2. Scientific foundation

2(a) Science principles

Source: **Washington Department of Fish and Wildlife**
Recommendation No. **43**

Recommendation: The Washington Department of Fish and Wildlife recommended adoption of the eight scientific principles listed in the Strawman as the ecological principles for the revised program. The scientific principles are intended to provide the basic foundation for the development of the fish and wildlife program. While these principles are themselves general in scope, implementation strategies can be based upon them. The Council and others should use these scientific principles and the resulting implementation strategies to guide the development and implementation of subbasin plans.

At the same time, the procedures for implementing the Council's program must include consideration of the highly altered state of the present day ecosystems, and allow for management actions that address the inability of the "system" to maintain natural ecological integrity. Habitat condition must dictate management direction. For this reason, there is a need to describe different principles to guide the decision making for systems targeted for management as a "natural system" (Ecological Principles) and for those systems targeted for management as "altered systems" (Management Principles).

Finding: The Council edited the scientific principles presented in the Strawman based on recommendations and comments received but did not materially change their substantive content, and then adopted the principles into the revised program as part of the scientific foundation, *see* Section III.B.2. *See* the next set of recommendations below for findings regarding the recommended management principles.

Source: **Spokane Tribe**
Recommendation No. **28**
Source: **Montana Fish, Wildlife and Parks**
Recommendation No. **31**
Source: **Colville Confederated Tribes**
Recommendation No. **33**
Source: **Burns-Paiute Tribe**
Recommendation No. **34**
Source: **Idaho Department of Fish and Game**
Recommendation No. **36**
Source: **Shoshone-Bannock Tribes**
Recommendation No. **38**
Source: **Coeur d'Alene Tribe**
Recommendation No. **42**
Source: **U.S. Fish and Wildlife Service**
Recommendation No. **46**
Source: **Kalispel Tribe**
Recommendation No. **48**
Source: **Kootenai Tribe**
Recommendation No. **50**

Recommendation: These agencies and tribes generally agreed that the eight scientific principles identified in prior Council documents, including the Strawman, provide a general overarching scientific basis for the program, for developing biological objectives, and for linking the vision, objectives and strategies at the basin, province and subbasin levels.

These entities first recommended a number of different versions of an introduction or preface to the scientific principles, all generally consistent in meaning despite differences in organization, wording and length, summarized as follows:

The scientific principles are intended to provide the basic foundation for the development of the fish and wildlife program. While these principles are themselves general in scope, implementation strategies can be based upon them. The Council and others should use these scientific principles and the resulting implementation strategies to guide the development and implementation of subbasin plans.

These principles are not intended to direct decision-making efforts, but rather to provide a representation of what ecological principles shape naturally functioning systems. It should be the intent of the Council, the region's fish and wildlife managers, and the ISRP to incorporate these principles into their review procedures and implementation decisions whenever possible. However, final decisions must be based on the actual condition and management potential of the ecosystem(s) within the basin.

The procedures for implementing the Council's program must include consideration of the highly altered state of the present day ecosystems, and allow for management actions that address the inability of the "system" to maintain natural ecological integrity. Habitat condition must dictate management direction. For this reason, there is a need to describe different principles to guide the decision making for systems targeted for management as a "natural system" (Ecological Principles) and for those systems targeted for management as "altered systems" (Management Principles).

Montana recommended a concept for the preface to the scientific principles not included in any of the others, summarized as follows : Remaining wild, self-reproducing ecosystems must be preserved for study and inherent species diversity. Relatively pristine areas adjacent to identified core areas should be prioritized for recovery. Other areas have been altered for human use to such a degree that native species can not be restored. These areas can be restored for sustained biological productivity using available management tools. Management of fish and wildlife in severely altered ecosystems must be human induced because the existing conditions do not allow for natural reproduction.

Next, these agencies and tribes recommended the text of the Ecological Principles. The one-sentence principles recommended were the same as those in the Council's Strawman. The brief explanations following each principle were revised versions of the explanations in the Strawman.

Ecological Principles for Natural Systems

Principle 1: Biological abundance, productivity and diversity reflect ecosystem structure and conditions.

Progress toward goals for fish and wildlife species is achieved by allowing the ecosystem to develop in a manner consistent with the biological needs of the priority species and requires restoration or preservation of suitable habitat conditions throughout the life cycle of those species. However, in highly altered systems, the activities necessary to restore the natural system may not be feasible.

The Fish and Wildlife Service added that activities over the life-cycle should strive to approximate natural system conditions.

Principle 2: Ecosystems are dynamic, evolutionary and resilient.

Natural ecosystems are dynamic and constantly changing. The program should anticipate and accommodate change, and must recognize that disturbances are an important part of development and maintenance of habitat. Efforts to stabilize and reduce disturbance will fundamentally alter habitats to the detriment of capacity, productivity and diversity of target species. However, in highly altered systems current evolutionary processes may be leading to the long-term detriment of the species targeted for management.

Principle 3: Ecosystems are structured hierarchically.

Any particularly described ecosystem is composed of smaller scale ecosystems and is also a component of larger-scale systems. At any point, the ecosystem reflects the behavior of smaller scale components and is constrained by the larger-scale system. Program elements developed at any level need to be consistent with elements developed at larger and smaller scales. Thus the vision and objectives for the Columbia River Basin will constrain and direct the vision and objectives for an ecological province and, in turn, the vision and objectives for individual subbasins and watersheds. Achieving the objectives at the basin and province levels will depend largely on the success of actions at the local levels.

The Fish and Wildlife Service added that basin wide actions are imperative to ensure restoration of healthy ecosystems and the ability to meet goals at the subbasin, provincial, and basin levels.

Principle 4: Ecological structure and performance are defined with respect to specific biological communities and questions.

Ecosystems and their conditions are defined in relation to a community or assemblage of interacting species and not by individual species. Efforts to maintain and restore healthy ecosystems must preserve functional links among all biota. Aquatic and terrestrial environments do not function independently of one another; plants and animals do not exist as isolated elements. Instead, they interact closely with other species and the habitat to form a system. Their ability to survive, reproduce and evolve depends not only on the hydrology, geology and climate, but also on interactions with other individuals and species through competition, predation and natural selection. In natural systems, these interactions select and develop healthy, robust populations. In highly altered systems, it is necessary to ensure that the robust populations do not conflict with the desirable species for that system or further impair the ability of the system to function.

