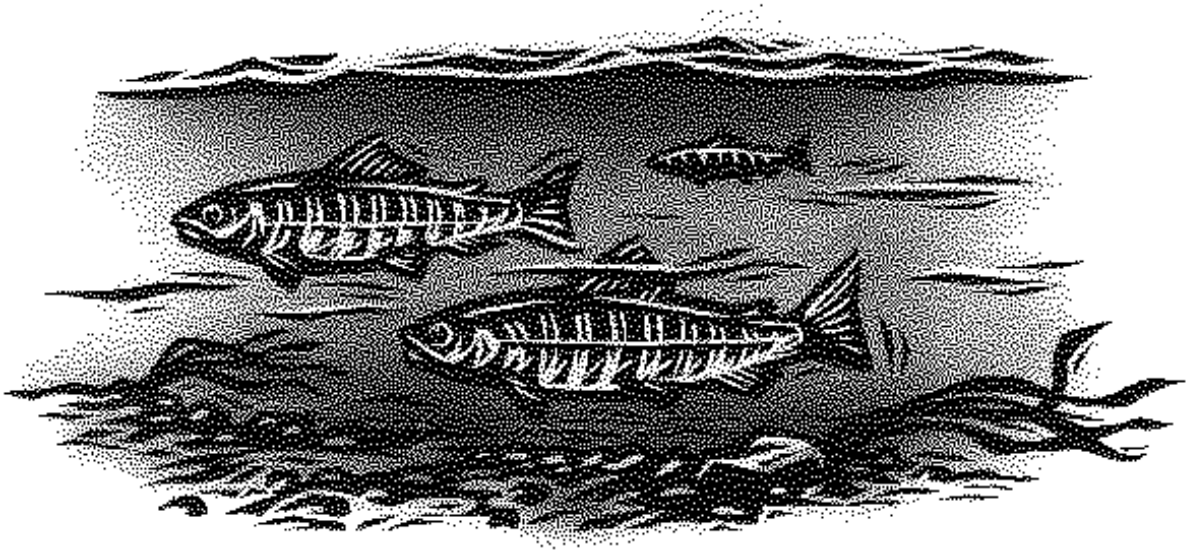
Independent Scientific Advisory Board
for the Northwest Power Planning Council
and the National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
ISAB@nwppc.org

Review of the Biological Objectives in the 2000 Fish and Wildlife Program



July 27, 2001
ISAB 2001-6

Peter A. Bisson
Charles C. Coutant
Daniel Goodman
Robert Gramling
Dennis Lettenmaier
James Lichatowich
Eric Loudenslager
William Liss
Lyman McDonald
David Philipp
Brian Riddell

Review of the Biological Objectives in the 2000 Fish and Wildlife Program

Table of Contents

Review of the Biological Objectives in the 2000 Fish and Wildlife Program

Executive Summary

Introduction

The Northwest Power Planning Council's 2000 Fish and Wildlife Program (FWP) established a broad framework for fish and wildlife mitigation and recovery within the Columbia River Basin. The framework included a vision for the Columbia River, which is intended to define the expected basin-wide outcome of the FWP, and a scientific foundation, which is a set of scientific principles that are intended to broadly summarize current scientific knowledge concerning ecosystem attributes, processes, and functions that are applicable to fish and wildlife mitigation and recovery within the basin. To achieve the vision, biological objectives were developed for the basin and will be developed for provinces and subbasins. The biological objectives describe the physical and biological changes needed to achieve the vision and they have two components: (1) biological performance, describing population responses to habitat conditions, and (2) environmental characteristics, describing the environmental changes that are needed to achieve the desired population responses.

The 2000 FWP charged the ISAB with reviewing the scientific soundness and basin-wide applicability of the provisional environmental characteristics, as well as their utility for further defining biological objectives at the province and subbasin levels (2000 FWP, Appendix D). The ISAB was given the option to review other elements of the framework, as appropriate to accomplishing its stated charge of reviewing the environmental characteristics. The Basinwide Provisions section of the 2000 FWP discusses the framework and Appendix D presents the provisional basin environmental characteristics.

Overview

Previous Fish and Wildlife Plan programs consisted largely of a catalog of measures and specific actions, but lacked an integrative framework that could provide a rational scientific basis for measures and actions (ISG, 2000). The 2000 FWP has attempted to remedy this situation by proposing such a framework, complete with a scientific foundation. The framework is intended to guide and integrate the planning process and help ensure that strategies and actions at the province and subbasin scales contribute to accomplishment of basin-wide objectives and thus the vision. This general approach appears sound.

The 2000 FWP embodies an ecosystem approach to mitigation and planning much more than previous programs. Through the framework structure, the program advocates a landscape-based approach that attempts to integrate, across several spatial scales, objectives, strategies, and actions pertaining to tributary and mainstem habitat, mainstem anadromous fish passage, harvest, and artificial production. The 2000 FWP provides a hierarchical structure that is intended to provide flexibility in application of the scientific principles and basin-scale biological objectives to the localized biological, physical, and

social conditions in the basin's ecological provinces and subbasins. The 2000 FWP also proposes to use the Ecosystem Diagnosis and Treatment (EDT) modeling approach as a tool to provide a quantitative analytical assessment of recovery and mitigation actions. Previous plans did not rely so extensively on quantitative assessment tools. This approach, too, appears sound; however, in addition to EDT, other available quantitative tools should be employed in assessment of recovery and mitigation actions.

