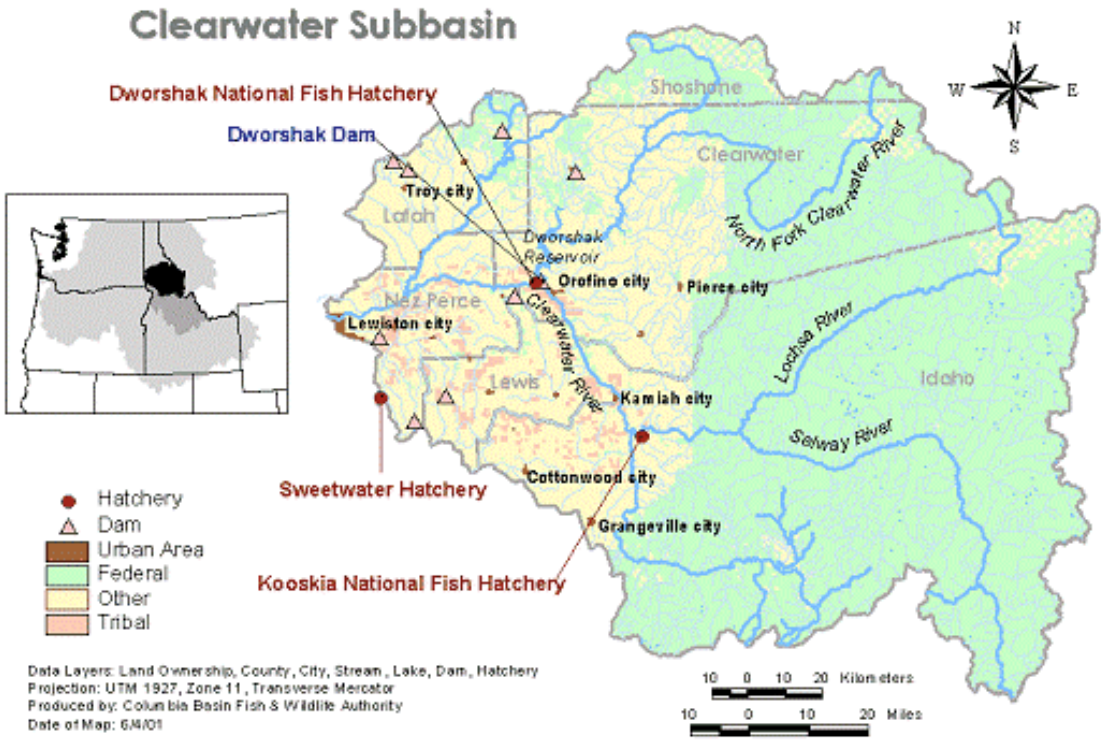
Independent Scientific Review Panel
for the Northwest Power Planning Council
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
isrp@nwppc.org

Review of Draft Clearwater Subbasin Plan



ISRP 2003-3
February 19, 2003

Review Team

ISRP

Charles C. Coutant
Susan Hanna
Nancy Huntly
William Liss
Lyman McDonald
Brian Riddell
Richard Whitney
Richard N. Williams

Peer Review Group

Jack Griffith
Ray White

Staff

Erik Merrill

ISRP Review of Draft Clearwater Subbasin Plan

ISRP Review of Draft Clearwater Subbasin Plan

I. Executive Summary

The draft Clearwater Subbasin Plan represents a major new step in the Council's Fish and Wildlife Program. It is the first of approximately 60 forthcoming subbasin plans intended to provide for each subbasin up-to-date biological assessments of fish and wildlife populations, a synthesis of past and ongoing fish and wildlife management activities, identification of factors currently limiting fish and wildlife production, a description of strategies to address the limiting factors, and a prioritization framework for future fish and wildlife activities in the face of limited resources.

Development of the Clearwater Subbasin Plan is laudable for several reasons: a) Clearwater subbasin planners organized an aggressive effort to draft a subbasin plan and submit it ahead of schedule; b) the Policy Advisory Committee (PAC) brought diverse public and private interests together for subbasin planning; c) the planners attempted to include socio-economic factors in the subbasin plan, and d) the initial portion of the Clearwater assessment describes the subbasin setting and its general environmental conditions thoroughly and well, and will provide a rich source of reference material for people working in this subbasin.

However, the draft Clearwater Subbasin Plan is not complete enough to be consistent with the Fish and Wildlife Program (FWP) and, in its current form, does not constitute a viable subbasin plan. The Plan does not fully and clearly set forth the desired direction for the subbasin or describe clear, problem-solving approaches (i.e., strategies) to restoration and protection. With limited funding, it is essential for objectives and strategies to be prioritized within the subbasin in order to facilitate project selection by the Council and allocate funding resources efficiently.

The Clearwater Subbasin Plan does not describe explicit linkages between the Assessment, Inventory, and Management Plan, and consequently does not provide an overall coordinated plan. The Assessment, which does a thorough job of describing physical features of the subbasin, needs to more thoroughly describe fish and wildlife resources quantitatively (status, abundance, distribution, productivity, etc). To accomplish this, the planners will need greater input from existing fisheries expertise within the basin than was evident in the draft plan. The Assessment should culminate in a rigorous analysis of factors currently limiting fish and wildlife production in the subbasin. The Inventory presents a comprehensive list of existing actions, as well as some past and planned activities, but needs to be expanded into a document that analyzes how well present activities are addressing the needs of fish and wildlife populations, and provides interpretative conclusions from the Inventory as a whole. The Management Plan and its components need to be more closely connected to the Assessment's limiting factors analysis and to biological and environmental objectives. The subbasin plan should develop a prioritized

restoration, production, protection, and research agenda reflecting the critical uncertainties and limiting factors, at the level of detail described in the Council's Technical Guide.

The Plan does not present analysis or justification of its priorities and allocations of effort. About 25% of the Clearwater Subbasin Management Plan's strategy items seem directed toward making human activity less damaging, about 1% to habitat protection, and about 27% to active restoration. Preventing, halting, and reducing harmful processes logically take precedence over repair and can foster passive restoration, which can be most economical. Alternative strategies and their costs, consequences, and contingencies are rarely presented, but are needed to judge overall scientific soundness of the Plan.

The Clearwater Subbasin Management Plan has the beginnings of a solid structural foundation and can be revised and expanded into a viable subbasin plan. To do this, the Assessment, which has a strong geologic and habitat base, needs to link habitat with fish or wildlife status and distributions in order to identify priority "potential management units" (PMUs) or "assessment units" (AUs) for classes of restoration or preservation actions. The reviewers felt that the AU and PMU approach, if linked quantitatively with historical and present fish and wildlife distributions and abundances, *and* with limiting factors, could link the Assessment with the Management Plan and facilitate the integrated subbasin plan intended by the Fish and Wildlife Program.

II. General Review Comments

Preamble

On November 13, 2002, the Council accepted delivery of the Draft Clearwater Subbasin Plan that is intended to guide future fish and wildlife projects in the Clearwater River subbasin of Idaho. The Draft Clearwater Subbasin Plan is the first to be completed since the Council called (in 2000) for development of subbasin plans to guide implementation of its Fish and Wildlife Program in the future. Upon submittal of the draft plan, the Council initiated this independent scientific review as called for in the Fish and Wildlife Program. On November 21 and 22, the Clearwater planners briefed the ISRP on the draft plan with specific focus on the technical approach to the subbasin assessment. This report includes the ISRP's review of the three elements of the draft plan (assessment, inventory, and management plan) and impressions from the briefing.

The Clearwater planners are expected to consider the ISRP review and submit a final subbasin plan to the Council as a recommendation to adopt the plan as a fish and wildlife program amendment. The Council then will conduct its own review and undertake a formal rulemaking process, including a public comment period, before making a final decision to adopt the plan into the fish and wildlife program.

The ISRP recognizes that the Draft Clearwater Subbasin Plan is the initial attempt in the region to develop a comprehensive subbasin plan. The Clearwater planners had no precedent subbasin plans and no previous reviews by the ISRP and other regional entities to provide them guidance. Furthermore, they were in the process of developing the Clearwater Plan even as the criteria for planning, as set forth in the Northwest Power Planning Council's 2000 Columbia River Basin Fish and Wildlife Program (Council document # 2000-19) and its technical appendix, were being developed and approved by the Northwest Power Planning Council. In this sense, the Clearwater planning effort is different from other ongoing planning efforts within the basin.

While the ISRP recognizes these special circumstances faced by the Clearwater planners, the decision was made to review this plan as we would future subbasin plans. The ISRP wanted other subbasin planners to have a clear sense of how the ISRP would review subbasin plans, the ISRP's expectations for each plan, and the criteria we would be using to evaluate the plans. The Fish and Wildlife Program (FWP) recognizes the need and importance of flexibility in planning processes at the subbasin levels. However, as noted in the Technical Guide for Subbasin Planners (hereafter called Technical Guide), there are basic requirements for content that all subbasin plans must meet. Subbasin plans adopted into the Council's 2000 Fish and Wildlife Program must be consistent with the standards set out in Section 4(h) of the Northwest Power Act. The Act requires that for a subbasin plan to be adopted as part of the 2000 Program, the Council must find that the measures identified in the plan meet four criteria. Specifically, the plan should: 1) complement existing and future activities of federal and state fish and wildlife agencies and Indian tribes; 2) be based on the best available scientific information; 3) use least-cost alternatives when there exist equally effective means of achieving biological objectives; and 4) be consistent with the legal rights of Indian tribes in the region. Additionally, subbasin plans should also be consistent with other applicable laws, mainly the Endangered Species Act and the Clean Water Act.

The criteria of the Northwest Power Act are concerned with general categories of content for subbasin plans. These content categories relate to the general functions that the plans must serve. Specific guidance for the content of subbasin plans is provided in the Technical Guide. While the content of subbasin plans needs to be uniform across the Columbia River Basin, the specifics of that content will vary across subbasins reflecting differences in visions, objectives, data and scientific knowledge.

Regional Recommendations

Development of Subbasin Plans

The ISRP recommends that subbasin planners follow the Technical Guide for Subbasin Planners (Council Document #2001-20) and refer to the Subbasin Planning Assessment Template in the Technical Appendix of the 2000 FWP. These documents have been reviewed and approved by regional entities. They define a comprehensive structure for an assessment that allows flexibility in completing recommended elements of the assessment and can be adapted to local problems and conditions. They also present a useful format for subbasin plans and describe how the

subbasin vision, objectives, assessment, and inventory are to be linked together into the subbasin management plan. Additional support and planning assistance is available from the Council's subbasin planning website (www.subbasins.org). Additional assistance in the use of EDT as an assessment tool is provided through an EDT website found at www.edthome.org.

Allocation of Time and Resources

It is important that subbasin planners consider the limited timeframe and funding for the development of their subbasin management plan. Planners should allocate time and effort from the outset for each major component of the plan, because there is a threat of spending too much effort in the assessment and not allocating adequate time for developing the management plan and an integrated set of linkages between vision, objectives, assessment, inventory, and strategies. Other assessment considerations include the choice of focal species, reliance on existing data (there should be no primary data collection as part of the plan preparation), and extensive engagement of local experts so that the assessment reflects the full range of scientific knowledge in the subbasin.

Clearwater Review Summary: Answers to Council Questions

The 2000 Fish and Wildlife Program calls for independent scientific review of proposed subbasin plans to help ensure that subbasin plans direct successful fish and wildlife and habitat actions. In an August 2002 Notice of Request for Recommendations (for subbasin plans), the Council further described its expectations for the independent scientific review. The Council specified that scientific reviewers evaluate whether subbasin plans were consistent with the FWP and its Scientific Principles. The Council also identified a list of seven additional considerations to assist in evaluating the scientific soundness of subbasin plans:

1. Do the assessments appear to be thorough and substantially complete?
2. Are the subbasin goals, objectives, and strategies scientifically appropriate in light of the assessment and inventory of existing activities?
3. Does the plan demonstrate a linkage between the strategies, the biological objectives, the subbasin vision and the assessment?
4. Are the goals, objectives, and strategies consistent with those adopted in the program for the province and/or basin levels?
5. Do the plans demonstrate that alternate management responses have been adequately considered?
6. Does the proposed subbasin plan include a procedure for assessing how well subbasin objectives are being met over time?
7. Does the plan provide a scientifically supportable procedure for refining the biological objectives as new information becomes available about how fish, wildlife and the environment interact, and in relationship to how the plans are implemented over time?

Consistency with the FWP and its Scientific Foundation

The Council first asked the ISRP to evaluate the Clearwater Subbasin Plan for its consistency with the Scientific Foundation adopted as part of the Program and with the requirements for "biological objectives" as described in the program. The core of the Council's Scientific Foundation is a set of eight Scientific Principles:

1. The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystem.
2. Ecosystems are dynamic, resilient and develop over time.
3. Biological systems operate on various spatial and time scales that can be organized hierarchically.
4. Habitats develop, and are maintained, by physical and biological processes.
5. Species play key roles in developing and maintaining ecological conditions.
6. Biological diversity allows ecosystems to persist in the face of environmental variation.
7. Ecological management is adaptive and experimental.
8. Ecosystem function, habitat structure and biological performance are affected by human actions.

In general, the Clearwater Subbasin Management Plan is not complete enough to be consistent with the Fish and Wildlife Program (FWP) and, in its current form, does not constitute a viable subbasin plan. The Plan does not fully and clearly set forth the desired direction for the subbasin or describe clear, problem-solving approaches to restoration and protection. Furthermore, the Plan lacks explicit linkages between the Assessment, Inventory, and Management Plan.

The plan shows some consistency with the eight principles of the FWP, but stronger linkages to the FWP's Scientific Foundation need to be developed as the subbasin plan is revised. The Management Plan falls short in conforming to Principle 1 because it does not adequately link the characteristics of the ecosystems (described in the Assessment), and how those characteristics will be managed, with abundance, productivity, and diversity of organisms. It also falls short of Principle 4 because it does not adequately discuss in the management context how habitats develop and are maintained by physical and biological processes; Principles 2 and 3 may also require more explanation in this regard. The Plan is weak in addressing Principle 7, adaptive and experimental ecosystem management. The plan does not convey a clear picture of how adaptive management would be applied in the Clearwater Subbasin. Finally, the Plan does not explicitly address biological diversity (Principle 6, and its relationship with Principle 5).

