fish and wildlife agencies use the CSS mark groups for planning and implementing fishery management actions, projecting numbers of returning adults to the hatcheries using overall SARs. The U.S. v Oregon Technical Advisory Committee uses the mark groups to determine

conversion rates between dams. In addition, NOAA Fisheries uses the CSS-tagged fish to improve the precision of their reach survival estimates for the FCRPS biological opinion analysis. Finally, the analysis of specific hatchery mark groups is utilized by hatchery managers to evaluate the effectiveness of their hatchery programs. CSS therefore supports a broad range of projects both within and outside of the program. Appendix B provides a partial list of studies utilizing CSS-related PIT-tag data in some form or another.

ATTACHMENTS

Excerpts and links to past ISAB and ISRP review comments, and related recommendations, of the CSS can be found in Appendix A. A partial list of studies or publications utilizing CSS-related PIT-tag data is shown in Appendix B.

Appendix A: ISAB and ISRP Comments on Comparative Survival Study Proposals and Experimental Designs 1997-2006

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ISRP and ISAB Comments on CSS Proposals

ISRP 2006-6: FY 2007-09 Review (August 31, 2006)

Final Recommendation and Comments

www.nwcouncil.org/library/isrp/isrp2006-6.htm

199602000 - Pit Tagging Spring/Summer Chin

Sponsor: Columbia River Fisheries Program Office

Province: Mainstem/ Systemwide **Subbasin:** Systemwide

Budgets: FY07: \$1,757,000 FY08: \$1,788,425 FY09: \$1,831,615

Short description: Adult and juvenile PIT tag recovery data are analyzed to compare survival estimates for transported fish of known origin, downriver stocks, wild and hatchery transported fish and fish handled and not handled at dams.

ISRP final recommendation: Fundable (Qualified)

Comment (from response loop):

The response by the project sponsors was adequate, and they agreed with all ISRP comments and recommendations that were mostly taken from the recent ISAB review report (ISAB 2006-3). One of the major recommendations in that report was that the 10-year ongoing Comparative Survival Study (CSS) project lacked a holistic perspective and needed a summary report providing an in-depth description of methods and detailed analyses and interpretation of the data in a retrospective style.

The CSS project responded that they would produce such a report in 2007. As most of the comments and recommendations in this review will be addressed in that report, it is critical that the ISRP/ISAB be involved in review of that report when it is released.

The ISRP agreed with critics who express concern that two downriver sites (Carson Hatchery and John Day River) are probably insufficient to give accurate upriver-downriver comparisons of SARs. This concern is bolstered by the variability among upriver hatcheries shown by the CSS data. For this upriver-downriver comparison to be generally accepted, it seems prudent to add more downriver sites in the future. In response, the CSS will add another downriver site in the Warms Springs River for wild Chinook tagging for 2007 to complement the ongoing tagging in the John Day River. This is a positive action, however, additional downriver hatchery sites are even more important to add because at this time, five upriver hatcheries are being used as tagging sites and only one downriver. There needs to be better hatchery to hatchery comparisons, and adding several lower river hatcheries which show a range in return rates will provide a more realistic comparison in survival rates.

If additional downriver tagging sites are to be added to the CSS, the project sponsors indicate that more funding must be made available, and the ISRP agrees that the budget will need to be adjusted accordingly.

Reporting of results by the project has been good with Annual Reports to BPA for each year of the project. There is potential for production of peer reviewed papers considering project results and this should be considered in the near future.

Preliminary Recommendation and Comments (June 2, 2006)

www.nwcouncil.org/library/isrp/isrp2006-4.htm

199602000 - Pit Tagging Spring/Summer Chin

Sponsor: Columbia River Fisheries Program Office

Province: Mainstem/Systemwide **Subbasin:** Systemwide

Budgets: FY07: \$1,757,000 FY08: \$1,788,425 FY09: \$1,831,615

Short description: Adult and juvenile PIT tag recovery data are analyzed to compare survival estimates for transported fish of known origin, downriver stocks, wild and hatchery transported fish and fish handled and not handled at dams.