Questions Addressed in the Review

The ISAB developed nine questions that would be addressed in its review. The condensed answers to these questions are given below, with a more detailed discussion of each provided in the main text.

1. Are the scientific principles consistent with current ecological and conservation theory? Are they adequate to provide guidance in developing biological objectives, including biological performances and environmental characteristics, and strategies and actions at the Columbia River Basin, province, and subbasin scales?

The scientific principles generally are consistent with current ecological and conservation theory. The principles are general and theoretical, provide good background, and are consistent with the vision, but they alone may not be adequate to provide guidance for development of more specific biological objectives, strategies, and actions. While the ISAB recognizes that flexibility in interpretation is important in applying the principles to areas of the basin that differ in ecological characteristics, we believe that additional, more explicit guidance may be needed to facilitate use of the principles in developing province and subbasin biological objectives.

2. Are the biological objectives at the Columbia River Basin scale 1) adequate to achieve the vision, 2) scientifically justified and consistent with the science foundation, 3) applicable to all species of concern, 4) accomplishable within the stated timeframes?

The structure and terminology of the framework leading from vision to strategies and actions need to be clarified. In particular, confusion arises because the term "biological objectives" is used repeatedly in different contexts. Coherence of the basin-scale objectives for biological performance with the vision and principles is not always apparent in the FWP. The objectives for biological performance may need to be more clearly linked to the principles; for example, by explicitly stating the principle(s) to which a particular objective is related. The objectives for biological performance, especially the "objectives for anadromous fish losses" do not reflect the conceptual richness and scope of the scientific principles. Finally, the objectives for biological performance for anadromous fish, for resident fish, and for wildlife differ considerably in their specificity with respect to both performance measures and timeframes. The level of specificity among the three sets of objectives needs to be consistent.

It is not possible to assess whether the numerical objectives for biological performance listed under "Anadromous fish losses" (p. 18) and the timeframes for achieving the

objectives are realistic because no quantitative or qualitative justification of the objectives and timeframes is provided.

3. *Are the objectives for environmental characteristics scientifically sound and applicable basin-wide? Are they useful for further defining biological objectives at the province and subbasin levels.*

The provisional objectives for environmental characteristics are scientifically sound, consistent with the Council's science foundation and recommendations in Return to the River (ISG, 2000), and are applicable basin-wide. These objectives, with some modification and expansion, are far more appropriate as basin-wide objectives than the objectives for biological performance; particularly the biological performance objectives related to anadromous fish. We review each of the provisional objectives for environmental characteristics in the full report.

4. At the Columbia River Basin scale, are the environmental attributes sufficient to achieve the desired biological performances?

There are differences in levels of specificity between the provisional objectives for environmental characteristics and the objectives for biological performance. The objectives for environmental characteristics are written in broad terms that express ideal ecological conditions while the objectives for biological performance are species-oriented with specific timeframes in which they will be accomplished. Thus it is difficult to determine if accomplishment of the broad environmental objectives will lead to accomplishment of the specific objectives for biological performance. However, the logic behind the objectives for biological performance (particularly the numerical, time-specific objectives pertaining to anadromous fish losses) is unclear and it is unlikely that these objectives can be accomplished within the stated timeframes.

5. Are the biological objectives at the Columbia River Basin scale, including biological performances and environmental characteristics, applicable to all areas of the Columbia River Basin including areas above barriers to fish migration?

The problems with the biological objectives described above, especially the biological performance objectives dealing with anadromous fish losses, make application of the objectives to all areas of the basin problematic. The provisional objectives for environmental characteristics are more comprehensive, though more general, than the biological performance objectives, more consistent with the scientific foundation, and probably more applicable basin-wide.

6. Are ecological provinces useful in subbasin planning?

Ecological provinces could be useful in both the planning process and in monitoring and evaluation. Provinces form an ecological planning unit that could link biological objectives, strategies, and actions at the basin scale to those at the subbasin scale, thus facilitating transition from regional planning to more localized planning. Furthermore, the consistency of boundaries of ecological provinces and ESUs could facilitate coordination between ESA recovery actions and the Council's program.

To function effectively, province plans need to be much more than simply the aggregate of subbasin plans. Each province should have its own level-specific objectives, strategies, and actions that address province-wide recovery problems characteristic of the province's dominant ecosystems (e.g., forested headwater, shrub-steppe plateau) and guide the formation of subbasin plans. Subbasin plans, in turn, should be evaluated in terms of their consistency with province objectives as well as the basin vision, objectives, and scientific principles. Subbasin planning is beginning, yet province objectives, strategies, and actions have not been developed. It is unclear what parties will be responsible for province planning and monitoring and evaluation.

