Independent Scientific Advisory Board

for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and NOAA Fisheries

and

Independent Scientific Review Panel

for the Northwest Power and Conservation Council; 851 SW 6th Avenue, Suite 1100; Portland, Oregon 97204

A Joint ISAB and ISRP Review of the

Draft Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion

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Introduction

In September 2003, NOAA Fisheries and the Northwest Power and Conservation Council requested that the ISAB and ISRP review the Action Agencies and NOAA Fisheries' draft *Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion.*[1] This draft plan was developed jointly by staff from NOAA Fisheries, the Bonneville Power Administration, the Army Corps of Engineers, and the Bureau of Reclamation, and is designed to help implement the NOAA Fisheries 2000 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) and the Federal Caucus Basinwide Salmon Recovery Strategy. The purpose of the RME Plan is to initiate and coordinate a process for evaluating the status of affected stocks of ESA listed anadromous salmonids and the effectiveness of mitigation and conservation actions. The focus of the Plan is on the BiOp and Recovery Strategy requirements as they relate to ESA-listed salmonids. The ISRP and ISAB recognize the importance of the Plan in providing a roadmap to demonstrate that recovery actions are having the desired effect or to identify actions that are not succeeding.

The ISRP and ISAB have looked forward to reviewing the document over the past year. Early in 2003, the ISRP completed reviews of proposals submitted in response to BPA's Mainstem/Systemwide solicitation and a subsequent set of Request for Studies intended to meet research, monitoring, and evaluation gaps for Reasonable and Prudent Alternative actions under the 2000 FCRPS BiOp. These reviews were conducted without the context of an ISAB/ISRP review of the RME Plan -- the subject of this review. That stated, this review benefits from the ISRP's experience with the proposal review process and the review of earlier RME group products.[2]

The draft plan is limited to the specific requirements of the NOAA Fisheries FCRPS BiOp. Additional RME requirements of the U.S. Fish and Wildlife Service (USFWS) FCRPS BiOp for ESA-listed resident fish will be integrated with this RME program as they are developed in coordination with resident fish recovery planning. This RME program will also be integrated with the broader RME needs of the Federal All-H Strategy and the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife (F&W) Program, in coordination with other regional Federal, state and tribal RME programs. The Action Agencies and NOAA Fisheries are working with these other regional entities to identify areas of program overlap, coordination efficiencies, and funding responsibilities.

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[1] The draft *Research, Monitoring and Evaluation (RME) Plan* is available at http://www.nwr.noaa.gov/1hydrop/hydroweb/fedrec.htm)

[2] See the ISRP's webpage on the Northwest Power and Conservation Council's website for the set of six reviews related to the Action Agencies' RME effort: www.nwcouncil.org/library/isrp/Default.htm.

NOAA Fisheries requested that the ISAB [and ISRP] review focus on the following questions:

1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional important gaps that it has not identified?

4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The ISAB/ISRP review of the draft RME plan begins with a general overview/executive summary that includes a summary of the ISAB/ISRP recommendations and identifies broad issues that apply to the overall framework and implementation of the Plan. This overview section is followed by detailed ISAB/ISRP reviews of each section of the RME plan: habitat, hydrosystem, hatchery/harvest (presented together in the RME Plan), Columbia River estuary and plume (received as a separate document), and data management. Under each section, the ISAB/ISRP provides general comments, answers to the NOAA Fisheries' questions, and detailed comments intended to help improve the final RME Plan.

In addition to the RME Plan, the ISAB/ISRP were also requested to review a draft report prepared by BioAnalysts, Inc. for the Upper Columbia Regional Technical Team and the Upper Columbia Salmon Recovery Board. This report, titled *Monitoring Strategy for the Upper Columbia Basin*, was meant to provide specific guidance to various stakeholders in the Upper Columbia River Basin for implementing a coordinated monitoring program. In this sense, it contained far more specifics than the RME Plan, and it pertained almost exclusively to tributary habitat restoration. A review of this document is limited to habitat recovery evaluation and is included in an appendix of this report.

General Overview/Executive Summary

The plan is well organized and quite comprehensive overall. It represents an excellent start, and its authors should be commended for their work. The RME document has broad applicability and should be instructive to all practitioners. However, the ISRP/ISAB review identifies some large contextual questions that would likely limit the effectiveness of the Plan, independently of how well it addresses the smaller issues. We highlight these important general concerns first below, followed by a summary of answers to the four NOAA questions, a summary of overall recommendations for the Plan, and a summary of major recommendations on each section of the Plan.

General Issues

Regional Coordination
The RME document presents what is inherently a regional plan to implement the BiOp; as such, it should clearly address the issue of regional coordination and should attempt to build effective regional coordination. Regional coordination must be a key part of the Plan. Although references are made throughout to the need and plans for interagency coordination in data management, monitoring, and evaluation, the Plan would be improved if it gave more detail on the process to enable that coordination. Success of the Plan depends on State, Federal, and Tribal agencies being willing to make changes in current sampling and data collection methods. The current draft does not make clear how it will encourage or ensure that the needed coordination and avoidance of duplication will take place. The Plan should better specify where the ongoing and state partnerships fit in, describe the coordination work to date, and explicitly identify strategies and plans to get the region involved. This RME effort presents the opportunity for planning at a basin scale, and coordination and efficiencies must be emphasized. The ISAB/ISRP suggest that the Plan include specific actions intended to foster implementation of regional planning for large-scale and long-term answers. The RME Plan could take a lead role in suggesting a regional plan to meet overall salmon recovery goals. For instance, many programs are PIT tagging fish, but there is no project aggregating all the sets of PIT-tagged fish to answer broader questions. The Plan could present the number of PIT-tags needed overall to estimate SARs, as well as identify specific tagging sites needed to achieve the marking levels necessary for regional data needs. The RME Plan also could foster needed coordination through planning exercises to develop experimental design or to analyze data and scope quantitative targets.

Conceptual Framework and Coordination across the Hs
The current RME plan is developed to follow the BiOp RPA action by action without sufficient attention to the overall intent of the BiOp. The RME plan needs a framework that ties all the Hs and RPA actions together and ensures agreement on the overall evaluation basis for recovery. This framework could then be used to coordinate the experimental design and data collection across the RME plan sections to facilitate an efficient and clearly integrated RME program. The Plan would benefit from explicit

development of an integrative conceptual model. Such a model could integrate the key questions over the life cycle of listed stocks and explain how the pieces of the RME plan fit into answering the overall key questions and key uncertainties. Such a model could be used to integrate components of the Plan into an explicit experimental design, guide priorities within the Plan, and aid in achieving regional participation and coordination. A specific example of an essential component of the monitoring and evaluation plan that integrates all actions is provided in the next paragraph.

Monitoring Designs for Natural Populations

The presumptive bottom line for recovery is the population growth rate (lambda) for the wild stocks. However, a monitoring program design of naturally produced salmon spawning in the natural environment is not adequately described in the RME plan. Monitoring data needs are described in the tributary habitat sections and the potential interactions of hatchery and wild fish are noted in the hatchery section. However, the Plan does not provide information on the populations to be assessed, and the sampling methods and biological parameters expected in those programs. The streams and populations to be monitored and ability to consistently collect data on naturally produced salmon will influence the region's ability to assess progress towards recovery. The absence of an actual design of the annual adult monitoring programs for the natural populations leaves significant uncertainty concerning this central feature of the monitoring and assessment plan. The Plan needs to ensure a quantitative basis for monitoring abundance trends and productivity in both adult and juvenile natural populations. If variability in annual adult monitoring programs were to exceed the changes in abundances between years, then the ability to assess recovery using lambda would be severely compromised. Specification of species, streams, and methods in the Plan would indicate acceptance of an assessment basis for recovery evaluation and facilitate coordination between agencies.

Issues of Experimental Design and Existing Data

More explicit discussion of experimental design is critically needed throughout the Plan. The Plan should explore thoroughly the strengths and benefits of treatment and control (including natural experiments or active manipulations) versus regression/correlation designs, and should give general procedures for deciding on preferable design. It should also state specific designs for specific questions in specific places (or concrete procedures and plans for deciding these), as these decisions are made. The Plan should explore the possibilities for using various designs or at least include an approach for having these background experimental design scoping exercises done as part of the implementation of the Plan. Design options can be assessed from subbasin or other regional inventory data, and one can calculate which approach is likely to provide the more effective study design for specific questions in specific places. The Plan should explore the ranges of conditions and combinations of conditions present in the Basin and should present designs for studies that can provide data to address cause and effect relationships between fish metrics and these conditions (whether naturally occurring or the result of planned or incidental human actions). Satisfactory designs may sometimes involve natural experiments and regression/correlation analyses, or may include establishment of true manipulative experiments, with applied treatments and complementary controls. It would

be helpful for the region if the possibilities for achieving these designs, as well as the likely power of each approach, were explored at the beginning of the RME process. This information dictates what experimental designs are reasonable to pursue. We expand on this discussion of design and make several suggestions as to what is the best approach in our comments on the Tributary Habitat Monitoring section of the Plan.

Sampling designs and targets also should include more quantitative scoping, either in the Plan itself or through processes scheduled to occur early in the implementation of the Plan. It would help if the Plan's authors explored what size effects are detectable under various scenarios and with what effort, and showed how this information would be used in deciding experimental designs and prioritizing efforts.

Additionally, the Plan should consider more thoroughly the distinctions between and interrelationships of status and effectiveness. Effectiveness of actions does not equal the only source of change in status or trend, and the Plan should include design and analysis elements that can best identify problems and possibilities.

Plan Development and Implementation

The Plan may need a tiered development approach. For instance, it may make sense to get status and background monitoring in place and implemented for several years before determining the more specific experiments. If so, exploration of data collected to date and what it suggests about critical needs, effective designs, etc, should be included in the phase-in stages. The data that are currently available (despite their limitations, which need to be specified) can and should be used in quantitative exploration of the costs and benefits of specific experimental designs to ask specific questions. The Plan should be tiered and sequenced, including a plan not just for implementation, as in the pilot studies, but also for adding desired or needed elements (e.g., larger channels, new species, etc.) and for eliminating parts that are no longer needed (e.g., scenario for response to cutbacks in funding, response to extinctions, retirements, answered uncertainties, etc.). It would be useful to imagine 5-year, 10-year, and 20-year scenarios. Additionally, the Plan largely sidesteps the issue of building coordination, but the Plan's implementation design could directly address this anticipated difficulty (perhaps a "critical uncertainty"). It may be that the RME Plan could structure group efforts to solve concrete problems in an integrated forum (e.g., the pilot projects, scoping workshops, etc.) and so begin to accomplish coordination.

Prioritization of Elements of the Plan

The elements of the Plan should be clearly prioritized. Its current organization closely follows specific RPAs but does not make clear their priority. It should also specify critical uncertainties in a way that is linked to key elements of the Plan rather than as stand-alone items. The Plan also should specify a relative priority for each of the monitoring initiatives, because the cost estimates provided, which are probably conservative, suggest the daunting expense of such an ambitious program and will likely impose compromises in RME design. Even though the RME Plan calls for widespread, expensive monitoring, the resources needed to implement such a program surely will be inadequate to achieve every objective in the Plan, thereby necessitating the prioritization

of monitoring activities. It would be helpful, therefore, if the Plan identified what aspects of the monitoring efforts were considered most essential and should receive priority funding. It should give highest priority to key integrative bottom-line measures (e.g., SARs) as core elements of the program. It also should prioritize critical uncertainties and should link these intimately into the program rather than having them as stand-alone projects. It should include quantitative targets and backgrounds (e.g., number of fish to be tagged). The current emphasis on piecemeal actions and RPAs does not supply adequate integration or prioritization of the effort. Better integration of sections also should lead to economy, consistency of outcomes, and higher usefulness of the Plan, as well as to better linkage to science and management questions**.**

Costs and Benefits of Measurement Precision

The RME report emphasizes that accuracy and precision of metrics should be determined and reported. Although the ISAB/ISRP agrees that precision and accuracy should be reported, the Plan should also present the rationale for the standards of precision and accuracy that are selected. In the current Plan, many of the standards selected seem arbitrary and perhaps unrealistic. The cost of precision is high, and the Plan should more carefully weigh (and explicitly present) how much precision is needed to answer specific questions, as well as what precision is likely possible, given what is known or can reasonably be assumed about the parameters to be measured and the techniques used to measure them. This is another area in which the Plan must weigh various costs and benefits and select, with explanation, the apparently most efficient monitoring plan to get the needed level of precision. That said, we note that at some point, planning must stop, limits on funds and resources must be established, and the monitoring plan must be finalized and come in under budget. In the end, it is difficult or impossible to finalize and implement a monitoring program in the field without knowledge of the funds and other resources available.

Pilot Projects

The plan to begin with pilot projects that will test methods could be used more ambitiously to advance many other acknowledged difficulties (e.g., regional coordination, inconsistent use of data collection protocols, lack of background data analysis, need to better define data needs and data management protocols). The Plan's implementation design should be expanded conceptually to include the needed analytical inventory of existing data, as well as planning of experimental designs. Pilot projects could include a survey of the potential for establishment of (1) applied treatment/control designs, (2) sample surveys of natural experiments, or (3) sample surveys of probabilistically selected sites. The Plan should explore the strengths and weaknesses of each of these techniques for answering specific questions. Such planning exercises could be developed and implemented by NOAA or other Action Agencies as an explicit part of the RME process and could be used to build buy-in to the Plan, as well as to link with Subbasin and other planning efforts.

Incorporation of the Corp's AFEP Program

The RME Plan states that projects supported through the Corps' Anadromous Fish Evaluation Program (AFEP) process will constitute adequate hydropower RME for this plan and will receive adequate review by that process which is already in place. We are concerned about the deference paid in this RME plan to the Corps' AFEP program and raise it as a general issue. Although other Action Agencies' programs were scrutinized, all RME related to AFEP is simply accepted with no apparent scrutiny. In this draft plan all dam-specific RME is assumed acceptable because it is vetted through the AFEP review process. That may be a mistake. The ISRP is independently reviewing the AFEP program. It has found that adequate review is unlikely to happen, because there is generally not sufficient time for review of final study plans prior to their adoption. The ISRP's yet to be completed review of the Corps AFEP process in the past few months indicates that the AFEP deserves as much scrutiny for overall RME goals as other programs, both for planning of research and monitoring and determining effectiveness of actions. Because the AFEP dominates the hydropower side of RME, the RME plan would be improved if it included the AFEP work. The ISAB/ISRP suggests that the ISRP AFEP review (due in early 2004) be considered a part of this RME review.

Answers to the four NOAA Questions

In part the purpose of the ISRP/ISAB's current review is to inform NOAA Fisheries if the Plan adequately meets the needs in the BiOp. The answer to this varies from section to section. In this overview, the ISAB/ISRP provides brief summaries of our answers to the questions. The subsequent section of the report provides more detailed answers for each section.

Question 1: Will the Plan provide useful information on the status of ESA-listed salmon? How could it be improved?

- Tributary Habitat: The Tributary RME Plan should provide useful information about the status of listed salmon. Potential improvements include reconsideration of the method to evaluate the accuracy of the sampling programs.
- Hydrosystem: The Hydrosystem RME Plan will likely provide much useful information, but the most pertinent information is approached only vaguely, namely whether the status of stocks is improving at acceptable rates.
- Hatchery: RPA 182 – The overall approach should provide useful information, but details of the proposed activities need to be better developed to ensure they will be adequate. RPA 184 - This element of the Plan requires further development, especially developing an explicit conceptual framework for integrating data to reach conclusions about populations or ESUs.
- Harvest: No. The Plan's response to a single Harvest RPA action (167) is a very limited consideration of harvest. It ignores the other four harvest related RPA actions, and as such, it presents an extremely narrow consideration of harvest.