Recommendation: Response requested

In general, this is a supportable proposal but a response is needed to address issues raised in the ISAB's recent report: Review of the 2005 Comparative Survival Studies' (CSS) Annual Report and Applicability of Comparative Survival Studies' Analysis Results. See www.nwcouncil.org/library/isab/isab2006-3.htm.

Specifically, the proponents should respond to the following selected recommendations from the ISAB report (which was issued after this proposal was submitted):

1) It has been ten years since the CSS was initiated. The report that the ISAB reviewed was the latest in a series of annual progress reports, and thus lacking a holistic perspective. The ISAB recommends that the CSS produce a ten-year summary report providing an in-depth description of methods and detailed analyses and interpretation of the data in a retrospective style.

2) The CSS needs to more effectively present the methodologies used in their analyses (in this proposal as well as their annual report), so the criticism of complicated and convoluted formulas can be avoided. The scattered explanations in several annual progress reports could be consolidated in the ten-year summary recommended above.

3) The ISAB agrees with critics who express concern that two downriver sites (Carson Hatchery and John Day River) are probably insufficient to give accurate upriver-downriver comparisons of SARs. This concern is bolstered by the variability among upriver hatcheries shown by the CSS data. For this upriver-downriver comparison to be generally accepted, it seems prudent to add more downriver sites in the future.

4) Data on size of all PIT-tagged fish from hatcheries and other release sites should be included in the report in much greater detail. Size at release may be a significant factor in differential SARs. The ISAB recommends including a specific section in the report focusing on the potential effects of size at release on survival of all PIT-tagged fish.

5) Assumptions inherent in the analyses should be specifically tested, with continued vigilance toward avoiding bias.

6) Pre-assigning the intended routes of passage at the time of release into in-river and transport groups would greatly simplify calculation of SARs and eliminate much criticism of current methods that are unnecessarily complex. This modification to the study design is scheduled for implementation in 2007 (according to the 2005 Annual Report but this change in protocol should be indicated in the proposal).

7) Analyses could emphasize more diverse metrics of differential survival, thus avoiding the criticism that the project staff focuses mainly on contentious issues such as the relative survival of transported and in-river migrants (T/C ratios) and differential delayed mortality between transported and in-river migrants (D). Passage routes, numbers of dams bypassed, distance from ocean, different hatchery practices, and other features have been explored beyond the issue of transportation.

Other comments:

A timeline with years (1996 - current) should be included within the background section to improve the proposal. Details in this section are sparse and references are lacking. The proponents either assume that the reviewers know all the background and justification for this project or decided not to go through the work needed to provide the details.

The project history section consists of only a few sentences and is lacking sufficient detail to provide project accomplishments and give adequate justification for continued support. For such a long-running project there have been a number of important accomplishments and completed documents that need to be listed in this section.

Please refer to proposal #s 199102900, 199302900, and 198605000 for examples of proposals for long-running projects that have clearly laid out study designs and protocols, project histories with adequate detail, and strong justification for continued support.

ISAB 2006-3: The 2005 CSS Annual Report and Applicability of CSS Analysis Results (March 15, 2006)

www.nwcouncil.org/library/isab/isab2006-3.htm

Executive Summary

On December 20, 2005, the Council requested that the Independent Scientific Advisory Board (ISAB) review the 2005 Annual Report for the Comparative Survival Study (CSS) prepared by the Fish Passage Center (FPC) and the Comparative Survival Study Oversight Committee, as well as critical comments on the draft of that report by the Bonneville Power Administration (BPA) and NOAA Fisheries. The CSS is a field study, begun in 1996, that addresses important and technically complex issues regarding the survival of PIT-tagged Spring/Summer Chinook and PIT-tagged Summer Steelhead through the Columbia River hydrosystem from juveniles through returning adults. The study focuses on relative survival of fish that traveled downstream as juveniles by alternative routes (e.g., in river, transported, different routes of dam passage, and different numbers of dams passed). The results can have important implications for operation of the hydrosystem to ensure protection and propagation of anadromous salmonids. The Council expressed a desire to aid resolution of disputes over the study by obtaining the ISAB review.