7. Are the biological objectives at the Columbia River Basin scale, including biological performances and environmental characteristics, sufficient to guide development of more specific biological objectives and strategies at the province and subbasin levels?

Development of objectives, strategies, and actions at the subbasin level could be encumbered by the rather confusing terminology and structure of the planning framework, the apparent lack of connection between objectives for biological performance at the basin level and the scientific principles, the differing levels of specificity between basin level biological objectives and environmental characteristics, and the lack of clarity and quantitative or qualitative rationale justifying the basin-level biological performance objectives and timeframes for their accomplishment.

8. Is EDT the proper analytical tool to link strategies and actions, environmental attributes, and biological performances to determine if the biological objectives are accomplishable?

EDT is a useful analytical tool but it should not be the only analytical tool used in assessments. EDT is limited to predicting biological response within the constraints of the environmental characteristics that define the survival landscape of select species. It is a species-centered, not an ecosystem-centered, model. It is, however, landscape-based in the sense that it predicts survival at the scale of 6th-field watersheds, which can be pieced together to create a landscape mosaic over an entire subbasin. This will be helpful in setting restoration priorities within subbasins and provinces.

EDT does not appear to be able to determine whether biological objectives are accomplishable. The designers of EDT emphasize that it is best used as a tool for hypothesis generation and predicting survival improvements from various restoration

actions that can be tested on the ground. EDT has another limitation: it is an equilibrium model that assumes once a biological response to a change in an environmental attribute occurs, the magnitude of the response thereafter remains constant. Furthermore, recovery goals often designate specific timeframes within which they are to be achieved. Since EDT focuses on the equilibrium state and not on the time required to reach that state, it is not useful for assessing whether recovery goals can be met in the specified time.

9. At the Columbia River Basin scale, is there sufficient logical and conceptual consistency between the scientific foundation, the biological objectives, and strategies and actions to provide a reasonable chance of fulfilling the vision?

The development of scientifically sound, coordinated subbasin plans seems to be at the heart of the 2000 Fish and Wildlife Program. The scientific principles provide a good conceptual foundation. The subbasin assessment and planning process is just getting started and it is too early to determine if the principles will be taken seriously in the planning process, or if the subbasin plans will revert to previous restoration approaches. However, the ISAB is concerned about the adequacy of the operational linkages between vision and principles, basin-scale objectives, and subbasin-scale objectives, strategies, and actions. The scientific principles are too general to provide specific guidance for development of objectives, constraints imposed by the principles are not clearly specified, and the objectives for biological performance are not well justified and not especially consistent with the principles. Furthermore there must be widespread agency, tribal, and interest group agreement on the principles, objectives, and strategies for the plan to have a reasonable chance of fulfilling the vision. How this consensus can be achieved, if at all, is unknown.

Review of the Biological Objectives in the 2000 Fish and Wildlife Program

Introduction

The Northwest Power Planning Council's 2000 Fish and Wildlife Program (FWP) established a broad framework for fish and wildlife mitigation and recovery within the Columbia River Basin. The framework included a vision for the Columbia River, which is intended to define the expected basin-wide outcome of the FWP, and a scientific foundation, which is a set of scientific principles that are intended to broadly summarize current scientific knowledge concerning ecosystem attributes, processes, and functions that are applicable to fish and wildlife mitigation and recovery within the basin. To achieve the vision, biological objectives were developed for the basin and will be developed for provinces and subbasins. The biological objectives describe the physical and biological changes needed to achieve the vision and they have two components: (1) biological performance, describing population responses to habitat conditions, and (2) environmental characteristics, describing the environmental changes that are needed to achieve the desired population responses. The biological objectives that are to be developed for provinces and subbasins are supposed to be consistent with the basin-scale biological objectives and the scientific principles.

The 2000 FWP charged the ISAB with reviewing the provisional basin-level environmental characteristics, a component of the basin level biological objectives (FWP, Appendix D). The Council requested that the ISAB consider "the scientific soundness and basin-wide applicability of the environmental characteristics, as well as their utility for defining further the biological objectives at the province and subbasin levels." The ISAB was also asked to consider the applicability of the environmental characteristics to areas of the basin above blockages to anadromous fish passage. Council staff recognized that the environmental characteristics were integrated with other elements of the framework, such as biological performances and the scientific principles, and, therefore, could not be evaluated outside of this broader context. Because consistency among the various elements of the framework is necessary if the framework is to provide the region a clear and logical vehicle for basin-scale planning, the ISAB was given the option to review other elements of the framework, as appropriate to help accomplish its stated charge of reviewing the environmental characteristics. The Basinwide Provisions section of the 2000 FWP discusses the framework, and Appendix D presents the provisional basin environmental characteristics.