Internal Consistency, Scientific Soundness, and Thoroughness of the Plan

The set of seven considerations from Council asked the ISRP to evaluate the internal consistency, scientific soundness, and thoroughness of the Clearwater Subbasin Plan and its component parts. Internal consistency means there is scientific support for the conclusion that the strategies proposed in a subbasin plan will in fact address the problems identified by the subbasin assessment. The Council's first three considerations also address these issues.

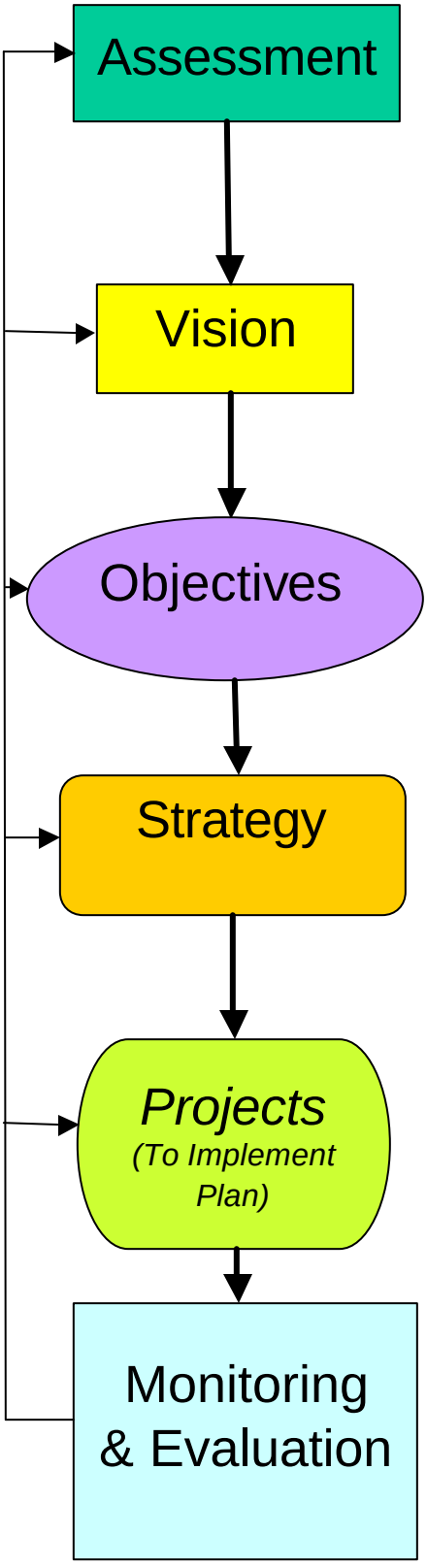
In general, the Clearwater Subbasin Plan and its assessment do not demonstrate internal consistency. For some topics, the assessment is quite comprehensive in presenting background information. The inventory appears to be a thorough listing of projects and programs underway historically and currently. However, the overall plan and assessment do not provide sufficient quantitative evaluation of fish and wildlife species and their habitats. The assessment emphasized habitat classification and evaluation but failed to make solid linkages to the abundances and distributions of fish and wildlife species' that are of concern for ESA and resource management. The analysis of limiting factors was cursory, yet it should be the heart of the assessment. Limiting factors – *the problems impeding desired biological conditions* – provide a foundation for linking the assessment and the inventory together into an integrated management plan.

Throughout, the Clearwater Subbasin Management Plan fails to develop clear operational pathways toward biological outcomes. The essential purpose of a management plan is to set forth "the strategies that will be implemented at a local level" (FWP 2000, p 41). The Clearwater Subbasin Management Plan's strategies, while related in a general way to the objectives, are not related in an explicit way. The strategies are worded so generally that, together with the objectives, they do not constitute a meaningful scientifically based management plan.

The 2000 FWP also explicitly calls for prioritization of biological objectives (FWP, p. 41). The Clearwater Subbasin Management Plan lacks a prioritized framework for the objectives. Every subbasin management plan will include numerous objectives and strategies that have varying levels of importance for restoring fish and wildlife within a subbasin. With limited funding it is essential for these objectives and strategies to be prioritized so that effort can be efficiently directed and to facilitate project selection by the Council.

The internal consistency and linkages between the Plan's three parts are handicapped by inconsistent, and sometimes non-traditional, use of terms including: goals, objectives, hypotheses, and strategies. Subbasin planners need to refer to the Council's 2000 FWP and the Technical Guide for definitions that are most pertinent to developing subbasin plans.

Planners should also refer to the ISRP flow chart provided below that illustrates the general linkages needed to create an internally consistent plan. The ISRP has presented this figure to the Council's Level Three Regional Coordinating Group and to the Clearwater planners. One important note on the flow chart is that existing projects should be described in the inventory and compared against strategies identified in the management plan for gaps. This linkage would allow plan reviewers and users to understand the implementation status of strategies and identify unimplemented strategies, or gaps. Such linkage would be especially useful for the next project solicitation, review, and selection process. Including these specific linkages in the subbasin plan does not mean that specific projects will be adopted as amendments to the Fish and Wildlife Program; they will not. Decisions to implement specific projects will be made through the project review and selection process.



Spawning habitat loss due to development in headwaters, passage problems at culverts, high water temperature in lower reaches, extinct coho run

Establish protected and rebuilt self-sustaining fish runs; maintain genetic integrity; reconnect habitats

Type 1, Population: Return 5,000 spring chinook & 1,000 coho
Type 2, Habitat: Water temperature <70 in lower reaches

Build from Strength *- protect all actively spawning redds*
Restore Ecosystem *- recover riparian functions in lower reach*
Artificial Production *- restoration of coho run*

Habitat Acquisition in Headwaters 198504501	Culvert Replacement and Fencing Exclosure 200100001
Coho Reintroduction (RFP)	

Indicators: water temperature, sediment load, redd and juvenile counts

Performance Standards: lower reach water temperatures not to exceed 70

Consistency with the Provincial- and Basin-level Program

The Council's next question was to evaluate whether the goals, objectives, and strategies proposed in the Clearwater Subbasin Plan were consistent with those adopted in the program for the province and/or basin levels.

The Council's 2000 Fish and Wildlife Program provides only general descriptions for basin-level (pp. 13-34) and province-level (pp. 35-38) goals, objectives, and strategies, noting that these will be developed at a future time. Therefore, it is not surprising that the Clearwater Subbasin Management Plan contains little information relating its proposed activities to province and basin level objectives. Nevertheless, given the FWP's emphasis (pp. 13-38) on building from subbasin level management plans upward into provincial and basin level objectives, the Clearwater Subbasin Management Plan might have taken the initiative to describe how those linkages might occur.

Consideration of Alternative Management Responses

Next, the Council asked the ISRP to determine whether the Clearwater Subbasin Plan demonstrated that alternate management responses had been adequately considered.

The Clearwater Subbasin Management Plan seldom proposes actions from an array of alternative options. Additionally, actions proposed in the plan lack specificity. Strategies are presented, for example to use a mix of hatchery and natural production within the subbasin, without a rationale as to why they are the best approach, or a description of what alternative strategies might be employed. Finally, no management responses are suggested, proposed, or discussed in the management plan, such as predictions of how focal species abundance would change in response to a proposed activity.

Plan for Assessing Progress toward Subbasin Goals

The Council's next question focused on accountability and self-assessment. The ISRP was asked to determine whether the Clearwater Subbasin Plan included a procedure for assessing how well subbasin objectives are being met over time.

In general, the Assessment, Inventory, and Management Plan do not provide an overall coordinated plan for research, monitoring, and evaluation in the subbasin. The Clearwater Subbasin Management Plan should include provisions for implementation monitoring as well as Tier 1 (trend and routine), Tier 2 (statistical), and Tier 3 (research) monitoring. The RM&E program needs to be more closely connected to a limiting factors analysis and the biological and environmental objectives. A prioritized research agenda reflecting the critical uncertainties and limiting factors should be developed and presented with the detail described in the Technical Guide. The research topics in the present plan are vague and unfocused. Additionally, no research is proposed to address the socioeconomic objectives.

Adaptive Management and the Subbasin Plan

Finally, the Council asked the ISRP to determine whether the subbasin plan provided a scientifically supportable procedure for refining the biological objectives as new information becomes available about how fish, wildlife, and the environment interact, and in relationship to how the plans are implemented over time.

The Clearwater Subbasin Management Plan seems to imply use of adaptive management, but does not include a procedure for conducting it. The plan does not provide an explicit description of how the objectives would be refined on the basis of new information. How will such adaptive management feed into prioritization of research? The plan contains 20 pages (about 21% of the material) on research, much of it for monitoring and evaluation, but it does not say how the knowledge gained will be used. The plan does not include a synthesis of the current information and a statement of biological objectives at the level needed to facilitate adaptive management. Thus the Plan is not currently in the form envisioned by the FWP.

Broad Participation in Developing the Clearwater Subbasin Plan

The 2000 FWP, the 2000 Subbasin Assessment Template (part of the 2000 FWP Technical Appendices), the 2001 Technical Guide for Subbasin Planners (Council document #2001-20), and the individual contracts to lead entities emphasize that the subbasin planning effort is to be a locally led process with assured participation by and collaboration with fish and wildlife managers, local governments, interest groups, stakeholders, and other state and federal land and water resources managers. The Technical Guide emphasizes that the plan development process should be broadly participatory such that the technical expertise in the subbasin contributes to the scientific base of the plan and policy makers, managers and planners communicate local concerns, conditions, and priorities. Broad participation and buy-in at local levels is critical if subbasin plans are to be implemented successfully. The Technical Guide also points out the importance of assembling a group of local or state technical experts to work on the assessment as a subbasin technical team. The team should have the biological, physical, and management expertise to refine, validate, and analyze data and should work in close interaction with the policy group.

The Policy Advisory Committee (PAC) established by Clearwater subbasin planners was designed to represent major public and private interests within the subbasin, and it had oversight over the planning process. This concept is laudable. It is unclear, however, how much direct involvement these diverse interests had in the actual planning process. It is especially unclear how much technical input was provided by local biologists and resource managers in developing the Clearwater Subbasin Management Plan. The expertise of state and federal agencies on matters of landscape processes, stream habitat, and wild fish populations does not seem as well represented as needed for a workable plan. Additionally, it is not clear that private landowners were sufficiently involved in development of the plan. For example, Potlatch Corporation is a major landowner within the basin and has extensive data on subbasin resources, yet we did not see that those data were used in the assessment or management plan.

A subbasin plan will be strongest when the technical assessment teams include numerous local biologists who are experienced in basic ecology and in management of the region's natural resources, especially in the practicalities of management to benefit fish and wildlife populations and terrestrial and aquatic habitat. The Clearwater planning did not seem to have enough of this participation, particularly in the aquatic technical team. The Clearwater Subbasin Management Plan lists only two aquatic personnel and a "spatial ecologist", whereas the terrestrial team included six biologists and a GIS analyst. From earlier annual and provincial reviews, the ISRP is well aware of the substantial fisheries expertise in the Clearwater Subbasin, and adequate use

and reliance of that expertise was not evident in the Clearwater Subbasin Plan. The plan would have benefited from substantial participation by state, tribal, and federal natural resource agencies, as well the Potlatch Corporation, via commitment of data, expertise, and possibly personnel time.

A management plan developed for a subbasin will affect diverse interests and should reflect the collective goals and objectives of these various interests, contain their knowledge, and represent their buy-in to a coordinated strategic plan for the subbasin. Too much reliance on subcontractors without concomitant participation by local stakeholders and technical experts can result in a plan that lacks integration, comprehensive context, and broad support. Valuable roles for subcontractors include gathering relevant background information and drafting the assessment and inventory sections. If subcontractors or consultants are used in the development of the subbasin management plan, their roles should be those of facilitating exchange of ideas and of representing the group's objectives and agreements in the document in a format that can be implemented.

The potentially extensive role of subcontractors in the Council's subbasin planning effort raises the need for the Council and the subbasin planning level 1, 2, and 3 coordination groups to be vigilant in their educational outreach to local groups, technical experts, and fish and wildlife managers, to motivate participation in the process at a high level. In addition, the Council and the coordination groups should closely track the process to ensure that the subcontractors are securing meaningful local participation and taking advantage of the wealth of expertise and information present in the subbasin.

Finally, the ISRP recommends that subbasin planners follow the Subbasin Planning Assessment Template in the Technical Appendix of the 2000 FWP and the Technical Guide for Subbasin Planners (Council Document #2001-20). These documents have been reviewed and approved by regional entities. They define a comprehensive structure for an assessment that allows flexibility in completing recommended elements of the assessment and can be adapted to local problems and conditions. They also present a useful format for subbasin plans and describe how the subbasin vision, objectives, assessment, and inventory are to be linked together into the subbasin management plan. Having a common format helps writers, reviewers, and implementers to locate topics readily. Additional support and planning assistance is available from the Council's subbasin planning website (www.subbasins.org).

III. Specific Comments and Recommendations on the Three Main Components—Assessment, Inventory, and Management

In the sections that follow, the ISRP provides more specific comments on each of the major sections of the Clearwater Subbasin Plan: the Assessment, Inventory, and Management Plan.

The Subbasin Assessment

Guidance for the Assessment (and the subbasin plan in general) comes from the 2000 FWP, the Program's Technical Appendix, a detailed 13-page Subbasin Planning Assessment **Template** (www.nwcouncil.org/library/2000/2000-19/TechAppC/SubbasinAssessmentTemplate.pdf), and the **Technical Guide** for Subbasin Planners (www.nwcouncil.org/library/2001/2001-20.pdf). Because this is the first subbasin plan submitted and reviewed, the ISRP assessed the extent to which the Clearwater assessment followed guidelines provided by the Template and the Technical Guide, although primary emphasis was placed on guidelines from the Technical Guide. For development of the remaining Columbia Basin subbasin plans, the ISRP recommends following the content and format recommendations in the Technical Guide. Attention to the Technical Guide should result in subbasin plans that are adequate for the ISRP review, and the Council's planning and amendment process.