- Estuary/Plume: This section is too vague to be useful in its current form; specific objectives, metrics, and methods are needed.
- Data Management: Considered as a "statement of the problems for data management" the Plan is clearly written and if the problems are solved, solutions would provide useful information. However, it does not have proposed "solutions." The plan is a statement of *intentions* to develop a plan in the future.

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

- Tributary Habitat: The combination of status and trend monitoring with more intensive investigations of cause-effect relationships in the Action Effectiveness Research (AER) watershed scale and project-based approaches should provide a clear indication of the response of salmon to tributary habitat actions. The more intensive AER efforts are well conceived, but several elements of this approach could compromise the quality of the information produced. Watershed-scale monitoring often occurs with little or no control over where, when, or what management and restoration actions will be applied. Control over where restoration actions are applied is required to maintain the integrity of reference sites. The response of salmon to a restoration project depends on both the action type and where the action is applied.
- Hydrosystem: The effectiveness of RME could be better judged if it was explicitly oriented toward whether ESA stocks are improving at acceptable rates. However, data variability may prevent clear evidence. Uncritical acceptance of the Corp's AFEP Program may be inappropriate.
- Hatchery, RPA 182: The proposed actions should produce useful information. RPA 184: The Plan is not adequately developed to effectively address the issue of effectiveness of hatchery reforms and conservation hatcheries, especially to wild/natural fish. Neither what will be measured nor how the data will be evaluated are clear.
- Harvest: In terms of action effectiveness, the study of catch-and-release mortality will improve the knowledge base for incorporating harvest impacts into an overall status assessment for listed species. But the current plan is inadequate unless there is further justification presented as to why: 1) the other four harvest related RPAs were ignored, and 2) the issue of total fishing mortality through the life cycle of the species was not addressed.
- Estuary/Plume: No. Objectives of habitat restoration are not stated clearly and specifically and goal statements are general and vague.
- Data Management: Considered as a "statement of the problems for data management" the Plan is clearly written and if the problems are solved, solutions would provide useful information. However, it does not have proposed "solutions." The plan is a statement of *intentions* to develop a plan in the future.

Question 3: In context of the BiOp, has the Plan identified the most critical RME gaps? Are there additional gaps?

- Tributary Habitat: The gaps identified are reasonable. However, the selected habitat metrics are extensive, dominated by physical-chemical parameters, and not prioritized; the ISRP/ISAB suggest more attention be given to aquatic food webs. Additionally, the context and goals for the proposed monitoring should be more clearly explored and presented. Methods to fill the gap in information on larger channels will need to be implemented as they are developed.
- Hydrosystem: The draft plan needs to be revised to take into account a new NOAA Fisheries white paper (Williams et al. 2003) [3] on salmon survival, which obviates much of the consideration of D and related factors in the current draft RME plan. Use of actual data is preferred over models such as SIMPAS. Dam-specific survival studies are still needed to fix problems in spite of the RME plan's emphasis on reaches and the whole hydrosystem.
- Hatchery: Methodologies to synthesize existing data on the impacts of hatchery production on natural populations and detect effects at the population or ESU levels remain a critical gap. A conceptual model of expected or possible effects could facilitate this.
- Harvest: The assessment of harvest RME gaps is not adequate, nor is the selection of one RPA and metric well justified.
- Estuary/Plume: No, it is not clear that an assessment of critical gaps has been completed.
- Data Management: Not all critical gaps are addressed. The Plan neglects the obstacle to "Evaluation" posed by the facts that the list of indicators that will be derived from the primary "Research and Monitoring" data have not been finalized. Further, the policy decision thresholds according to which conclusions will be drawn from those estimates remain undefined.

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The ISRP/ISAB believe that coordination of data collection and data management could be improved by stronger initial and long-term strategic planning as the Plan is developed and implemented. Unless a specific coordination plan is developed it is unlikely that improved coordination will result. The plan should address how to ensure consistency of methods (data collection and management) and format across projects. It should also specifically address the process through which information needs of decision-makers will be understood, as well as the process for learning, adaptation, and revision across projects within a pre-determined,

[3] Williams et al. 21 December 2003. Preliminary Draft: Effects of the Federal Columbia River Power System on Salmon Populations. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA. www.salmonrecovery.gov/remand/analysis_reports/Tech_Memo_for_FCRPS_impacts_22_Decembe.pdf

structured process and design. Coordination of data collection and data management should be an explicit part of the Plan, and these might best be developed and implemented at the pilot project stage.

Sections of the RME Plan differ in attention given to data coordination. The Tributary habitat sections give little attention to the coordination problems inherent in the implementation of multiple, complex habitat recovery actions, or to the coordination problems that will attend data management issues. The Hydrosystem section would be improved if more attention were given to including metadata in PIT-tag data management and if data from radiotelemetry and acoustic telemetry were integrated with the PIT-tag data. The Hatchery RME requires that tagging and marking of hatchery fish be sufficient for their enumeration on the spawning grounds within specified statistical limits. Thus, the Plan should explain what methods will be used to identify which spawning populations, as well as which hatchery releases are adequately monitored and marked versus which need to be upgraded. The Hatchery and Tributary components of the Plan should be better coordinated to ensure the adequate enumeration of the hatchery-origin fraction on the spawning grounds. The scientists who will use the data to estimate abundance and productivity for natural populations should be active participants in choosing sampling locations and data collections. The section on Harvest does not address data coordination or management. The Estuary section addressing coordination is too brief and incomplete to assess whether it will improve coordination of data collection and management; the Plan continues to call for an oversight group, which does not indicate a fully coordinated process even with the estuary.

Finally, in review of the Data Management section we endorse the NPCC and NOAA Fisheries agreement May 3, 2003, to move forward with development of a Columbia Basin Cooperative Information System (CBCIS). However, goals of this high level information management needs assessment document cannot be achieved by funding alone. Substantial policy issues must be solved to make significant progress. In the short term, it is critical that data can be freely accessed by all concerned in the region to enhance the best, complete scientific analyses.

Overall ISRP/ISAB Recommendations

The ISAB/ISRP recommend that the RME group take the following actions to improve the Plan:

- Strengthen the integration among the major sections of the Plan, to facilitate efficient and integrated data collection and to coordinate experimental design, sampling, and data sharing.

- Base experimental designs and data precision targets on thorough analysis and synthesis of all pertinent existing data, and present these analyses and syntheses as part of the documentation for the rationale of the program.

- Explore what is needed to meet the basic objectives of the BiOp, rather than restrict design only to reflect what is dictated by the current specific RPA actions in the 2000 BiOp.

- Develop an explicit plan for phased development and implementation.

- Develop specific priorities, including core integrative or essential measures, that are based on an assessment of precision and power versus cost, need, and value, for elements of the Plan. (The proposed monitoring may be more than is needed and may include some infeasible elements or be missing critical elements.)

- Include a conceptual model (or set of related models representing all of the H's) to aid in coordination, prioritization, evaluation, and modification of regional and project-specific contributions.

ISRP/ISAB Recommendation on Sections of the Plan

Tributary:

- Expand the monitoring to include some attention to food resources for juvenile salmonids.

- Prioritize the extensive set of proposed measurements.

- Consider alternatives to paired treatment-control experimental designs.

- Consider the watershed-level evaluation of action effectiveness.

- Re-evaluate the measurement precision targets for habitat parameters and biological response variables.

Hydrosystem:

- Explicitly integrate the Army Corps of Engineers Anadromous Fish Evaluation Program (AFEP) studies at mainstem hydropower sites in RME planning rather than accept all studies without scrutiny.

- Take a more direct approach and carefully define what needs to be estimated to establish if survival targets for adult and juvenile salmonids have probably been achieved, then explain in detail how those estimates can be obtained, including description of what will be measured where, what the design is, what the sample sizes of marked fish will be, and what statistical models will be employed.

- Explore whether a 3% improvement in adult survival as specified in the BiOp is a measurable (and thus a reasonable and realistic) goal, considering variability in data.

- Reconsider the current RME Plan's focus on delayed differential mortality, extra mortality, and related delayed mortality and latent mortality of smolts in light of the new NOAA Fisheries white paper (Williams et al. 2003).

- Incorporate metadata in PIT-tag information, and develop a plan for integrating radio- and acoustic-telemetry in data management.

- Incorporate project-specific as well as overall performance metrics.

- Avoid extrapolation of survival estimates and instead emphasize collection and use of direct data as shown in the white paper by Williams et al. 2003.

Hatchery/Harvest:

- Better coordinate Hatchery RME with other RME efforts, especially tributary RME.

- Develop an analytical framework to quantify the effects of hatchery reforms on the natural spawning populations.

- Develop the framework to assess ESU level viability based on the population level response metrics for evaluating hatchery reform.

- Include an explicit plan for marking sufficient fish to obtain needed overall performance metrics.

- More thoroughly develop Harvest RME and better integrate it with the rest of the Plan.

Estuary/Plume:

- State clear, specific objectives of the RME program and construct the program to meet those objectives.

- Conduct and present an assessment of information needs, existing information, critical gaps, and priority of identified critical uncertainties.

Data Management:

- Prioritize for the key essentials: that each data collection activity result in verified electronic data and metadata that are quickly available for use, and that each database system be housed in an organization that can guarantee data integrity, maintenance, access, and documentation.

- Ensure that all electronic data and metadata are accessible by one of the current Columbia River Basin Fish and Wildlife Program funded databases, while moving to creation of a CBCIS.

- Use the pilot projects to refine methods and procedures of QA/QC, data transfer and entry, data access rules, metadata standards, and methods to link data for queries.

- Take advantage of existing, potential data centers.

Comments on RME Plan Front Matter: Introduction, Overview, Project Implementation, Compliance Monitoring and Regional Coordination

General Comments

The ISRP and ISAB reviewed the document "Research, Monitoring and Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion (Draft of 9/11/03, with section on Estuary/Plume of 9/30/03). The document states that it "defines an RME program that is limited to the specific requirements of the NOAA-Fisheries FCRPS BiOp" and that "Additional RME requirements of the U.S. Fish and Wildlife Service (USFWS) FCRPS BiOp for ESA-listed resident fish will be integrated with this RME program as soon as they are developed in coordination with resident fish recovery planning". Integration with the Northwest Power and Conservation Council's (Council) Fish and Wildlife Program (FWP) and coordination with other regional, Federal, state tribal RME programs are also noted as necessary and intended.

Although the Plan repeatedly notes the need for regional coordination and integration with other programs of other action agencies and with the Council's Fish and Wildlife Program, these are rarely dealt with explicitly in the Plan, which is cast as stand-alone and appears to have been written by relatively few authors from four federal organizations. Throughout the Plan, the need for coordination and integration is frequently noted as a hurdle.

The Plan is cast as designed to support the BiOp evaluations of performance standards specified in the 2000 BiOp and to address uncertainties in the RPAs therein. As such, it is quite narrowly written and follows the RPAs apparently without much attempt to integrate and prioritize them. The ISAB/ISRP strongly recommend that the RME Plan be more generally and broadly cast, to meet the spirit of the BiOp and to mesh with the complementary regional RME needs and goals, rather than being tied directly and without obvious integration or prioritization to the 2000 BiOp RPAs. This could contribute to development of the needed regional coordination that the Plan notes, and should make the Plan a more robust long-term effort. While achieving improved coordination within the time deadlines of the BiOp Remand Decision is a tall order, we stress the need to vigorously address this important problem as quickly as possible.

The RME Plan states three core scientific principles to be emphasized: that RME data have known accuracy and precision, that RME actions be implemented within a basin-wide experimental framework, and that data management be regional. The Plan identifies six central components as essential to meeting the requirements of the 2000 BiOp: Populations and Environmental Status Monitoring (abundance, trend, and condition of fish populations and key environmental attributes), Action Effectiveness Research (for hydrosystem and offsite mitigation actions on status measures), Critical Uncertainty Research (addressing key uncertainties in assessment of population survival),

Implementation and Compliance Monitoring (tracking execution of management actions), Data Management, and Regional Coordination. The emphases on defined data quality, experimental approaches, and regional organization are appropriate and laudable, but the ISRP/ISAB recommend that the Plan develop specific approaches and actions to meet these important goals. The data quality targets need more empirical justification, including formal analysis of data quality needs and of the costs, benefits, and feasibility of quality targets; the Plan needs to state explicit experimental designs and their rationale throughout; and specific processes to achieve regional involvement should be part of the Plan.

The RME document includes an Overview, but this overview is presented separately for each section of the Plan and does not present a true overview of the entire Plan nor integrate the sections. The sections are organized according to the four Hs: Tributary population and environmental status and restoration action effectiveness monitoring (Habitat, 84 pages plus a 31 page attachment on methods), Hydrosystem RME Plan (Hydrosystem, 30 pages plus 3 attachments), Hatchery/Harvest RME Plan (Hatchery and Harvest, 20 pages), and Data Management Plan (21 pages). The Estuary/Plume section was delivered in a separate document (52 pages). These sections were written by separate working groups and no formal integration of the sections is given in the Plan; it appears that there was insufficient conversation or integrated planning among the groups that produced the separate sections. The ISRP/ISAB strongly recommend that the overall Plan be more closely integrated and that the conceptual and methodological framework of the integration be explicitly developed and stated in the Introduction to or Overview of the Plan. Specific suggestions for improved integration have been provided in an earlier ISAB report (ISAB 2001-7 " A Review of Salmon Recovery Strategies for the Columbia River Basin").

The Plan states that a project tracking system has been developed for programmatic reporting and will be developed further to accommodate requirements of the Federal Caucus Salmon Strategy; this is intended to assure that actions are executed as prescribed.

Regional coordination is presented most often in the Plan as a challenge or hurdle and it undoubtedly is such. The Plan states that significant progress toward much-needed regional participation and coordination has been accomplished, and it lists the key groups that are involved in overlapping programs for overall RME and for specific components (e.g., Hatchery, Harvest, Hydrosystem). The Plan describes the sorts of coordination that are desired (integration of objectives, collaborations to improve power of studies and reduce their costs, coordination and standardization of data collection and reporting, etc). However, the Plan does not identify concrete actions to achieve these goals, and it should focus more effort on development of specific plans to promote and achieve needed coordination. For instance, pilot projects could include actions designed to build regional coordination; the Plan could pose workshops or other fora to inventory and analyze existing data, coordinate with Subbasin planning, and build efficient experimental and sampling designs for RME using these pieces of background information.

Detailed Comments on the RME Plan Introduction and Overview

The Table of Contents should be expanded to include all the subsections so the reader can more easily find specific subjects.

The plan would be enhanced by including a glossary and list of acronyms, as the estuary/plume plan does.

Introduction

How it is anticipated that having biological and physical performance standards will address uncertainties should be clarified (p.1).

The core scientific principles that are outlined in section B are good ones. Some discussion should be included as to how to move ongoing projects (the many that are listed in tables throughout the document) toward meeting those principles; that is, collect data according to statistically derived sampling designs, conduct controlled experiments, and develop data consistency across projects.

P.5, the estuary plume plan avoided the use of the term "critical uncertainties," reserving it for hydrosystem related uncertainties specified in the BiOp. Should the word (p.5, #4, 3rd bullet) be modified here?

Overview of the BiOp RME Plan

P.7, under "ecosystem status questions": it's not clear why "distribution of adult salmonids" shouldn't be under "population and habitat status monitoring questions"

Regarding the discussion of the questions to be answered by the Action Effectiveness Research plan: at some point, with multiple actions under experimentation, the question of effectiveness should also address cost-effectiveness. Actions that are comparable in terms of their biological effectiveness should be compared on the basis of cost. This has been a big piece missing from research under the Fish and Wildlife Program and other funding sources in the Columbia River Basin, and some mention of it in this document would be useful in raising the issue.