The Council asked that the ISAB assess the overall integrity and scientific soundness of the CSS report and address the following specific questions:

- 1. Are the design, implementation, and interpretation of the statistical analyses underpinning the report based on the best available methods? Does the ISAB have suggestions for improving the analyses?*
- 2. What is the applicability of the CSS results, taking into account whatever scientific criticisms of the analyses that the ISAB decides are valid, if any? In other words, what weight should the analyses be given and what qualifiers should be considered when using the analyses for decision-making?*

The ISAB accepted the assignment on January 12, 2006 and received a briefing on the CSS Annual Report from the study's Principal Investigators on January 27th. The ISAB considers that there are two parts to this review: (1) review of the 2005 CSS Annual Report and (2) a determination of the utility of the CSS comparative survival estimates for various management and hydrosystem operational decisions.

The ISAB finds that the CSS is an ambitious, long-term study that is being criticized because its objectives are not yet fully met, despite prodigious efforts in both the field and in complex data analyses. The CSS has used the PIT-tag technology to mark and track individual salmon and steelhead through their smolt-to-adult life stages. Expectations of this mark-recapture technology exceed the results that are practically attainable, and its use is still evolving. The CSS study participants have been major players in this evolution. We find the present annual report to be a further incremental step in the direction of documenting different survival rates of different stocks under different migration conditions. That the present report is not a perfect reconstruction of differential survival histories is largely a result of the current analytical capabilities and available sample sizes. The deficiencies seem to be highlighted in some aspects because of experimental design and analytical approaches taken by the authors. The ISRP comment from their 2002 review still applies that "the formulas [used to compute relative survival rates] are complicated, convoluted, and in general, very unsatisfactory from a statistical point of view."

Specific Responses to the Council's Questions

1. Are the design, implementation, and interpretation of the statistical analyses underpinning the report based on the best available methods? Does the ISAB have suggestions for improving the analyses?

All in all, the design, implementation, and interpretation of the *statistical analyses* underpinning the report are very good. Nonetheless, there are broader concerns over the design of the study such as sample size, sampling sites, time periods for analyses, and other features. Improvements can be made, and our recommendations follow.

Since the region is unwilling to conduct the manipulative experiments in the hydrosystem that the ISAB and ISRP have recommended for many years, the CSS is doing the next best thing. That is, the study is following as many fish through their life cycle as possible, calculating the survival, and comparing outcomes.

2. What is the applicability of the CSS results, taking into account whatever scientific criticisms of the analyses that the ISAB decides are valid, if any? In other words, what weight should the analyses be given and what qualifiers should be considered when using the analyses for decision-making?

The ISAB believes the Council should view the CSS as a good, long-term monitoring program, the results of which should be viewed with increasing confidence as years pass. Under scrutiny from periodic peer reviews and agency comments, the methods should improve and the results become ever more valuable. The project is definitely worthy of Council support.

The Council's question is difficult to answer with the present annual progress report. The project needs a synthesis report that clearly describes the analytical methods and summarizes the project results in a holistic way for its decade of effort.

The ISAB recognizes there is a disconnect between the present status of results and much of the decision-making that takes place regarding hydrosystem operations and fish protection. Although the project is making good progress at addressing such issues as the value of transportation and the relative survival from different passage routes, many relationships between survival and specific operational alternatives or environmental features during migration cannot be resolved when data are aggregated simply by year of migration. For this information to be most useful for making management decisions, aggregations of data within years and across years for different operational options and environmental constraints should be pursued. We encourage the project to move in that direction.