General Format and Content

The 2000 FWP does not contain specific criteria or required scientific elements of a subbasin assessment, but refers planners to the Subbasin Planning Assessment Template in the Program's Technical Appendix. In further defining the process, the Council developed a Technical Guide for Subbasin Planners. The guide was non-mandatory to allow some flexibility among subbasins, but provides a common structure and format. The ISRP assessed the extent to which the Clearwater assessment followed these formats.

The initial portion of the Clearwater assessment describes the subbasin setting and its general environmental conditions thoroughly and well, and will provide a rich source of reference material for people working in this subbasin. However, much of the remainder of the assessment is incomplete and does lay an adequate scientific and technical foundation for a functional management plan.

The subbasin description incorporates topics 1, 2.1 – 2.3, and 3.1 in the Template and topic A.1 in the "Technical Guide. The Clearwater assessment did not follow the exact topic heading or sequence given in either suggested format, but did succeed in describing the setting in an orderly and generally thorough manner. This portion of the assessment is lengthy, detailed, and useful. However, data sources for figures and tables in the subbasin description and throughout the management plan need to be better documented. Good historical summaries are provided in several sections. The salient land uses that shape the subbasin (roads, agriculture, grazing, mining, and dams) are summarized. Almost half the subbasin has some protected status as a roadless or wilderness area. The assessment divides the subbasin into eight biophysical "assessment units" (AUs) about the size of a 4th field HUC. Each assessment unit is characterized on the basis of its geology, precipitation, dominant land use, primary land ownership, predominant landform, and elevation. Later in the assessment, Ecovista used another

organizing scheme whereby 6th field HUCs were characterized by 22 or more variables into "potential management units" (PMUs).

Documentation of Methods

Greater documentation of methods, literature citations, and development of the assessment tool is needed throughout the Assessment to provide a solid foundation for the Management Plan. Methods and procedures used to assess fish and wildlife populations and their habitats need to be documented or references given to literature so that they can be repeated elsewhere and in the future for the Clearwater Subbasin. Decisions made in developing the analytical tools also need to be documented. For example, with respect to EDT, justification is needed for each "rule" (supporting literature, studies, data, expert opinion, best judgment of the modeler, etc). It appeared that many critical decisions on inputs into the Ecovista assessment tool reside only within the Ecovista team; they are not described in the assessment. At a minimum, this reliance on the expert opinion of the assessment team should be described and the methods used should be included, perhaps in an appendix. Better, scientific literature should be cited to support, suggest, or define questions about the assumptions used.

The EDT Primer (www.edthome.org) provides strong advice to "begin documenting information sources early and diligently." This advice extends beyond EDT to all data endeavors. The ecological structure of a subbasin is always complex and will be described by many different sources of information. Much of the value of an assessment lies in its complete and explicit documentation of the sources of information and the rationale for inferences made. Documentation is especially important because the subbasin plans are iterative documents and will need to be revisited as new information is presented, such as that generated by NOAA Fisheries' Technical Recovery Teams.

Quantitative Approaches to the Assessment

A quantitative approach is essential in subbasin planning, especially for determining limiting factors and the expected response of fish and wildlife species to management actions. The Clearwater Subbasin Plan should place greater emphasis on more detailed quantitative analysis of available data, particularly as related to fish and wildlife populations.

Subbasins will differ in the quantity and quality of existing data and in the kinds of analyses that have been done before planning was initiated. Subbasin planners are not expected to engage in collection of primary data in the field, but rather to use information that has already been compiled. The planners should make optimal use of existing data and analyses in developing the subbasin plan. The analytical methods that are appropriate for developing the assessment include expert opinion, expert systems, and empirical models. These same tools are useful for establishing a prioritization of efforts. The ISRP expects that one or more of these procedures will be used in prioritization of efforts.

- **Expert opinion** involves compiling the opinions of knowledgeable experts such as local managers and scientists. Expert opinion is often the least reliable of the decision-support tools because it is subjective and assumptions generally are not explicitly identified or substantiated.

- **Expert systems** represent a more formal decision-support tool that utilizes both quantitative information and expert opinion. This method attempts to make underlying assumptions explicit. Expert systems that have been used in the Columbia River basin include the Interior Columbia Basin Ecosystem Management Plan's (ICBEMP) Baysian belief network (Quigley and Arbelbeide 1997) and Ecosystem Diagnosis and Treatment (EDT; Mobrand Biometrics 1999).

- **Empirical models** use quantitative information to develop associations between fish and wildlife population performances (e.g., extinction, abundance) and environmental conditions. They have been used extensively in the Columbia River basin. The utility of empirical models depends in part on the quality and quantity of available data.

A good approach would be to utilize a variety of analytical methods for developing subbasin plans. Subbasin planners should clearly specify which types of analytical methods were used in the assessment and should include use of quantitative methods as one of their tools. The Independent Scientific Advisory Board (ISAB) is in the final stages of preparing a report titled "A Review of Strategies for Tributary Habitat Recovery." That report contains more detailed discussion of the use of expert systems and models in subbasin planning. The full report of the ISAB will be available on the Northwest Power Planning Council website by April 2003.

We also feel it is important to comment on the role of prediction in using various empirical models as an assessment tool. For example, EDT is most useful as a tool for comparing alternative management scenarios, rather than as a predictor of actual fish or wildlife population responses to various management actions. As such, EDT is useful in "predicting" actions that are most likely to provide benefits to fish and wildlife populations, but is not an appropriate tool to predict absolute values, such as total production capacity or productivity of stocks.

Limiting Factors and Completeness of the Assessment

While the initial portion of the Clearwater assessment provided a thorough description of the subbasin setting and its general environmental conditions, the assessment lacked sufficient quantitative evaluation of fish and wildlife species and their specific habitat conditions. Population abundance and productivity were not adequately addressed. Virtually no quantitative data on fish productivity were presented. Instead, the subbasin planners attempted to use data on aquatic invertebrate abundance as a surrogate for fish productivity, but this falls short of providing a connection to numbers of fishes.

The rest of the assessment summarizes biological information. The Council's Technical Guide calls for a list of native and non-native fish and wildlife and their legal status, and also special status plants. The Clearwater assessment does this, with a separate CD of 340 vertebrate species in the appendix and a text table of the 30-plus species of fishes. Reviewers noted the good identification of vegetative cover types and their related plant species in the assessment, as well as a list of plant species with special status (in an appendix), but not a comprehensive plant species list.

The analysis of limiting factors was cursory; yet, it should be the heart of the assessment. The identification of limiting factors – the problems that impede desired biological conditions – is

intended to provide a foundation for working hypotheses concerning ecological response to human interventions. These hypotheses then shape the objectives and strategies presented in the management plan, which will in turn provide the basis for Council recommendations on project funding. The assessment offers general speculation as to limiting factors based on exceedingly large land/water units, but it did not partition limiting factor analysis by fish life stage, as the Technical Guide suggests. A quantitative assessment of focal species-habitat relationships (including identification of important habitat features and processes, etc.) was not accomplished. Population dynamics of focal species in other subbasins could be incorporated into the assessment to provide context and fill in information gaps, but were not.

The Clearwater Assessment authors speculate regarding limiting factors in only a very general but largely meaningless way based on exceedingly large (AU) land/water units (Table 58). They produce a long list of possible limiting factors, ranked on a 1-through-3 scale. This process so reduced information that its value is questionable. There should be documentation for the utility of the 1-through-3 rankings of limiting factors. The simple term, "importance rating", would seem to be more in accordance with established terminology for ecological investigations. The text (p 343) says the ratings were "assigned" depending on the degree to which they "are thought" to limit the species involved. This seems to overly rely on professional judgment, without substantiation of its basis in data: Whose judgment was involved – the primary author, the technical team, or others? Would other people, given the same information that the authors had, come to the same conclusions? The rating process should be explained more explicitly and the data upon which ratings are based provided in an appendix.

Potential Management Units (PMUs)

The assessment bases much of its analysis on the identification and aggregation of Potential Management Units (PMUs). The assessment describes PMUs as groups of HUCs (either contiguous or noncontiguous) intended to characterize areas that have similar themes regarding species distributions, disturbance regimes, and other characteristics that will influence future subbasin scale restoration or recovery planning. This approach could be useful for prioritizing actions; however, the assessment states that PMUs were defined largely in a subjective manner and were not delineated in a species-specific manner due to a lack of comprehensive distribution and status information for some species, the heavy reliance on landscape level characteristics used to define them, and the potential for altered species distributions in the future (through reintroductions or habitat improvement). The subjective PMU delineation process should be clarified. It is not clear why a statistical process (e.g., cluster or ordination analysis) was not used to look for association of like attributes. Use of such a technique would allow documentation of existing grouping, as well as replication of results by future analysts, neither of which can be done with the subjective process that apparently was used.

The final section of the Clearwater Assessment, the synthesis/interpretation described in the technical guidelines, is not complete; the assessment does not clearly link PMUs or aggregations of PMUs with AUs and with fish or wildlife status and distributions to prioritize specific PMUs or AUs for restoration or preservation actions. This is a critical shortcoming in both the Assessment and the Management Plan. The Plan should identify for each focal species where stronghold populations exist and should be protected, where restoration efforts are apt to be most effective, and what types of restoration actions are most prudent. The reviewers felt that the AU

and PMU approach, if linked solidly with historical and present fish and wildlife distributions and abundances, could link the Assessment with the Management Plan and facilitate the integrated subbasin management plan intended by the Technical Guide.

Choice of Focal Species

The choice of focal species is critical to an assessment and a limited number must be selected due to limitations on time, budget, and analytical tools. The Technical Guide suggests that focal species be chosen on the basis of special ecological, cultural, or legal status, and that they be indicators of ecosystem health. It recommends that focal species should include one or more wildlife, resident fish, and anadromous fish species. In general, planners are able to deal effectively with a maximum of five focal species. In the Clearwater plan, the selection of 12 terrestrial focal species is problematic both in sheer number and in species choice. The Clearwater subbasin focal species are endangered plants and big game species. This selection is counter to the advice of the Technical Guide and overlooks the approach of the Fish and Wildlife Program, which emphasizes a network of species and an ecosystem approach.

There is a precedent for using a tractable number of focal species, especially with Environmental Impact Statements conducted under the National Environmental Policy Act (NEPA). Typically, keystone and endangered and threatened species are selected as focal species. Subbasin plans are ecosystem plans, so some attention must also be given to other non-focal species; these non-focal species, however, need not be described and considered with the same population-level of detail that is required for focal species. Attention to non-focal species provides a biological context for the focal species and serves to draw attention to unanticipated consequences of a management plan that uses focal species to make many central decisions. The choice of focal species needs to be made carefully to ensure that they represent the ecosystem. For example, stream habitat in the Grande Ronde subbasin is primarily suitable for cool or warm water species, so if bull trout were chosen as a focal species, they would not be representative of the entire system.

Out-of-Basin Effects

The management plan contends that out-of-basin effects are the primary factors limiting recruitment of anadromous spawners to the Clearwater. This assertion needs to be scientifically justified and documented in the assessment. Adult passage data are available for the lower Snake River, as are data on reach survival of juvenile outmigrants. Given the asserted importance of out-of-basin factors, it would be useful to know how much improvement in anadromous fish populations would accrue if the objectives of the management plan were accomplished. The assessment and subsequent management plan need to deal more explicitly with out-of-basin factors.

For example, the dominant limiting factor for lamprey in the Clearwater system may be difficulties with upstream passage by migrating adults at hydroelectric projects, rather than habitat limitations within the Clearwater subbasin. The assessment ought to point out that this finding probably has identified the single most important factor limiting the abundance of lamprey in the subbasin. Then, when it comes to prioritizing actions to restore lamprey in the subbasin, highest priority ought to be given to improving passage conditions for lamprey at the mainstem ladders. Actions that might be suggested within the subbasin are of much lower

priority – in fact they may be of no particular importance in restoring abundance of lamprey, particularly in the absence of mainstem actions to improve passage. The Plan should say so.

While out-of-basin factors also affect Clearwater salmon and steelhead populations, within-basin factors such as water quality, habitat type, quantity, and quality, and the blockage of historical spawning areas also effect salmonid production in the subbasin. Out-of-basin effects conceivably could negate any actions within the subbasin. For example, unless offshore and lower river fisheries are regulated to allow specified numbers of fish to elude the fisheries, it is unlikely that goals established for the subbasin will be achieved, regardless of actions within the subbasin. A strong subbasin plan would endeavor to partition recovery potential for anadromous stocks into the fraction that would be expected from in-basin vs. that from out-of-basin expenditures of effort. Another approach might be for the subbasin plan to provide a sensitivity analysis of "out-of-basin" factors on subbasin goals; i.e., what is needed outside the subbasin to achieve their goals?

Riparian Habitats and Wetlands

Riparian habitats and wetlands are essentially ignored in the aquatic assessment. The discussion of wildlife habitat in the Management Plan acknowledges the importance of riparian areas, but that discussion (of black cottonwood vegetative cover type) suffers from a lack of any description of the previous quality and quantity of those resources. Similarly, management objectives identify the desire of managers to restore 500 acres of historical wetlands and to protect/restore 300 miles of riparian habitat, but these objectives are not based on documented needs or problems and so neither the realism of the specific objectives nor their priority can be judged.

The absence of information on riparian habitat is particularly noteworthy given the Technical Guide's explicit discussion of the contribution of subbasin assessments to the NMFS and USFWS development of recovery plans for ESA listed species. The Guide presents a draft list of seven questions that concern habitat that NMFS has identified as important to recovery planning and that assessments should be able to answer. Riparian habitat is one of these.