P.9, 1st sent: "compliment" should be "complement"

P.11, para 2: some discussion should be included as to how the research conducted under the AFEP can be integrated with this plan. Is integration intended?

P. 12: It wouldn't seem that shifting from survival indexing (outcomes) to a simple confirmation that passage management actions are being implemented (inputs) would satisfactorily address the question of effectiveness.

P.18, top paragraph. Who is going to coordinate all these RME programs, and how will coordination be done? This deserves some thought and careful planning, and it's not clear that there is a specific plan for coordination.

P.20: more detail as to the CBFWA project will be helpful, as the project has changed since the ISRP reviewed the proposal. What does it mean to say that the primary focus of the CBFWA plan will be development of technical products?

P.22: did SAIC make recommendations in more detail than those listed in Table 2.1? If so, they should be included. The 8 listed are too general to mean much, and they have no operational content.

P.22, in the list of coordination process groups, should the STT of the PFMC be included?

A. Tributary

General Comments

In general, the RME Plan does an excellent job in weaving between the requirements of the BiOp, recommendations of the ISAB/RP, States and Tribes, and others. The status and trends monitoring component, in particular, incorporates many of the comments and recommendations that have been provided by the ISAB and ISRP on monitoring. The ISAB strongly supports the establishment of the three pilot studies in the Wenatchee, John Day, and Salmon subbasins and implementation of the RME effort. Furthermore, a lot of monitoring has already been done in these pilot areas, and we encourage the RME participants to build upon the previous work.

Answers to NOAA Questions

Question 1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

Overall, the ISAB believes that the tributary RME plan is very well thought out and will provide useful information about the status of ESA listed salmon. The "ecosystem status" and "population and habitat status" questions address core issues that are needed for an effective monitoring program. The authors of the RME Plan have clearly taken the recommendations of ISAB 2003-2 (*A Review of Strategies for Recovering Tributary Habitat*)[4] to heart.

We applaud the RME Plan's emphasis on assessing juvenile as well as adult salmon. Certainly, both are needed but many monitoring programs emphasize adult counts at the expense of information on juvenile fish. Certainly, adult counts are fundamental to the monitoring program if *lambda* is to be the basic measure of success or failure, and we urge continued improvement in adult monitoring techniques. However, we believe the number of smolts per female may be the most useful overall indicator of habitat trends at the watershed scale over time, and we are pleased to see this metric highlighted in the RME Plan. Estimating juvenile abundance through the period of freshwater rearing and life-history stage specific survival rates should greatly improve the identification of those factors most responsible for controlling smolt production. Although it is important to include juvenile fish surveys in the pilot studies, we recognize that estimation of juvenile abundance in a large-scale status and monitoring program is difficult. This was Idaho's experience in the Supplementation Study; estimation of juvenile abundance was dropped on many streams. In the Oregon Coastal Coho monitoring, pools are surveyed for presence-absence of juveniles, but stream-wide juvenile population assessments are not

[4] ISAB 2003-2. A Review of Strategies for Recovering Tributary Habitat. www.nwcouncil.org/library/isab/isab2003-2.htm

performed. We acknowledge that there is no easy answer, and juvenile monitoring of the kind needed to yield smolts produced per returning adult will be very difficult and expensive, even in the pilot areas. Despite these problems, juvenile abundance data should be included in the monitoring effort as this information may be the most valuable in terms of evaluating the effectiveness of tributary habitat actions.

The plan suggests that the accuracy of the probabilistic sampling scheme to estimate abundance of adult salmon will be verified by comparing it with values from the current adult protocol. It is naïve to assume that the standard for testing the sampling based approaches will be the ongoing census based surveys that will act as the 'truth' against which the sampling data can be compared. Remember Wayne Fuller's rule number one: "The good old _____ are not that good"? Fill in the blank with "data." The verification process must include a thorough assessment of the accuracy of the current protocol. Unless this assessment indicates that the current data represent an accurate, total count of adult fish, the verification process should not rely on the current census information.

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

The combination of status and trend monitoring with more intensive investigations of cause-effect relationships in the Action Effectiveness Research (AER) watershed scale and project-based approaches should provide a clear indication of the response of salmon to tributary habitat actions. The status and trend monitoring was well developed in the Plan. However, we believe the long list of variables proposed for evaluation may ultimately be detrimental to the program. Monitoring of all the proposed parameters would be extremely expensive and would make the program a highly vulnerable target during times of tight funding. Restricting the variables to be measured to those that are most significant to fish, measurable with reasonable certainty, and most apt to be influenced by the management actions being applied would produce a more economical list -- one that would be better able to withstand the vagaries of budget cycles. The list of proposed monitoring variables should be assessed to identify economies in implementing the status and trends portion of the monitoring plan.

Some additional thought as to how status and trends monitoring sites will be managed should be included in the Plan. For example, there may be a significant advantage to keeping the locations of the sites a secret. If the local managers in charge of implementing management actions and the public do not know the locations, they cannot introduce bias (unintentional or intentional) in the way the monitored sites are treated. Although it may be difficult to retain the anonymity of the sites, especially from local managers, maintaining secrecy may help eliminate a potentially serious element of error. Also, it should be acknowledged by the authors that repeated sampling may alter some sites sufficiently that they are no longer representative, an issue recognized by Scott

Overton, OSU. A process should be included for identifying and eliminating these "worn-out" locations and selecting replacement sites.

The more intensive, Action Effectiveness Research efforts are well conceived but several elements of this approach could compromise the quality of the information produced. Watershed-scale monitoring often occurs with little or no control over where, when, or what management and restoration actions will be applied. Control over where restoration actions are applied is required to maintain the integrity of reference sites. The success of the watershed scale effort, in particular, depends on some ability to restrict the application of actions within watersheds designated as controls. We recognize the political difficulties related to controlling the application of management actions in the Columbia Basin. Nonetheless, the importance of the information that can be generated by the proposed RME effort should be sufficiently compelling to evoke some basinwide recognition of the critical need for the establishment and maintenance of reference sites. At a minimum, a commitment to establish and maintain selected reference watersheds should be a component of the subbasin plans covering the three pilot study areas. Those developing subbasin plans should work with the RME project leads to select reference sites.

Where suitable treatment-control paired watersheds with similar potential productivity cannot be located, we recommend use of statistical association analysis (correlation/regression) and modeling with time and time x treatment interaction predictor variables. This approach may be a more feasible analysis plan for data that are likely to be generated. Maintaining reference watersheds in a condition that provides adequate controls for treated watersheds may be difficult over extended time periods. Even with the development of methods to remove hidden biases from observational studies (Rosenbaum 2002), it is unlikely that these paired watershed comparisons will be done with sufficient care over the necessary evaluation period, and the scientists analyzing the data may have vested interests in the outcome.

The analyses of action effectiveness also could be done by correlation-regression type testing and modeling, which would reduce some of the concerns raised in the preceding paragraph (but not eliminate them entirely). If it is unlikely that treatment or control sites can be maintained as such for more than a year or two, we suggest that the design of the action effectiveness monitoring be changed to focus more on analysis by a statistical association approach (see Roni et al. 2002). This approach would involve selecting watersheds or sites reflecting a range of management actions, and with a range of time since implementation of the actions. These sites would supplement the sites probabilistically selected by the EMAP methods in the status and trends monitoring. Regression modeling with time and the interaction of time with management actions as independent predictor variables may be the best method for analysis of the data, given that new management actions will be implemented during the course of the study. Our recommendation would entail a significant change in experimental design from a series of treatment-control experiments. It is critical that a clear plan for the analysis of RME data be developed before data are collected as the analytical method to be employed will dictate the manner in which the data is collected. Correlation/regression modeling cannot

provide definitive evidence of a cause and effect relationships in a single data set. However, correlation/regression modeling can provide solid conclusions given adequate replication over space and time with corroborating results.

The tributary habitat section of the RME proposal places considerable emphasis on understanding whether or not specific types of actions are effective. We believe the focus on action types may hinder the evaluation of the overall effectiveness of tributary habitat restoration efforts in the basin. The response of salmon to a restoration project depends on both the action type and where the action is applied. The project-based approach to evaluating the effectiveness of types of actions will certainly highlight the significance of project location in determining biological response. However, the question of whether or not the process being used to select project location and type (project prioritization) is working cannot be answered with this approach. The question of the effectiveness of the processes being used to develop restoration plans is much more significant in terms of understanding overall effectiveness of tributary habitat actions than would be an improved understanding of the variability in biological response to a specific class of restoration actions. The watershed scale approach will enable the evaluation of whole restoration programs, including the process used to select projects. For this reason, we believed this approach is more promising than the project-based approach.

The authors may be overly pessimistic about their ability to separate the effects of types of actions on sub-population level responses in the watershed-scale approach. The very complete information the authors propose to collect on the fish populations should enable the estimation of life-history stage specific survival values. This information may help to identify the types of actions that are most effective. The objective of nearly all restoration projects is the improvement of some specific habitat characteristics, such as increased pool area or reduced fine sediment in spawning gravel. Generally, these habitat objectives can be associated with a single salmon life-history stage and the information on watershed-scale survival during this life-history stage will indicate if the actions have achieved the desired biological response.

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional gaps it has not identified?

The list of habitat metrics to which fish populations will be compared is dominated by physical-chemical parameters, including a variety of geomorphic and water quality measures. For years this has been the traditional approach to relating fish populations to their habitat in streams. Unfortunately, we worry that this approach undervalues the importance of trophic considerations, i.e., the sources and abundance of food resources for rearing salmonids. This is particularly true at the landscape scale (e.g., HUC-7 subwatershed or larger) where there has been very little research on landscape indicators of trophic condition. Available food resources can be altered by human activity in the same way that physical habitat and water quality can be altered, but changes in the trophic structure of streams have not received nearly the attention that physical-chemical

changes have been given. Analyses of macroinvertebrate communities are usually framed in terms of detecting water pollution; for example, the RIVPACS method described in the Monitoring Strategy for the Upper Columbia Basin is a sensitive technique (developed in Europe) for relating changes in invertebrate presence or absence to what would be expected in an "unmanaged" or relatively unaltered watershed. But while measuring macroinvertebrate community changes may involve state-of-the-art methods of water quality bioassessment, techniques such as RIVPACS or BIBI do not provide strong inferences about the relative *productivity* of watersheds for salmonids.

Productivity involves a very complex interaction between having a safe place to live and getting enough food to satisfy life cycle requirements. In a comparison of the production of stream-dwelling salmonids worldwide, Bisson and Bilby (1998)[5] observed that the most productive streams often did not possess habitat attributes associated with "ideal" salmon and trout rearing conditions – cold water, heavily forested watersheds, and very coarse channel substrate. Instead, the most productive streams tended to be characterized by moderate temperatures, nutrient-rich conditions, relatively open channels, abundant aquatic plants, and low to moderate gradients. They speculated that these conditions favored the types of macroinvertebrates that constituted most of the food resources for rearing salmonids, and that trophic considerations merited an importance equal to the quality of the physical and chemical environment.

The ISAB does not believe that there is currently a simple, direct way of monitoring the trophic condition of streams in the context of understanding salmon population status. More research is needed. However, we do encourage additional experimentation with assessment techniques that include estimates of both aquatic and terrestrial macroinvertebrates, and the relationship between macroinvertebrates and salmonid survival and growth (the latter requiring multiple censuses annually). We encourage additional research on the relationship between nutrient concentrations, physical habitat conditions, and macroinvertebrate abundance. While it may be true that metrics of trophic condition are poorly developed, the importance of such tools in understanding the capacity of watersheds to produce salmon suggests that development of such metrics be given a high priority in the targeted gaps research program.

There is little discussion about how monitoring habitat and population status will be interpreted with regard to progress in achieving "desired future conditions". We realize that specifying such conditions involves certain policy choices, but making such a large investment in monitoring suggests that the context and goals for monitoring should be fairly clearly spelled out. Presumably, population goals developed through the TRT process will constitute one target. The BiOp mentions habitat performance standards that usually center around environmental hazard thresholds for salmonid spawning or rearing (e.g., maximum percent fine sediment in spawning areas), but the RME Plan is relatively silent on these standards. It would be helpful for the RME Plan to address how desired future conditions will be identified and how monitoring data will be used to track

[5] Bisson, P.A. and R.E. Bilby. 1998. Organic matter and trophic dynamics. Pages 373- 398. *In*: R.J. Naiman and R.E. Bilby (editors). *River Ecology and Management: Lessons from the Pacific Coastal Ecoregion*. Springer-Verlag, New York, New York, USA.

progress toward achieving desired conditions. The ISAB 2003-2 Tributary Habitat Report recommends, for example, that habitat recovery be tracked as the rate of change in the direction of achieving the natural range of conditions that would likely occur in relatively unmanaged watersheds. If the RME Plan agrees with this approach, or something like it, some added explanation would be useful.

The final gap is one that the authors of the RME plan recognize and clearly state; the protocols and approaches being tested are specifically designed for wadeable streams. The ISAB/RP agrees that the limitation to these smaller systems is appropriate as adequate sampling protocols for many of the most important variables have not been developed for large channels. However, as data from the RME effort are compiled and analyzed, the caveat that some important parts of the channel network were not included in the probabilistic sampling framework should be prominent. Also, the RME effort should expand as proper protocols for these larger channels are developed.

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The RME Plan breaks tributary monitoring into four categories: (1) status and trends monitoring, (2) habitat restoration action effectiveness monitoring, (3) programmatic and implementation issues, and (4) data management. Of these four categories, most attention is given to status and trends monitoring and restoration action effectiveness monitoring. The coordination problems inherent in the implementation of multiple, complex habitat recovery actions are not given the same level of detail, nor are the coordination problems that will attend data management issues. In fairness to the authors, many of the problems involving interagency coordination and cooperation with state, tribal, and interest groups cannot be adequately addressed in this report. However, the challenges of coordination may add to the expense of the RME effort for tributary habitat. Thus the cost estimates provided may be less than will actually be needed to coordinate and implement data collection and management. Even the cost estimates provided suggest the daunting expense of such an ambitious program and will likely impose compromises in RME design. Both the RME Plan and Upper Columbia Monitoring Strategy call for widespread, expensive monitoring, but surely the resources needed to implement such a program will be inadequate to achieve every objective in the Plan. This will necessitate prioritizing monitoring activities. It would be helpful if the Plan identified what aspects of the monitoring efforts were considered most essential and would receive priority funding.

Detailed Comments

Page 38. The RME Plan correctly states that it is very helpful to know both the precision and accuracy of different methods for measuring fish populations and their habitat. Furthermore, the Plan proposes precision targets for different types of measurements. For example, it recommends that “controllable” variance components due to within year, among year, across crew, etc, sources be kept within a coefficient of variation (CV) of <

15% for population, biological condition (aquatic community indicators), and chemical water quality measurements, and < 25% for physical habitat measurements. We certainly agree that specification of precision and accuracy is worthwhile. However, the level of precision and accuracy required of a measure should be related to the degree of change expected of a parameter as a result of the application of management actions. A CV of 15% or 25% may not be required if responses in a parameter are quite large. In addition, we are not sure that the specified CV targets can be achieved for the various population and habitat parameters. There are very few studies, unfortunately, that report precision error for many of the measures specified in the RME Plan, and we are not provided with citations that suggest these targets are really achievable. Furthermore, "controllable" variance might include within year variability (due to time of sampling) or inter-crew variability (due to differences in sampling techniques), but among year variability will be strongly influenced by annual climate differences and these are not controllable. We believe that (1) additional research is needed to establish realistic precision targets for each of the parameters in the Habitat Status Monitoring section, and (2) additional refinement of the targets is needed to distinguish controllable from uncontrollable sampling variation. Our concern is that establishing CV targets for population and habitat monitoring that range from < 15% to < 25% may be setting the bar excessively high. The authors may wish to check with Russ Thurow at the Forest Service Rocky Mountain Research Station Lab in Boise for up-to-date information on population variability.