Overview

Previous Fish and Wildlife programs consisted largely of a catalog of measures and specific actions, but lacked an integrative framework that could provide a rational scientific basis for measures and actions (ISG, 2000). The 2000 FWP has attempted to remedy this situation by proposing such an integrated framework, complete with a

scientific foundation. The framework is intended to guide and integrate the planning process and help ensure that strategies and actions at the province and subbasin scales contribute to accomplishment of basin-wide objectives and thus the vision. This general approach appears sound, although the ISAB has identified some serious problems with the framework structure and terminology, the structure of basin-scale biological objectives, and the applicability of the scientific principles and basin-scale objectives to provinces and subbasins scales. These problems are discussed later in this review. That problems exist is not surprising considering that the approach taken in the 2000 FWP is new, and that difficulties are to be expected. These problems will need to be addressed as implementation of the FWP moves forward at the province and subbasin scales.

The 2000 FWP embodies an ecosystem approach to mitigation and planning much more than previous programs. Through the framework structure, the program advocates a landscape-based approach that attempts to integrate, across several spatial scales, objectives, strategies, and actions pertaining to tributary and mainstem habitat, mainstem anadromous fish passage, harvest and artificial production. The 2000 FWP departs from a "one-size-fits all" approach that sometimes characterizes large-scale ecological restoration planning. It provides a hierarchical structure that is intended to provide flexibility in application of the scientific principles and basin-scale biological objectives to the localized biological, physical and social conditions in the basin's ecological provinces and subbasins.

The 2000 FWP also proposes to use the Ecosystem Diagnosis and Treatment (EDT) modeling approach as a tool to provide a quantitative analytical assessment of recovery and mitigation actions at subbasin, province, and basin scales. Previous plans did not rely so extensively on quantitative assessment tools. This approach, too, appears sound; however, in addition to EDT, other available quantitative tools should be employed in assessment of recovery and mitigation actions.

Questions Addressed in the Review

The ISAB developed nine questions to be answered in this review. In general, the questions address the scientific soundness and basin-wide applicability of the scientific principles and the biological objectives, including both biological performances and environmental characteristics. They also assess whether there is sufficient logical and conceptual consistency between the science foundation and biological objectives at the Columbia River Basin scale to provide guidance for development of biological objectives, strategies, and actions at the province and subbasin scales.

1. Are the scientific principles consistent with current ecological and conservation theory? Are they adequate to provide guidance in developing biological objectives, including biological performances and environmental characteristics, and strategies and actions at the Columbia River Basin, province, and subbasin scales?

The scientific principles generally are consistent with current ecological and conservation theory. The principles are general and theoretical, provide good background, and are consistent with the vision, but they alone may not be adequate to provide guidance for development of more specific biological objectives, strategies, and actions. While the ISAB recognizes that flexibility in interpretation is important in applying the principles to areas of the basin that differ in ecological characteristics, we believe that additional, more explicit guidance may be needed to facilitate use of the principles in developing province and subbasin biological objectives. The generality of the principles leaves them open to interpretation that could become too broad. The explanations, implications, and constraints posed by each principle need to be expanded. The narratives for each principle should explicitly tie the underlying theory to the existing and expected conditions in the Columbia River and should explain how the principle constrains or shifts the current focus of recovery work in the basin. For example, the narrative under Principle 7 should state how an adaptive approach implemented in a hierarchical system would change the existing decision making process. Although the ISRP will evaluate subbasin plans for their consistency with the scientific principles, they too may need more specific guidance to assist their evaluations.

The principles emphasize interactions between biological communities and their environment, and they do not focus on individual species-centered management goals. Principles 2 and 6 state that ecosystem stability is buffered by biodiversity. They do not adequately address the role of non-native species and their interactions with native fishes.

Metapopulation theory was not adequately represented in the principles, although the metapopulation concept was implicit in the scientific principles. Two aspects of that theory have particular relevance to the Columbia River Basin: the disadvantage of synchronous fluctuations in abundance of local populations and the importance of core populations. The dams and the operation of the hydropower system can synchronize the dynamics of local populations, reducing variation in abundances among populations and, in theory, reducing metapopulation persistence. Core populations are critical to the persistence of metapopulations; however, some or most of the core populations may have been eliminated by the construction of the hydropower system. Synchronization and loss of core populations likely have an importance influence on the risk of extinction (ISG 2000).

Principle 8 needs to be altered to read something like: “Ecosystem function, habitat structure and biological performance are affected by human actions, and in turn affect human social and economic systems.” That people are part of the ecosystem is implied in the discussion, but not in the principle itself.

2. Are the biological objectives at the Columbia River Basin scale 1) adequate to achieve the vision, 2) scientifically justified and consistent with the science foundation, 3) applicable to all species of concern, 4) accomplishable within the stated timeframes?

The structure and terminology of the framework leading from vision to strategies and actions need to be clarified. The "overarching objectives" are simply a re-statement of the vision. As a result, either the vision or the overarching objectives should be changed. Even though the "biological objectives" are stated to have two components, biological performance and environmental characteristics, the biological objectives themselves--the statements that reflect the union of biological performance and environmental characteristics --are not given. What is given in the FWP are "objectives for biological performance." The term "biological objectives" appears again as "biological objectives for environmental characteristics." Environmental characteristics "describe the environmental conditions or changes sought to achieve the desired population characteristics." Presumably, environmental conditions include more than just biological conditions. These overlapping definitions and concepts are confusing. To further complicate matters, all of this is supposed to be repeated at the province and subbasin levels.