The results of the CSS appear to indicate that PIT-tagged fish do not have the same survival rate as untagged fish. This conclusion is not emphasized by the current progress report, but it has major implications for many uses of the PIT-tag technology. Comparisons among PIT-tagged groups of fish are probably appropriate, but extrapolations of the results from PIT-tagged fish to untagged populations should be made with caution.

Recommendations

- It has been ten years since the CSS was initiated. The report the ISAB reviewed was the latest in a series of annual progress reports, and thus lacking a holistic perspective. The ISAB recommends that the CSS produce a ten-year summary report providing an in-depth description of methods and detailed analyses and interpretation of the data in a retrospective style.
- The CSS needs to more effectively present the methodologies used in their analyses so the criticism of complicated and convoluted formulas can be avoided. The scattered explanations in several annual progress reports could be consolidated in the ten-year summary recommended above.
- The ISAB agrees with critics who express concern that two downriver sites (Carson Hatchery and John Day River) are probably insufficient to give accurate upriver-downriver comparisons of SARs. This concern is bolstered by the variability among upriver hatcheries shown by the CSS data. For this upriver-downriver comparison to be generally accepted, it seems prudent to add more downriver sites in the future.
- Data on size of all PIT-tagged fish from hatcheries and other release sites should be included in the report in much greater detail. Size at release may be a significant factor in differential SARs. The ISAB recommends including a specific section in the report focusing on the potential effects of size at release on survival of all PIT-tagged fish.
- Aggregation of data solely by juvenile migration year should be supplemented with analyses that group data on environmental and operational factors that may be amenable to control.
- Assumptions inherent in the analyses should be specifically tested, with continued vigilance toward avoiding bias.
- Pre-assigning the intended routes of passage at the time of release into inriver and transport groups would greatly simplify calculation of SARs and eliminate much criticism of current methods that are unnecessarily complex. This modification to the study design is scheduled for implementation in 2007, but should begin in 2006, if feasible.
- Analyses could emphasize more diverse metrics of differential survival, thus avoiding the criticism that the project staff focuses mainly on contentious issues such as the relative survival of transported and in-river migrants (T/C ratios) and differential delayed mortality between transported and in-river migrants (*D*). Passage routes, numbers of dams bypassed, distance from ocean, different hatchery practices, and other features have been explored beyond the issue of transportation.
- The CSS should be supplemented by funded research into analytical methods that can improve, and hopefully simplify, the mathematical and statistical approaches currently in use. It is not clear from available information whether the problem is that the formulas are unnecessarily complicated, inappropriately specified, or just not well explained (see bullet #2 above).

- More attention should be given by the CSS and the region as a whole to the apparent documentation that PIT-tagged fish do not survive as well as untagged fish. This point has major implications for all uses of PIT-tagged fish as surrogates for untagged fish.

ISRP 2002-14: Final Mainstem and Systemwide Review (November 6, 2002)

www.nwcouncil.org/library/isrp/isrp2002-14.htm (See pages 62-73 for comments on the set of smolt monitoring projects.)

ProjectID: 199602000

Comparative Survival Rate Study (CSS) of Hatchery Pit Tagged Chinook & Comparative Survival Study Oversight Committee

Sponsor: PSMFC & CBFWF

FY03 Request: \$1,742,776

5YR Estimate: \$9,497,683

CBFWA Adjusted FY03: \$1,736,542

3YR: \$5,420,981

Short Description: Adult and juvenile PIT tag recovery data are analyzed to compare survival estimates for transported fish of known origin, downriver stocks, wild and hatchery transported fish and fish handled and not handled at dams.

ISRP Final Comments:

Fundable (Qualified), agree with CBFWA's Core Program ranking, but some reallocation of effort for mathematical and statistical research, as indicated in the following, should be worked out by the Council during the project selection process and implemented by BPA in the contracting process. The response provided adequate details on monitoring activities, and connections with other projects such as 35033. If 35033 is funded then the functional melding of 35033 with the CSS is likely assured.