B. Hydrosystem

General Comments

On the whole, this section of the draft plan has many good features and is a credit to its writers. It should serve as a good basis for a final document. We provide comments that are intended to assist in finalization. NOAA Fisheries requested that the ISAB and ISRP's review focus on four questions. The following general comments are organized by the questions.

Answers to NOAA Questions

Question 1: If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

The most pertinent usefulness issue seems to be whether the Plan will provide information that will assist managers in determining whether goals for recovery are being met. While the Plan will provide much other useful information, it does not appear that it can be used to determine whether the status of ESA listed stocks is improving or not. A general impression of the Hydrosystem section of the RME Plan is that it generates a checklist that proffers rather vague promises that every issue will be addressed. A more direct approach would have been for the authors to carefully define just what it is they think they need to estimate in order to establish that survival targets for adult and juvenile salmonids have probably been achieved, and then explain in detail how they intend to obtain those estimates. What exactly will be measured where; what is the design; what will be the sample sizes (of marked fish released); and what statistical models will be employed? There now exists enough knowledge about realistic ranges of expectable survival rates and expectable detection rates that full specification of the design and sample sizes will allow a very credible prediction of what precision will be achieved in the future estimates. Only then would we know whether the proposed monitoring is likely to answer the needs.

Question 2: If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

The first two sentences of the answer to question 1 also apply to this question. That is, a plan aiming more to the point would focus on ensuring RME work that would answer whether the status of the ESUs has improved or not. The present suite of efforts may accomplish this, but the Plan is not clearly focused on demonstrating it.

There are several places in the Hydrosystem portion of the Plan where it is assumed or stated that projects supported through the Corps' Anadromous Fish Evaluation Program (AFEP) process will constitute adequate hydropower RME for this plan, and will receive adequate review by that process, which is already in place. We are concerned about the deference paid in this RME plan to the Corps' AFEP. Although other Action Agencies' programs were scrutinized, all RME related to AFEP appears to be simply accepted with no scrutiny. In this draft plan all dam-specific RME is assumed acceptable because it is vetted through the AFEP review process. That may be a mistake. The ISRP is independently reviewing the AFEP. It has found that adequate review is unlikely to happen through the AFEP process, because there is generally not sufficient time for review of final study plans prior to their adoption. The ISRP's yet to be completed review of the Corps AFEP process in the past few months indicates that the AFEP deserves as much scrutiny for overall RME goals as other programs, both for planning of research and monitoring and determining the effectiveness of actions. Because the AFEP dominates the hydropower side of RME, it should be included in this RME Plan. Perhaps it could be included as a "Phase 2" RME Plan rather than being included in this plan, with appropriate notes to that effect in this plan. However it is accomplished, the AFEP should be an integral part of this FCRPS RME plan. The ISAB/ISRP suggests that the ISRP's AFEP review (due in early 2004) be considered a part of this RME review.

With respect to adult passage and improvements in survival, variability may thwart efforts to measure stock improvements, especially over the short term. The plan mentions annual variability in quality (precision and accuracy) of the estimates due to "correction factors". In addition, we note that annual estimates may vary because of variation in the "true" value, due to changes in operations at the dams, river conditions and other factors. From the discussion in the Plan's text, it appears that the requirement in the BiOp for a 3% improvement in adult survival may be unreasonable and unrealistic, simply because of the impracticality of measuring that small an improvement. The same difficulty might occur for the target of 9 or 10% improvement in juvenile survival, as mentioned on page 165, depending on experimental design and sample sizes. This subject deserves more discussion because it might be interpreted as a key weakness in determining the status of ESUs in the first place. On page 157 under the heading "Progress and Compliance Tests, *ESU Coverage*" the Plan states "This means that only qualitative evaluations may be possible at the check-ins for most ESUs." It may be possible, using the methods described in the preceding part of the section, and the appended Smith et al. paper, to make a statement about how large an estimated improvement would have to be to reasonably conclude that it was real with a given sample size.

The December 21, 2003 (draft) NOAA Fisheries white paper (Williams et al. 2003) on effects of the hydrosystem on survival presents the best available synthesis to date and raises some serious questions that should now be addressed in the RME plan. The white paper acknowledges (p 53, Williams et al.) that "…the relative role of the hydrosystem in overall stock performance is still uncertain." That is an important statement that should motivate the RME effort to analyze, more pointedly, why that uncertainty exists, and specifically what (and how much) new data can be acquired to resolve that uncertainty, as

well as how much of the uncertainty is likely to be unresolvable in the foreseeable future. The NMFS analysis also raises an important new issue—the evidence, not evaluated systematically heretofore, that there is a significant handling effect in PIT tagging that reduces the survival rates of the PIT tagged fish by a detectable amount. The conclusion of that draft document (p 53) is that "…although PIT tagged wild chinook salmon provide useful data when assessing the difference in return rates of different treatment groups, they do not provide good information on the absolute adult return rates of fish." This requires further investigation, and its implications for the intended BiOp evaluations need to be explored in the RME Plan. This uncertainty likely merits some specific additional experimentation to quantify the effects.

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional important gaps that it has not identified?

We believe there are more crucial RME gaps associated with the Hydrosystem than estimates of "D", which occupy center stage in this section of the Plan. This emphasis in the Plan springs from the BiOp itself. The rather confusing questions of D and related issues of extra mortality, delayed mortality, and latent mortality potentially caused by the hydrosystem have been clarified by the NOAA Fisheries draft white paper noted earlier (Williams et al 2003). The RME draft plan needs to be revised based on this paper.

Prior to reading the white paper, the panel was concerned about the whole RME effort related to D, EM, and related delayed mortality and latent mortality of smolts. Five of the ten actions listed in Table 4.1 deal with this aspect of the hydro-related issues that are discussed in the Plan. The ISRP/ISAB are painfully aware that the definition of PATH "extra mortality" (EM) was elusive, that the appearance of "differential delayed mortality" owing to transportation was vulnerable to uncertainties caused by substituting assumed values or extrapolations into places in the calculation where specific data were needed, and that reach and dam survival rates are quite variable from year to year. We also are gratefully aware that the mathematics and statistics of survival rate estimation by mark-recapture methods is very well developed and sophisticated (and there are people available who know these techniques inside and out). The white paper specifically proposes abandonment of methods previously used involving the SIMPAS model with its flaws and use direct mark-recapture methods in their stead to obtain survival estimates. Because adequate numbers of recoveries of marked juveniles are available since 1997, it is now possible to do so, and the white paper provides those estimates for outmigration years from 1997 to 2000. That paper includes analyses of the survival estimates thus obtained and concludes, among other things that, considering the high average return rate of in-river migrant spring/summer chinook (4%) in recent years, there is little or no room for expression of delayed mortality. To increase SARs for transported fish so that T/I would be estimated as equal to 1, would require a 6% return rate for transported fish, which is an unrealistic expectation.

There are other information gaps that should be discussed in the Plan, and we outline them here. As noted in answer to Question 1, it would be helpful for the RME team to better address the basic question, "What kinds of research, monitoring and evaluation

studies need to be undertaken to help managers decide whether or not a stock's status is improving?"

The RME studies would be helpful in making management decisions such as, "What percentage of juvenile migrants should be transported in a particular year?" The white paper notes that a very high proportion of migrants is transported (85%), but that the return rates vary from year to year and within a year, with fish transported early in the year showing the lowest return rates, lower than in-river migrants. The RME plan might be revised to address such issues raised in the white paper.

Satisfactory implementation of the RPAs spelled out in the BiOp, as is the focus of this plan, may not necessarily lead to recovery. The RME plan develops an "Action Effectiveness Research" category (see page 165), and defines it as follows: "This approach shifts focus from annual survival indexing, focusing instead on confirming that the suite of adult passage management actions prescribed in the BiOp are satisfactorily implemented…..".. This raises the question whether a convincing argument has been developed to suggest that the list of actions in the BiOp will lead to recovery. This RME plan can contribute to that assessment.

If problem sites for survival are to be fixed, project-specific survival still needs attention. On page 149, at the third paragraph from the bottom, project specific survival is given short shrift. The text on page 150-151 continues this emphasis. Although the emphasis appears to be upon survival estimates through specified reaches, as spelled out in the BiOp, the result might be to fail to identify individual projects that are sources of significant mortality. Because actions have to be taken at the project level (even if implemented systemwide), where overall system performance is affected is very important. The need is for both overall system metrics and project-specific metrics to get the full picture. Combining transported and in-river survival estimates prevents identification of in-river factors that affect performance and the ability to fix them, which might allow a phasing out of the wholly artificial transportation process.

The use of extrapolation of survival estimates has been questioned, as the Plan notes. The plan would be better, in our opinion, if it advised that the practice be abandoned, carrying with it the use of models, such as SIMPAS that attempt to substitute a modeling exercise for obtaining real data. The white paper (Williams et al. 2003) makes it clear that PIT-tag estimates of survival through the reach from Lower Granite to below Bonneville dam are now possible and provide better information. The ISAB has previously recommended that the PIT tag estimation procedure be adopted for the purposes described in the Plan. We learn from Williams et al. that this has only been possible since 1997 when adequate numbers of recoveries of marked fish have been recovered below Bonneville Dam.

If models like SIMPAS are used, they should be well explained, including their limitations. On page 155, the Plan refers to the use of SIMPAS, which is proposed for estimating survival of juvenile salmonids during in-river passage in cases where empirical estimates are not available. It refers to an updated version of SIMPAS. Considering the importance of the missing data thus provided, it seems to be equally

important to provide a full description of the version of SIMPAS that was used. Perhaps this could be provided as an attachment similar to the two attachments already provided or as a reference to a source. In our discussion above, we have recommended abandonment of SIMPAS where it is used for the purpose of estimating relative return rates of transported fish and in-river migrants when real data are not available over large reaches or many steps in the model. It may be useful for evaluating relative survival expectations of fish exposed to proposed operational or engineering options.

Estimation of direct survival during transportation is called for on page 151 and is needed to fill a significant gap. The plan states that direct survival is presumed to be 98 percent, but no direct estimates are available. A study to provide a direst estimate will serve the purpose of replacing a questionable assumption that has been made. However, the design of such a study presents a significant challenge. On page 153 the Plan states that it is not clear which agency has responsibility for conducting a study of direct survival. The responsibility needs to be decided soon because this could be an important contribution.

Further explanation of proposed mid-Columbia actions seems needed. On page 155 under the heading "Middle Columbia ESUs (Chinook and Steelhead)", the Plan states "…stocks from this drainage were assigned a secondary position governed by opportunity in using fish dedicated for other purposes." This statement demands a fuller explanation. Recovery of listed fish that originate in mid-Columbia tributaries above dams that are not part of the FCRPS is dependent to some degree upon actions of the non-federal hydrosystem, which may be beyond the scope of the FCRPS 2000 BiOp. However, some of these actions are taken in concert with NOAA Fisheries and the FCRPS. In fact, the Plan might make reference to the Habitat Conservation Plans (HCPs), that are agreements entered into by NOAA Fisheries with Douglas and Chelan County PUDs that specify survival targets for adult and juvenile salmonids at three of the five mid-Columbia projects and lay out a process for producing estimates for compliance. Approval of the mid-Columbia HCPs requires a federal action because these HCPs are intended to satisfy the requirements of the FERC, the Endangered Species Act, the Stevens-Magnuson Act, and several other federal laws. These agreements might be described in the Plan.

In addition, FERC (a federal entity subject to coordination with NMFS with respect to endangered species) has in place requirements for spill levels that are designed to provide certain survival levels for juvenile salmonids at the two Grant County PUD projects. On the same page we read, "Empirical estimates of in-river survival from the first FCRPS dam encountered to BON tailrace are required." We wonder what is the reason for limiting the estimates to the first FCRPS dam encountered? In fact, are not Grand Coulee and Chief Joseph dams, as well as the upstream storage systems, part of the FCRPS? In addition, do they not have an effect on survival of adult and juvenile salmonids? The application of flow augmentation originates from the federal storage system above Grand Coulee and Chief Joseph dams. Grand Coulee and Chief Joseph dams also contribute to problems with total dissolved gas in the mid-Columbia Reach. The serious shortcomings of this "first dam encountered" approach should be recognized.

It seems as though these matters should at least be discussed in the Plan, preferably with incorporation of survival standards where these are available, such as in the HCPs. Similarly, reference should be made to the BiOp developed for the offshore fisheries, which take place on the listed stocks under the provisions of the Stevens-Magnuson Act. It would be appropriate to include a brief summary of the incidental take provisions allowed there. The whole life cycle of listed salmon and steelhead should be included in the discussion.

Question 4: The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

There are significant data management gaps regarding the hydrosystem that are not addressed by the Plan. The current PTAGIS system for PIT tag detection data is a fine model for a shared database with high standards for data organization, excellent public access, and essentially universal and rapid acquisition of the detection data from experiments conducted by many different organizations and individuals. More programs should adopt this approach. Nevertheless, the PTAGIS system suffers from one very serious shortcoming (which we have pointed out before). It does not contain the required meta-data (i.e., supporting information) for each release group. Because of this lack, PTAGIS data users do not have an indication (from the database) as to which tagged fish were representative of that year's wild or hatchery outmigration versus which fish were part of an experimental treatment that actually should be evaluated as a distinct statistical stratum. It is very telling that even a high level group of "insiders" namely the authors of the current NOAA Fisheries draft white paper (for the remand analysis) of the effects of the hydrosystem, had to acknowledge (p 14 of the 12/21/03 draft on the web) that their own analysis did not have access to the meta-data necessary for culling unrepresentative experimental release groups from the analysis.

A second very serious gap in data collection coordination and data management is the independence of the various radio-tagging and acoustic-tagging efforts from the PIT tagging effort. These data are not contributed to PTAGIS (or any other common database). For this reason, these data are not generally accessible for conducting the kinds of syntheses that are possible with aggregate of PIT tag data. The planning for the radio-tagging and acoustic-tagging efforts tends to focus narrowly on very specific questions about survival or passage route at a particular dam, without much regard for the contribution that the data from these tagged fish will (or might) make to estimates addressing larger questions. As for PIT tags, these larger questions include overall survival rates (especially as components of lambda for purposes of BiOp evaluation), transportation effectiveness, and possible effects of outmigration history on subsequent survival as reflected in the SAR). Since these larger questions may be the real bottom line in subsequent jeopardy determination or recovery evaluations, it is a loss if the investment in radio-tagging and acoustic-tagging does not add as much as it might to the effective sample size for resolving these questions. Given the relatively shorter effective life of these tags (compared to PIT tags), the seemingly more invasive nature of their application, and the different opportunities they present for subsequent detection, there

should be significant benefits if the planning for the radio-tag and acoustic-tag experiment were folded into the planning for PIT tagging, in a comprehensive way, and if the relative merits (and costs) of the various technologies were weighed appropriately in that planning effort.