We suggest a clarified framework that includes the vision, scientific principles with expanded interpretations to provide specific guidance for development of biological objectives, the biological objectives (which should represent a melding of the objectives for biological performance and environmental characteristics), strategies and actions, and a means of assessing whether the strategies and actions accomplish the objectives.

Much of the operational success of the FWP depends on the biological objectives, strategies, and actions that will be developed at the subbasin level. It is imperative that the biological objectives at the basin level both be consistent with the vision and scientific principles and provide clear guidance for development of subbasin biological objectives, strategies, and actions. Coherence of the basin-scale objectives for biological performance with the vision and principles is not always apparent in the FWP. The objectives for biological performance need to be more clearly linked to the principles; for example, by explicitly stating the principle(s) to which a particular objective is related. The need for subbasin plans to be consistent with the scientific principles should be mentioned. The objectives for biological performance, especially the "objectives for anadromous fish losses" do not reflect the conceptual richness and scope of the scientific principles. Whereas the scientific foundation emphasizes ecosystems and communities, the objectives for biological performance are very traditional and have a strong species orientation. The scientific principles are not needed to provide conceptual support for the objectives for anadromous fish loss; these objectives flow easily out of the current management perspective. The Council should consider developing biological objectives that would fulfill the need for healthy and productive aquatic and terrestrial ecosystems. Finally, the objectives for biological performance for anadromous fish, for resident fish, and for wildlife differ considerably in their specificity with respect to both performance measures and timeframes. The level of specificity among the three sets of objectives needs to be consistent.

Although scientific principle 3 states that biological systems are hierarchical, the plan does not reflect a hierarchical system in which higher levels constrain and provide context for lower levels. The province and basin level programs appear to simply consist of the accumulated programs from the subbasin level. Are there basin-wide attributes that can be described in terms of measurable endpoints? Flow patterns and the effects of regional climate might fit this category. Cumulative harvest from the ocean through tributary streams might also fit. Cumulative effects of hydrosystem operation on the estuary and plume could be a basin-level concern. According to scientific principle 3, there should be specific recovery activities described at the basin level. At a minimum, these activities might include collection, analysis, and reporting of information relevant to the basin-level performance expectations shown on page 18 of the FWP. The information may simply be collected from the other levels in the hierarchy or there may be a specific data gathering at the basin level -- tracking the effects of climate and ocean conditions, for example. Who will be held accountable for tracking progress at the basin level? The history of salmon recovery has shown that statements of intent without a clear assignment of responsibility do not achieve effective implementation.

It is not possible to assess whether the numerical objectives for biological performance listed under “Anadromous fish losses” (p. 18) and the timeframes for achieving the objectives are realistic because no quantitative or qualitative justification of the objectives and timeframes is provided. Furthermore, the objectives as stated are unclear. For example, what does halting the decline in salmon and steelhead by 2005 mean? Does a halt by the year 2005 apply to all populations in the basin, half of the populations or a few indicator populations? Given the natural variability in the abundance of salmon and steelhead, what basin-scale metric(s) will be used to establish that the decline has in fact halted? It is not clear what elements of the program the Council expects to have implemented in time to halt the decline by 2005. For chinook salmon with a three-year ocean life history, any improvements affecting the freshwater life stage would have to be in place and effective by 2002. If halting the declining trend means causing an upward trend in the moving 5-year average, how would the benefits of management actions be distinguished from a climate shift toward favorable ocean conditions? How do we quantify the negative effects of a severe winter drought so that they are not counted against anthropogenic habitat losses? The statement "restore the widest possible set of naturally reproducing populations of salmon and steelhead in each relevant province by 2012" has many of the same shortcomings described above. What does the widest possible set mean? This can only be defined in terms of the constraints mentioned earlier, that is, the kinds of recovery actions that are possible to undertake and the kinds that are undertaken. The timeframes appear arbitrary and impossible to meet.

Although the 100-200 year long-term objectives include “full mitigation” for losses of anadromous fish, it is not clear what the term “full mitigation” means or whether “full mitigation” is feasible in the face of regional population and economic growth, much less the uncertainty of climate change. The changes in salmon management caused by this winter’s drought and resultant energy crisis (an example being the de-watering of lower Columbia River chum salmon spawning areas) are an effective illustration of why full

mitigation is not realistically achievable. The ISAB is not aware of any salmonid fishery in which the biological objective of maintaining native fish species at "near historical abundance" while allowing relatively high harvest rates of hatchery fish (p. 19) has been achieved.