Principle 5: Biological diversity accommodates environmental variation.

Variations in biological characteristics help species cope with environmental variation. A more diverse species or interrelated collection of species has a greater range of possible solutions to the challenges posed by variation in the environment. Biological variation is reflected in life history traits, behavior and physical features of each species. We should manage our activities to allow natural expression of biological diversity. In highly altered systems the recruitment and persistence of undesirable species contributes to an increase in species diversity. In these situations, it may actually be necessary to reduce species diversity to ensure the success of desirable species.

Principle 6: Ecosystem conditions develop primarily through natural processes.

Natural ecosystems are created, altered and maintained primarily by natural processes encompassing the entire life history of species of interest. Habitats develop in response to both biotic and abiotic influences (e.g., local hydrology, geology, climate and water quality). Species and communities develop to match the resulting habitat template. Management to achieve goals for specific species implies allowing normal ecological processes to operate and develop an appropriate environment. In highly altered systems, the ability of natural processes to promote the persistence of desirable species may be

limited. It is necessary to ensure that the "functions" that these natural processes contributed be retained in the altered system.

Principle 7: Ecological management is adaptive and experimental.

What is critical to fish and wildlife restoration in one period of time may not be critical in another as the ecosystem shifts in response to internal or external factors. As we learn about ecosystems, new strategies may be indicated. Monitoring and evaluation need to be built into management programs from the ground up, in order to provide and make use of relevant information about how actions actually affect ecosystem conditions and how those changes affect biological response.

The Fish and Wildlife Service added that large-scale actions should not be delayed (based on unresolved uncertainty), but should be implemented through carefully designed monitoring and evaluation. The high degree of risk of extinction for many populations throughout the Columbia river basin warrants immediate aggressive actions; status quo management (with better monitoring and evaluation) is a recipe for failure.

Principle 8: Human actions modify ecosystem function and biological performance.

In highly developed ecosystems like the Columbia River, human actions and technology will continue to dominate the system. However, these actions can be managed in a manner consistent with maintaining the integrity of the ecological systems.

Finally, these entities recommended a number of versions of three Management Principles, which were not in the Strawman:

Management Principles for Altered Systems:

Principle 1: Management goals and objectives for altered systems must satisfy the resource demands that were supported by the natural system.

The change in population and community composition throughout the basin has shifted the pressures of resource utilization. Although important to protect, mitigate and enhance native species, resource managers must also meet the demands placed upon the resource by the "users" of the resources. In some areas, the shift has been dramatic (e.g., blocked areas) and led to greater intensity of use on non-traditionally managed species. Therefore, resource managers within the basin must balance the management of today's resources with the demands placed upon them by the resource users. For example, in the upper Columbia River blocked area, resource managers now focus upon resident fish (both native and non-native) and wildlife populations to meet the resource needs once met by anadromous fish.

Montana did not include the last sentence in its recommendation for Principle 1.

Principle 2: The program preference is to support and rebuild native species in native habitats, where feasible.

Fish and wildlife habitat should be protected and restored to promote production of native species, especially if these species are capable of meeting the identified resource needs for that system.

The Spokane, Coeur d'Alene, Kootenai, Kalispel and Colville Tribes added that the Council should have no interest in a program that does nothing more than simply protect fish populations from extinction at a non-fishable level, to the exclusion of developing thriving fisheries by substitution.

Principle 3: The availability and function of the habitats present in highly altered systems will dictate management decisions.

In certain instances fish and wildlife habitat has been altered to the extent that native species are ill adapted. In these situations, projects that enhance species adapted to the altered habitats are appropriate and may in fact be the only available form of mitigation.

Idaho, Washington and the Shoshone-Bannock, Burns-Paiute, Spokane, Coeur d'Alene, Kootenai, Kalispel and Colville Tribes added to Principle 3 that efforts to promote alternative species must follow a thorough evaluation of the consequences, if any, to existing native species or the practicality of restoration of native species. The Spokane, Coeur d'Alene, Kootenai, Kalispel and Colville Tribes then further added that resident fish substitution activities using introduced species should not be terminated or de-ranked in prioritization on this basis alone, without further information demonstrating the native/non-native conflicts. Montana recommended more definitively that efforts to promote alternative species must not damage existing native species or the future restoration of species. The Fish and Wildlife Service included only the statement of the principle, and ordered the principles differently.

Finding: Based on these and other recommendations and on comments on the draft program, the Council edited the scientific principles, and the preface to the principles, as presented in the Strawman, and then adopted the scientific principles into the revised program as part of the scientific foundation, at Section III.B.2. While the final wording is not precisely the same as these recommendations, the differences are not substantive, and thus the revised program is consistent with these recommendations.

The Council did not adopt the management principles as recommended into the scientific foundation section of the program. Other provisions of the revised program are consistent with these recommendations, however. For example, the vision statement (Section III.A.1), the planning assumptions (Section III.A.2), , the biological objectives (Section III.C.2.), and the habitat strategies (Section III.D.3), all state, in various ways, a program preference to support and rebuild native species in native habitats, coupled with the recognition that management decisions in highly altered ecosystems will need to work with the habitats and species present and possible and aim to satisfy the resource demands of the region within that framework. In particular, the program continues to recognize a resident fish substitution policy, generally consistent with the recommendations of the upriver tribes, while also calling for the use of introduced species to be compatible with and avoid adverse impacts on native species and habitats, consistent with Montana's recommendations, *see* Sections III.A.2, III.C.2.a.2, III.D.3.

Source: **Oregon Department of Fish and Wildlife**
Recommendation No. **26**

Recommendation: Oregon agreed that scientific principles should describe the scientific basis of the Council's fish and wildlife program. Oregon then recommended eight scientific principles, edited versions of what appeared in the Strawman. Oregon's edits appear designed largely to make the text that was in the Strawman more clear, not to change its meaning.

Principle 1: Ecosystem structure and conditions affect biological abundance, productivity and diversity.