Detailed Comments

Page 143, Table 4.4: It would be helpful if there were an appendix or table that gave the full project title without acronyms. What is highlighted (see legend)—is it the capital X's? Need to be clearer. There appears to be a missing link between Table 4.4 and the text. The table shows no "X" mark for RME 191, while the text says "This general survey indicates that all hydro RME actions are being actively pursued at some level and that every action except one (191) is being addressed by more than one research effort." Perhaps the words "except one" were meant to appear earlier in the sentence. On the other hand, on page 146 it is said, "Action 191 involves expanding an existing COE adult counting program and does not require a specific project. These activities fall under the auspices of the established COE Fish Passage Program." Elsewhere, it is suggested that counts might be extended into the winter and documenting fall back through the juvenile passage facilities, page 146. But the Plan also notes, under the heading "Physical Performance Standards" that "These standards are guidelines for operating the system. They include flow targets and spill schedules. The BiOp does not call for specific tests to determine compliance with the guidelines, nor does it call for additional mechanisms to monitor these beyond procedures in place. So this plan does not treat this further." To be as transparent as possible this plan should describe or refer to sources for information on what those mechanisms for monitoring and compliance consist of.

Page 3, heading for section B: A point of fact is spelled principle, not principal. All uses of these words need to be checked in the document, for the spelling is often wrong.

Page 3, bottom paragraph, first line: tenses are way off in this sentence. It would be better to read: Monitoring data that lack accompanying…assessments are of far less…

Page 3, bottom paragraph, fourth line: there should be hyphens after sampling and error.

Page 3, bottom paragraph, last line: principle, not principal.

Page 5, second paragraph, first line, principal, not principle.

Page 5, item 3, why only critical uncertainties related to EM and D? There are certainly other uncertainties. Is it because they are spelled out in the BiOp?

Page 11, first line: We suggest that the term "hydro-corridor" perpetuates the notion that the mainstems are just corridors for migrations and not real habitats for migrating and rearing juvenile salmonids. Certainly, some salmonids do just zoom through, but even

then they need special habitat features to assist that migration. We suggest using migration habitat of mainstem rivers instead.

Page 11, third paragraph: Again, why not other major uncertainties besides D and EM?

Page 12, top bullet: We cringe at more transportation, but if the experiment will be useful, we support it.

Page 12, first paragraph under Evaluation and Assessment: This paragraph is vague. Do you mean that a suite of tests can be assumed to give multiple measures that will instill confidence when they have similar results? In second line, procedure should be plural.

Page 139, second paragraph: should health be added to survival? This would account for gas bubble disease monitoring and other condition metrics.

Page 139, third and fourth paragraphs: In the context of the rest of the report, deference to the Corps' AFEP program seems like a mistake. Focus on EM and D seems to be short-changing other critical uncertainties.

Page 140, next to last paragraph: It might be useful to briefly describe the "procedures in place" or show where they can be found.

Page 142, table 4.3: Too many acronyms. Please define or spell out.

Page 144, next to last paragraph: When you say there are four projects to generate in-river survival estimates, are you suggesting that they are duplicative, supportive, necessary? What is a reader to grasp from the apparent redundancy? Also, the project/proposal numbers don't mean much without a key (see above comment).

Page 145, top paragraph: What about adult counts at dams and the calculated between-dam losses? How accurate are they? Could they be calibrated with PIT tags so that the dam counts would be more reliable as well as having a long history? See also 4th paragraph on this page.

The proposed shift from radio tracking adult salmonids to estimate between dam losses to use of PIT recovery data, is a useful and economic shift. The PIT recovery data are needed for estimation of SARs in any case, and the in-river survival estimates can be obtained as a secondary benefit of the PIT recoveries.

Page 145, second paragraph: Why is it not possible to determine this?
Answering the "why" is important for improving things.

Page 145, third paragraph: Where is the information noted in line 3 given in this report (would be more useable with specific cross referencing).

Page 146, Action 191 Gap assessment: Dam counts and survival estimates need calibration with PIT tags (related to Action 192). But the data need to be evaluated, not just have detectors installed.

Page 146, next to last paragraph: Will every reader know what "high-Q-detection" is?

Page 147, top sentences. We would add that new ideas are needed.

Page 147, first full paragraph: It would be useful to reproduce Fisher's (2002) appendix table 8 here or in an appendix. Readers of this report shouldn't have to track down Fisher 2002. Also, they shouldn't have to assume that the AFEP forum is adequate to vet those projects.

Page 147, D section heading: It is confusing to start a heading with a one-letter acronym. This suggests a listing with this being D (of A, B, C, D). Better to start with words, like: Delayed Mortality (D; Actions 185, 186, 187).

Page 147, last full paragraph: Why has the review of the Corps proposal not been done?

Page 148, top: With all the current high interest in performance differences between hatchery and wild fish, is use of hatchery fish wise?

Page 148, EM heading: same comment as for D heading.

Page 149, Action Plan. A short paragraph introducing this section on "Action Plan" would be helpful for those who get lost in the details and are not sure what's coming up next and why.

Page 149, ESU-specific monitoring: need space after ESU in sentence.

Page 150, first line of full paragraph: Table is 4.5.

Page 150, Table 4.5: the heading might say currently estimated. H and W might be defined in the heading, as well as other acronyms.

Page 151, top paragraph, fourth bullet: Wouldn't you want to identify which collector dam? Lumping all collection does not allow discrimination of any effects between collection projects.

Page 151, 2nd paragraph: Shouldn't it say In-river estimation procedures…? (You don't mean the results should be jiggered to agree, do you?) Or what do you mean?

Page 151, next to last paragraph: …estimates to be…

Page 153, top paragraph, 4th line: It seems that the responsibility ought to be sorted out quickly, for this could be an important and timely contribution.

Page 153, second paragraph: Reiterate earlier comment about combining in-river and transport data, to the loss of analytical capability and ability to actually fix anything.

Page 153, Next to last paragraph: The method of Zabel (actually Smith and Zabel) ought to be briefly described here, with reference to the attachment.

Page 153, bottom bullets: The ISAB and ISRP have been recommending for years that the detectors be started earlier and continued later. What's the problem with doing so?

Page 154, item 1: It would be clearer if you said …from a combination of empirical and … (the combination seems important). The paragraphs that follow all seem good.

Page 155, top paragraph, last line (the reference order for "respectively" gets lost—better to parenthetically say chinook and steelhead.

Page 155, last line of paragraph headed by Populations monitored: "tghus"?

Page 156, next to bottom paragraph: It is not clear that the paragraph that follow are a summary of Attachment 3. Might identify it as such (assuming this is so).

Page 158, top bullet: Why is fallback considered only at BON and the terminal dam? Aren't fallback rates at intermediate dams important, too? Terminal dam might be defined.

Page 158, second paragraph: The estimates do not make use of many years of dam counts, either, apparently. Note that the last line should have detection not detected.

Page 166, top. This project specific approach is what was referred to above as being needed rather than the systemwide approach. Fixes are at the projects, but add up to the system as a whole.

Page 167, bottom full paragraph: The compiled secondary (calculated) data are important and need a repository. PTAGIS still needs to keep the primary data.

Page s 169-182: The Attachment 1 by Steve Smith is an excellent update of the BiOp survival estimates (baseline) using current information. The adjusted values should give the best estimate of the baselines for improvements. Incidentally, "Attachement" is not spelled correctly in the footer (it's Attachment).

Page 183, 3d paragraph, line 2, insert hatchery before the second fish. Attachment 2 is a valuable contribution.

Page 188-206: Attachment 3 is a fine example of detailed thinking that is needed to determine progress (2005) and compliance (2010) with BiOp goals. It should be reviewed by a statistician to determine its technical accuracy. Conceptually, it seems fine.

Page 190. top paragraph, second line: Should be …are to be achieved on…

Page 190, bottom paragraph of text, line 7: “needed” should be indeed.

C. Hatchery/Harvest

1. Hatchery

General Comments

The Hatchery portion of this RME plan is intended to fulfill BiOp RPA 182 and 184, the Harvest portion of this RME plan is intended to fulfill BiOp RPA 167. The RME plan addresses the complication that hatchery fish create when action agencies attempt to establish the status (abundance and productivity) of component populations of listed ESUs (RPA 182). It also addresses whether hatchery reforms can reduce suspected deleterious effects of artificial production activities on listed populations and whether conservation hatchery activities can contribute to recovery (RPA 184). The ISAB and ISRP agree that these topics cover the most pressing problems that hatchery programs generate for evaluating the effect artificial production has on natural populations and whether artificial production can contribute to recovery.

Answers to NOAA Questions

Question 1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

Hatchery related RME to provide information on the status of ESA-listed salmon species is contained in actions to fulfill RPA 182. These actions consist of "counting" hatchery fish on the spawning grounds as a component of habitat tier 1 or tier 2 population status monitoring and determining the relative reproductive contribution of natural spawning by hatchery-origin adults using existing studies and "new" projects as a component of critical uncertainty research (CUR). The technology (tagging and marking, genotyping, fish collecting) and analytical methodologies (statistical models and other quantitative methods) all are sufficiently developed to effectively address the RPA. If implemented this information will improve determining the status of ESA-listed salmon species. However, details of the actions proposed to fulfill RPA 182 need to be developed more fully to ensure that these studies provide the Columbia River Basin with useful information for determining the status of listed salmon species.

The "masking problem" -- the uncertainty in the abundance and productivity (lambda) estimates for natural-origin fish populations due to mixing with hatchery-origin fish -- is clearly stated. Describing the consequences of masking warrants additional consideration. The last sentence of page 208 states, "As a result, estimates of recruits per spawner for the naturally reproducing component of the population can be inflated." This statement may be true but estimates could also be underestimated. If the number of hatchery fish spawning is low but there is an increase in the number of hatchery fish in

the next return, then the R/S estimate will be high. However, if there were large numbers of unmarked hatchery fish in the spawning population that have poor fitness and "normal" numbers in the return, then the R/S of natural fish will be underestimated.

If either the counting portion or reproductive performance of hatchery fish portion of RPA 182 actions are inadequate, then progress to reduce the uncertainty in status assessments will be compromised. ISAB and ISRP concerns about "counting" are detailed below in our answer as to how adequately the Plan addresses coordination of data collections. ISAB and ISRP concerns about evaluating the reproductive performance of hatchery fish spawning naturally follows.

For the reproductive performance of the hatchery-origin adults portion of RME actions for RPA 182, the suggested approach is to use DNA pedigree analysis generated in existing studies, as well as in a few new studies. Studies comparing hatchery-origin and natural-origin reproductive success in the Pacific Northwest are beginning to produce results. They reveal instances where there is little difference between hatchery-origin and natural-origin reproductive success and instances where there is considerable difference. At this time there is only conjecture as to the mechanisms accounting for these differences. We expect that spawning effectiveness would vary over time in response to a number of factors, and we do not know the full range of factors or the range of spawning effectiveness. One issue is how to control for inter-mating effects before implementation of genetic monitoring. Past interactions will definitely influence the relative reproductive success in each comparison. Consequently, the number and type of studies required needs clarification and more thought so the variation in this parameter can be estimated.

For the purposes of fulfilling RPA 182 and improving listed ESU status assessment, the ramification of these observations is that differences between natural-origin and hatchery-origin adults need to be evaluated using populations of the listed ESU contrasted with hatchery populations spawning with it. The uncertainty of the spawning effectiveness of hatchery-origin adults is unlikely to be resolved in a general way.

For some populations of listed ESUs (i.e., Snake River fall chinook ESU and Lyons Ferry fall chinook hatchery population), the population sizes and physical setting of the spawning terrain make using pedigree analysis inappropriate. In those cases, using alternative analytical approaches for estimating the proportion of juveniles or adults produced by hatchery-origin adults spawning naturally might be required. If the programs were only initiated in 2003, then there will only be 1 to 2 data points for F_2 adult productivity when the 2010 "check point" occurs. (There could also be a few more estimates if measured at the smolt stage.) If the data are this limited, then less rigorous measures over more studies (than are currently being conducted) could be considered. In those streams and studies where pedigree analysis is feasible, measuring reproductive difference in terms of F_2 productivity does not consider any explanation of reduced reproductive fitness. A few detailed studies into the F_3 generation with back-crosses would be wise.

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

RME to provide information on the effectiveness of hatchery actions at improving the status of ESA-listed salmon species is contained in actions to fulfill RPA 184 - The Effectiveness of Hatchery Reforms and Conservation Hatcheries. In contrast to the actions outlined to fulfill RPA 182, which the ISAB and ISRP believe are nearly sufficient, the actions outlined for RPA 184 are not adequately developed.

The RME actions for RPA 184 is a review (listing) of existing studies of hatchery research. The purpose of the list is to facilitate a gap analysis of whether sufficient hatchery action effectiveness research is underway. The research is to determine: 1) if hatchery reforms will reduce the deleterious impacts of artificial propagation and reduce ESU extinction risk, and 2) if conservation hatchery programs can contribute to recovery.

The RME plan states (p. 223): *it appears that sufficient studies directed at the effectiveness of conservation activities are underway* (item 2 above). No such assertive statement is provided that sufficient studies of hatchery reform are underway (item 1 above). Rather, several issues were identified as gaps relating to the effectiveness of hatchery reforms in reducing extinction risk.

The gaps identified are:

- methodologies and analytical models to synthesize the studies of hatchery reform and transform the results of the studies into required improvements to lambda and extinction risk probabilities;

- benefit/risks of steelhead kelt reconditioning;

- studies of predation by hatchery steelhead smolts and by spring chinook hatchery smolts, and studies of short-term competition between hatchery and natural-origin fish for food and space in tributary spawning and rearing habitat.

A framework and methodology for evaluating hatchery reform is needed. At the present time deleterious impacts to listed ESUs from hatchery releases is only reasonable conjecture. No quantitative estimates of hatchery impacts to any of the metrics – abundance, productivity, diversity, geographic distribution – that form the basis for determining the viability of a salmonid population is available. If there are no estimates of the impacts from artificial propagation, how can we measure the reduction of impacts? The ISAB and ISRP have serious concern about even the ability to measure a reduction in extinction risk. Is this even a reasonable starting point for an assessment?

The ISAB and ISRP do not concur with the conclusion that sufficient studies of conservation hatchery activities are underway. The ISAB supplementation report[6] concludes that the Columbia River Basin does not have an adequate experimental design in place to determine if "supplementation" will provide a demographic benefit and quantify the cost to natural spawning fitness from interbreeding between hatchery-origin and natural-origin salmon. There may be sufficient studies underway to develop the fish culture techniques for captive broodstock and captive rearing programs, but these are not studies of whether the products of these programs make a meaningful contribution to recovery. The RME plan could provide a vehicle for the Columbia River Basin to develop a large-scale experimental approach to evaluating supplementation.

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional gaps it has not identified?

Action 182 Performance Standards, Current Projects, Gap Assessment, and Action Plan. The performance standard for 2003 BiOp check-in is that adequate studies have been initiated. Table 182-a lists a number of projects investigating relative reproductive success of hatchery fish. A formal assessment of the sample design, methodology, and data collection is required before concluding that the projects underway will address the questions in the BiOp. The current implication is that all the projects in this table are equally good or acceptable. That implication needs to be verified. Spring/Summer chinook supplementation and steelhead supplementation in Idaho are listed as projects. Based on a recent ISAB review of these activities, these projects do not provide data appropriate to evaluate differential reproductive success of natural and hatchery-origin adults. It would be helpful if the document discussed the extent to which studies in a given geographic area are likely to be generalizable to another area. The same comment applies to the studies listed in Tables 184-1 and 184-2. Table 182-a only comments on half of the issue; there is no treatment of the "counting" problem itself.

Table 182-a should be complemented with another table of ESUs, the number of acceptable projects, project reference numbers, the number of populations included, methods, and number of years of data collected.

"Plans for addressing gaps in Action 182" on page 214 needs to be updated. The ISRP and Workgroup have completed evaluations of new projects and some have been approved for funding. Although the ISAB appreciates that the RME plan is a fluid document, to be most useful throughout the Columbia River Basin, the RME plan needs to be very clear and transparent as to how individual existing and new projects serve to fill RPA 182 obligations.