A subcommittee of the ISRP met with representatives of the Comparative Survival Study (CSS) in Seattle on September 24, 2002. We appreciate the sponsor's willingness to meet and discuss the technical issues of the design and analysis of the study. The long-term solutions to the mathematical and statistical problems in estimation of smolt-to-adult return rates (Bonneville to Bonneville and Bonneville to Low Granite SARs) appear to be: 1) detection of sufficient numbers of PIT tagged juveniles passing Bonneville No. 2 Dam at the planned corner collector, estimates of mortality of fish passing via that route, and/or 2) sufficiently large sample sizes of PIT tagged fish downstream of Bonneville. The ISRP recommends that these sampling efforts for PIT tagged juveniles be given high priority by the Council and the Corps of Engineers. In particular, task 2 of proposal 198331900 from NMFS for development of PIT tag detection in the corner collector at Bonneville No. 2 Dam should be given high priority.

Various scientists in the region, in particular scientists from the CSS project and NMFS, have considered the problems in estimation of the LGD to LGD SARs from currently available data and have apparently arrived at what they consider to be the "best" formulas. Unfortunately, the formulas are complicated, convoluted, and in general, very unsatisfactory from a statistical point of view. There is high probability that the complicated, convoluted methods will continue to spawn arguments and counter arguments over trivial issues that will occupy the resources of the region, because the stakes are high (e.g., high costs of spill, high costs of transportation, unknown long term effects of the non-normative transportation, high costs of augmented flow, etc).

We do not provide unqualified endorsement of the particular estimation formulas that are proposed, and we recommend that continuing statistical methods research be directed at investigating the performance of various proposed estimators and possible alternatives, including but not limited to the proposed methods and planned bootstrapping. Such research on mathematical and statistical methods could be pursued by the sponsors of this project, and by others. As an aid to clarity in comparison among possible alternative analyses, we recommend that the FPC make available a single reference data set which includes all the necessary interpretation of route of passage of PIT tagged fish and culls any suspect or ambiguous data that might be subject to further interpretation. The budget for the recommended mathematical and statistical analyses is relatively minor compared to the total cost of the project so investigation of our unresolved questions about statistical methods should not require substantial reallocation of the budget in this project.

ISRP 1999-2A: Review of FY 2000 Proposal (June 15, 1999)

www.nwcouncil.org/library/isrp/isrp_99-2.pdf

ProjectID: 8712702

Comparative Survival Rate Study (CSS) Of Hatchery Pit Tagged Chinook

Pacific States Marine Fisheries Commission

Short Description: Adult and juvenile PIT tag recovery data are analyzed to compare survival estimates for transported fish of known origin, downriver stocks, wild and hatchery transported fish and fish handled and not handled at dams.

ISRP Recommendation - Fund for 1 YR / CBFWA Tier 1 / ISRP Comparison with CBFWA: Agree-fund

Sponsor Funding Request = \$936,201 / CBFWA Funding Recommendation = \$936,201

Recommendation:

Fund for one year. Subsequent funding contingent on programmatic review. This entire set of smolt monitoring projects needs to receive a programmatic review with one of the goals to develop and justify a program-wide design that really is capable of delivering enough data, of high enough precision, to answer the management questions.

Comments:

The proposal adequately describes the connection of the work to the PATH recommendations. The need for addressing the problem is clear. The objectives are clearly stated but not all expected outcomes are well defined. More details are necessary for the project design, specific tasks to meet the objectives, and provisions for evaluating the results. In particular, objective 5 to evaluate growth patterns is vague and the expected outcomes are not clear. The project is scientifically sound regardless of the uses intended by the authors for the data. It is an effective application of the PIT tag technology to hatchery fish prior to release that produces survival and behavior information through the hydroelectric system and beyond to points down river such as Rice Island. This project has created the most extensive PIT tag data set in the basin. The data can be used to evaluate the efficacy of program measures, such as juvenile transportation, and survival of hatchery fish to the point of entry into the hydroelectric system. The data set has the potential to permit at least a qualitative comparison of juvenile survival by passage route; spill, turbine, and bypass. These data are expected to help decide critically important management issues on the use of spill and transportation in salmon recovery. Based on the proposal, it is not clear that the design is adequate. They need to explicitly address adult recovery localities and methods. Specifically, they need to examine nearby

spawning localities outside the hatcheries for the presence of tagged fish. It is good that they make attempts to address sampling and study design.