Goals for fish and wildlife species are achieved by protecting and restoring ecosystem structure and conditions to meet the biological needs of fish and wildlife. Efforts must protect and restore suitable conditions for habitat used throughout the life cycle. Human activities must enable the biological system

to operate in ways that ensure the survival and prosperity of fish and wildlife over the full range of environmental conditions they face in their life.

Principle 2. Ecosystems are dynamic, evolutionary and resilient.

Natural ecosystems are dynamic and constantly changing. The program should anticipate and accommodate change, and must recognize that habitat is developed and maintained through the occurrence of natural disturbances. Actions should protect and restore processes that create and maintain habitats necessary for abundant, productive and diverse fish and wildlife.

Principle 3. Ecosystem structure and conditions are affected by processes that operate on a variety of landscape scales.

The structure and conditions of an ecosystem are affected by small and large scale processes. Program elements developed at one scale need to be consistent with elements developed at larger and smaller scales. Therefore, achieving the objectives at the basin and province levels will depend largely on the success of actions at the subbasin and watershed levels.

Principle 4. Ecological structure and performance can be evaluated with respect to specific biological communities.

Ecosystems and their conditions can be evaluated in relation to a community or assemblage of interacting species. Plants and animals interact closely with each other and with the habitats they occupy and use to form a system. Their ability to survive, reproduce and evolve depends not only on the hydrology, geology and climate, but also on interactions with other individuals and species through competition, predation and natural selection. The health and robustness of plant and animal populations can be used as a gauge of the health of the ecosystems of which they are a part.

Principle 5. Biological diversity accommodates environmental variation.

Variation in biological characteristics helps species cope with environmental variation. A more diverse species or interrelated collection of species has a greater range of possible solutions to the challenges posed by variation in the environment. Biological variation is reflected in life history traits, behavior and physical features of each species. We should manage our activities to allow natural expression of biological diversity.

Principle 6. Natural processes are critical to creating and maintaining ecosystem conditions.

Natural ecosystems are created, altered and maintained primarily by natural processes. Habitats develop in response to the local hydrology, geology and climate. Species and communities develop to match the resulting habitat template. To achieve goals, management programs must allow normal ecological processes to operate and develop an appropriate environment.

Principle 7. Ecological management is adaptive and experimental.

The factors that limit the survival and productivity of fish and wildlife vary over time with changes in ecosystem structure and conditions. Ecosystem structure and conditions, and the responses of fish and wildlife to changes in their environment must be continually monitored and evaluated. Correspondingly, management programs should be designed to promote learning and to be flexible so they can be changed in response to new knowledge about successes and failures.

Principle 8. Ecosystem function and biological performance are affected by human activities.

Human activities have affected, and will continue to affect the function and biological performance of the Columbia River Basin ecosystem. These activities must be managed in ways that protect and restore ecosystem structures and conditions necessary for the survival and recovery of fish and wildlife in the basin.

Finding: The Council edited the scientific principles (and the associated description of the purpose) as presented in the Strawman, based on this and other recommendations and on comments on the draft program, and then adopted the scientific principles into the revised program as part of the scientific foundation, Section III.B.2. While the final wording is not precisely the same as this recommendation, the differences are not substantive, and thus the revised program is consistent with this recommendation.

Source: **Columbia River Inter-Tribal Fish Commission**
Recommendation No.: **40**

Recommendation: The Commission agreed that the program should be based on a sound scientific foundation. The scientific foundation in the Strawman was an important step, but it needs further agency and technical review before it will have the level of technical capability necessary for inclusion in the program. Thus the Council should produce a draft scientific foundation document for review, solicit fish and wildlife managers' comments on this draft, and submit those comments and the draft document to the ISAB for a formal peer review, before adopting the scientific foundation as part of the program. Following the peer review, the Council staff should work collaboratively with interested parties to draft guidelines on how to apply the scientific foundation principles to hydropower, harvest, and habitat actions; this has already been done for artificial production in the Artificial Production Review report.

The Commission recommended improvements to the draft scientific foundation document in several areas. For example, the description of the hierarchical ecosystem does not recognize the significant body of work characterizing many ecosystems and their components in terms of interconnected networks or webs (food webs, energy webs, etc.). The web analogy is also much closer to how the tribes conceive of nature and their place within the ecosystem. The hierarchical characterization is also very "anadrocentric," based as it is on the hydrological routing of the Columbia River, and does not adequately represent the ecosystems used by many resident fish and wildlife species.

The Commission also recommended that the program's scientific principles be selected for their practical ability to guide conservation management actions. The eight scientific principles in the Strawman are primarily theoretical principles of general ecological science. The scientific foundation should extend further than general ecological science alone; the large body of specific, agreed-upon information available for the Columbia basin itself must be incorporated. The scientific principles, and associated biological objectives and performance measures derived from the scientific foundation, must be stated in practical terms customized to guide actions in each of the 4-H areas (hydropower, habitat, hatcheries and harvest). The Commission recommended the following five principles as more practical:

Principle 1: Critical ecological processes must be maintained or restored.

A long list of ecological processes can be described for the Columbia Basin Ecosystems. The specific ecological processes to be managed must be determined by the spatial and temporal needs of key migratory species (salmon: chinook, coho, steelhead and rainbow, sockeye and kokanee, and chum, lamprey), key semi-migratory or resident species (white sturgeon, bull trout, kokanee) and key habitat processes that support the desired biodiversity determined under Principle 2.

Protection and restoration of ecosystems are achieved by allowing the ecosystem to develop in a manner consistent with the biological needs of the key species throughout their life cycle. Those ecological processes that enable the full expression of a watershed's ability to support the maximum natural biodiversity must take precedence over bioengineered approaches to accommodate human

activities. The non-conservation activities of man must be adjusted to operate within a viable and supportive ecosystem.

Principle 2: Goals and objectives must come from an ecological understanding of the physical system and its biological components.