[6] ISAB 2003-3. A Review of Salmon and Steelhead Supplementation. www.nwcouncil.org/library/isab/isab2003-3.htm

Action 184 Performance Standards, Current Projects, Gap Assessment, and Action Plan. The performance standard for action 184 is that an unspecified number of studies be underway that are sufficiently precise that they can detect changes in survival *of naturally produced fish* (emphasized words added) as a result of reforms or conservation hatchery activities.

Twenty studies of the effectiveness of hatchery reforms are listed in Table 184-1 and 42 studies of the effectiveness of conservation hatchery actions are listed in Table 184-2. The studies in these lists were evaluated to "identify apparent gaps in priority research" (page 215). Two categories of gaps were identified for evaluating the effectiveness of hatchery reforms, and no gaps were identified for conservation hatchery actions.

The first gap identified in category 1 is a keystone to evaluating hatchery reform.

"Methodologies or analytical models for synthesizing the results and detecting the effects at the population and ESU levels of a myriad of hatchery reforms and conservation hatchery activities in terms of their effects on extinction risk or recovery".

In fact, until these methodologies are established, reviewing the list of projects is unjustified. It is against these criteria for precision and methodology that studies will be evaluated to determine if they will produce useful information. On page 215 "evaluating reforms" lies in isolating the effect of the reform in a controlled study and quantifying it in terms of its effect on population viability. This criterion is not listed in Table 184-1, and the ISAB and ISRP are doubtful that many of the studies in the previous table even have this objective. Can they be directed toward addressing this objective? Is anything being done to promote data consistency across projects?

The text in the hatchery reform section of RPA 184 is unclear as to what they are going to measure and how that will be evaluated. P. 223: *"As noted previously, most studies of hatchery reforms necessarily will focus on effects on individual lots of fish at a particular life stage."* P. 224: *"Action 184 studies should outline the method employed to isolate and estimate the effects of a particular hatchery reform or conservation hatchery activity on survival, and how it is proposed that these effects will be extrapolated to extinction risk and/or recovery of the affected listed populations or ESUs."*

The appropriate study design will evaluate the effect of the reform on the abundance and productivity of naturally produced fish. From the statement that measurements will be made on individual lots of fish, the ISAB and ISRP are concerned that the focus of the measures is on how effective hatchery reform is in altering the survival and behavior of hatchery fish. For example does the use of acclimation ponds reduce residualism and straying, and do NATURES rearing procedures improve survival or behavior of hatchery reared smolts? These effects are important to measure, but they are not the measurement of interest in evaluating the effects of hatchery reform on a reduction to extinction risk. That measurement needs to assess the change in the abundance and productivity of naturally produced salmon.

Projects like "NATURES rearing" and acclimation ponds measure the usefulness of these actions for altering hatchery fish survival or behavior (increased survival in the case of NATURES rearing and decrease straying in the case of acclimation ponds). They contrast the behavior/result of two hatchery treatments. There is no evaluation of whether NATURES rearing program or programmatic changes as a result of success (reduced hatchery production and release) have any impact on abundance, productivity, diversity, or geographic distribution of any potentially affected natural populations. Quantifying the impact of hatchery programs on natural populations requires evaluating the status of the natural population, not the hatchery population.

There is a general challenge in Columbia River Basin recovery planning to figure out how to aggregate individual population assessments into ESU level assessments. These are problems general to all four Hs, not just hatchery reforms. It is not clear from the RME plan that this subtlety is understood.

To recapitulate, before the projects in Table 184-1 can be assessed, the methodologies of analysis must be established. The ISAB and ISRP recommend beginning with a conceptual outline of the types of deleterious impacts anticipated – direct predation on emergent natural fry by hatchery smolts, competition, disease transmittal in tributary habitats, competition in the ocean, estuary, and mainstem habitats, genetic consequences of interbreeding – and then developing analytical approaches to measure these interactions. A first effort could involve the continued "mining" of the extant data. Recent work by NOAA Fisheries on the effects of brook trout on spring/summer chinook, competition in the ocean, and steelhead smolt releases in the Salmon River system are examples. Mark Chilcote (steelhead) and Tom Nickelson (coho) have had their regression analysis of hatchery spawning levels versus productivity published by CJAFS. These analyses could provide a provisional basis for setting performance thresholds for hatchery/natural interaction levels, i.e., proportion of hatchery fish that can spawn with a natural population, numbers of juveniles that can be released to compete, the number that can residualize, etc. Hatchery reform studies could then contribute by identifying any actions that could lower the incidence of interaction below threshold performance metrics.

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

Action 182 requires counting hatchery fish that are mixed with natural-origin salmon and steelhead on the spawning grounds. To accomplish this hatchery fish must be tagged and marked at a sufficient scale to be enumerated on the spawning grounds within specified statistical limits. The status of hatchery marking programs is not reviewed in the RME, and this is a significant omission. In the recent draft APRE report recruits per spawner, smolt to adult survival, escapement, and total catch are available for only 4.6, 35.6, 20.7, and 33.3% of Columbia Basin hatchery programs. In the September 2003 BiOp check-in, marking of "federally funded" hatchery releases for harvest is noted, along with a

statement "Work on a comprehensive marking plan continues". An adequate comprehensive marking plan is required for RPA 182 actions to provide useful information on the status of ESA listed populations. There is a need to decide on the precision required for the abundance and productivity estimates in the status assessment. This precision will in turn dictate what monitoring is needed to count hatchery fish and the level of hatchery marking necessary. Once this is established, the methods that will be used to identify not only which spawning populations and which hatchery releases are adequately monitored and marked but also which should be upgraded need to be developed and made transparent. The details of these prerequisites would be best described in the RME document. If they are not sufficiently described in the RME (which they are not now), they should be added as a "gap" with an RFS or RPA identified to address the gap.

The enumeration of the hatchery-origin fraction on the spawning grounds will be accomplished as part of tier 1 or tier 2 status monitoring described in the Tributary RME plan. The cohesion required between the Hatchery RME workgroup and the Tributary RME workgroup to ensure that the data collections are adequate is not evident in the RME plan. The scientists that will be using the data on spawning effectiveness of hatchery fish and the counting data to perform estimates of abundance and productivity for natural populations should not surrender the choice of locations and data collections on the "counting" portion of the task to the tributary habitat status monitoring effort. There needs to be annual assurance that the sites and precision of the estimates will be usable.

2. Harvest: Action 167. Improving estimates of incidental mortalities in fisheries

General Comments and Answers to NOAA Questions

Question 1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

No. The Plan's response to the single Harvest RPA action 167 is a very limited consideration of harvest. It ignores the other four RPA actions, and as such, it presents an extremely narrow consideration of harvest. The BiOp has five RPA actions associated with harvest (see page 9-145 of 2000 BiOp):

1. RPA 164 - selective fishing gear testing and development;
2. RPA 165 - Fishery Management and Stock Assessment Models to address effects of selective fishing;
3. RPA 166 - implement and enable changes in catch sampling programs for mass marking programs and/or selective fishery regimes;
4. RPA 167 - incidental mortality, effects of selective fishing;
5. RPA 168 - develop methods for crediting harvest reforms.

It was not apparent to the ISAB/ISRP why the other RPA actions were not addressed. Furthermore, in general, this response to Action 167 was minimal. There are incidental mortalities in ocean and coastal fisheries, plus there is an obvious issue of expanding mass-mark selective fisheries for hatchery-produced fish. Incidental mortality in the hydrosystem also occurs between enumeration sites and may well be attributed to fishing impacts (i.e. inter-dam losses), such as the possible "ghost nets" in Bonneville pool or other sites. The issue of relating incidental mortality to a listed species was not addressed at all. Are current programs collecting tissue samples to identify the stocks present during fishing, and how accurately can specific listed stocks be identified?

Because we are uncertain why the response only focused on RPA 167, we are uncertain of the expectations for harvest in general. *In our opinion, this response would not be expected to provide the necessary information on harvest effects on listed species.* Further, the standard for assessing fishing effects is the "effect on ultimate spawning (reproductive) success" (page 225). This assessment will be extremely difficult and will likely be a minor component of total fishing mortality. There is a need to ensure that the immediate and short-term mortality is estimated well (and first), and then consider how to assess the long-term impacts on reproductive potential.

An additional consideration is that this response refers to one research proposal in the basin. The ISRP has reviewed proposals for that research in the past and has provided extensive comment (most recently for the Mainstem & Systemwide project #35018). The committee, therefore, finds it very difficult to accept that "no specific gaps have been identified at this time", in the Gaps Assessment section. Many other sections of the RME plan used tables of projects to outline activities, a more comprehensive presentation of projects and data requirements to meet the Harvest related RPAs (identified above) would be a useful addition to this section of the Plan.

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

In terms of action effectiveness, the study of catch-and-release mortality will improve the knowledge base for incorporating harvest impacts into an overall status assessment for listed species. As commented above, however, the current plan is inadequate unless there is justification presented as to why the other four RPAs were ignored. In addition, the issue of total fishing mortality through the life cycle of the species was not addressed.

In our opinion, the Plan would be improved by consideration of how to incorporate all sources of mortality, i.e., from each of the four H's, into a comprehensive assessment covering the entire life-cycle of the anadromous salmonids.

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional gaps it has not identified?

The assessment of RME gaps related to Harvest is inadequate. As commented in the answer to the first question, the ISAB/ISRP was concerned about the focus of this response on the "effect on ultimate spawning (reproductive) success". The response did not provide support for focusing on this issue relative to estimates of immediate and short-term mortality. Other issues limited to catch-and-release fisheries include cumulative mortality due to multiple encounters, and identification of stocks actually present in fisheries. (Other information needs were identified under the first question.)

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The response on harvest does not address any aspects of data coordination or management. This is of course a serious omission because there are obvious data coordination and collection issues associated with integrating information on harvest with other aspects for the Basin-wide RME plan. For example, what level of stock resolution must be used in monitoring harvest impacts for consistency with other assessment programs? Are there specified levels of precision and accuracy that sampling programs should be designed to achieve? Are the data being collected comparable with data being collected in ocean and coastal fisheries so that data collected within the Basin can be integrated with those fishery programs to provide a life-cycle assessment of all mortality sources?

Detailed Comments

(from page 225 RME draft) "Action 167 is presented in Section 9.6.3.2.2 of the BiOp and states: *The Action Agencies shall work with NMFS, USFWS, and Tribal and state fishery management agencies to develop improved methods for estimating incidental mortalities in fisheries, with particular emphasis on selective fisheries in the Columbia River basin, doing so within the time frame necessary to make new marking and selective fishery regimes feasible*."

The ISAB has underlined portions of this statement to emphasize the "action" components of the RPA, and that were commented on in the RME draft material. The RME authors note the need to estimate the incidental mortality, and that:

- the "critical question relates to effect on ultimate spawning (reproductive) success,"
- the purpose of action 167 is to improve estimates of incidental mortality rates for existing fisheries and to determine or verify rates in new or experimental fisheries,
- the Action Agencies are required to have initiated studies and/or developed methods by the 3-year check-in.

Although the ISAB sees a basis for the second and third bullets (assuming there is some basis for the use of the three-year check-in), we do not understand the emphasis on "ultimate spawning success" in this response. This concern is heightened in the very brief *Performance Indicator and Standards* section that again emphasizes this point and reiterates that it must be measured with "sufficiently accurate and precise estimates as needed to make fishery management decisions in the context of listed fish." While there was agreement on the need to study the potential long-term effects of catch-and-release fishing, the basis for emphasis on reproductive impacts is not provided. What evidence is there that this is the critical question, and what would be used to establish the performance standard? It is not apparent to the ISAB why there is not an equal emphasis placed on improved estimates of immediate and short-term mortality by stock. It is also not clear if current assessment models account for these mortalities rates and the potential for cumulative mortality effects through multiple fisheries.

Based on the current projects, the *RME needs assessment* and *Gap assessment* sections conclude that "no specific gap has been identified at this time." This statement is not well supported since there is no evidence presented that the current programs are adequate. A table of projects and objectives should be provided as with actions 182 and 184. What is the likelihood that these studies will meet the experimental standard defined above (i.e., assess impact on reproductive potential)? More detail could be given about the ongoing experiments with tooth-tangle nets in the Zone 6 commercial fishery. Is immediate incidental mortality being measured? How does this study relate to survival of incidental catch and subsequent reproductive success? How will the existing studies address this Action item?

The action plan for 167 also needs much more detail. Rather than wait for selective fishery proposals as they emerge, a more proactive approach would be to identify research needs and issue an RFP to address those needs. For example, within the context of a life history model and using current knowledge of mortality rates on listed species, how much incidental mortality may be allowable to achieve rebuilding goals and how precisely can incidental mortality rates be predicted?

In the Overview on Tributary RME there is the statement that "In order to track the status of a population, spawner escapement and removals en route to the spawning ground must be estimated." This statement seems to ignore ocean harvest, especially for fall chinook. The RME Plan authors may be planning to use current estimates of ocean harvest, but they should at least discuss the accuracy and precision of the coded wire program on hatchery fish for estimation of the harvest of wild populations and ESUs. Also, they should be concerned about the incidental take and mortality of released spring-summer chinook and steelhead in the ocean. The ISAB continues to think that the coded-wire program is in trouble and questions whether estimates based on hatchery fish are representative of harvest rates on wild fish.

D. Columbia River Estuary and Plume

General Comments

The overall structure of the draft Columbia River Estuary and Plume Plan is reasonable and provides a good framework within which to develop a plan, though fundamental pieces are missing. To assist in the development of this draft section into a completed plan for the Columbia River estuary and plume, we provide extensive comments by section. However, there is a significant organization issue that needs to be considered before addressing specific comments.

The plan is structured around three objectives: status monitoring, action effectiveness research, and uncertainties research. The plan then addresses an Action Plan and a Risk Assessment dependent upon existing projects in the estuary and lower Columbia River. However, in Appendix A the authors list the RPAs that address the estuary and should be the focus of this report. At no point do the authors' address the fundamental question of whether these projects actually meet the requirements under these RPAs. We agree that this plan should provide "data on the performance of the estuary program" and "increase the knowledge-base", but in the absence of a specific assessment of the information needed to satisfy the multiple RPAs, the reader is left to assume that the existing projects are sufficient. The authors do return to this issue in consideration of the Action Plan, but we recommend that the report should begin with a consideration of what is required and why. In the absence of this background, the question of what is required to meet the RPAs pervades this entire plan, and any strategic consideration of the RPAs is not evident.

The reviewers were also concerned about the depth of review and comment relative to each RPA. The ISRP recently reviewed one extensive document addressing only RPA 159 (Johnson et al. 2003, reviewed in ISRP2003-13). Three of the authors of this report were also involved in the previous report, so we can assume coverage of the RPA 159 should be authoritative. However, this does draw into question how extensive the other projects were and how thorough the gap assessment was. This issue is commented on further in this text but specifically concerns the process used in assessing gaps.

Answers to NOAA Questions

Summary

In general, the document provides a good framework within which to develop a plan, but it is lacking fundamental pieces. The reported timeline shows that many of these pieces are scheduled to be completed in Fall 2003; perhaps final review of the Plan should await these pieces. Even without the missing pieces, the Plan needs to tighten up the objectives to make them more specific by rephrasing them and expressing them in measurable terms where possible. There are many measurement, sampling, and analysis issues that are left unaddressed by the Plan. Because this plan does not explicitly consider the RPAs and

what RME plan would be necessary to address the RPAs, we must conclude that this draft is inadequate and must be thoroughly reassessed. Brief comments to the questions are provided but the detailed comments on the draft are expected to be of more value.