Socio-economic Themes

Section 3.10 "Population and Land Uses" contains information that could be used as a basis for forming socio-economic objectives and strategies (Hypotheses 18-20 in the management plan) that tie in to the biological objectives. For example, what effect will changes in grazing, agricultural production, and participation in the Conservation Reserve Program likely have on the proposed restoration strategies? How will the social and economic environment of the Clearwater Subbasin affect the likelihood of success of strategies to recover fish, wildlife, and plant communities? These objectives and strategies should be developed through broad interest group participation under the guidance of a qualified economist or social scientist.

Specific Review Comments on the Assessment

1. The description of the subbasin's geology is well done for general descriptive purposes, but does not address the important question of which assessment units have a higher fish production potential (see comments on productivity below). Specifically, for example, it is important to identify the extent to which parent rock contains calcium and magnesium constituents that lead

to greater stream productivity. Unfortunately, Table 3 lumps carbonate with shale (as schist), and the single category "granite" is similarly too broad.

2. The Technical Guide requests an assessment of fish "productivity" and as a result the authors of the assessment gathered data on aquatic invertebrate abundance to use as a surrogate for fish abundance. The assessment confuses the terms productivity and production and states that productivity is defined as the rate of production. Actually, fish production (the weight of fish tissue generated over a certain period of time, including that of those individual fish that die during the period) is a standard, directly calculated measure of population performance, as is "standing stock", the weight of fish present at a point in time. More importantly, the attempt to provide a foundation for an assessment of aquatic productivity using data collected on macroinvertebrates falls short of establishing what is desired – a connection to numbers of fishes identified in Table 2.

The discussion of fish productivity, and the generation of that new macroinvertebrate data, is flawed because (a) the approach requires the assumption that fish production in the Clearwater subbasin is food-limited (more invertebrates will mean more fish), which is not necessarily true, (b) it ignores the relative quality of various invertebrates as fish food, and (c) it ignores much more extensive efforts to attempt to do the same thing elsewhere (i.e., the Salmon subbasin). A simpler, cheaper, and more powerful procedure would have been to directly assess fish abundance at a variety of sites, or to simply make use of a measure of edaphic potential, such as specific conductance of stream water. A substantial body of literature has demonstrated a connection between geological constituents of watersheds (e.g. sedimentary strata v. granitic strata) and the resulting abundance of fishes (and macroinvertebrates too). There is no need to repeat that work to establish the relationship, only to determine where the particular stream reach within the Clearwater subbasin fits into the picture already developed in the literature. Of course the result is only a rough estimate, but certainly the best that can be expected at this stage, and certainly adequate for planning purposes.

3. The significance of the modeled thermal limitation parameter, MWMT, is useful but should be described more clearly. Is it not intended as an estimate of the *mean of daily water temperature maxima during the warmest week of the year* at a given point in a stream? If so, this should be said. Moreover, the terminology is needlessly confusing and is expressed in inconsistent form. Thus, even though the actual parameter being calculated might be valid and useful in considering thermal limitations, many readers, including plan users and evaluators, may misunderstand its meaning. The first time MWMT appears (1st paragraph in the section "Temperature Limitations (modeled)" on p 354), it is called "*mean* weekly maximum temperature," but further on, in the captions for Table 61 and Figure 101, it is called "*maximum* weekly maximum temperature" (italics added). Only the correct term should be used, whichever it is. The section on MWMT should be made simpler and clearer. Is there any ecological value in this parameter, any appropriate references to its use?

4. On page 283 it is stated with respect to interpreting the results of applying the method for estimating smolt carrying capacity (cited as NWPPC 1989) that there is "…little discernable pattern with regard to high or low production areas." This finding calls out for further discussion,

as it suggests that either the NWPPC method or the method of defining high and low production areas is inadequate (or both). What is the explanation?

In this regard, the paragraph discussing Chapman's (1981) findings and the comparison with the NWPPC estimate deserves a more in-depth examination, as well. Because Chapman's estimate relates to "pristine conditions", it ought to be reasonable to conclude that his numbers would be near carrying capacity. And because his estimate includes areas no longer available to salmon, his number might be expected to be higher than those derived from the NWPPC process. Why are they not higher? The subject should be examined more fully, because the bottom line ought to provide some guidance as to what might reasonably be expected to be produced in the subbasin, as compared to what is currently being produced, and that is a primary subject that ought to be dealt with in some detail in the text.

5. On page 286 there is a discussion of fall chinook counts at Lewiston Dam. The fact that the ladder was determined to be inadequate for passage should be mentioned here – and it is mentioned in a later section.

6. On page 326 primary factors limiting salmonid populations in the subbasin are identified. It should be brought out that out-of-basin effects have a significant effect on the populations – to the point that within basin effects may be secondary. Fishing is a good example, as noted above. The text brings this out well on page 328 where it says that it is unlikely that improvement within the subbasins alone can increase survival enough to ensure recovery of listed salmonid populations. This statement belongs at the beginning of the section or the beginning of the Plan. It now appears on page 9 of the Plan as the first item in the discussion, which is good.

7. Effects of draw down of Dworshak Dam on resident fishes downstream of the dam should be enlarged upon. With 47 m of drawdown and periodic releases purportedly to benefit juvenile and adult salmon migrating in the lower mainstem, there are bound to be some adverse effects on resident fishes in the Clearwater below Dworshak Dam. These effects are not discussed here, but are discussed in the management plan.

The Inventory

The draft Clearwater Subbasin Inventory presents brief descriptions of the subbasin's activities toward fish and wildlife recovery, as well as of applicable policies and plans. This constitutes a comprehensive list of existing actions, as well as some past and planned activities.

As noted in the Technical Guide, the inventory of existing projects will be most valuable when it is reviewed in the context of the limiting factors identified in the assessment. The purpose of reviewing existing projects is to evaluate those projects against actions needed to address limiting factors – identifying gaps. The "gap analysis" will then guide the development of management strategies.

The draft Clearwater Subbasin Inventory needs to be expanded from the present simple listing into a document that analyzes how well present activities are addressing the needs of fish and

wildlife populations. Toward this it would be advisable to (a) more completely follow the Inventory requirements set forth in the 2000 FWP, as outlined in the Technical Guide, and (b) include a new, interpretive, summary section which draws conclusions from the Inventory as a whole.

As recommended in the Technical Guide, the inventory should, but this draft plan does not, include a synopsis of accomplishments or failures of each activity, related to established goals and objectives where possible; identify limiting factors or ecological processes the activity is designed to address; and identify relationship to other activities in the subbasin. For example, the Inventory's extensive Table 4 contains few synopses of results, even for projects that have been underway for four or more years. Without the synopses of results, the inventory cannot form a meaningful part of the subbasin plan. Correspondingly, a required item for the inventory is a statement of objectives for existing projects and programs. Most project and program descriptions in the Inventory contain objectives, but seldom in quantitative or target-date terms.

Sources, methods, and procedures used to compile the Inventory must be given in sufficient detail so that the inventory can be repeated in the future and future results compared by quantitative methods to the present inventory.

The Management Plan

General and Summary Comments

The 2000 Fish and Wildlife Program characterizes the management plan as "the heart of the subbasin plan." It is supposed to "reflect what is learned in the assessment and inventory work," and, on that basis, merge "policy, legal, and ecological considerations" and set forth "the strategies that will be implemented at a local level" (FWP 2000, p 41). The Draft Clearwater Subbasin Management Plan does not satisfy these requirements adequately and is of limited utility in recovering key populations of fish and wildlife. The draft Management Plan does not follow the FWP criteria in important ways. It does not, for the most part, *enunciate true strategies*, draw sufficient *connection with the Assessment and Inventory*, or adequately show how *policy, legal, and ecological considerations are merged*. As a result, the Management Plan does not present what should constitute the main aspect of any management plan for biological resources: clear explanations of how the objectives, i.e., quantifiable benefits to focal species, are to be accomplished.

The FWP concedes that basin-scale biological and environmental objectives must be general and qualitative but "should become increasingly quantitative and measurable at the province and subbasin levels" (p. 16 and 41). The Technical Guide notes that the vision expressed by a plan is qualitative and should reflect the conditions, values, and priorities of a subbasin in a manner consistent with the Council's Program vision for the Columbia River Basin. The biological objectives, however, are benchmarks that should be quantitative expressions of biological and physical changes needed to address the limiting factors and achieve the vision.

The biological and environmental objectives in the present draft of the management plan are general and mostly qualitative. In only a few cases does the management plan give *quantitative objectives* and timeframes for accomplishing the objectives. The authors of the management plan

assert that they lacked sufficient data and information to develop quantitative objectives. The objectives in this management plan apparently are designed as just a first step, namely to develop methods and acquire the necessary data and information. Thus, the management plan is essentially a proposal to conduct the needed background work, rather than a plan with specific management objectives that will be accomplished within a specified timeframe. Although there are undoubtedly important information gaps, the management plan should provide more specific objectives and strategies based on information given in the assessment, even if many are tentative.

The Clearwater Subbasin Management Plan does not describe clear, *problem-solving approaches* to the subbasin's restoration and protection needs. It should present the array of needs, each in straightforward terms: Here's the *problem*; here's the *result* needed (the objective); and here's the *solution* (a strategy). The management objectives and strategies are vague and incomplete. The strategies should provide the core operational guidance but do not. A management plan should contain framework guidance about procedures to be followed under certain contingencies. It should also contain specifics about actions and regulations that will be taken to meet the objectives. These two elements are missing from this plan, which fails to *develop clear operational pathways toward biological outcomes*. The essential purpose of a management plan is to set forth "the strategies that will be implemented at a local level" (FWP 2000, p 41). The management plan's strategies are not explicitly related to the objectives. The strategies are worded too generally to constitute a meaningful scientifically based management plan. Each strategy should consist of an *integrated set* of actions (FWP 2000), a logical sequence of actions for performance. The strategies should be explained in terms of their effects on the ecology and population dynamics of the focal (and perhaps non-focal) species.

The 2000 FWP explicitly calls for *prioritization of biological objectives* (FWP, p. 41). The Clearwater Subbasin Management Plan lacks a prioritized framework for the objectives. Every subbasin management plan will include numerous important objectives and strategies for restoring fish and wildlife within a subbasin. With limited funding, it is essential for these objectives and strategies to be prioritized so that effort can be efficiently directed and to facilitate project selection by the Council. Additionally, there is no indication in the Plan of how needed information will be acquired through adaptive management. In its current form, the management plan has limited utility for directing protection and restoration efforts in the Clearwater Basin and for project selection and funding allocations. It does not establish a strategic prioritizing framework for allocating limited funding toward specific actions or objectives within the subbasin. Stronger linkage between the Assessment and the Management Plan could lead to rearrangement of the subject matter discussed in the Clearwater Subbasin Management Plan, according to the "pyramid" of actions identified in the analysis given in the Assessment. It appears that a given category or type of AU possesses characteristics in terms of potential action types, and these can be prioritized.

The plan does not, but should, justify that the proposed actions represent *appropriate allocation of effort* for getting the recovery job done with dispatch and efficiency. The plan should explain of the connections between the assessment, the objectives, proposed investigations, and actual recovery work. About 25% of the Clearwater Subbasin Management Plan's strategy items seem directed toward making human activity less damaging; these include measures to alter land use or resource use, as well as education. The highest proportion of strategy items, 36%, involve

studies (mainly field investigations, some stating evaluation), other development of information, and development of study methods. Active restoration (mostly of fish or wildlife habitat but also artificial fish propagation for "supplementation" or mitigation) accounts for 27% of the items; habitat protection for 1%; development of restoration methods for 3%; and coordination, other administration, and program development for 9%. Generally, changing human activities so that they do less harm is the most essential category of effort in a habitat-based program for fish and wildlife recovery. Preventing, halting, and reducing harmful processes logically take precedence over repair and can foster passive restoration, taking advantage of the self-healing power of nature and allowing self-regeneration of habitat and of fish and wildlife populations. Letting nature do the work can be most economical.

Throughout the Management Plan, failure to provide *substantiation from pertinent, basic literature, and from the Assessment*, violates scientific soundness. The management plan sometimes refers readers to the Assessment, but usually without specific reference to where in the Assessment the pertinent information exists; section and subsection numbers should always be given, usually also page numbers. The elements of the management plan need to be directly related to the watershed Assessment and Inventory; both these and the primary scientific literature should be used and referenced to justify the hypotheses, objectives, and strategies. Information from the Assessment need not always be reiterated in the management plan, but the planners should—for every hypothesis, and probably for every objective and most strategies—specifically reference the assessment tables, figures, pages or section numbers—and in some cases paragraphs—that support the items.

The Plan omits several significant *administrative issues*. It is unclear precisely how the coordination of both ongoing and new activities will take place. Further, a management plan usually should reflect the approach a public entity (which holds authority to make management decisions) will take to achieve certain objectives and legislative mandates. This plan is different in that there is no specified action authority and no particular specific mandates under which that authority would act. It is not clear what motivation will ensure that actions are taken.

In general, the Assessment, Inventory, and Management Plan fail to provide an *overall coordinated plan for research, monitoring, and evaluation* in the subbasin. The management plan should include provisions for implementation monitoring as well as Tier 1 (trend and routine), Tier 2 (statistical), and Tier 3 (research) monitoring. The research, monitoring, and evaluation program needs to be more closely connected to a limiting factors analysis and to biological and environmental objectives. The Plan should develop a prioritized research agenda reflecting the critical uncertainties and limiting factors, with the detail described in the Technical Guide. The research topics in the present plan are vague and unfocused, and inventory is sometimes confused with research. Additionally, no research is proposed to address the socioeconomic objectives.

The ISRP recommends the following 5 actions to aid in the development of an improved Management Plan:

1. Thorough adherence to the Council's Technical Guide for subbasin plans.

2. More direction of the planning by experts in the biological *science* of the subject.

3. Greater inclusion on the planning team of *biologists* who are experienced in *basic ecology* and in *management* of the region's natural resources, especially in the practicalities of management to benefit wild populations and stream habitat.

4. Increased participation by private, state, and federal natural resource managers via commitment of data, expertise, and personnel time.