Choosing the right fish and wildlife projects to fund depends upon having well defined management goals and objectives derived from a rigorous understanding of the ecological properties of the system. A starting point is the development and use of ecological risk management tools such as population viability analyses to determine the risk of extinction for key species and minimum viable population analyses to determine the population sizes required to meet ecological and harvest goals. The use of habitat viability analysis to describe, diagnose, and prescribe treatments rounds out tools needed to develop an ecological understanding of species and watershed needs from which goals and objectives can be formulated. These tools reflect the magnitude of the natural variation in bio/geo/chemical processes within an ecosystem necessary to ensure that efforts to stabilize and reduce disturbances reflect natural dynamics.

Principle 3: External threats must be minimized and external benefits maximized.

Natural river processes must be buffered from hydrosystem, land and water use practices that disrupt natural processes, that is, buffered from processes that permit the invasion and/or have introduced exotic chemicals, plants, and animals. The salmon ecosystems of the Pacific Northwest were relatively stable and resilient to the natural perturbations. Evolution was relatively slow even during the exceptionally warm and dry period from 5500 to 2000 B.C. During this same period resource management by native cultures co-evolved within the ecosystems to meet climatic changes. The tribal nations management practices were based on traditional environmental knowledge. In this post Columbian period the rate of man-induced environmental change has outpaced the ability of the natural system and traditional cultures to co-evolve, leaving damaged human populations, ecosystems and endangered species in place of healthy, diverse, and productive fish bearing watersheds managed by robust native societies.

Principle 4: Evolutionary processes must be conserved.

Species populations need to be sufficiently large to withstand local perturbations that threaten extinction (such as the eruption of Mount Saint Helens) and ensure that species retain sufficient genetic diversity to permit adaptation to changing environments. Pre-Columbian populations have been subject to losses in genetic material and demographic instability. The preponderance of scientific knowledge demonstrates that genetic diversity is best retained when the species is subdivided into populations with numerical and genetic exchange between local populations -- that is, in a metapopulation structure. Management actions must facilitate improvements in genetic diversity and demographic stability. This principle also requires that water pathways among healthy populations be always available to straying individuals. This reinforces Principle 3 that external threats be minimized to avoid pressures outside of a species' natural rate to evolve.

Principle 5: Management must be adaptive and minimally intrusive.

Management practices should match the scale of the problem with the least amount of environmental intrusion possible. Scientifically based management must be adaptive and flexible. All programs and projects that directly impact the environment must have a monitoring and evaluation component that provides a feedback loop to management. Natural environmental changes and management actions lead directly to dynamic ecosystems. Restoration ecology is an emerging science necessitating close adherence to the principles of adaptive management.

Traditional species and ecosystems management was adaptive and characterized by an approach of minimally intrusion. This approach is consistent with modern principles of adaptive management and

led to the robust biodiversity in fish, plants, and wildlife complemented with diverse life histories. For example pre-Columbian management used selective harvest, fire management, and stock translocations moderately. Post-Colombian over-management is characterized by large-scale de-forestation, dams with poorly designed passage or none at all, and traditional hatcheries. These are all examples of poor land, water, and stock management practices. These practices are being replaced with more refined logging techniques, removal of dams or improved passage, and small scale stream/species specific conservation hatcheries to rescue and restore populations of salmonids.

Finding: The Council included the proposed scientific principles and foundation not only in the Strawman but then, as revised, as part of the draft program, for review by the fish and wildlife managers and the public generally. The reaction to this set of principles was favorable; the Council notes that even the Commission's September 2000 comments on the draft program recommended only minor edits to the principles, not their exclusion from the program or the substitution of something different. The Council decided not to submit the principles for further review by the Independent Scientific Advisory Board, because the principles have been under development for some years, and the ISAB had previously reviewed them -- the version of the scientific principles included in the Strawman and thus the subject of the recommendations of other agencies and tribes (see above) had already been revised to reflect the ISAB's comments. The revised program also charges the ISAB with the primary role in reviewing and recommending modifications to the principles in the future. The Council concluded that it was important in this first phase of the amendment process not to delay, but instead to state explicitly in the program the set of basic scientific principles that underlie the program, to respond to criticisms of past programs for being silent on this point.

The Commission's concerns seem to relate less to the substance of the scientific principles than to a perception that the proposed scientific foundation is too limited in its scope. That is, the principles ought to go beyond general ecological thought and incorporate the large body of specific, agreed-upon information available for the Columbia Basin itself, and the principles should be more practically directed toward guiding management actions. There is little in the Commission's recommendation as summarized here that the Council disagrees with or that is inconsistent with the revised program. However, the Council incorporated these points or concepts in other parts of the revised program, especially in the vision, planning assumptions, general biological objectives, and strategies. For example, the Commission's recommended principles that "critical ecological processes must be maintained or restored" and "goals and objectives must come from an ecological understanding of the physical system and its biological components" are reflected not just in Principle 4 in the revised program but also in the vision, Section III.A.1; the planning assumption on a habitat-based program, Section III.A.2; the general concept of biological objectives; Section III.C.2, the provisional biological objectives for environmental characteristics, Section III.C.2.b and Appendix D; the general linkage of biological objectives and strategies, Section III.D.2; and the habitat strategies, Section III.D.3.

Thus to the extent what the Council adopted was not consistent with this recommendation, the Council finds that what the Council did adopt is more effective than what was recommended in the protection, mitigation and enhancement of anadromous fish, resident fish and wildlife, Northwest Power Act §4(h)(7)(C), and more consistent with the recommendations and activities of a wider group of the fish and wildlife agencies and tribes in the region, §4(h)(6)(A), (7), (7)(B). However, the Council also concludes that the revised program is largely consistent with the substance of this recommendation.

Source: **PNUCC**
Recommendation No. **55**

Recommendation: PNUCC recommended that the Council be clear in the program about the scientific assumptions guiding its policy decisions, adopting a scientific foundation proposed by the Council's science advisors to support the Council's policy decisions. The complexity of the salmon's life cycle has left the door wide open for different interpretations and applications of scientific information. The Council's analysis should use the best available peer reviewed scientific information, incorporate actual data whenever available, and be flexible enough to incorporate new information as it becomes available.

Finding: The revised program is consistent with this recommendation. The Council has relied on the best available scientific knowledge in adopting a scientific foundation for the program, consisting of a set of general ecological principles, with a detailed discussion of the principles and more specific elaboration of the scientific foundation in the Technical Appendix. The basic principles are expected to be relatively fixed, although subject to review and possible modification when the program is revised in the future. The Council intends the other aspects of the scientific foundation to change over time in response to new scientific information and the results of implementation.