Question 1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

The status monitoring statement is too vague to be useful. Objectives should be rephrased, include more specifics, and include statements of specifically what will be measured and how.

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

The assessment of effectiveness of actions is limited by the lack of a clear and specific statement of objectives for habitat restoration. Goal statements are very general and sometimes poorly worded. For example, the FCRPS goal is expressed as to "contribute" to the increase. As with status monitoring, action effectiveness objectives should be rephrased, include more specifics, and include statements of specifically what will be measured and how. While we like the structure of implementation, effectiveness, and validation as steps in the Action Effectiveness Research, the objective statements are confusing.

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional gaps it has not identified?

It is not clear that a thorough assessment of critical gaps has been conducted. The section lacks a specific assessment of the information needed to satisfy the BiOp RPAs and does not address whether ongoing projects are sufficient to meet RPA requirements. Strategic consideration of the RPAs is not evident.

The section on uncertainty research is usefully organized around management questions that are being addressed by current programs, but some attempt should be made to prioritize these uncertainties according to the degree of importance for decisionmaking. Areas of critical uncertainty not being addressed by ongoing projects should also be identified.

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The section addressing coordination is too brief and incomplete to assess whether it will improve coordination of data collection and management. Unless a specific coordination plan is developed it is unlikely that improved coordination in the estuary will result. The plan should address how to ensure consistency of methods (data collection and management) and format across projects. It should also specifically address the process through which information needs of decision-makers will be understood as well as the process for learning, adaptation and revision across projects within a pre-determined, structured process and design. Within the estuary province, this plan continues to call for an oversight group, which does not indicate a fully coordinated process even with the estuary.

Detailed Comments

Summary
This estuary/plume section needs to be reviewed after revisions. At present, this text does not seem consistent with main body of the text. For example, under Status Monitoring, the summary refers to listed salmon frequently, but there is no reference to any work on stock identification for identification of component stocks and members of each ESU?

Preface
The preface identifies the RME plan as a work in progress, and as such is incomplete. It is missing identified performance targets, a sampling design, methods for data collection and analysis, methods for monitoring, a conceptual model, a plan for data management, and a coordination plan. It does include a timeline for completing these elements, but as they are the central elements of the Plan their inclusion is central to having a workable plan. It is hard to review the document as a plan without these elements, and it is also seems that it is putting the cart before the horse to present performance indicators, monitoring variables, etc without having specified the end point (performance targets.)

As the document notes, actions recommended in this plan will be funded elsewhere, so it is particularly important that the basic components of the Plan be complete so that the overarching framework, rationale and identification of critical gaps in knowledge are clear to funding agencies.

Contents
The overall structure of the Plan is logical and systematically developed. The glossary and list of acronyms are helpful.

x. Glossary, Adaptive management … reasonable definition but would prefer to include reference to a "structured learning process", the text does not follow this definition very closely.

x. Glossary, Estuary … includes river miles zero to 146, but many other documents will refer to estuary as zero to 46 miles, and then the tidally influenced river from 46 Rm to 146 Rm. Why the estuary is so broadly defined in this section? There is a concern with most of the report about what environments are actually considered. Are the lower river tributaries included and considered?

Background and Purpose

The introductory paragraph lists RME components of RPA actions. This plan is designed to address the monitoring and research component. It would be helpful in the introduction to include some reference as to how the companion Columbia River Estuary and Plume RME parts (protecting and enhancing; compliance monitoring) will be carried out.

P1. Figure 1 and text, how is the Willamette River included in this definition of estuary? Is any of the lower Willamette included, and if not, why not?

P2, para 3: it is stated that the purpose of the Columbia River Estuary and Plume RME plan is to provide a scientific basis for the Columbia River Estuary and Plume RME program. Is this correct? This is a confusing statement, since the programs cited in this text *are* the Columbia River Estuary and Plume RME program. What is meant by this statement? Is it actually that this plan is intended to be the evaluation basis of the program and review against the BiOp tasks? Isn't the purpose of the Plan to provide a strategic framework for conducting research, monitoring and evaluation? A plan is a decision tool and guiding framework as to how scientific information will be developed and used, but the Plan doesn't provide a scientific basis as such. It is important not to lose the sense of the strategic guidance characteristic of a plan.

P2: Status monitoring, "monitor trends in status of the ecosystem" … two questions come to mind: status relative to what? And how would you assess the status of an ecosystem? Ecosystems are dynamic and will change, so what are you to compare against?

P2: Status monitoring refers to "habitat tracking …" This wording is not very clear, what is tracking? Should re-word to improve clarity in future text.

P2, footnote 2: even if the term "critical " is too specific a meaning in terms of the BiOp, it is still necessary to have some way to denote when an uncertainty is "key." Not all uncertainties can or even need to be resolved, so there needs to be a way to direct funding to the most important.

P3: it would be helpful to report annual average discharge for both pre- and post-dam time periods.

P4, section 1.3: The description is confusing. What coordinates all these separate RPA actions? It sounds like there is a lot of duplication. Is there any process to assess the effect of all actions to determine areas of potential duplication?

P5, the description of the CRE&P in the first paragraph makes it sound as if performance standards are already developed. Is there intent to use these?

How will the COE's General Investigations Study fit with the work proposed in this plan? The two would appear to be duplicative. Does the COE study have quantified objectives?

P5, bottom: more detail about the two categories of performance standards should be included here.

P6, table 1: is "recovery" defined in the context of the performance standard?

Developing the performance standard – defined here as a specified numerical objective or target – would seem to be needed before the rest of the Plan is developed, not inserted afterwards. The process seems backwards.

What is specifically the difference between performance standards and objectives, given the definition in Table 1? The plan treats the two as different. How were objectives developed without performance standards?

Are BiOp goals not quantified? This discussion of objective and goals generates the obvious question and concern about the specification of goals in the BiOp. This is again an example where these is clear need to relate this text back to the original objectives and requirements of the RPAs.

P7. 2nd para., the sequence of development applied in this text provides a logical framework for development of the Plan.

Section 2.0 Goals

P.9 Columbia River Estuary and Plume RME goals: Action effectiveness: to determine effectiveness the effects have to be assessed in relation to stated objectives for habitat restoration. Are these objectives clearly stated and where?

P.9 These statements are very general and sometimes poorly worded. For example, in the FCRPS goal, is the only goal really to just "contribute" to the increases? And what would a reasonable contribution be? In the Columbia River Estuary and Plume RME goals, the status monitoring statement is vague:

- status … relative to what, is it related to a starting point in time, or to a future goal?
- trends … is this simply a trend in a parameter over time, or does it involve evaluation of variability and the ability to measure a trend against this variability?

- listed salmon … are the program goals only with respect to list salmon and if so, how will those listed stocks be identified?
- usage and survival … presumably if listed salmon used the estuary more but the survival rate did not increase, you would be more interested in the survival rate. So is the basic goal to increase use or just ultimately the survival?
- survival … do you mean to imply survival just in the estuary or overall?

Under Uncertainties, the goal is now to "resolve" … this is a strong goal but differs from the program statement to identify uncertainties (page 2). This is just an example of the need for consistent clear goals in this text. "Uncertainties" should be "Uncertainties Research" to be consistent with other sections of the document. Should be "Resolve key uncertainties" rather than "resolve uncertainties"

Section 3.0 Conceptual Model
P11. to P13 Conceptual Model … while we agree with the value of developing a Conceptual Model, this section does little to provide that or assist this plan. For example, Figure 5 does not fit the description of Figure 5 1n the 2nd para., page 12. Figure 5 is actually only labeled as a "Feeding sub model …"
- last sentence 2nd para, page 12, "restoring" should be restoration
- para. Page 13, point (2), delete "of" from phrase
- last sentence page 13, spelling of capabilities
- p.13, typo: "trough" should be "through"
- Figure 5 … at examine survival should involve predation, not in the model.

Substantial work is needed on this Conceptual Model section before it benefits the development of this Plan. This section doesn't provide enough detail to be a useful conceptual model. Does the model as presented advance understanding or help to focus research or monitoring resources?

Section 4.0 Status Monitoring
P15: The list of objectives, now phrased as questions, should be rephrased in standard objective format. E.g. Objective 1: To determine the ecosystem status of the Columbia River Estuary and Plume. The benefit of this wording is that is focuses attention on the need to quantify the elements of "ecosystem status."

All objectives contain lists of "selected" or "included" variables. Which will be monitored? All those listed or a subset?

- Objective 2: the discussion should be more specific about which variables are to be measured to determine timing, location and presence.
- Objective 3: The text indicates that methods to determine survival below Rm 146 are not yet finalized. For consistency, shouldn't the same methods be used as above Rm 146?
- Objectives 4 and 5 should be specific about what variables will actually be measured.
- What will be measured under objective 6?

P17-20: In Table 2, it is not clear which attributes will be measured. Will all of them be measured?

P15. Section 4.2 … Objective 1 apparently describes "ecosystem" traits for status monitoring, but they are all just physical features. Aren't there any biological features to be considered in an ecosystem assessment? Question 2 refers to biological features but only of juvenile salmonids.

P15. Section 4.2 … Objective 2 now refers to "life history diversity, which is hypothesized to be important to salmon resiliency." Presumably the authors are referring to observed phenotypes that use different environments as juveniles (life histories) but there will not be any direct proof that these are genetic traits or life history strategies. Is this a critical uncertainty that needs to be added to your text? Also, how is resiliency used in this context? It is never defined.

P16. Section 4.2 … Objective 3 Survival. This will be the most difficult parameter to assess but it is not apparently how this objective will be monitored or exactly what will be measured. We need a clear statement of the required attribute so that how it is to be monitored can be assessed.

P16. Section 4.2 … Objective 4. Water quality directly affects salmonid fish use … but it may not directly affect survival. In extreme cases it could affect survival but presumably you do not intend to only monitor for extreme water quality issues.

P16. Section 4.2 … Objective 5. Is this objective included because all tributary streams entering the lower 146 miles are included in the "estuary" definition and to be included in this Columbia River Estuary and Plume RME plan? If so, this needs to be made much clearer in the Study Area section … and if not, then why does this objective refer to spawning areas?

P16: How can performance targets be developed in FY04 after sampling, data collection etc has already begun?

P18. Table 2. ID. SM2 … a monitoring program does not monitor "Life history diversity", the expression of these life histories, i.e., Juvenile distributions, would be monitored. We disagree that the Indicator is "Life history diversity" and the text for Rationale seems to equate spatial diversity with life history strategies. This debate is not needed in this table or for the monitoring program. An important observation from the monitoring program may be to prove this linkage.

P18. Table 2. ID. SM2 … Indicator "Usage". Is this indicator necessary? The three attributes can each be incorporated in "Juvenile Distributions" or in "Growth". Residence time is an attribute related to Growth, and Spatial distribution and Migration pathways are both attributes related to Distribution.

Section 5.0 Action effectiveness Research
The review committee questioned why flow management wasn't considered a "primary management action?" This is a potentially important consideration that is omitted.

P21. Section 5. The same comments apply to the Action Effectiveness Research objectives as stated above for the Status Monitoring objectives. Objectives should be rephrased, include more specifics, and include statements of specifically what will be measured and how. While we like the structure of implementation, effectiveness, and validation as steps in the Action Effectiveness Research, there is some confusion about the objective statements.

- Objective 1 involves both individual projects and their collective role in meeting program goals. These are important but different aspects of implementation. The implementation of a project can be monitored, but the collective value of these projects to meet the overall goals requires a more comprehensive assessment than a monitoring program. This is actually undertaken in Section 7.0. Would it be clearer to have two sub-objectives associated with implementation monitoring? Also, it is not clear how adaptive management, as in the glossary, pertains to this objective.
- Objective 2 … agreed
- Objective 3 … need to be clear on what estimate of survival is being validated. If the cumulative effect of projects is being evaluated, then the survival to be assessed should be survival through the estuary (as defined in the glossary). However, it is not clear that this is the evaluation standard. Further, is it the intention to associate survival trends to specific habitat restoration projects? This may never be possible. Since the answer to the question posed as objective 3 is critical to determining effectiveness of habitat restoration actions, variables to be measured need to be clearly specified.

P22: what is meant by "directed analysis?" More specific description of the type of analysis should be provided. Is this somehow different from analysis?

P22, under section 5.3, last sent of para 1: this is an interesting question, and if it is important it should be listed as an objective.

P22, last sentence on page is too vague. There should be a better developed plan to ensure coordination of research.

P22. Section 5.3 1st para. The section on conceptual foundations never referred to habitat capacity, opportunity, and realized functions. Should move to that section and more adequately describe the basis for these terms (as described on page 24).

P23. 1st para. Last sentence. "monitoring, cumulative effects, is not currently covered" ***… this is a major shortcoming and severely limits our review of this Plan.***

P23. Table 4. It is not clear why certain Attributes may address Opportunity and Capacity, but others that are very similar do not? For example, essentially all of AER 1 could address both.

P23. Table 4. AER 3 Resilience … what is this Indicator and how would it be monitored? Foraging Success under the Growth Indicator … how would this be monitored?

P24. The first paragraph and the box should all be before Table 4 so that the table is better explained.

P24. Last sentence of first para. "If habitat opportunity and capacity are acceptable relative to historical levels, and realized function is acceptable according to monitoring, this may serve as a surrogate for measurement of the effectiveness of habitat restoration actions in the estuary." While this may seem like a fairly important comment, it is so subjective and poorly defined that it cannot be assessed. What would it be a surrogate too, do you mean a surrogate for the cumulative effect of the projects? How determines what is acceptable?

P24 and P25. last two paragraphs. There is a serious concern for the use of historical conditions in this context. While the temporal component is important to consider, you may have very little control over temporal effects due to annual climate variation. Further, how would you ever know the "Historical Days per Year Available" in the equation (page 25)? Given the changes in the hydrosystem and estuary landscape, couldn't you accomplish the same by standardizing to a flow level in the current hydro-system, or to some "potential level" that is set as an interim goal? This may keep people focused on the current situation and what is achievable as opposed to the distant past.

P24: What is the specific meaning of "directed research?" As above, the use of these adjectives creates questions whether something different is implied.

P25, it's not clear in the Plan why methods of data collection and analysis will not be developed until FY04.

Section 6.0 Uncertainty Research

The organization of this section around management questions could be a useful approach. However, these questions seem to be the initial questions that the current programs are addressing but without any effort to identify areas not being covered? Is it possible to prioritize among these key uncertainties according to their relative importance to management decision making?

- Uncertainty 2a: how would the sediment core research address the question of how hydrographic change relates to habitat function or quality? What indicators of function or quality would be measurable in the sediment?
- Uncertainty 2b: As with the Columbia River Estuary Plan, more attention should be given to the meaning and relevance of "historic." What would determine a condition

as historic? How about changes in habitat condition over time within the "historic" (by which is meant pre-European influence?) time period. What is the relevance of "historic" given current uses and settlement patterns?

- The concept of "historical conditions" deserves more careful development. Given the dynamic system of the Columbia River Estuary, more consideration should be given of an historic range of conditions, of the key salmon-promoting properties of this range of conditions, and of the extent to which these properties are achievable today.
- Question 4 does not seem appropriate; surely the answer depends on the confidence required in assessing specific objectives, many of which will vary between projects.

Section 7.0 Action Plan
Section 7.1 Project-Level Assessment
P31, 7.1: How will the "action-level assessment" actually be done?

P31. Section 7.1.1 Project Inventory … good idea but it is difficult to identify programs. Could an appendix be provided with the project title, lead scientists, abstract of proposal, and any cited publications? In Table 7, also include years of actual data, several are new projects that are not yet implemented or funded. Should also identify that two of the projects are in the plume and do not consider the estuary.