5. More incorporation of fundamental knowledge about the *ecology of the species and ecosystems* targeted in the planned recovery efforts, with *documentation of the scientific literature sources* for that knowledge. This requires ample use of primary sources, not just gray literature.

Review Comments on Sections of the Management Plan

ISRP comments on specific parts of the Clearwater Subbasin Management Plan are organized below according to the plan elements specified in FWP (2000, p 41), as well as plan elements added by the authors.

A Vision for the Subbasin

The vision statement is a properly comprehensive expression of broad objectives.

Goals

This helpful section (3.2) of the Clearwater Subbasin Management Plan contains nine goal statements, each begun with a verb such as respect, protect, or promote. Expressed are some general purposes and general actions, together representing a code of conduct for participating parties. It provides excellent, overarching guidelines for proceeding with action in the subbasin. The next logical step is to specify the desired results of potential actions; Table 2 in the next section is a beginning to do this (see the comments below on hypotheses, objectives, and strategies).

The label "Goals" for this section, however, introduces an avoidable element of confusion. Fundamentally, the words goal and objective carry the same meaning, so it is best to avoid the word, goal, and stick with objective, unless some special need exists for using goal and both terms are defined. Moreover, most of this section's items do not represent a goal (a desired end product or status), but rather state general, belief-based *modes of operation* to which all parties should commit. Respecting, protecting, promoting, etc. are actions, not products or outcomes, unless the performance of actions rather than attainment of results is the purpose, which should not be the case. It would be more appropriate to call the items (and the section) "Guiding Principles" since the actual desired end products or outcomes of the management plan are embodied in the objectives presented in a later section. If labeled "Principles," then readers would be more likely to accept them as the very general guidance that they are, and would not

expect the rest of the Clearwater Subbasin Management Plan necessarily to refer back to them, although they should be consistent with them.

The 2nd item—on protecting, enhancing, and restoring habitats—should be augmented to include recognition that, beyond sustaining and recovering "aquatic and terrestrial species diversity," proper habitat work leads to recovering population abundances. Also, native species should be specified. Thus, the statement could be recast as follows (italics show additions): Protect, enhance, and restore habitats in ways that will sustain and recover *native* aquatic and terrestrial species diversity *and abundance to ecologically appropriate levels* with emphasis on . . . (etc.). Doing this lends further, essential purpose to the statement and makes it more consistent with basin biological objectives (FWP 2000, p 16).

The 8th item should be revised to include the all-important activity of *deciding what to do* as follows: Develop a scientific foundation *for diagnosing biological problems, for designing projects to deal with those problems,* for prioritizing projects, and for monitoring and evaluation.

A 10th item should be added: that of commitment to adaptive management. An outcome of the evaluations mentioned in the 8th item should be alteration of further management to better achieve objectives.

Biological Objectives for Fish and Wildlife

The present Clearwater Subbasin Management Plan combines the *Objectives* element with the FWP's next specified element, *Strategies,* in major section 3.3, entitled "**Hypotheses, Objectives and Strategies**." The section should tell what will be done and why. It should be the main explanation and guidance of management, the core of the subbasin plan. The present draft is insufficient. The section is shorter (barely 19 pages) than the subsequent section on research, monitoring and evaluation (21 pages) and, more importantly, its content is less substantial in many respects, less detailed, and less logically expressed than the research material. This indicates too little attention to the primary management goal of a management plan. The section needs to be substantially developed and improved.

The section states hypotheses that express problems (conditions the planning team views as negatively affecting resources), states objectives to be achieved in overcoming or reducing the problem, and states strategies for meeting the objectives. This basic organization—objectives (intended outcomes) following from problem statements (diagnoses), and strategies (plans of action) following from objectives — is logical. However, the content lacks much critical detail and does not meet criteria set forth in FWP (2000) as outlined earlier in this report.

The Clearwater Subbasin Management Plan states: "To avoid redundancy, the readers are referred to the Clearwater Subbasin Assessment for supporting data and information used to develop the following components. Only in cases where information is considered critical to the immediate understanding of the stated hypothesis, objective, or strategy is that information reiterated in this section." This approach does not draw direct connections with the Assessment upon which the hypotheses, objectives, and strategies should be based and leaves the reader in the position of having to hunt through the Assessment to find supportive evidence and further pertinent detail. The organization limits understanding and use of the subbasin plan, and it does

not evidence that the Plan is in fact wisely drawn from the information in the Assessment. Information from the Assessment need not always be "reiterated", but the authors should, for every hypothesis, and probably for every objective and most strategies, specifically reference the Assessment tables, figures, pages, or section numbers—and in some cases paragraphs—that support the items. The hypotheses, objectives, and strategies must be justified through reference to the Assessment and to the primary scientific literature. Without this, the soundness of the Plan cannot be evaluated.

Working Hypothesis

The Clearwater Subbasin Management Plan's section 3.3 contains a first subsection entitled "Working Hypothesis" before the second and main subsection, "Component Hypotheses, Objectives and Strategies." This subsection does not state a hypothesis, but rather 14 premises in paragraph form. The premises can be listed as follows (paraphrased for the most part):

a. Human activities have harmed ecosystems of the subbasin (with some specific categories of activity mentioned).
b. Many species are at risk and, absent proper management, may be further compromised.
c. Out-of-subbasin factors and in-subbasin habitat factors limit the subbasin's anadromous fishes.
d. The major practice of releasing hatchery-produced anadromous fishes "is not thought to limit persistence of existing stocks" and "is a valuable tool" in the subbasin. (This appears to be the only category of management mentioned in the list or in the Clearwater Subbasin Management Plan.)
e. Genetic introgression, deteriorated habitat, and loss of fluvial population components limit or threaten resident fishes.
f. "Better understanding and combined consideration of economic, biologic, and flood control needs" can lessen impacts of Dworshak Dam operations on resident and anadromous fishes.
g. Dworshak Dam's operations and secondary effects harm wildlife resources.
h. Habitat alterations of certain (specified) kinds have harmed the subbasin's terrestrial species.
i. Urban and rural development and introduced plants have harmed plant and wildlife populations in the subbasin.
j. Anthropogenic changes in habitat complexity have reduced habitat condition for various plants and animals. (This is essentially a rewording of item a?)
k. Reduced and lost anadromous fish runs have altered nutrient cycling, thereby harming terrestrial plants and animals.
l. Integrating the Management Plan with existing programs will yield benefits beyond those associated with individual plans or programs.
m. Achieving the Management Plan's objectives requires interagency coordination of policies.
n. Restoring and protecting ecosystems will have economic benefits and detriments, which the elements of this Management Plan can balance.

Most of these statements are reasonable, but they stand as a list of assertions, requiring documentation, e.g., by reference to the Assessment and other literature for credibility. Interposing hypotheses or premises between the Assessment and the Management Plan's

objectives could be a sound idea, but it should be shown how each major item derives from the Assessment, from the Inventory, or from principles of ecology, economics, sociology, or another pertinent basic field.

Many of the next subsection's "Component Hypotheses" are redundant with the first subsection (c, d, e, f, k, l, and specifics of a). Although the introduction to the "Component Hypotheses" says they are "derived from the above working hypothesis [*sic*]," they appear to be mainly repetition. The "Component Hypotheses" and the objectives under them should instead *derive from the Assessment*. FWP (2000) stipulates that a management plan's biological objectives be "responsive to the subbasin assessment findings." For this section to serve as useful background, its points should be developed more fully and should be integrated with each other.

One premise of the "Working Hypothesis" needs to be carefully evaluated: "Hatchery production of anadromous fish is not thought to limit persistence of existing stocks within the Clearwater subbasin, . . ." This assertion runs contrary to the preponderance of scientific knowledge; thus the Plan needs to include greater justification on that issue; i.e. what is it about stocks and hatchery practices in the Clearwater subbasin that would lessen the potential for negative interactions between wild and hatchery produced fish? It is well substantiated that imposing hatchery-produced salmonids, anadromous or otherwise, on wild salmonid populations can cause detriments in terms of pathogenic interactions (Coutant 1998; Goede 1986; Goede 1994; Moffitt et al. 1998), ecologic interactions (Bachman 1984; McMichael et al. 1999; McMichael et al. 1997; Nickelson et al. 1986; Sholes and Hallock 1979), and, where interbreeding is involved, genetics (Hindar et al. 1991). The Management Plan's assertion that hatchery fish do not affect anadromous stocks in the Clearwater ignores the probability that the genetic introgression mentioned in the very next sentence as limiting or threatening to resident fish could also affect anadromous fish; that introgression derives from fish introduced from hatcheries breeding with wild fish. It is also inconsistent with the existence of the Clearwater Subbasin Management Plan's proposed research program V. on interactions between hatchery and wild anadromous stocks (Clearwater Subbasin Management Plan, p 35), with "Strategy" III.A.1 on continuing "to develop stock specific knowledge of interactions between hatchery and wild fish," and with "Strategy" III.B.1 on impacts of coho reintroduction on other species.

The Component Hypotheses, Objectives, and Strategies

For the Management Plan to be effective in guiding managers toward end products, this section needs to state problems more clearly, rather than "hypotheses", sharpen the objectives (desired outcomes), and most importantly bolster the content and form of strategy statements. This section does not draw on the standard, fundamental literature concerning ecology and restoration of wild aquatic and terrestrial fauna, and it does not adequately refer to the subbasin Assessment and Inventory. There is no indication that the hypotheses and their objectives and strategies are listed in a prioritized order.

This section's content is particularly inadequate with respect to fish, because the material insufficiently specifies species and life history stages, does not adequately relate to population processes, and misses important stream habitat components and processes. Table 2 is a start toward considering focal species among the fishes; the objectives and strategies should more

often show *how* recovery of each species is to be achieved and what the crucial life history stages are.

With respect to the relationships of population processes of wild fish to stream habitat, this section refers five times to natural fish production or productivity, defining neither term, and too seldom deals with the processes involved, such as reproduction, body growth, survival, predation/harvest, competition, and movement/migration.[1] The subsequent section on research and monitoring mentions population processes more frequently, but consideration of these matters should enter prominently into the action plan.

Important functions of the riparian zone are not adequately considered. "Component Hypothesis" 10 states that loss of wetland and riparian habitats "has negatively impacted native terrestrial focal species," five of these specified by name. The "Hypothesis" does not mention that riparian habitat loss affects fish, but then, under its Objective C (protect and restore an additional 300 miles of riparian habitat . . .), the first "Strategy" item specifies giving "first priority to riparian habitats along streams that support . . . salmonids." This interjection of a fish item, as the first priority, into an effort "hypothesized" for solely terrestrial species is inappropriate. Objectives of protecting and restoring wetland and riparian habitat are important for terrestrial and aquatic species and coordinated effort to restore habitat for both is surely in order. The Management Plan should emphasize the importance of riparian conditions for stream fishes, include it prominently in problem statements and objectives, and treat it in much more substantial detail.

This section should be more specific about stream habitat components, such as channel forms (pools, riffles, etc.), and habitat processes, such as riparian plant succession, large woody debris recruitment, the functions of such debris and other large, relatively stable elements in channels, and the channel-forming action of flow regimes. The aquatic parts could be more useful if reorganized according to the ecological needs of focal species and how habitat functions to meet those needs—or how it could function better if anthropogenic impairment were reduced. There is much attention to summer water temperature; the appropriateness of this is undoubted, but should be shown by specific reference to the Assessment's geographic analysis (where do the problems exist?) and to thermal requirements of the species of concern. Unfavorably cold water in winter is probably also a problem that should enter into objectives and strategies for improving thermal conditions or winter habitat.

Component Hypotheses

This core subsection of the Management Plan consists of 20 "Component Hypotheses" (which could be re-labeled as "Problems"). These are organized into three very general categories:

1. Biological: six hypotheses—three dealing with anadromous fishes, two with resident fishes, and one with terrestrial species. (Of the six, item III on coordination of hatchery and natural production is the only one stated as a hypothesis, but it is probably not a testable hypothesis. The problem to be solved is not clear.)

[1] Natural reproduction is alluded to via the terms spawner or spawning only 5 times, growth is mentioned once, survival once other than ocean survival and in relation to Dworshak Reservoir, predation never, competition twice, movement/migration twice 2 other than in relation to Dworshak, and rearing once.

2. Environmental: 11 hypotheses—one affecting fish, eight affecting terrestrial species, and two affecting both aquatic and terrestrial species.
3. Socioeconomic: three hypotheses. (These are indeed expressed as hypotheses, not as statements of problems to be solved. Associated problems should be defined.)

The items in this section need to be more clearly related to the Assessment and should make better use of specific biology of focal species or considerations of biodiversity. Only two of the ten hypotheses dealing with fish or other aquatic subjects contain definite information from the Assessment, one of these being Hypothesis 2, containing Table 2. Presentation and use of material such as exists in Table 2 is central to the subbasin planning and implementation effort. This approach should be enlarged to include not just fishes, but all features of the landscape (e.g., habitat attributes) and its associated biota that are the desired end products of actions, and the specific parts of the Assessment that support information should be referenced. Then, the strategies that follow should explain operations in ways that show managers how to reach the desired, quantified end products. The aquatic hypotheses and objectives should identify the species at issue more often than they do because objectives should state desired outcomes, and the outcomes for a fish and wildlife recovery program should be in terms of the species involved. Six of the eight aquatic hypotheses do not mention the species, however, 11 of the 22 objectives beneath these six do. The plan needs objectives and strategies that are species-specific and life-stage-specific because the life histories and habitat requirements of each species differ. Sometimes species that have similar habitat requirements at a life stage can be grouped.

Most of the nine hypotheses dealing with terrestrial issues are more detailed, mentioning individual species and apparently incorporating findings from the Assessment, but still not referencing the latter by page or section number. This section's terrestrial items usually identify species in the hypothesis (a problem statement), and then state objectives that deal with the ecological and human-generated processes that affect those species. This approach would also be beneficial in the aquatic items.