Source: **Public Utility District No. 1 of Chelan County**
Recommendation No. **4**

Recommendation: The Public Utility District No. 1 of Chelan County noted that the concept of managing around a "focal" or indicator species is good, but recommended that provinces and subbasins have the flexibility to establish their own "focal" species. At the basin level, the Council should simply encourage ecosystem management.

Finding: Consistent with this recommendation, the Council focused at the basin or program-wide level on general ecological principles and did not prescribe specific focal species for which all provinces and subbasins must plan.

Source: **Sierra Club -- Columbia Basin Field Office**
Recommendation No. **27**
Source: **Save Our Wild Salmon**
Recommendation No. **29**

Recommendation: These groups recommended that the program rigorously follow the basic ecological principle of providing and restoring healthier, more diverse, more productive, and better connected habitats for fish and wildlife. For anadromous and resident fish, the program should adopt the "normative river" concept of the Independent Scientific Group and reject technological fixes.

Finding: Consistent with these recommendations and the recommendations and activities of the fish and wildlife agencies and tribes, the Council adopted a foundation set of scientific principles and an associated vision, biological objectives, and strategies that call for protecting and restoring natural ecological functions, habitats and biological diversity wherever feasible, as the most appropriate means to satisfy the region's fish and wildlife protection, mitigation and recovery obligations. The Council did not use the "normative river" concept or term, as it is susceptible of many different interpretations. Also, the

Council did not "reject" the use of technology, but instead noted that non-natural interventions for fish and wildlife should be used only if consistent with the central effort to protect and restore habitat and avoid adverse impacts to native fish and wildlife species. Section III.A.2 (third planning assumption).

Source: **Washington State University -- Center for Reproductive Biology**
Recommendation No. **12**

Recommendation: The Center recommended that an integrative scientific approach combining fish biology, habitat, and economics is required to address salmon restoration problems and develop working solutions. Utilize the universities as a resource for the program, especially in expanding the basic science and in gathering the detail required to address the salmon restoration problem.

Finding: The revised program is consistent with this recommendation. The Council did not specifically identify the universities as a resource, but university-based scientists and economists contribute significantly in the review and implementation of the program through participation on the Council's scientific and economic advisory bodies and through sponsorship of research and other projects funded under the program.

2(b) Geographic structure, including province concept and boundaries

Source: **Oregon Department of Fish and Wildlife**
Recommendation No. **26**

Recommendation: Oregon recommended an edited but substantively similar version of the Strawman's description of the proposed geographical structure for the revised program. including the same ecological province organization.

Finding: The Council adopted this recommendation in the revised program. Differences in wording are editorial in nature. The only substantive difference was a minor regrouping of subbasins within two upper Columbia provinces in response to the recommendations of other fish and wildlife managers, described below.

Source: **U. S. Fish and Wildlife Service**
Recommendation No. **46**

Recommendation: The Fish and Wildlife Service recommended that the program framework be organized at the three geographic levels proposed in the Strawman -- the basin as a whole, smaller geographic divisions of the basin called ecological provinces, and subbasins that are components of each province.

Finding: The Council adopted this recommendation in the revised program.

Source: **Columbia River Inter-Tribal Fish Commission**
Recommendation No. **40**

Recommendation: The Commission criticized the proposed provincial structure for failing to account adequately for the ecological organization of resident fish and wildlife or the metapopulation structure of fall chinook. The provinces proposed are primarily administrative subdivisions that are not necessarily better than the six subregions found in the present program. The Commission agreed that it made administrative sense to subdivide the basin into smaller units for administration, but was unconvinced that eleven subdivisions make more sense than the existing six.

The Commission also asserted that it is premature to conclude, without evidence, that animal metapopulations might conform to the proposed provincial boundaries. The province concept as described appears to be heavily influenced by the hydrology of the basin and an anadrocentric view. Different boundaries would likely be drawn to represent subregions based upon the ecology of resident fish or wildlife species. Fall chinook population structure cuts across several provincial boundaries, and it is also unlikely that wildlife population structures are adequately encompassed by the proposed provincial boundaries.

Considering that subbasins flow through several ecoregions, the Commission recommended that it might be more appropriate to describe the ecological structure of the basin, at least for salmon populations, as a sequence of ecological webs, rather than as an ecological hierarchy. The hydropower

system is presently managed on a basin-wide scale; it would be totally ineffective to deal with hydropower issues a few dams at a time, as implied by the proposed provincial structure.

Finding: There are a number of reasonable ways to divide the basin for more specific planning and administrative purposes, and each method has its strengths and its drawbacks. Faced with no perfect method, the Council adopted a province structure for the revised program based on "patterns related to hydrology, climate and regional geology," creating provinces that consist of "a set of adjoining watersheds with similar ecological conditions and tributaries that ultimately connect, flowing into the same river or lake." These physical patterns are not necessarily distinct from biological population patterns, even if the fit may not be perfect, as the Commission observed. The "[p]opulations within a province are more likely to be related to other populations within that province than to populations in other provinces," with "[l]ife history and other characteristics that group into patterns that reflect physical habitat structure."

Under the Northwest Power Act, the Council is required to address all of the fish and wildlife affected by the hydrosystem in the Columbia River basin. Thus the central legal and policy focus of the program is a *river basin*, and large-scale geological patterns and hydrologic connections are the base underlying the formation and functions of a river basin. These same natural features, then, offer a logical principle for ordering the program. This approach has the great added benefit of preserving subbasins as single, coherent ecological units, thereby simplifying specific planning and implementation decisions. (Many other organizational schemes, such as by vegetation patterns, break subbasins into separate pieces and then link together the pieces of different subbasins, making for a more difficult planning unit).

A critical factor in the status of fish populations, which are a central focus of the Council's program and the region's restoration efforts, is the quantity and quality of water flow. And flows strongly influence most other habitat characteristics. Therefore, organizing the provinces and subbasins around hydrology makes particular sense for a habitat-based program, in ways that organizing it around certain fish and wildlife populations probably would not. Moreover, an organization based on one specific population would be most unlikely to work for other fish and wildlife populations, while a pattern based on the basic geology and hydrology of the river basin affects all species.