3. *Are the objectives for environmental characteristics scientifically sound and applicable basin-wide? Are they useful for further defining biological objectives at the province and subbasin levels.*

The provisional objectives for environmental characteristics are scientifically sound, consistent with the Council's science foundation and recommendations in Return to the River (ISG, 2000), and are applicable basin-wide. These objectives, with some modification and expansion, are far more appropriate as basin-wide objectives than the objectives for biological performance, particularly the biological performance objectives related to anadromous fish. The provisional objectives link protection and restoration of biodiversity with habitat conditions and emphasize restoration of natural ecosystem processes, to the extent possible, as a basis for habitat protection and restoration. Below we review each of the provisional objectives for environmental characteristics.

1. "Protect the areas and ecological functions that are at present relatively productive for fish and wildlife populations (e.g., the Hanford Reach fall chinook; spring chinook in the upper John Day River) to provide a base for expansion of healthy populations as we rehabilitate degraded habitats in other areas.

    - Protect and enhance habitats and ecological function to allow for the restoration of more natural population structures, by allowing for the expansion of productive populations and by habitat restoration actions that connect weak populations to stronger populations and to each other. Allow for the recovery of depleted and listed populations to at least the point of self-sustainability and a low probability of extinction.

    - Protection and expansion of habitats and ecological functions should allow for an increase in the number, complexity and range of multi-species fish and wildlife assemblages and communities. Increases in the productivity, abundance, and life-history diversity of specific fish and wildlife populations are dependent on, and should not be viewed in isolation from, these multi-species communities."

This objective is based upon the metapopulation concept that localized strong populations (sources) provide colonists for satellite areas with low population abundances. This concept is consistent with general conservation biology principles and with the recommendations in Return to the River (ISG, 2000). The objective, however, could be more explicitly linked to metapopulation theory to clarify its intent, especially concerning colonization and gene flow patterns. As stated, the objective could be construed as support for outplanting fish from one or a few selected populations throughout the basin. One component of core area protection that is not mentioned in this objective is protection from invasion by non-native species. Certain exotic species (both aquatic and

terrestrial) can be as damaging to habitat as harmful land and water use activities, and explicit recognition of their threat is needed.

2. "Protect and restore freshwater habitat for all life history stages of the key species. Protect and increase ecological connectivity between aquatic areas, riparian zones, floodplains and uplands.

    - Increase the connections between rivers and their floodplains, side channels and riparian zones.

    - Manage riparian areas to protect aquatic conditions and form a transition to floodplain terrestrial areas and side channels.

    - Identify, protect and restore the functions of key alluvial river reaches.

    - Reconnect restored tributary habitats to protected or restored mainstem habitats, especially in the area of productive mainstem populations."

As statements of general objectives, these objectives are well grounded. One suggestion is that Objective 2 should also recognize the longitudinal (river continuum) and vertical (surface flow-hyporheic channels-groundwater) dimensions of connectivity. Because of their importance as fish habitat, perhaps alluvial areas of rivers should receive high priority for restoration.

3. "Allow patterns of water flow to move more than at present toward the natural hydrographic pattern in terms of quantity, quality and fluctuation.

    - Habitat restoration may be framed in the context of measured trends in water quality.

    - Allow for seasonal fluctuations in flow. Stabilize daily fluctuations.

    - Increase the correspondence between water temperatures and the naturally occurring regimes of temperatures throughout the basin.

    - Significantly reduce watershed erosion where human activities have accelerated sediment inputs."

This objective recognizes the importance of the natural hydrologic regime and the importance of maintaining natural seasonal fluctuations. The first bullet should not be taken to mean that habitat restoration be framed only in terms of water quality trends, rather that water quality trends are important indicators of recovery. Daily fluctuations in flow may be quite normal in some circumstances; the second bullet should be changed to reflect elimination of deliberate flow regulation that strongly departs from natural patterns. The bullets should be expanded to include other elements of the disturbance regimes such as flood events.

4. "Increase energy and nutrient connections within the system to increase productivity and expand biological communities."

This objective stresses the importance of natural nutrient pathways to the maintenance of aquatic and riparian productivity. A bullet explicitly recognizing the importance of salmon carcasses as nutrient sources for a variety of fish, wildlife, and plants would be helpful. Another bullet stating the importance of periodic inundation of floodplains for normal nutrient cycles would be useful.

5. **"**Allow for biological diversity to increase among and within populations and species to increase ecological resilience to environmental variability.

   - Expand the complexity and range of habitats to allow for greater life history and between species diversity.

   - Manage human activities to minimize artificial selection or limitation of life history traits.

   - Restoring habitat and access to habitat that establishes life history diversity is a priority."

This objective provides general support for restoring biocomplexity, but does not go into very much detail about how this will be accomplished. Many of the points contained in this objective are restated in other objectives. Again, there is no distinction drawn between native and exotic species. The second bullet appears to call for minimizing artificial production. Was this what was intended? The concept of "between species diversity" needs to be clarified.

6. "Increase genetic connections and gene flow within the ecological system to facilitate development, expansion and protection of population structures.

   - Increase the abundance and range of existing habitats and populations.

   - Expand and connect existing habitat pockets to facilitate development of resilient population structures for aquatic communities."