P31, last sentence under 7.1.1. "The Action Agencies are working to coordinate these projects to form a cohesive EP-RME program": isn't that what this RME document is supposed to direct? Is there a plan to ensure that this plan is used in that way?

P32. This paragraph identifies an important omission that should be clearly identified in this report, but why is this not identified in the critical uncertainties research?

P36. Table 8 is a good presentation of coverage, but a suggestion is to separate existing programs from those that are *New with No data yet*. It is misleading to show that these new programs are on par with ongoing and productive programs. Caption Table 8, "but data still in pipeline" needs to be clarified.

Cov seems to refer to Indicator and to Attribute, these assessments are not explained in the text, which conducts the assessment and assigns the values? With multiple attributes in an Indicator, how is the *Cov* value for the Indicator determined? It does not seem to be simply the lowest common value in the attributes.

P37. Table 8 Survival … this assessment in particular is optimistic. Three of the six projects noted in this row are new with no data! P2 involves the plume only, and P3 can not yet provide an estimate of survival through the estuary. What is the basis of this "complete coverage" assessment?

The general comment on Table 8 is that there is no documentation of how the various assessments of coverage were determined. Who did the assessment, was it reviewed (the authors of the projects should not have been involved)?

P38. Table 9. Similar concerns to above for Table 8. Uncertainty U2b relies on P23 but this is a bathymetry project in the outer estuary only. How does this relate to food webs?

Section 7.1.3 Risk Assessment

P39. Risk Assessment. Risk is defined as the likelihood that programs goals and objectives will not be met if pertinent data are not available. Is the latter phrase really necessary, does it add something to this definition?

P39. Status Monitoring, 1st para. While the risk assessment may be useful, this paragraph is not very clear. Is the first criterion asking "Could program goals be met with current knowledge?" And then, is the second criterion "How vulnerable is the success of a project regarding implementation and successfully acquiring the related data?

P39. Table 10. In several rows, the assessment of vulnerability seems dependent on the assessment of Data Disparity, why would this be the case? These two criteria could be assessed separately and then scores added. *The risk assessment does not refer to the extent of habitat disruption in the current environment or to species. It would seem that these should be considered in assessing risk to the RME objectives.*

P39, 7.1.3 More detail is required as to how the "risk assessments" were conducted. Who did the subjective assessments? What methods were used? How sensitive are the results to those who did the assessments? I.e., would another group performing the same risk assessment be likely to replicate the findings?

P40. Table 10 has a lot of 5's: how will indicators be prioritized among those with the same scores? The document should discuss how Action Effectiveness Research indicators can be prioritized given that most were determined to be at risk.

P40. and P41. Tables 11 and 12 are apparently to be completed. Tables 11 and 12 do not have numerical scores as does Table 10. What is the difference?

Section 7.2 Program-Level Assessment

P42. This section on monitoring oversight is quite brief and tentative. It should be developed to be more of a plan. Surely a missing point here is that the projects must be considered within agreed goals and objectives, otherwise, why monitor? Generally this section is incomplete, makes broad encompassing statements that need not pertain to all projects, and really draws into question who is running this RME ship?

P42. Sec 7.2.2: How will consistency of methods (data collection and management) and format be ensured across projects? In order to produce data useful to decision makers, the document notes that the Estuary and Plume RME data team will have to understand the information needs of decision makers responsible for adaptive management and program evaluation. The document should discuss the process by which this knowledge will be acquired. It won't happen without a systematic plan.

P43. Sec 7.2.3 Adaptive Management: does adaptive management include adjusting program objectives as new information is acquired, or adjusting methods and approaches for meeting specified objectives? More detail on adaptive management should be included in this plan. What is the process for learning, adaptation, and revision? The protocols from the basinwide RME should be included here. This form of adjustments can be done, but this text is not consistent with the definition of adaptive management in the glossary. To be consistent, sampling program adjustments should be conducted within a pre-determined, structured learning process and design.

P43. Sec 7.2.4 Funding. Why is this included in this plan?

Section 7.3 Recommendations
The recommendations in this list should be more thoroughly developed with discussion of timing, constraints, potential problems and approaches.

P43. Section 7.3.1. 2nd para. The suggestion of another monitoring site in the estuary is a decision within the RME project, why would they choose one in the estuary over any other? This again draws attention to how the tributaries in the estuary are being considered in the overall RME.

P44. Table 13. The value of this table is not clear. The implication seems to be that most recommendations are being addressed by existing or new projects. What is then gained from this table? Surely there are uncertainties that still need study or improved monitoring. The need for this table should be clarified.

P45. Recommendations. This section seems incomplete, as it is the messages seem trivial. For the first two, one needs to ask "for what?" The oversight group should exist now, and the last three recommendations are simply work tasks of the oversight group.

P45. Timeline … again refers to need for an oversight group. The agencies and groups funded by all these sources are provided huge amounts of money. If they cannot organize an oversight group, then the region should reconsider where to recommend funding.

E. Data Management

General Comments

All sections of the RME Plan included a statement to the effect that "There is no formal database in place that houses all of the information necessary to generate annual production, productivity and recovery progress performance metrics for populations, ESUs and fish habitat. One must be established." The ISAB and ISRP do not believe this is feasible or in the best interests of scientific analysis of the data in the short term, given the history of independent development of databases in the region, the independent nature of agencies and other players in the region, and (we believe) the need to move toward a system consisting of a mixture of distributed databases and information portals. However, the ISAB/ISRP endorse the overall recommendations in the Data Management Section 6, namely:

- Develop an overall RME information system architecture—a detailed blueprint of the design of the RME system.
- Take advantage of existing, potential data centers. Include information portals/distributed database-management system tools as necessary to consolidate data and communicate using the Internet.
- Develop a data management cost-sharing approach to achieve BiOp requirements.
- Promote the free exchange of information and development of a systems view of the Columbia River Basin.

The document correctly recognizes the obstacles posed by the facts that: 1) the lists of variables that will be measured have not yet been finalized, either in principle or in detail, and 2) there are significant institutional and policy issues that must be solved for effective storage and retrieval of primary data.

Answers to NOAA Questions

Question 1. If implemented, will the plan provide useful information about the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

Question 2. If implemented, will the plan provide useful information about the effectiveness of hydro, habitat, hatchery, and harvest actions at improving the status of ESA-listed salmon species? In what ways could the plan be improved to provide better information?

Given the nature of data management (i.e., data storage, retrieval and evaluation), we provide one answer to the first two questions.

The data management plan attempts to address the data requirements for BiOp Actions 179-199. Considered as a "statement of the problems for data management" the plan is clearly written, and if the problems are solved, solutions would provide useful information. However, it does not have proposed "solutions." The plan is a statement of *intentions* to develop a plan in the future.

There will eventually be some decisions about what variables will be measured in a monitoring mode in each of the other modules of the Plan: tributary habitat, hatchery, hydrosystem, etc. Hopefully, some consensus will be achieved about measurement methods, and the approved methods will be documented. Hopefully, some guidelines will be adopted for choosing the times and places where measurements are made, and this too will be documented. Realistically, there may be several different bases for choosing when and where to measure, but each should have a documented rationale and a detailed procedure for implementation, so it should be possible to associate each measurement with one of a short list of designs that it conforms to. At a minimum, then, an effective data management plan must guarantee that each data collection activity takes responsibility for getting its data recorded in some electronic database system in a timely manner, where every data entry will record, in defined electronically interpretable fields (i.e., *NOT* in comment fields):

- What variable was measured (this description should include the medium in which it was measured);
- What value was obtained;
- What method was used for the measurement (referring to a common manual of approved methods, and the associated quality control and quality assurance procedures);
- The location where the sample was taken or the measurement was made, as appropriate;
- The date and time when the sample was taken or the measurement was made, as appropriate; and
- The design type (referring to a common manual of approved designs, and the documentation for how that design was implemented).

Question 3. In the context of the BiOp, has the plan identified the most critical RME gaps? Are there additional gaps it has not identified?

The document has identified some of the critical "Research" and "Monitoring" gaps elsewhere in other segments of this review. However, it neglects the obstacle to "Evaluation" posed by the fact the list of indicators that will be estimated (derived statistics) from the primary "Research and Monitoring" data have not been finalized, and that the policy decision thresholds according to which conclusions will be drawn from those estimates remain undefined.

When it becomes apparent how the data are actually to be used, those responsible for the analysis will develop interfaces (and links between various distributed databases as

needed) to package the data in ways that are convenient for the analysis. If decision rules are adopted, that define how conclusions are drawn, this may suggest particular designs (including minimal sample sizes and minimal precision for some of the measurement methods) that provide a high probability of conclusive results, within whatever cost constraints are operative at that time.

When the first attempts are made to draw conclusions, it may emerge that the data that have been collected up to that time will prove inadequate or excessive for the purpose. This will naturally lead to suggestions for revisions of the design (or even revision of the list of variables that are measured). The possibility of such iterative false starts should motivate all the policy-level players in this enterprise to attempt to crystallize their statistical analysis techniques and decision rules as soon as is feasible. When statistical procedures and decision rules are defined in advance, it is technically possible to analyze proposed designs and determine in advance the probability that the design will deliver conclusive results after some stated period of time. This gives added depth to the concept of planning, and is much encouraged.

Question 4. The plan describes the need for better coordination of data collection and data management throughout the Basin. If implemented, will the plan lead to improved coordination of data collection and data management?

The RME Data Management Group has recommended that the Columbian Basin Cooperative Information System (CBCIS, see remarks below) effort be the basis for the development of the needed RPA 198 action item and as the foundation for the extensive regional RME coordination necessary to achieve standardization of data collection and reporting protocols.

The ISAB/ISRP endorse the NPCC and NOAA Fisheries agreement May 3, 2003, to move forward with the following actions relative to development of a Columbia Basin Cooperative Information System (CBCIS): to receive public comment on the CBCIS report, to propose a draft administrative structure for CBCIS, to identify a budget and cost-sharing agreement, and to approach the stakeholders about commitments for a CBCIS-style regional information system. We share the RME Data Management Workgroup's position that goals of this high level information management needs assessment document cannot be achieved by funding alone. Substantial policy issues must be solved to make significant progress.

The following overall conclusions from the SAIC report read as if they could have been taken directly from some of our ISAB/RP reports:

- There is no comprehensive, systematic, planned information system in the Columbia River Basin
- There are no common protocols for field collection of data
- The collected data are of variable quality and sometimes unknown quality
- There is no single inventory of available data or the location, and the data are kept in many different locations in different database systems
- Data analysis needed to create information is an inefficient and frustrating process

- When data can be located and extracted they often must be validated before they can be used
- Data consolidation is needed but the data quality issues and disparate systems compound this problem
- There are data gaps that are currently not being satisfied
- No single organization or authority has authority or responsibility for fixing this regional data management crisis.

The SAIC report looks at the big picture; from (1) obtaining stakeholder buy in, to (2) establishment of an administrative framework for a CBCIS, to (3) setting of regional goals and objectives, and to (4) development of data collection protocols and metadata requirements. The recommendations are in one-sentence bullets with no detail on how to accomplish the desired end results. For example, number 19 is "Develop basinwide monitoring protocols and data standards addressing data collection, storage and analysis." This one recommendation seems to cover everything that SAIC was charged with and everything that the Action Agencies are dealing with in the RME Plan. The recommendations in the SAIC seem to be complete, but the devil is in the details! However, if a CBCIS is implemented, then improved coordination of data collection and data management will occur.

In the short term it is critical that data can be freely accessed by all concerned in the region to enhance the best, complete scientific analyses. Each database system must be housed in some organization with enough stability to guarantee integrity, maintenance, common access and documentation. In addition, we recommend that before projects are funded, the proposals should include evidence that the resulting primary data and metadata can be electronically accessed by at least one of the currently funded Columbia River Basin Fish and Wildlife Program databases: StreamNet, Fish Passage Center, PTAGIS, Coded Wire Tag Recovery (CWT), Regional Mark Information System (RMIS) or Data Analysis in Real Time (DART). The Principal Investigators of projects, e.g., the pilot RME work on status and trend monitoring of tributary habitat in the John Day, Wenatchee, and Salmon Subbasins, might be responsible for and request funding to store their own data and metadata in a database under their control in the short term, but if complete scientific analysis is to occur, then the data should be electronically accessible by another primary (e.g., StreamNet) or secondary tier database (e.g., DART) responsible to the Council's Fish and Wildlife Program. Evidence in proposals that standards have been developed for electronic transfer of information will help work out the necessary methods and procedures addressed in the RME Plan.

Solutions for the big picture policy and funding problems will require some time and debate. In the meantime science can help make some progress at the grass roots level. We can endorse, e.g., the pilot programs for status and trend monitoring in the John Day, Wenatchee, and Salmon Subbasins and insist that they have common data collection protocols, procedures for recording metadata, etc. Having real data in hand (not hypothetical, from three states, collected by common protocols, and with assurance that these data are accessible by at least one of the Fish and Wildlife Program's current databases) will of necessity help solve the problem of how to store and retrieve them.

Appendix 1. Comments on "Monitoring Strategy for the Upper Columbia Basin"

Macroinvertebrates

Macroinvertebrate studies are divided into two types – "transport" and "composition". The transport studies refer to the export of invertebrates and coarse organic detritus from small, fishless headwater streams to larger fish-bearing streams. The way in which the results of such a study would be used to assess the productive capacity of those streams that did contain fish could have been made more explicit. In addition, the presumed leader of this study, Dr. Mark Wipfli, has recently accepted a position at the University of Alaska at Fairbanks, so his ability to carry out this work is uncertain.

The "composition" type of macroinvertebrate studies appeared (as in the RME Plan) to emphasize changes in invertebrate community structure in response to altered water quality ("stressors"), but did not clearly address how such data would be used to monitor habitat restoration. It was also not clear how the RIVPACS method, the technique of choice, would be calibrated.

The monitoring strategy did not explain how macroinvertebrate studies would be used to address the issue of trophic conditions in streams, i.e., the relative abundance of food resources for rearing salmonids, or the changes in food availability that would accompany habitat restoration.

Adult Escapement

For species such as bull trout (not adult salmon and steelhead), snorkel surveys are recommended, with electrofishing being used as a secondary method for a subsample of snorkeled sites. Two questions need clarification: (1) how will electrofishing be used (if at all) in streams too deep to wade, but not to snorkel, and (2) what fraction of the snorkeled sites will be electrofished for calibration purposes? The latter question is important because electrofishing is generally more expensive to conduct than snorkeling, and carries with it additional logistical difficulties, e.g., transporting the fish shocker to the sites.

Water Temperature and Other Water Quality Indicators

Temperature monitoring focuses solely on daily and weekly maximum temperatures, presumably during summer. Diel thermal variation or winter minimum temperatures are not addressed, although these can be important to fish. It is relatively easy to maintain year-round temperature loggers at monitoring sites.

In addition to temperature, other indicators are recommended. These include turbidity, conductivity, pH, and dissolved oxygen. The monitoring strategy proposes that effectiveness monitoring include automated, continuous water quality loggers at the

upstream and downstream boundaries of treatment and control sites. Setting aside the difficulties with maintaining paired treatment-control sites (see above), the cost of implementing such an approach may be prohibitive. The Hydrolab DataSonde® 4a logger, recommended in the Plan, costs approximately $10,000-15,000 per unit, depending on how many types of sensors are included. If there were 15 treatment-control pairs (30 sites total, each with two loggers), costs for water quality monitoring would range from $600,000-900,000. Such a cost may exceed the budget for water quality indicators, and this would be strictly for equipment costs; data analysis would be an additional expense.