In addition, the quantity and quality of water flow strongly influence most other habitat characteristics that affect not just fish populations but also related wildlife populations. Therefore, organizing the provinces and subbasins around hydrology makes particular sense for a habitat-based program, in ways that organizing around certain fish and wildlife populations might not. Under the Power Act, the Council is required to address all of the fish and wildlife affected by the hydrosystem in the basin. Moreover, an organization based on the structure of one or a few specific populations would be less likely to work for other fish and wildlife populations, while a pattern based on the basic geology and hydrology of the river basin affects all species.

The recommendation criticized the proposed organizational pattern, but did not offer a different organizing scheme, except to express no preference for the proposed province structure over the subregions in the current program. The recommendation also criticized the proposed province structure for being "anadrocentric." This is not correct, given that provinces are ecologically related sets of subbasins defined without reference to specific species. Moreover, the recommendation inconsistently criticized the proposed province structure precisely for failing to match the population structure of fall chinook.

The Council included the proposed ecological province organization in the draft program. While the Council received comments from the upper Columbia tribes seeking a revision in the boundaries of two provinces in the upper river, the comments were otherwise supportive of or at least did not object to

the province organizational scheme. This includes the Commission's own comments in part, which repeated general concerns about the proposed province structure but then, in a redlined version of the draft program, did not object to the provinces or propose a different organizational scheme.

Finally, the Council agrees with the recommendation that there are activities that transcend specific provinces -- such as hydrosystem operations and associated mainstem water management. As a result, the revised program calls for the development of a separate mainstem plan for the program, as well as annual planning and implementation procedures for the mainstem as a whole. Also, the ecological provinces are not intended as on-going planning and implementation units in and of themselves. Specific planning and implementation will take place at the subbasin level or at the basinwide level. The provinces are indeed largely administrative units that will allow for the grouping of related subbasins for planning and project review purposes, and which will also allow for the adoption into the program of specific biological objectives for the provinces where similar environmental and population characteristics exist, guiding subbasin planning and implementation and providing a measuring point for evaluating success.

For these reasons, the Council concludes that the recommendation was less effective than what the Council adopted in assisting in the protection, mitigation and enhancement of anadromous fish, resident fish and wildlife, Northwest Power Act §4(h)(7)(C).

Source:	**Spokane Tribe**
Recommendation No.	**28**
Source:	**Coeur d'Alene Tribe**
Recommendation No.	**42**
Source:	**Kalispel Tribe**
Recommendation No.	**48**
Source:	**Kootenai Tribe**
Recommendation No.	**50**

Recommendation: These tribes recommended that the Council reorganize the proposed ecological provinces to include what they called the Upper Columbia River Basin Blocked Area Province, as described and supported in the Upper Columbia River Basin Blocked Area Provincial Amendment drafted by the Upper Columbia United Tribes. This province would be a re-configuration of the proposed Inter-Mountain and Mountain Columbia Provinces, and include the following subbasins:

- Spokane (all, not separated as in Council's proposal)
- Upper Columbia
- Nespelem
- Sanpoil
- Colville
- Kettle
- Coeur d'Alene
- Lower Pend Oreille
- Upper Pend Oreille
- Priest
- Kootenai
- numerous minor tributaries to the Upper Columbia River
- mainstem Columbia River between and including Chief Joseph Dam and the US/Canada Border

The Coeur d'Alene Tribe added that the Council's province level boundaries did not conform appropriately to ecosystem characteristics and relevant management jurisdictions, and that it would be inefficient for the Council to overlay a new set of artificial boundaries onto a map that already includes non-aligned boundaries for numerous state, tribal, local and federal watershed planning units. To that comment the Spokane Tribe further added that the Council based its province boundaries on climate patterns and regional geology, whereas other entities based their planning boundaries on vegetation patterns, terrain features, and political jurisdictions. The program should allow flexibility for the managers and stakeholders to revise province boundaries through the subbasin assessment and planning processes. The Spokane Tribe agreed that the Columbia River Basin is too large to manage as a single geographic area, and that management at the subbasin level is appropriate as long as the interrelationships of subbasins are acknowledged.

Finding: Based on this recommendation and on subsequent comments from the same tribes, the Council modified the boundaries of the Inter-Mountain and Mountain Columbia provinces, shifting subbasins so that the Inter-Mountain province resembles the upper Columbia province recommended here. For a response to the general concerns expressed, *see* the finding immediately above.

Source: **National Marine Fisheries Service**
Recommendation No. **54**

Recommendation: The National Marine Fisheries Service recommended that the Council designate the mainstem lower Snake and Columbia Rivers (from Lewiston Idaho to below Bonneville Dam) as a separate province or subbasin for planning purposes. The Fisheries Service understood from the Strawman that the Snake and mainstem Columbia Rivers would be considered to be part of the provinces, i.e., divided up based on provincial boundaries, which the Service considered an inappropriate subdivision of the mainstem system. Because of the continuity of mainstem "habitat" created by the dams and reservoirs, and because of its dissimilarity to the tributaries which feed into the mainstem, the Fisheries Service urged the Council to designate the mainstems of the Snake and Columbia rivers as either a separate subbasin or province. Such designation would not only recognize how mainstem issues are addressed, but would also provide a "planning home" for integration of the myriad activities currently underway, as well as new ones to be undertaken relative to the NMFS 2000 Biological Opinion.

Finding: The Council agreed with the recommendation that there are activities which transcend specific provinces -- such as hydrosystem operations and associated mainstem water management. As a result, the revised program calls for the development of a mainstem plan for the program as well as annual planning and implementation procedures for the mainstem as a whole.

Source: **Hiram Li -- Oregon Cooperative Fish and Wildlife Research Unit**
Recommendation No. **16**

Recommendation: Mr. Li recommended a geographical structure dividing the basin into landscape regions makes sense because landscapes reflect similar environmental and land use constraints on the ecological functioning of watersheds. All other things being equal, similar types of limiting factors may be operating in that region, and thus a concentrated effort across the landscape scale to reduce those factors becomes possible. Landscape regions should be populated by genetically similar stocks, thereby favoring large, coordinated management experiments. Alternatively, regions could be defined by the criteria of genetic stock structure or by phenotypic diversity. Management could then be driven directly

by concerns for the persistence of genetic groups using the appropriate metapopulation models (Levins' model, source-sink model, core-satellite model).