ISRP 1998-2A: Review of FY 1999 Proposal (June 18, 1998)

www.nwcouncil.org/library/isrp/isrp_98-1a.pdf

Comparative Survival Rate Study (CSS) of Hatchery Pit Tagged Chinook 8712702

ISRP Evaluation: Adequate

ISRP reviewers note the considerable aggregate cost of this and related efforts in what is presently the third year of a long-term program.

ISAB 98-1: Review of Comparative Survival Rate Study of Hatchery PIT Tagged Chinook (January 6, 1998)

www.nwcouncil.org/library/isab/isab98-1.htm

Introduction

To review the chronology of the project from the ISAB perspective, the Council first requested review in December 1996. The first ISAB review, entitled Report of the Independent Scientific Advisory Board Regarding a Research Proposal for Inclusion in the 1997 Smolt Monitoring Program, was provided in January 1997.¹ Subsequently, a subcommittee of the ISAB met with the project scientists in Spokane in April 1997. An oral report of the technical meeting was given to the Council at its Spokane session the day following. In May 1997 two members of the ISAB subcommittee made a site visit to Lower Granite Dam to view sampling procedures and methods during the emigration of tagged fish. The present report is submitted in response to a request from the Council submitted in October 1997.

.....

Findings

- The number of PIT tags to be applied is appropriate to the purposes of the study.
- The utility of PIT tagging now and in the future goes beyond the immediate purposes of this study. Annual PIT tagging of similar numbers of juvenile salmon as a basis for management of the hydroelectric system is advisable.

Points of concern

- Questionable comparability of results on hatchery spring chinook to those that would be obtained from naturally produced spring chinook, other chinook life history types, and other life history types of other species of salmon, increases the uncertainty of advice given to managers.

¹ See ISAB 1997-2: www.nwcouncil.org/library/isab/isab97-2.htm.

- The two hatcheries most distant from the hydroelectric system in the 1997 study, Pahsimeroi and McCall, are not proposed for tagging in 1998. Loss of information on geographic variation in survival to Lower Granite Dam that could be important to management should be avoided.
- Comparability of survivals of PIT tagged juvenile salmon relative to survivals of juveniles not PIT tagged is unknown.
- The present suite of survival estimation programs, including this project, does not provide estimates of survival applicable to the entire Snake-Columbia River federal hydroelectric system.
- Coordination and cooperation among agencies applying PIT tags and other marks may not be sufficient to insure the maximum return on the tagging dollar.

Recommendations

1. Fund the proposed study.
2. So long as the present configuration and operation of the federal hydroelectric system exists, extend (or continue) PIT tagging to include naturally reproducing populations of spring chinook whenever population sizes may permit. Continue PIT tagging other chinook life history types, and extend PIT tagging to other life history types of other species of salmon, including steelhead, whenever possible.
3. Apply enough PIT tags to spring chinook production from Kooskia, Pahsimeroi, McCall, Sawtooth, and Clearwater (Powell, Crooked River and Red River Ponds) hatcheries to estimate survival to Lower Granite Dam. Whenever possible apply enough PIT tags to spring chinook at these hatcheries to estimate survivals to McNary Dam.
4. Compare rates of return to each hatchery of PIT tagged and untagged adults to establish degree of comparability of survivals of PIT tagged juvenile salmon to survivals of juveniles not PIT tagged. To investigate rate of shedding of PIT tags through the adult stage, and where straying of adults from another hatchery is possible, investigate thermal mass marking of all hatchery production. Where smolt to adult survival of PIT tagged fish is compared to that of coded wire tagged (CWT) fish, develop a procedure to study tag loss and to compare rate of return of PIT to CWT within the hatchery release.
5. Make estimates of survival applicable to the entire Snake-Columbia River federal hydroelectric system as soon as possible.
6. Use the funding proposal format to promote coordination and cooperation among agencies applying PIT tags and other marks by including a list of other agencies marking salmon and steelhead of the same origin in the proposal, along with comments from those other agencies. Sponsor an interagency workshop on the use of tagging data at five-year intervals. The workshop would produce consensus recommendations and procedures for coordinating tagging activities.