Like Objective 5, it is a bit difficult to understand the real intent of Objective 6. As it reads, Objective 6 seems to call for maximizing genetic diversity, but there is no distinction between natural genetic diversity and diversity introduced by various aspects of artificial production, run re-establishment, and introduction of exotic species. Additionally, the bullets refer to habitat restoration and do not really address genetic issues. The objective appears to be well intentioned, but it needs to be clarified.

7. "Identify, protect and restore ecosystem functions in the Columbia River estuary and nearshore ocean discharge plume as affected by actions within the Columbia River watershed.

    - Evaluate flow regulation, river operations and estuary-area habitat changes to better understand the relationship between estuary and near-shore plume characteristics and the productivity, abundance and diversity of salmon and steelhead populations."

Objective 7 is another scientifically sound objective; however, it is the only one that does not call directly for improvement but rather for research. As such, it is not a biological performance objective. At least one bullet should indicate that estuarine interrelationships that have been altered by human activity should be rectified by some actions.

8. "Enhance the natural expression of biological diversity in salmon and steelhead populations to accommodate mortality and environmental variability in the ocean."

Like Objectives 2, 5, and 6, this objective stresses maintaining natural diversity within salmon species. Unfortunately, it is very general and leaves considerable room for interpretation. Additional bullets clarifying this objective would be helpful, particularly because it focuses on marine mortality and because freshwater options for improving ocean survival are somewhat limited. Within-species diversity could buffer impacts of environmental change during all phases of the life cycle, not just during the ocean phase.

9. "Accept significant variation in the productivity, capacity and life-history diversity for any particular population over any particular time period, as part of the normal environmental condition. A measure of whether key ecological functions have increased sufficiently will be whether the system can accept normal environmental variation without collapse of the fish and wildlife population and community structure."

Objective 9 appears to deal with the issue of biological resiliency, that is, healthy populations will contain sufficient life-history diversity to be able to cope with environmental variation. The distinction between natural variation and variation stemming from human actions needs to be sharpened. To what extent should we "accept" variation caused by human activities? It was not clear why this objective was needed, except as a caveat to those above, because success with the other objectives will virtually guarantee resiliency in all but the most extreme conditions. If the goal was to rebuild resilient populations, it might have been better to base this objective on the assumption that most of the salmonid populations in the Columbia Basin may not be able to endure environmental extremes and identify the strategies (with bullets) for restoring resiliency.

Summary of Comments on Environmental Objectives

The objectives for environmental characteristics represent a set of ideal conditions that, if met or even approached, would lead to significant recovery of fish and wildlife in the basin. The challenge in application of these objectives will be to interpret them in such a way that the intent of the basin level objectives is reflected appropriately in the objectives at the province and subbasin levels. Like the scientific principles, the objectives for environmental performance are general, and specific guidance and interpretation probably will be needed if the intent of the basin level objectives is to be carried through to provinces and subbasins. For example, the meaning of terms used in the objectives such as "protect and enhance" will need clarification as the planning effort moves to the province and subbasin levels. There may be a need to relate to productivity to population abundance. At some point, concepts such as life history diversity, genetic diversity, ecosystem function and process, capacity, and productivity will need to be defined operationally.

4. At the Columbia River Basin scale, are the environmental attributes sufficient to achieve the desired biological performances?

There are differences in levels of specificity between the provisional objectives for environmental characteristics (Appendix D) and the objectives for biological performance (Basinwide Provisions section). The objectives for environmental characteristics are written in broad terms that express ideal ecological conditions, while the objectives for biological performance are species-oriented with specific timeframes for which they are to be accomplished. As a result, it is difficult to determine if accomplishment of the broad environmental objectives will lead to accomplishment of the more specific objectives for biological performance. However, the logic behind these objectives (particularly the numerical, time-specific objectives pertaining to anadromous fish losses) is unclear and it is unlikely that these objectives can be accomplished within the stated timeframes.

5. Are the biological objectives at the Columbia River Basin scale, including biological performances and environmental characteristics, applicable to all areas of the Columbia River Basin including areas above barriers to fish migration?

The problems with the biological objectives described above, especially the biological performance objectives dealing with anadromous fish losses, make application of the objectives to all areas of the basin problematic. The provisional objectives for environmental characteristics are more comprehensive, though more general, than the biological performance objectives, more consistent with the scientific foundation, and probably more applicable basin-wide.

6. Are ecological provinces useful in subbasin planning?

Ecological provinces could be useful in both the planning process and in monitoring and evaluation. Provinces are defined by patterns of climate, regional geology, hydrologic boundaries, and the distribution of native fish and wildlife. Their boundaries are generally similar to the boundaries of ESUs. This consistency of boundaries could facilitate coordination between ESA recovery actions and the Council's program. Most salmon populations cross the boundaries of several subbasins on their journeys between freshwater and the sea. Province-level planning and evaluation could help to ensure that all aspects of the salmon's life history were addressed effectively. All subbasins within a province should have both large-scale ecological similarities (e.g., climate, major ecological features such as forested headwaters, shrub-steppe plateau, etc.) and common recovery problems that require somewhat similar strategies and actions. Thus, provinces form an ecological planning unit that could link biological objectives, strategies, and actions at the basin scale to those at the subbasin scale, thus facilitating transition from regional planning to more localized planning.