Finding: The revised program is consistent with the first alternative in this recommendation -- an organization of the basin into ecological provinces that are internally similar in terms of the geographical and hydrological constraints on the functioning of the watersheds in that province.

2(c) Loss assessment/mitigation issues in general

Source: **Oregon Department of Fish and Wildlife**
Recommendation No. **26**

Recommendation: Oregon noted that in 1986, the Council estimated the annual losses of adult salmon and steelhead caused by the development and operation of the federal hydrosystem to be from five to eleven million, when compared to annual run sizes in the 1980's of about 2.5 million. The Council estimated that approximately half of the annual losses were due to the fact that areas previously accessible to anadromous fish were now blocked, and the other half due to the effect of the projects on migrating juveniles and adults. This estimate represented the annual reduction in numbers of adult salmon and steelhead returning to the Columbia Basin to spawn and did not reflect the cumulative loss over the life of the federal hydrosystem. Oregon then recommended that the program contain objectives and measures to mitigate fully for these losses, and that the program retain and expand the hydrosystem operational and structural measures and the resident fish substitution projects to address the unmitigated losses of salmon and steelhead attributable to development or operation of hydropower projects.

Oregon also noted that a number of native resident fish populations throughout the basin are so depressed to an extent that they require immediate attention, recommending that the program call for the completion of assessments of resident fish losses throughout the Columbia Basin and for immediate actions to protect healthy populations and ensure the survival and recovery of listed fish species. The program should contain measures that fully mitigate for resident fish losses.

Finding: The revised program is consistent with this recommendation. The program identifies the Power Act obligation to mitigate for the losses caused by the hydrosystem as an underlying basis for understanding and developing the program's basinwide biological objectives for population performance, Section III.C.2.a. The same section sets forth a number of objectives for population characteristics that culminate in a long-term objective of achieving "population characteristics that, while fluctuating due to natural variability, represent on average full mitigation for losses of anadromous fish," Section III.C.2.a.1. This section also calls for completing assessments of resident fish losses, and states a similar long-term objective to achieve population characteristics of resident fish "within 100 years that, while fluctuating due to natural variability, represent on average full mitigation for losses of resident fish," Section III.C.2.a.3. The revised program also continues the resident fish substitution policy to mitigate for salmon and steelhead losses in blocked areas, Sections III.C.2.a.2, III.D.2 and .3. Operational and structural measures for the hydrosystem will be addressed in a subsequent phase of the program revision process, *see* Sections III.D.6; VIII.1.

Source: **Bonneville Power Administration**
Recommendation No. **37**

Recommendation: Bonneville provided an extensive discussion of the current wildlife crediting system and recommended that the program incorporate a similar crediting system for non-wildlife projects, emphasizing the following principles:

- Bonneville needs credit when it implements a successful habitat mitigation project. It makes no difference whether the primary focus of an action is anadromous fish or watersheds; if it improves or secures habitat, the ratepayers' contribution must be recognized.
- Bonneville needs credit whenever the action mitigates fish and wildlife or their habitats--regardless of the initial legal or policy impetus for taking the action.

- Crediting should be in terms of habitat quality and quantity. Fish and wildlife populations typically fluctuate too much to be fair or accurate gauges of the effectiveness of a particular mitigation.
- Crediting should be 1:1; that is, one credit for each habitat unit of equal quality mitigated.
- The region should use a habitat evaluation process to assess quality and quantity of habitat. Such models could be developed for all aquatic and terrestrial species subject to mitigation under the Act.
- Bonneville mitigates for hydrosystem construction and operation losses.
- When the power impacts on a species or habitat are difficult or impossible to quantify, then Bonneville could mitigate in habitats which currently support core populations, and improve those habitats and surrounding habitats to secure those populations. Habitat models reflecting properly functioning conditions could be used to show when Bonneville has restored the amount of habitat lost through hydrosystem development and operation.
- Where it is impossible to accurately translate habitat improvements into species improvements, credit should be based on the best available science, using analytical tools and models such as (but not limited to) the Council's Ecosystem Diagnostic and Treatment model.

Finding: The Council did not adopt a program-wide mitigation crediting scheme in this phase of the program revision process, although it clarified the program's mitigation crediting policy with regard to wildlife, *see* Section III.D.7. The revised program does set the stage for the development of a crediting approach along the lines of Bonneville recommendation. It does so by virtue of its emphasis on a habitat-based program in which (1) biological performance objectives are to be based in the fish and wildlife losses caused by the construction and operation of the hydrosystem, which require mitigation under the Power Act, and then (2) by stating objectives for the environmental conditions and habitat changes required to allow the system to mitigate for those losses. As the Council develops the program in more detail based on this framework, that will be the time to consider the adoption of a crediting mechanism beyond the wildlife section that matches actions to fulfillment of the specific biological objectives.

Source: **Shoshone-Paiute Tribes**
Recommendation No. **23**

Recommendation: The Shoshone-Paiute Tribes recommended a number of general principles relating to losses due to the development and operation of the hydrosystem and the required mitigation for those losses:

- Develop and fund fish and wildlife mitigation, especially in blocked areas for future protection, mitigation and enhancement.
- Base compensation on the loss of historical populations and potential harvest of fish and wildlife as well as on the loss of habitat and species of fish and wildlife, not actual current populations of species present.
- Hold all entities responsible for expenses incurred for reduction and extirpation of native species of fish and wildlife (i.e., including those who introduced exotic species that have caused genetic introgression of native species).
- Mitigate for resident fish populations lost due to the loss of ecological functions and relationships as a result of anadromous fish resources no longer present in the blocked areas.
- Mitigate for anadromous fish losses in the areas where they have been extirpated until the time anadromous fish return to these areas.
- Mitigate for cultural resources lost due to the construction and operation of the federal hydropower system.