ISRP Programmatic Comments Related to CSS and Smolt Monitoring

ISRP 2006-4a: FY 2007-09 Preliminary Review: Part 1 Programmatic Comments (June 2, 2006)

www.nwcouncil.org/library/isrp/isrp2006-4.htm (page 17)

Recommendation: The ISRP has in the past² recommended that Smolt Monitoring, PIT Tag, Radio Telemetry Technology, Coded Wire Tag, and Sonic Tag projects should undergo a comprehensive programmatic review that gives special consideration to the complex interactions between the projects. This review is critical because regulations requiring mass marking of hatchery fish and selective fisheries have significant impacts on the results of the projects. The Council concurred with the recommendation. The ISRP reviewed the set of projects in the Mainstem and Systemwide Reviews in 2002, and again in this FY07-09 solicitation. These broad reviews do not allow the ISRP the time required for a detailed review of individual topics. The ISRP envisions a more focused, comprehensive programmatic review to make progress toward ensuring these projects are executed in best service to the Fish and Wildlife Program.

ISRP 2005-14: Retrospective Report 1997-2005 (August 31, 2005)

www.nwcouncil.org/library/isrp/isrp2005-14.htm (pages 33-34)

Coordination of Monitoring of Marked Smolt and Adults in the FWP

The ISRP has recommended (ISRP 1998) that Smolt Monitoring, PIT Tag, Radio Telemetry Technology, and Coded Wire Tag projects should be subjected to a comprehensive programmatic review that gives special consideration to the complex interactions between the projects. To this list, we would now add the sonic tag projects. The Council concurred with the recommendation. Although the ISRP reviewed the set of projects in the Mainstem and Systemwide Reviews in 2002, the ISRP envisions a more comprehensive overall programmatic review than can be accomplished during a standard proposal review process. Critical components needing review include the PIT tag projects, mass marking of hatchery fish, and the CWT projects.

Recommendation: The ISRP recommends that the Smolt Monitoring, PIT Tag, Radio Telemetry Technology, Coded Wire Tag, and Sonic Tag projects be subjected to a comprehensive programmatic review.

Pit-Tags in RM&E

Much has been learned about survival and return rates of salmonids based on PIT-TAG technology. Unfortunately, there is not a coordinated annual operations and management project for application of PIT-TAGS in support of long-term monitoring and evaluation of out-migration survival of

² A variation of this recommendation was first made in the ISRP's Fiscal Year 1999 review of proposals (ISRP 1998-1; pages 32-33; June 15, 1998; www.nwcouncil.org/library/isrp/isrp_98-1.pdf). It was repeated the following year; see ISRP 1992-2 FY2000 Report Volume 1; June 15, 1999; pages 52-54; www.nwcouncil.org/library/isrp/isrp_99-2.pdf.

juveniles and return rates of adults. Fortunately, there have been enough special interest research projects in the past, e.g., the Comparative Survival Study, to provide large numbers of PIT-tagged anadromous juveniles for analysis. At the time of this report, it does not appear the ISRP's recommendation for a coordinated effort to ensure adequate PIT-tagging of anadromous juveniles has been fully appreciated by the Council.