The socioeconomic hypotheses, objectives, and strategies show no connection to the Assessment and need strengthening. These require expansion and greater detail as well as references to existing economic evaluation tools. Although research is proposed to address information gaps related to other objectives and strategies, none is associated with the socioeconomic objectives. The material in the socioeconomic section often seems platitudinous; this might be reduced by identifying end products and showing their relationship to actually getting things done, i.e., accomplishing fish and wildlife recovery. Education *per se* is not adequately considered; public understanding and enthusiasm for the overall program are essential.

Objectives

There are five anadromous fish objectives, eight resident fish objectives, two terrestrial *species* objectives, and 30 environmental objectives, most of which are somewhat vague and lack substantiation of the appropriateness or priority of the objective, failing to provide rationale from either the primary scientific literature or from the Assessment. Most of the problems for terrestrial wildlife are covered under the environmental category, which may represent a more habitat-oriented approach by the terrestrial planning team. Some environmental objectives list specific targets (e.g., restore 500 acres of historic wetlands, and protect/restore 300 miles of

riparian habitat), but give no basis for the targets. Specific rationale should be provided for target amounts of habitat to be restored, as should their priority and their likely locations.

It is unclear whether there is agreement between IDFG and CRITFC with respect to the anadromous fish objectives:

1) Increase naturally spawning adult number within 25 years to specific numbers.
2) Improve subbasin habitat to increase fish production.
3) Establish index streams.
4) Optimize use of hatchery fish: Use a mix of hatchery and natural production strategies.
5) Restore coho.

Analysis and models should be given to support the high harvest rates that are targeted. Comparisons between existing returns and proposed targets should be given in greater detail. The use of index streams needs to be reconciled with the ISRP's recommendation for probabilistic sampling. Better description of what constitutes optimal use of hatchery fish is needed. The scale of production proposed for hatchery chinook and steelhead in the Clearwater subbasin is large, and figures into the attainment of objective number 1 above. The subbasin management plan would benefit from greater justification of the scale of effort and better descriptions of the safeguards and monitoring that will be used to protect wild stocks in the subbasin (e.g., steelhead in the Lochsa and Selway rivers).

Many of the Management Plan's objectives specify quantified achievement levels and times, as an objective should, but others lack this. To enable evaluation, each objective should include such quantified criteria and times (or footnoted explanation of why it is not appropriate). Each quantification should be referenced to the appropriate Assessment section, table, or graph and/or other document that contains the data for it and that show the method by which it was calculated. The subsection's second introductory paragraph, which discusses this matter, should document methods used to quantify levels and times. It is stated that where sufficient data were lacking, objectives designate timelines for developing the criteria; however, the timelines are not provided for all objectives that lack quantified criteria. Each objective should be reworked to meet standards of quantifiability and achievement date, and to reference these to the Assessment.

Some statements of objective diverge into matters of method. Objectives should be statements of desired outcomes; methods to accomplish the objectives belong in the strategies. For example, Objective I.A.: "Increase the number of naturally spawning adults to achieve goals in Table [2] within 25 years ... *by ameliorating or mitigating the manageable limiting factors, or provide data key to out-of-basin efforts to improve limiting factors*. Progress toward goals will be assessed at least every 2 generations" (italics added to highlight methods). The objective here is to increase the number of naturally spawning adults to achieve Table 2's goals within 25 years. The methods part of the statement should be covered in a sequence of steps that constitutes a strategy for achieving the objective. Other examples include Objective II.A and III.B. Objective II.A should read: "Improve anadromous fish survival," omitting the rest of the present lengthy statement, but adding species and saying how much survival is to be improved by what date. Objective III.B also contains a method statement that should be in its strategy instead.

Strategies

The greatest shortcoming of the section on "Component Hypotheses, Objectives, and Strategies" involves its strategies. These generally fail to develop *clear operational pathways toward biological outcomes*. The essential purpose of a management plan is to set forth "the strategies that will be implemented at a local level" (FWP 2000, p 41). The Clearwater Subbasin Management Plan's strategies are only generally, rather than explicitly, related to the objectives, and they are worded too generally to constitute a management plan.

The instructions on strategies stipulate that the management plan include (a) an explanation linking the strategies to the established subbasin biological objectives and vision and the subbasin assessment; (b) an explanation of how and why the strategies presented were selected over other alternative strategies (e.g. passive restoration strategies v. intervention strategies); and (c) a proposed sequence and prioritization (FWP 2000, p 41). The Management Plan does not incorporate these important elements. The Management Plan occasionally refers to linkages with the Assessment, but does not identify and explain them. Alternative strategies are not given. Activity lists do not have a proposed sequence. Prioritization, particularly a framework for spatial prioritization, is discussed in a special Management Plan section; however, each strategy (set of actions toward an objective) outlined should show the method by which efforts will be or have been prioritized. Vague statements such as: "Address relevant issues delineated under 'Prioritization of efforts' section" are not helpful.

Most of the "strategies" are not adequately developed. Often, a "strategy" is stated as a single activity, which may name a strategy, but does not provide adequate operational guidance. The Technical Guidelines define strategies as "sets of actions to accomplish the biological objectives." Further, strategies are "plans of action to accomplish the biological objectives" and "in developing strategies, the program takes into account . . . the desired outcomes . . . [and] the physical and biological realities expressed in the scientific foundation" (FWP 2000, p 19). It follows from this that each strategy should consist of an *integrated set* of actions, in the form of a logical sequence of actions for performance, probably often cast as a decision tree involving if-then branches (or terminations) and statement of contingencies that would trigger them. A decision tree also tends to reveal logical alternative options in a strategy, and the circumstances in which they would apply.

Further, the logical *series* of actions in each strategy should explicitly describe the design for achieving measurable benefits for target species at specific life stages. The strategies should be explained in terms of their effects on measurable biological objectives, e.g., the behavioral ecology or population dynamics of species, and, where appropriate, in terms of genetics. The Clearwater Subbasin Management Plan's activity-lists, in which the items are labeled as strategies, should be thoroughly reexamined and reworked to come up with genuine strategies. In some cases, a list of "strategies" that the Management Plan presents under an objective could constitute a strategy if the list itself were labeled as the strategy and the present items (and often others) were shown as steps in a sequence that constitutes a procedure toward achievement of the objective. In all cases, the linkage of steps, and possible alternatives, should be explained.

For example, the material under "Component Hypothesis 2" (labeled also as item II) could be restated along the lines of the following framework:

Problem 2: Habitat quantity and quality limit anadromous fish production in parts of the subbasin (reference to supporting information in assessment here or below).
Objective 2A: Increase rearing-stage survival[2] of spring chinook salmon to a 5-year mean of __%[3] by the period 2010-2015.

Strategy (all of the following apply specifically to spring chinook salmon):

1. Analyze habitat factors that limit survival in each PMU that they inhabit. (Statements of known or likely habitat problems—from the Assessment—could be worked in here.)
2. Analyze for each PMU alternative kinds of habitat restoration, and from among them prescribe sub-strategies and methods likely to overcome the limiting factors. (This could involve a number of decision nodes and branches; for example, different general, potentially appropriate approaches to habitat restoration.)
3. Prioritize PMUs according to probable benefit/cost effectiveness of habitat restoration for the specified survival level (the expected, quantified biological result vs. the sum of logistic costs, labor costs, etc.).
4. Consider, on the basis of predicted benefit/cost, whether to proceed with any of the work. If not worthwhile, cancel the project (a possible termination branch on the decision tree) or reassess methods (a back-loop).
5. Identify the PMUs (or streams) in which to restore habitat in the first management cycle of __ years.
6. Select a *probabilistic* sample of streams (rather than index sites) from among those in item 4 for monitoring of habitat and fish-population. Begin monitoring at least one year (preferably several years) before habitat work starts, and continue monitoring in a sample of years on each stream for at least 7 years after its habitat work is complete.
7. Apply the habitat restoration prescriptions developed in item 2 to the streams selected in item 4.
8. Evaluate the levels of habitat and biological response achieved 7 years after habitat work was complete.
9. Use adaptive management in the next management cycle of __ years (and in similar management elsewhere), apply the lessons of what works and what does not.

At the end of this itemized strategy, insert a paragraph explaining such matters as the aspects of spring chinook salmon habitat use (behavior) at the rearing stage(s), as well as the habitat deficiencies in the subbasin (and their causes), that lie at the root of the problem; why the survival level specified in the objective level was chosen (how calculated or based on literature as sufficient for recovery of the species?); linkages in the strategy, where not obvious; and the

[2] Survival is the parameter stated in the present Management Plan, so it is applied in this example, but with further specification of *rearing* survival in order to make it more meaningful in terms of life history. Perhaps some other survival or production parameter would be more appropriate.
[3] The Assessment should state current survival rate for spring chinook, and show what it could be under desired environmental conditions, but does it? (The same applies to the other species of Table 2.)

alternative strategies or steps that were considered and why they are or are not thought to be feasible. Then go on to state objectives 2B, 2C, etc., each covering another species from Table 2 and the special strategy required for it.

The ISRP suggests that all other strategy lists of the Clearwater Subbasin Management Plan should be revised according to the above comments.

Sometimes an item listed as a "strategy" more properly expresses an objective that ought to be followed by a step-wise strategy showing how it will be accomplished. For example, under Objective X.C on protection of riparian habitats, "strategies" 3, 4, and 5 seem to be major objectives (indeed, programs), each calling for a strategy (and for consideration of alternative strategies) to achieve it. A further example: Under Objective XI.B, the four items could together constitute an excellent, integrated strategy, particularly if it were shown a bit more explicitly how some of these measures follow from or otherwise relate to each other. And with regard to item 1, *how* should the managers encourage establishment of riparian pasture systems, etc.? What are the proven methods for such encouragement under the sorts of conditions that exist in the subbasin? Intended users of the Clearwater Subbasin Management Plan should be able to see guidance on such matters.

Comments on Specific Parts of the Objectives-and-Strategies Material

The sections of the Management Plan that deal with aquatic species and habitats are not sufficiently oriented to focal species. Objectives and strategies intended to affect fish seldom specify species, and outlined actions are not related to the special habitat needs and behaviors of the various fishes and their life stages. The plan also gives insufficient attention to the highly important riparian issues involved in habitat for salmonid fishes, including the roles of woody debris produced by riparian vegetation. Indeed, completely missing from the Management Plan are such common terms in considering stream fish habitat and its restoration as *riffle*, *hiding cover*, *woody debris* (or *LWD*), *log*, *tree*, and *bush*. Even the word *pool* occurs only once and only in a research context. Also appearing only once—and in no objective or strategy—are the word, *gravel*, and the term, *cover*, in the sense of shelter for fish. This is supposed to be "a habitat-based program" (FWP 2000, p. 13), yet the Management Plan does not adequately deal with major aspects of stream habitat characteristics and functions and does not come to grips with the practical, on-the-ground realities of habitat restoration for fish. One could conclude from reading the management plan that very little is known about habitat conditions and fish populations in the Clearwater basin. This is hardly the case, as the assessment should have demonstrated.

There seems to be a tendency to blame the anadromous fish scarcity on "Out-of-subbasin factors…[that] are the primary factors limiting recruitment of anadromous spawners to the Clearwater subbasin" ("Component Hypothesis" 1). However, the long lists of high priority issues with low or moderate opportunity for improvement in Tables 4, 5, and 6 would seem to indicate a major contradiction.

In the present Management Plan, item 4 of the strategy list for Objective II.A, that on Dworshak Dam operations, seems a special case that deserves a separate objective and step-wise strategy.

The present Objective II.A says that improved anadromous fish survival is to be attained in part "through quantifiable improvements outlined for individual habitat components under Environmental Objectives (defined below)." However, no objective in the Environmental category mentions quantification of survival rates. Did the authors intend to place such emphasis on survival per se? What about reproduction and body growth?

In the strategy for Objective I.A there should be an item making it clear that data will be provided to fishery managers outside of the subbasin to guide their appropriate regulation of fisheries to ensure adequate returns of anadromous fishes to the subbasin.

Objective III.B refers to recovery and harvest objectives that are spelled out in Table 2. Logically, these ought to be consistent with information provided in the Assessment. The discussion should provide a link between the Assessment and the Plan at this point. The Objective mentions "timelines delineated in Table 2"; that table contains no timelines.

"Strategy" III.B.1 is very vague. It needs much expansion to show how it is supposed to meet the objective.

"Strategy" III.C.1 is "Continue coho restoration efforts." What are those efforts? This expresses no strategy.

"Component Hypothesis" 4 outlines threats to long-term persistence of resident fishes. Some of these apply to anadromous fishes, as well. Appropriately parallel items should be added in the anadromous category of problems, objectives, and strategies.

"Strategy" IV.C.1: This item should be omitted. Experts often have difficulty with field characters to distinguish hybrids of rainbow trout and cutthroat trout, so a public education campaign to increase angler ability to do this will be difficult to accomplish. Also, it is not explained why this should be done. What action would be taken on the basis of the information gained?

"Strategy" IV.C.4: If anglers identify hybrids, then what? Why should they do this?

"Strategy" IV.D.4: Why do this? What would the reasonable extent of effort on this in view of more urgent needs elsewhere? What would be the priority of such an effort? An intent to avoid competition with bull trout is expressed in this item; avoiding competition with other native salmonids, such as redband trout should also be considered.

"Strategy" VII.B.2: Rather than "maximizing" the activity, it would be better to optimize it by prioritizing barrier removals to *maximize results.*

"Strategy" VII.E.6: Replace the term, "glory holes," with a description that outside readers will understand.

"Strategy" VII.G.1 mentions "habitat improvement efforts." This is too vague. What are they?

"Strategy" VII.G.2 mentions "appropriate measures." This is also much too vague. What might those measures reasonably consist of—or, for those already being done, what are they? Anywhere else that "appropriate measures," "representative samples," and such terms are used, the actual items should be specified instead.

Item XVIII (the first of three in the "socioeconomic" category): This set of objectives and strategies is not particularly socioeconomic. It deals with attributes, which, as sound natural resource management, should pervade the biological and environmental categories; parts of the present Management Plan for which this is not the case should be corrected.

Objective XIX.A and its "strategy": Once these things are accomplished, what will be done with the output? How will it be integrated into future management? Prioritize what?