Finding: The revised program is largely consistent with this recommendation. The program recognizes as a basis for program-wide biological objectives the obligation to mitigate for fish and wildlife losses caused by the hydrosystem. The program continues the policy of fish and wildlife mitigation in the blocked areas and other places where anadromous fish have been extirpated. Also, the biological objectives related to mitigation for affected fish populations recognize the loss of ecological functions and relationships as a key aspect of the mitigation effort.

The Power Act calls on the Council to develop a program to protect, mitigate and enhance *fish and wildlife* affected by the development and operation of the hydrosystem. While the Council is sensitive to the tribes concern for impacts to *cultural* resources, it would be beyond the scope of the Power Act, and thus beyond the authority of the Council in revising the program, to call for mitigation for cultural resources lost due to the construction and operation of the hydrosystem. This is an issue the tribes have to address directly to the federal agencies. Also, the Power Act's focus, and thus the program's focus, is on the responsibility of the *hydrosystem* for adverse effects to fish and wildlife, not on the responsibility of everyone who adversely affected fish and wildlife, including those who introduced exotic species to the detriment of native species. The program has to be aware of these kinds of past and present impacts, in order to understand what is the obligation of the hydrosystem under the Power Act compared to the obligations of others, to be able to call for the equitable sharing of the costs of the overall responsibility to improve fish and wildlife conditions in the basin, and to protect what investments the program does make to enhance native species. That is not the same as using the program to assign responsibility to and assess program expenses on everyone whose activities adversely impacted native fish. That is beyond the authority or the capacity of the Council and the program.

Source: **Columbia River Alliance**
Recommendation No. **39**

Recommendation: The Columbia River Alliance recommended that the Council re-evaluate the extent to which the hydrosystem, as presently configured and operated, has an adverse impact on salmon and steelhead stocks in the Columbia River Basin. The Council should assess the success and accomplishments of past mitigation efforts against the effects of present dam operations to determine whether and to what extent additional efforts to protect, mitigate and enhance fish and wildlife are appropriate. The Alliance submitted a legal memorandum with an extensive discussion questioning the legal obligation of the hydrosystem to further mitigate salmon losses, pointing to evidence that suggests no presently measurable adverse effects on salmon from the dams.

The Alliance also recommended that the Council consider calls for a "normative" river and for dam breaching to be inconsistent with past mitigation efforts and to represent an unlawful attempt to impose new and substantial remedial obligations on federal dam operators. Recommendations for "normative river" conditions, to the extent that they mean something other than continued operation of the Federal Columbia River Power System and other hydroelectric facilities, fall outside of Congress' charge to the Council. As a political matter, the Council can recommend anything it wants to Congress, but the Council's fish and wildlife program has legitimacy, and legal effect upon dam operators, only to the extent that it guides continued operation of hydropower facilities.

The Alliance also recommended that the program liquidate and cap the current habitat mitigation efforts funded by Bonneville, substitute the Bonneville Environmental Foundation or some other vehicle for habitat grants, and create a one-time endowment of habitat funding with monies saved through mainstem operational changes.

Finally, the Alliance recommended that the program give dam operators credit for cash mitigation efforts by the federal government. One possible explanation for the fishery managers' decision to focus on lower river mitigation efforts is that upriver fishery interests have received large cash payments in compensation over the years from federal dam operators. Many of these payments were made to the tribes. Payments to the tribes amount to a buy-out of obligations that would otherwise arise under relevant treaties or other federal law. The Alliance stated that Congress plainly did not intend mitigation for hydropower losses to include both restoration of salmon runs and full payment for lost runs, yet the Alliance was unaware of any effort to credit ratepayers for these and other payments against salmon losses.

Finding: The revised program is partially consistent with this recommendation. The program as revised does not call for anything other than the continued operation of the Federal Columbia River Power System.

The Council decided not to undertake a re-assessment of the salmon and steelhead losses estimates completed in the late 1980's. That was an enormously time consuming and expensive process, and the Council deemed it to be an imprudent investment of staff time, funding and other resources to revisit those loss estimates at this time. There was no support for this recommendation from any other entity, as shown not only by recommendations and comments from fish and wildlife agencies and tribes (e.g., *see* the recommendation above of the Oregon Department of Fish and Wildlife), but also by the fact that none of the other governmental and private entities, including Bonneville, recommended a new loss assessment effort or commented in favor of one.

On the other hand, as noted in response to the Bonneville recommendation above, there is an interest in the development of a usable approach to determining how to credit mitigation against losses in parts of the program other than wildlife. The revised program has, for really the first time, the kind of framework, approach to biological objectives, and analytical methods that should, if developed further in the proper way, allow the Council and others to assess the extent to which population and habitat conditions have changed due to hydropower development and operations and then the extent to which past and future mitigation efforts have addressed and might address those effects. If this analytical approach is carried out as proposed, not only will the Council and the program be able to roughly determine how much mitigation credit to assign to an action, it will also be able to revisit the extent of the mitigation obligation itself.

Nothing in the Power Act or its legislative history authorizes the Council to accept, as part of the program, monetary payments made by the federal government to the tribes (or anyone else) in partial compensation for the adverse effects of the hydrosystem, in lieu of taking actions under the program to protect and increase fish and wildlife, including related spawning grounds and habitat, affected by the hydrosystem. The Power Act calls on the Council to develop a program to protect, mitigate and enhance *fish and wildlife* affected by the hydrosystem, and then for Bonneville to use its fund to protect, mitigate and enhance *fish and wildlife* in a manner consistent with the program. The program's focus or scope is improvement in the conditions of fish and wildlife and fish and wildlife habitat, not monetary payments, in mitigation for adverse effects on fish and wildlife and habitat. The part of the recommendation specifically concerning an endowment for habitat funding is discussed below under habitat strategies.

For these reasons, the Council finds that to accept these aspects of the recommendation into the program would be inconsistent with the Northwest Power Act; would not complement the activities and recommendations of the region's fish and wildlife agencies and tribes, Northwest Power Act §4(h)(6)(A), (7)(B); and would be less effective than what the Council adopted in ensuring the protection, mitigation and enhancement of anadromous fish, resident fish and wildlife, §4(h)(7)(C).