ISRP 2002-14: Final Mainstem and Systemwide Review (November 6, 2002)

www.nwcouncil.org/library/isrp/isrp2002-14.htm (page 6)

Programmatic Issue: Measure Smolt Survival Directly

Various scientists in the region, in particular scientists from the Comparative Survival Study project and NMFS, have considered the problems in estimating the LGD to LGD smolt-to-adult survival rates (SARs) from currently available data and have apparently arrived at what they consider to be the "best" formulas. Unfortunately, the formulas are complicated, convoluted, and in general, very unsatisfactory from a statistical point of view. Accordingly, there is high probability that these methods will continue to spawn arguments and counter-arguments over trivial issues that will occupy the resources of the region, because the stakes are high; e.g., high costs of spill, high costs of transportation, unknown long term effects of the non-normative transportation, high costs of flow augmentation, etc.

The long-term solutions to the mathematical and statistical problems in estimation of smolt-to-adult return rates (Bonneville to Bonneville and Bonneville to Low Granite SARs) appear to be: 1) detection of sufficient numbers of PIT tagged juveniles passing Bonneville No. 2 Dam at the planned corner collector; 2) estimates of mortality of fish passing via that route; 3) and/or sufficiently large sample sizes of PIT tagged fish downstream of Bonneville. The ISRP recommends that these sampling efforts for PIT tagged juveniles be given high priority by the Council and the Corps of Engineers. In particular, Task 2 of NMFS proposal #198331900 for development of PIT tag detection in the corner collector at Bonneville No. 2 Dam should be given high priority.

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Appendix B

The following is a partial list of studies utilizing CSS-related PIT-tag data in some form or another. References were found through a combination of queries of AFS Journals (<http://afs.allenpress.com/>), Canadian Journal of Fisheries and Aquatic Sciences (<http://pubs.nrc-cnrc.gc.ca>), and ISI Web of Science (<http://portal.isiknowledge.com>) databases. Some studies made extensive use of CSS PIT-tag release information, whereas others used the CSS data for only minor applications (e.g., to validate model predictions). Note that this is not an exhaustive list of studies or publications.

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- Budy, P.B., and H. Schaller. In press. Evaluating the potential of tributary restoration to increase the overall survival of salmon. *Ecological Applications*.
- Budy, P.B., G.P. Thiede, N. Bouwes, C.E. Petrosky, and H.S. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. *North American Journal of Fisheries Management* 22:35-51.
- Burke, B.J., and M.A. Jepson. 2006. Performance of passive integrated transponder tags and radio tags in determining dam passage behavior of adult Chinook salmon and steelhead. *North American Journal of Fisheries Management* 26:742–752.
- Muir, D.D., D.M. Marsh, B.P. Sandford, S.G. Smith, and J.G. Williams. In review. Post-hydropower system delayed mortality of transported Snake River stream-type Chinook salmon: unraveling the mystery. *Transactions of the American Fisheries Society*.
- Paulsen, C.M., and T.R. Fisher. 2001. Statistical relationship between parr-to-smolt survival of Snake River spring–summer Chinook salmon and indices of land use. *Transactions of the American Fisheries Society* 130:347-358.
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- Paulsen, C.M., and T.R. Fisher. 2005. Do habitat actions affect juvenile survival? An information-theoretic approach applied to endangered Snake River Chinook salmon. *Transactions of the American Fisheries Society* 134:68–85.
- Schaller, H.S. and C.E. Petrosky. In review. Evaluating the influence of delayed mortality on Snake River stream-type Chinook salmon. *North American Journal of Fisheries Management*.
- Scheuerell, M.D. 2005. Influence of juvenile size on the age at maturity of individually marked wild Chinook salmon. *Transactions of the American Fisheries Society* 134:999–1004.
- Wagner, T., and J.L. Congleton. 2004. Blood chemistry correlates of nutritional condition, tissue damage, and stress in migrating juvenile chinook salmon

(*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 61:1066-1074.

Zabel, R.W., J.J. Anderson, and P.A. Shaw. 1998. A multiple-reach model describing the migratory behavior of Snake River yearling chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 55:658-667.