Objective XIX.B: "Account for" these in doing what? The strategy list does not clearly relate to the statement of objective. The objective statement does not express an outcome.

"Strategy" XIX.B.1 would develop measures to evaluate the economic effectiveness and efficiency of implementing the Plan. To accomplish this would require that all actions be evaluated on a common basis, e.g., number of salmon or other benefits expected to be produced. To simply measure the relative costs of projects in dollar amounts would overlook the value of the relative benefits to various sectors of the community. In other words, this sounds easy, but promises to be very difficult.

Research, Monitoring and Evaluation Plan (RM&E)

One of the questions asked of the ISRP was "Does the proposed subbasin plan include a procedure for assessing how well subbasin objectives are being met over time?" In general, the answer to this question is "no". However, as the introduction's 4th paragraph indicates, current RM&E programs described in the Inventory "likely incorporate many of the RM&E needs identified in this section". A list of ongoing research/monitoring projects is given in Table 4 of the Inventory and brief summaries of the projects are included. Unfortunately, the Assessment, Inventory, and Management Plan fail to fully summarize and analyze the ongoing research/monitoring projects. The readers should be shown in each research/monitoring proposal the aspects of the proposal that are met and unmet in existing projects and in what ways the proposal would fill gaps of knowledge.

Development of the Clearwater Subbasin Plan offers a unique opportunity to better coordinate long-term monitoring of aquatic and terrestrial resources using common data collection procedures, storage of data in a system of distributed databases with common format and to fill data gaps to allow statistical inferences to be drawn to large subsections of the subbasin. In general, the Assessment, Inventory, and Management Plan do not provide an overall coordinated plan for research and monitoring in the subbasin and to promote the use of common methods throughout the subbasins of the Columbia Basin.

The introductory discussion on RM&E states that the section was developed in response to limiting factors identified in the Assessment and associated vision, hypotheses, objectives, and strategies sections of the Management Plan. RM&E material does not refer to specific pages,

tables, or figures in the Assessment. The "goals" sections names no limiting factors, and the hypotheses, objectives, and strategies should derive *from* the limiting factors identified in the Assessment. It would be well for the planning team to rework their ideas on how the proposed research and monitoring relates to limiting factors. The plan should tie the RM&E back to the limiting factors and objectives, which may be difficult given the objectives are very general. There is apparently no research that can be tied back to socio-economic hypotheses.

In general, the RM&E section of the Management Plan is vague and unfocused. For example, the terrestrial section often confuses inventory with research. It is important to separate data collection and evaluation of research, Tier 3, from Implementation Monitoring, Tier 1 (trend or routine) monitoring, and Tier 2 (statistical monitoring) of large areas and over long time periods. Evaluation is an important part of all three processes and there must be a perceived need and clear procedure for analysis of data being collected. Granted that there is a perceived need and clear procedure for analysis of data being collected, plans for evaluation of the data are less important for Tier 1 and Tier 2 monitoring than Tier 3, because Tier 1 and Tier 2 data should have a long shelf life (in the range of 50 to 100 years minimum). In fact, the methods for evaluation of Tier 1 and 2 data in the future, say 2025, probably have not been conceived. On the other hand, Tier 3 research data are often for relatively short term evaluation of specific research projects and must have well defined plans for analysis and evaluation. To help distinguish between the different types of monitoring, we repeat some of our programmatic issues from the rolling reviews of the Provinces.

Implementation Monitoring is monitoring of task completion in a specific project. For example, miles of stream fenced, number of culverts removed, completion of reports, irrigation diversions maintained, etc. Implementation monitoring is often given in proposals to the Council's Fish and Wildlife Program. Implementation monitoring results must be presented for projects, but sound science requires that project results also be measured in terms of benefits to fish and wildlife. In addition to Implementation monitoring, all projects should also include one of the following types of monitoring in proposals and plans for observational studies or experiments.

Tier 1 (trend or routine) monitoring obtains repeated measurements, usually representing a single spatial unit over a period of time, with a view to quantifying changes over time. Changes must be distinguished from background noise. For example, temperature of water entering and leaving a habitat improvement site might be measured in August every third year for a 21-year period. This can be a low level of monitoring on individual project sites or on a large area. For example, the ISRP anticipates that aerial photography or data layers in a GIS would be used for long term trend monitoring of riparian and other terrestrial habitat over time. In general, Tier 1 monitoring does not establish cause and effect relationships (i.e., is not research) and does not provide statistical inductive inferences to larger areas or time periods. It is not necessarily expensive or time consuming. However, Tier 1 mapping or trend monitoring on similar projects replicated over time and space can provide compelling evidence for general conclusions. Also, aerial photography or data layers in a GIS yields a census of the study area thus eliminating the need for spatial sampling and classical statistical analysis at the scale studied. Unfortunately, the aerial photography or data layers often have unknown measurement errors which may limit their usefulness for detecting changes and trends when compared to future data.

Tier 2 (statistical) monitoring provides statistical inferences to parameters in the study area as measured by certain data collection protocols (i.e., The Methods in a report). These inferences apply to areas larger than the sampled sites and to time periods not studied. The inferences require both probabilistic selection of study sites and repeated visits over time. A good model is the Oregon Plan for Salmon and Watersheds Monitoring Program (http://www.nwr.noaa.gov/pcsrf/Moore/) as implemented in the Oregon coastal coho streams. The Oregon Plan, successfully implemented for estimation of coho distribution and abundance, applied a rigorous design for probabilistic site selection to answer key monitoring questions. Individual proposals can support larger Tier 2 statistical monitoring projects such as the Oregon Plan by using the same field methods and methods to select study sites that contribute information to Tier 2 statistical monitoring. Most large projects should implement sampling designs that allow Tier 2 statistical monitoring or contribute data to statistical monitoring. Tier 2 statistical monitoring will be required for estimation of parameters such as number of spawners in the escapement, juvenile production, acres of noxious weed present, etc.

Tier 3 (research) monitoring is for those projects or groups of projects whose objectives include establishment of mechanistic links between management actions and salmon or other fish or wildlife population response. Bisbal (2001) defines this level of effort as *effects* or *response monitoring*; the repeated measurement of environmental variables to detect changes caused by external influences. The key words here are "establishment of mechanistic links" and "detect changes caused by external influences." Tier 3 research monitoring requires the use of experimental designs incorporating "treatments" and "controls" randomly assigned to study sites. Generally, the results of Tier 3 research monitoring qualify for publication in the refereed scientific literature. Examples of Tier 3 monitoring would include: 1) projects to evaluate the effects of different levels of fertilization on growth and survival of juvenile salmonids with streams selected randomly for reference and treatment; 2) projects to evaluate the survival rates of adult salmonids caught and released from tangle nets; 3) projects to evaluate the survival rates of juveniles migrating past a dam at different levels of spill and turbine passage; 4) projects to evaluate the swimming ability of lamprey during upstream migration; 5) projects to evaluate the effectiveness of various land restoration or management techniques, etc.

Large scale observational studies that involve "treatment-control", "before-after" or "before-after-control-impact (BACI)" designs fall under Tier 1 or 2 trend monitoring and do not establish cause and effect relationships as in Tier 3 research monitoring. A good example in the Clearwater Subbasin is the Idaho Supplementation Study (ISS) on chinook salmon. With a large number of replications, as in the ISS, compelling evidence for general conclusions based on regression-correlation type analyses can be obtained. However, the ISRP cautions that maintaining the essential elements of a large-scale observational study over a long period of time is a difficult task. For example, in the ISS there have been changes in the original design that will make interpretation of the data difficult.

Reference to the Clearwater Subbasin Management Plan's "hypotheses" (i.e., to problem statements) is by number. The functional relationship of the proposed investigation to the resource problem is not discussed, and it is not said what managers are supposed to do with the expected research results in order to achieve fish or wildlife recovery. It would add much to the

meaning of the program statements, if an item were added to each on the types of results expected, the envisaged applicability to management, and how this could benefit fish or wildlife. Because reference to those matters and to the Assessment are missing, readers cannot judge appropriateness of the proposed RM&E subjects except on the basis of their prior knowledge about natural resource ecology and the Clearwater Subbasin.

Specific Comments on the Aquatics RM&E

Many of the proposed research topics in this section of the Management Plan are vague and unfocused and should be expanded.

Some specific comments and questions are:

1. The research items should be carefully examined to indicate which are actually research projects with a limited life (Tier 3) and which are long term Tier 1 or 2 monitoring projects. For example, the ISRP judges that Item I.3 "Develop appropriate intensity and spatial distribution of monitoring to estimate parr carrying capacity" is a limited life research project, but Item I.2 "Determine migration characteristics and timing of smolts outmigrating from the subbasin and assess hatchery:wild ratio" has components that probably should involve long term Tier 1 or 2 monitoring.

2. In proposed research item I.2, we agree with the authors of the Management Plan that "Sites should be distributed probabilistically within a PMU, ensuring that both "good" and "bad" sites are appropriately represented." However, this statement immediately follows and contradicts the statement that the plan is to "Establish or use preexisting index sites to gather baseline, trend, and comparative data." Item IV.2 "Develop/expand index areas" is correctly identified as Tier 1 and 2 monitoring with new sites to be collected by probabilistic procedures. This approach yields a 100% sample from the stratum "index sites" and a probabilistic sample from the rest of the area. Statistical inference would involve estimation of a parameter on the larger area not in the index sites combined with data from the index sites.

3. The ISRP recommends that a general protocol for probabilistic selection of aquatic sites be developed and included in the subbasin plan and that new sites be overlapped with existing index sites for a few years, say 5 to 10 years. In our judgment, the best model to follow in development of probabilistic sampling plans is the EPA EMAP strategy in the "Oregon Plan" as implemented in the Oregon and Washington coastal coho streams and in the Yakima Subbasin. Details for implementation of a probabilistic sampling procedures are not trivial and should be developed in the Subbasin Plan to the point that scientists working for management agencies can apply the procedures with help from, say Don Stevens, Department of Statistics, Oregon State University.

4. In addition to contact with the Department of Statistics at Oregon State University or entity with similar expertise, we recommend that the authors review the plans for status (Tier 2) monitoring of fish and habitat being developed by the Action Agencies (Bonneville Power Administration (BPA), Corps of Engineers (Corps), and Bureau of Reclamation (BOR) and the NMFS) in their RME Plan (see the BPA Draft Report "Research, Monitoring &

Evaluation, For the NMFS 2000 FCRPS Biological Opinion"). Plans are being developed for implementation of the EPA EMAP probabilistic selection of sites in a pilot project in the Salmon Subbasin. Every effort should be made to include the same site selection protocols and data collection methods in the Clearwater Subbasin. This is a unique opportunity to promote the collection of research and monitoring data with common methods throughout not only the Snake River Basin, but the entire Columbia Basin.

5. Proposed Research II.4 is to study temperature impacts of Dworshak Dam operations on downriver fish populations. An ISRP comment on the Assessment brings out that the Assessment does not mention this aspect of the situation. Again this points to the need for stronger linkage between the Assessment and the Management Plan. It is not clear if this proposal intended to include the possibility of studying effects on juvenile salmonids in the lower Clearwater River and Columbia River mainstem.

6. Proposed Research III.1 to study a minimum flow requirement would involve evaluating the accuracy of existing stream gauge data. Past work on this subject suggests that the data should include hourly records. In most cases, the continuous records are simplified to daily or longer averages. Such averages may be meaningless if there are water withdrawals or interruptions upstream.

7. Proposed Research V.1 is on genetic interactions of hatchery and wild fish. It is said in the M&E item that effects of interactions on "fitness" will be measured, but fitness is not defined, and it is not said how it would be measured. Definition and measurement of "fitness" is likely to be one of the most difficult steps in this process, if it is even possible.

8. Proposed Research V.2 on assessing interactions between reintroduced and native anadromous salmonid populations say under M&E: "Using appropriate methods, assess habitat use . . ." Methods should be specified or referenced for all such proposed research.

9. Same Proposed Research, next paragraph, item a) deals with comparing growth rates between native and introduced species. What are the species? Are the fish to be examined wild or hatchery-produced or both?

10. Proposed Research VI.1, item c involves "population status monitoring of fluvial x resident genetic interchange." What is this, exactly? What is population status supposed to mean here? What does the "x" mean? Why do this? What sort of output is supposed to result, and how would it be used in restoration?

11. Proposed Research VI.2 on effectiveness of planting sterile rainbow trout. A subject not discussed is the extent of competition for food and space of these fish with fish already resident in the river.

12. Proposed Research VI.3 concerns lamprey studies. These seem superfluous given that the primary limiting factor for lamprey abundance is passage at the mainstem dams. Factors within the subbasin are not likely to have any effect at all, and even if they do, it is unlikely, given the low abundance of lamprey, that the effects within the subbasin could be measured.

Genetic analysis seems especially unlikely to lead to any results that would lead to restoration actions. Perhaps the Plan should propose participating in or encouraging studies by the Corps of Engineers to find a solution to the passage problem.

13. Proposed Research VIII.2 on profiling anadromous salmonid genetics. What will be done with the information that results from this? How will it be used in restoration?

14. Proposed Research VIII.3 to study out of basin factors affecting smolt outmigration success. While it is necessary and desirable for subbasin participants to be kept informed on these subjects and to assist where possible, it seems redundant to fund studies under the subbasin heading that are more logically organized as part of the Mainstem and Systemwide component of the FWP.

15. Proposed Research VIII.6 to study effects of unclipped hatchery fish on natural production. It is regrettable that there are unclipped fish being released. However, it is not clear how unmarked hatchery fish can be identified with any degree of reliability when they spawn in the river.

Specific Comments on the Terrestrial RM&E Section

The ISRP is less critical of the research/monitoring proposals in the terrestrial section than we are of those in the aquatic section, primarily because of the more detailed analyses of terrestrial issues presented in the Assessment and Inventory. However again, readers should be shown in each research/monitoring proposal the aspects of the proposal that are met and unmet in existing projects and in what ways the proposal would fill one or more gaps of knowledge. The hypotheses, objectives, and strategies should derive *from* the limiting factors identified in the Assessment and the proposed research/monitoring should be more clearly tied back to both.