In effect, province plans could unify the plans of their subbasins. To function effectively, province plans need to be much more than simply the aggregate of subbasin plans. Each province should have its own level-specific objectives, strategies, and actions that address province-wide recovery problems and guide the formation of subbasin plans. Subbasin plans, in turn, should be evaluated in terms of their consistency with province objectives as well as the basin vision, scientific principles, and objectives. The utility of province-scale planning has been compromised because the logical process of developing province objectives, strategies, and actions prior to engaging in subbasin planning has not occurred. Subbasin planning is beginning, yet province objectives, strategies, and proposed actions have not been developed. It is unclear what parties will be responsible for province planning and monitoring and evaluation, in part because provinces are distinguished based on ecological characteristics rather than on geographic or jurisdictional boundaries.

7. Are the biological objectives at the Columbia River Basin scale, including biological performances and environmental characteristics, sufficient to guide development of more specific biological objectives and strategies at the province and subbasin levels?

Development of objectives, strategies, and actions at the subbasin level could be encumbered by the rather confusing terminology and structure of the planning framework, the apparent lack of connection between objectives for biological performance at the basin level and the scientific principles, the differing levels of specificity between basin level biological objectives and environmental characteristics, and the lack of clarity and quantitative or qualitative rationale justifying the basin-level biological performance objectives and timeframes for their accomplishment. As general guidelines, the strategies (pp. 22-45 in the FWP) could be more helpful to subbasin planners than the biological objectives because they outline specific approaches to different issues. As stand-alone recommendations, they appear to be consistent with current science, although there is insufficient linkage among strategies across each of the

categories (i.e., artificial production, harvest, habitat, hydropower, wildlife, oceans, research and monitoring). One notable exception is the table on page 23, that shows how habitat and artificial production strategies might vary depending on habitat conditions. More tables are needed showing how other strategies could be linked.

8. Is EDT the proper analytical tool to link strategies and actions, environmental attributes, and biological performances to determine if the biological objectives are accomplishable?

EDT is a useful analytical tool but it should not be the only analytical tool used in assessments. The EDT tool is limited to predicting biological response within the constraints of the environmental characteristics that define the survival landscape of select species. It is a species-centered, not an ecosystem-centered, model. It is, however, landscape-based in the sense that it predicts survival at the scale of 6^{th}-field watersheds, which can be pieced together to create a landscape mosaic over an entire subbasin. This characteristic will be helpful in setting restoration priorities within subbasins and provinces.

One of the chief advantages of EDT is that the rule sets forming the basis for equilibrium forecasts are explicit and can be altered easily, as more accurate data become available. As a result, EDT can be calibrated with local data to improve forecasting ability; in fact, the more local data that are available, the greater is its predictive value.

EDT does not appear to be able to determine whether biological objectives are accomplishable. The designers of EDT emphasize that it is best used as a tool for hypothesis generation and for predicting survival improvements from various restoration actions that can be tested on the ground. The question of whether broad biological objectives are accomplishable goes beyond potential biological response to political and cultural issues. The value of EDT, or any other biological response model, would be limited if the management action being modeled could not be implemented for other reasons.

EDT has another limitation with respect to long-term biological objectives. It is an equilibrium model that assumes that once a biological response to a change in an environmental attribute occurs, the magnitude of the response thereafter remains constant. This assumption does not reflect ecological reality. Furthermore, recovery goals often designate specific timeframes within which they are to be achieved. Since EDT focuses on the equilibrium state and not the time required to reach that state, it is not useful for assessing whether recovery goals can be met in the specified time. Given the inevitability of climate change and other long-term environmental trends (including human development), EDT predictions will have a very high level of uncertainty over periods of decades or centuries.

9. At the Columbia River Basin scale, is there sufficient logical and conceptual consistency between the scientific foundation, the biological objectives, and strategies and actions to provide a reasonable chance of fulfilling the vision?

The development of scientifically sound, coordinated subbasin plans seems to be at the heart of the 2000 Fish and Wildlife Program. The scientific principles on pages 15-16 provide a good conceptual foundation. Because the subbasin assessment and planning process is just getting started, it is too early to determine if the principles will be taken seriously in the planning process, or if the subbasin plans will revert to previous restoration approaches. The ISAB is concerned about the adequacy of the operational linkages between vision and principles, basin-scale objectives, and subbasin-scale objectives, strategies, and actions. The scientific principles are too general to provide specific guidance for development of objectives, constraints imposed by the principles are not clearly specified. The objectives for biological performance are unclear, not well justified, and not especially consistent with the principles.

The Fish and Wildlife Program assumes existing organizations and institutional relationships will remain in place. If this is the case there must be widespread agency, tribal, and interest group agreement on the principles, objectives, and strategies for the plan to have a reasonable chance of fulfilling the vision. How this consensus can be achieved, if at all, is unknown.