In the Proposed Research IX.1, it is unfortunate that there does not exist a good model for Tier 2 statistical sampling and inventory of terrestrial components of the subbasin. The National Resources Inventory (NRI) studies long-term changes in cultivated agricultural lands, but not forest or grazing lands. The Forest Service has its Forest Inventory and Analysis program, but it does not extend and is not really appropriate for many terrestrial parameters. The Bureau of Land Management apparently has little to mimic. The EPA Environmental Monitoring and Assessment Procedure (EMAP) is helping some of the states instigate valid probabilistic sampling for certain aquatic parameters. In short, there is not a good existing program on which the Tier 2 terrestrial monitoring might be attached or modeled after.

The Clearwater Subbasin is in a position, as the first subbasin to go through the planning process of the Council's FWP, to help implement a coordinated Tier 2 terrestrial monitoring program for estimation of key terrestrial parameters over the subbasin and to influence the direction of terrestrial monitoring for the entire Columbia Basin. The ISRP recommends that a general protocol for probabilistic selection of sites be developed and included in the subbasin plan. During the province reviews by the ISRP, the Albeni Falls Workgroup prepared a Draft Monitoring and Evaluation Plan for the Albeni Falls Wildlife Mitigation Project, dated August 2001(see www.nwcouncil.org/library/isrp/isrp2001-4AlbeniFalls.pdf). In the Upper and Middle

Snake Provinces, the Southern Idaho Wildlife Mitigation projects (199505700 though 03) have adopted the Albeni Falls M&E Plan for use in southern Idaho in wetland cover types and were in the process of expanding that plan to include techniques for monitoring upland habitat and wildlife species. We encourage the authors of the terrestrial section of the Clearwater Subbasin Plan to work closely with the Albeni Falls Workgroup, the Confederated Salish and Kootenai Tribes, and the Southern Idaho Wildlife Mitigation projects to develop common site selection procedures and data collection protocols for terrestrial monitoring. This is a unique opportunity to promote the use of common terrestrial monitoring methods within the Columbia Basin.

General Guidance on Research, Monitoring, and Evaluation to Evaluate Effectiveness of Habitat Restoration Activities

The Independent Scientific Advisory Board (ISAB) is in the final stages of preparing a report entitled "A Review of Strategies for Tributary Habitat Recovery." That report contains pertinent information on design of Tier 2 and 3 research and monitoring studies to evaluate the effects of actions intended to recover or improve tributary habitat for fish and wildlife. For consistency, we repeat some of that information and give recommendations that are particularly relevant to RM&E of tributary habitat improvement techniques that might be implemented in the individual subbasins. Please note that at the time of preparation of the review of the Clearwater Subbasin Plan, the ISAB report is still in draft format and minor changes in the following paragraphs may exist in the final version. The material is written primarily for RM&E on fish populations and aquatic habitat; however, the basic principles apply equally well to terrestrial wildlife and habitat. Pertinent text from the ISAB report is presented below in italics:

Understanding the effect of habitat conditions on salmon population performance requires replicated observational studies or intensive research level experiments to be conducted at large spatial and long temporal scales. Very few evaluation efforts for tributary habitat that have been implemented to date in the Columbia River basin meet these criteria. Considerable expense and effort are required to establish studies or experiments that can enhance our understanding of habitat-population relationships and thus provide a sound basis for the development of tributary habitat restoration efforts.

Two general approaches, i.e., philosophies, of conducting field studies exist to collect empirical data for evaluation of the effectiveness of tributary habitat restoration activities. The first approach seems to be consistent with that currently promoted by the Action Agencies (Bonneville Power Administration (BPA), Corps of Engineers (Corps), and Bureau of Reclamation (BOR) and the NMFS) in their RME Plan (see the BPA Draft Report "Research, Monitoring & Evaluation, For the NMFS 2000 FCRPS Biological Opinion"). For example, a large number of pairs of sites (e.g., watersheds) might be located where the primary difference is that one member has a certain habitat improvement (e.g., grazing by livestock is excluded by fencing of streams) and the other does not. Future changes in management would be uniformly applied to both members of a pair. Enough pairs of sites are obtained to generate acceptable power for standard statistical tests to detect important differences in the estimated indicator variable(s). Given the number of pairs involved, parameters that can be monitored by Tier 1 or 2 methods within a reasonable budget are limited; perhaps, to estimates of spawners entering the watersheds and smolts leaving. The design of such a study will be similar to that used in the

large scale "treatment-control" observational Idaho Supplementation Study (ISS). With a large number of replications of treatment and control sites (e.g., watersheds), compelling evidence for general conclusions based on regression-correlation type analyses can be obtained. However, the ISAB cautions that maintaining the study design for a large number of replications over a long period of time is a difficult task. For example, in the ISS there have been changes in the original design that will make interpretation of the data difficult. Furthermore, this design requires study of essentially one factor at a time, e.g., fencing. Study of the interactions between two different types of habitat improvements (e.g., fencing and placement of large wood) would double the number of required sites in a 2x2 factorial design.

The second approach is to focus evaluations in a few watersheds in each subbasin, a monitoring approach the state of Washington has termed Intensive Watershed Monitoring (IWM). The basic premise of IWM is that cause-effect relationships in complex systems can best be understood by concentrating monitoring and research efforts at a few locations. Closely spaced measurements in space and time are often required to develop a thorough understanding of the processes responsible for habitat or fish population response to a management action. Concentration of effort can focus sufficient resources and research expertise to begin to tease apart some of the complex interactions governing system response to restoration activities.

There are obvious advantages and disadvantages to each approach. The first (e.g., ISS) attempts to drawn inferences based strictly on the design of the study to a very large area by, e.g., spreading a large number of pairs of sites over the target region. Obviously, the inference would be stronger if Tier 3 monitoring with random assignment of treatments and controls is used, but this requirement for cause and effect conclusions is likely not practical. Inferences are usually based on correlation-regression type analyses and confidence is gained in the conclusions as the numbers and geographical distribution of the study sites are increased. The primary disadvantages of the approach are costs and logistical difficulties in dealing with a large number of sites in a large area over a long time period.

The second approach (e.g., IWM) limits inferences to a small number of sites with limited geographical coverage, but with intense study of more parameters and their relationships. Again, randomization of treatment and control to relatively large watersheds is probably not practical, but perhaps some randomization can take place on streams within the larger units. Inferences concerning applicability of the conclusions to large regions are based on professional judgment. The primary disadvantages are costs, limited inductive inferences to large regions, and logistical difficulties of dealing with long-term studies.

The scientific debate between the relative advantages and disadvantages of these two philosophies will not be settled here. However, based on our collective judgment, we recommend the IWM philosophy for the evaluation of effectiveness of tributary habitat actions. This approach to research and monitoring has a proven history of effectiveness. Some of the earliest intensive watershed monitoring efforts were instituted by the Forest Service in the 1950s to better understand watershed responses to logging. ……..…

Intensive Watershed Monitoring is a method of achieving the level of sampling intensity necessary to determine the response of salmon to a set of management actions, but admittedly in limited numbers of areas. ……

Further discussion of the Intensive Watershed Monitoring philosophy for conducting research to evaluate effectiveness of tributary habitat actions will shortly be available in the ISAB report referenced above. The report will be posted on the Northwest Power Planning Council website in the late winter of 2002-2003.

It is not easy to condense the advice given by the various government agencies to a simple set of recommendations on research and monitoring for the effectiveness of habitat restoration actions in a subbasin. Further, the situations in different parts of a subbasin are likely to require different approaches, e.g., evaluation of effectiveness of habitat actions on forest lands might be integrated with the U.S. Forest Service monitoring procedures, while evaluation on private lands may require development of survey procedures. We believe the following bullets contain the essential elements for development of an appropriate RM&E plan in subbasin planning:

- First, develop a sound Tier I trend monitoring procedure based on remote sensing, photography, and data layers in a GIS. Landscape changes in terrestrial and aquatic habitat and land use should be monitored for the smallest units possible. Accuracy and precision of data layers in the GIS should be evaluated using "blind" classification of randomly selected units by on-the-ground verification during field visits.

- Second, cooperate with Columbia Basin-wide attempts to develop common Tier 2 probabilistic (statistical) site selection procedures for population and habitat status monitoring and common protocols for on-the-ground or remotely sensed data collection. In so far as possible, measurement of indicator variables should be collocated on the same sites. Status Monitoring plans are being developed by the Action Agencies for implementation of the EPA EMAP probabilistic selection of aquatic sites in a pilot project in the Salmon Subbasin (BPA Draft Report "Research, Monitoring & Evaluation, For the NMFS 2000 FCRPS Biological Opinion"). Every effort should be made to include the same site selection protocols and data collection methods in the Clearwater Subbasin. This is a unique opportunity to promote the collection of research and monitoring data with common methods throughout not only the Snake River Basin, but the entire Columbia Basin. Status of fish and wildlife populations and habitat would be evaluated in a long-term biological monitoring program.

- Third, as data are obtained in a wildlife or fish population and habitat status monitoring program, develop empirical models for prediction of current abundance or presence-absence of focal species. Potential predictor variables include not only physical habitat variables (flow, temperature, etc.), but also measures of habitat recovery actions that are currently in place or are implemented in the future. Use the empirical models to evaluate the relative importance of physical factors and habitat improvements and to predict abundance or presence-absence throughout major sections of the subbasin. If adequate coverage exists with current study sites, it may be advisable to conduct initial analyses on current data as part of the assessment plan. However, a shift to probabilistically selected sites should be made as soon as possible to avoid inherent biases in subjectively selected and non-collocated study sites.

- Fourth, make your best judgment based on the assessment and inventory as to whether any new research in the spirit of the Intensive Watershed Monitoring approach should be instigated immediately. This step can be based on expert systems and existing data if adequate coverage of the subbasin (or part thereof) exists and if unique research needs exist in the subbasin. However, a subbasin plan will be an ever-changing document as new information becomes available. The ISRP judges that most new unique intensive research to be implemented in a subbasin should arise as a result of interaction of the Assessment and Inventory with new data arising in population and habitat status monitoring.

The ISRP judges that the approach in these four steps is the most likely to accomplish a successful long term RM&E program. An extensive long term status monitoring program identifies important and unexplained trends and changes, i.e., identifies the intensive research that if conducted would explain the "why." Tier I trend monitoring by remotely sensing procedures and Tier 2 statistical monitoring provide indications of trend and change in indicator variables, but the "why" of certain trends and changes is not well understood. For example, the status monitoring may indicate that a major and unexpected increase in juvenile fish production occurred in a watershed with high summer water temperature and low flow during the period 2010 to 2020. Why? A population of bull trout is detected in an area where current knowledge and logic indicate they should not exist. Why?

We do not recommend an intensive research project to explain, "why changes occurred" on every habitat improvement project, but rather periodic economical monitoring on individual projects to indicate benefits to fish and wildlife. We grant that replicated and coordinated data on habitat actions can provide compelling evidence for their effectiveness, but, in general, individual projects should depend on the Action Agency's status monitoring program (or in the unlikely event the Action Agency's status monitoring program is not implemented, a similar regional effort with standard protocol) to establish changes and trends in populations and habitat on a larger scale and their relationships to actions intended to improve habitat.

The basic elements of our recommendations that can be implemented in the near term in a subbasin are: 1) ensure the existence of sound Tier 1 level monitoring using modern GIS (Step 1) and 2) put a major effort into cooperation with and development of a probabilistic Tier 2 status monitoring program as recommended by the Action Agencies for the Upper Salmon subbasin (Step 2). Step 3 and perhaps step 4 depend on collection of data in the future.

References

Bachman RA. 1984. Foraging behavior of free-ranging wild and hatchery brown trout in a stream. Transactions of the American Fisheries Society 113(1):1-32.

Bisbal, G. A. 2002. The best available science for the management of anadromous salmonids in the Columbia River Basin. *Canadian Journal of Fisheries and Aquatic Sciences* 59:1952-1959.

Coutant CC. 1998. What is "normative" for fish pathogens? A perspective on the controversy over interactions between wild and cultured fish. Journal of Aquatic Animal Health 10:101-106.

Goede RW. 1986. Management considerations in stocking of diseased or carrier fish. In: Stroud RH, editor. Fish culture in fisheries management. Bethesda, Maryland: American Fisheries Society. p 349-355.

Goede RW. 1994. Aquaculture/disease/wild fish. In: Wiley RW, Hubert WA, editors. Wild trout and planted trout: balancing the scale. Laramie: Wyoming Game and Fish Department.

Hindar K, Ryman N, Utter F. 1991. Genetic effects of cultured fish on natural fish populations. Canadian Journal of Fisheries and Aquatic Sciences 48(5):945-957.

McMichael GA, Pearsons TN, Leider SA. 1999. Behavioral interactions among hatchery-reared smolts and wild *Oncorhynchus mykiss* in natural streams. North American Journal of Fisheries Management 19:948-956.

McMichael GA, Sharpe CS, Pearsons TN. 1997. Effects of residual hatchery-reared steelhead on growth of wild rainbow trout and spring chinook salmon. Transactions of the American Fisheries Society 126:230-239.

Moffitt CM, Stewart BC, LaPatra SE, Brunson RD, Bartholomew JL, Peterson JE, Amos KH. 1998. Pathogens and diseases of fish in aquatic ecosystems: implications for fisheries and management. Journal of Aquatic Animal Health 10:95-100.

Nickelson TE, Solazzi MF, Johnson SL. 1986. Use of hatchery coho salmon (*Oncorhynchus kisutch*) presmolts to rebuild wild populations in Oregon Coastal streams. Canadian Journal of Fisheries and Aquatic Sciences 43:2443-2449.

Sholes WH, Hallock RJ. 1979. An evaluation of fall-run chinook salmon, *Oncorhynchus tshawytscha,* to yearlings at Feather River Hatchery, with a comparison of returns from hatchery and downstream releases. California Fish and Game 64:239-255.