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Introduction: Science, Theology and the Interdisciplinary Nature of Ecological Restoration

The scope and magnitude of our planet's environmental crisis is a sobering reality confronting humanity with the daunting and complex nature of ecological degradation and restoration. The macrocosmic nature of this crisis has not left a species, ecosystem, biome or human society untouched. Moreover, as humanity struggles to gain its bearings at the crossroads of hope, we have become aware that the environmental crisis has impacted nearly every human discipline—from art to zoology—of the post-modern era. The complexity of ecological dynamics provides compelling evidence that this complex problem will require novel collaborative and interdisciplinary approaches to the production of knowledge, the search for creative solutions and the necessary ethical horizon in the effort to achieve ecological restoration and planetary sustainability. To that end this article proposes a significant role for the creative partnership between science and theology as applied to the microcosmic case study of restoring salmon and steelhead populations in the Lower Columbia River Basin of the Pacific Northwest. Readers should bear in mind that the current status of salmon recovery efforts in the Pacific Northwest is a dynamic ongoing process. Consequently this article is of necessity a snapshot view taken at a moment in time.

Salmon, arguably the most important cultural icon of the Pacific Northwest, have been in serious decline during the last century and, as keystone species indicate the ecological health of the region. An attempt to restore these magnificent species in the Columbia River Basin, due in part to their threatened status under the Endangered Species Act (ESA), is currently underway but an analysis of this process strongly suggests that far more collaboration and far less contention will be needed for success. It is the view of

this essay that an interdisciplinary collaboration between science and theology can propel the process of salmon restoration in a new direction by expanding the current boundaries of restoration discourse and action.

To some a collaborative effort between science and theology may appear unique, even preposterous, but perhaps that is a sign of our post-modern times. Nevertheless the relationship between science and theology has been quite varied throughout history. According to Ian Barbour's excellent typology, four types have defined the spectrum of interaction between the two disciplines: conflict, independence, dialogue, and integration.[1] Conflict is the relationship of hostility between science and theology and the holders of this position—be it the scientific materialists or the biblical literalists—see a great chasm between the two disciplines with any rapprochement unimaginable. Independence is characterized by the view that science and theology have their own unique fields of inquiry, as well as their separate methods and presuppositions, and by the sentiment that "each party must keep off the other's turf." According to Barbour, the separation of science and theology "into watertight compartments is motivated, not simply by the desire to avoid unnecessary conflicts, but also by the desire to be faithful to the distinctive character of each area of life and thought."[2] This position, like conflict, forecloses the possibility of interdisciplinary collaboration.

At the other end of the spectrum is dialogue characterized by openness to conversation with the possibility of meaningful exchange that may be guided by such interests as disciplinary presuppositions, methodological similarities and convergent public policy issues. Within this position the public policy debate over environmental problems

provides a framework for dialogue and potential collaboration that centers on such common concerns as values, ethics and policy formation and implementation.

Integration carries dialogue to the next level of interaction and is characterized by the actual effort to integrate the contents of science and theology. Barbour sees three versions of integration: natural theology, a theology of nature, and systematic synthesis where "science and religion contribute to the development of an inclusive metaphysics" an example of which is process theology. It is within the framework of dialogue and integration that interdisciplinary collaboration between science and theology can occur. In fact this essay proposes a fifth model to Barbour's typology, what may be called *strategic interdisciplinarity*. Strategic interdisciplinarity may be defined as the collaborative attempt to address a complex problem utilizing scientific and theological-ethical analysis with the aim of proposing ethical solutions and policy guidelines, which for the purpose of this essay's project, impacts the discussion of conflicting beneficial uses within watersheds targeted for salmon restoration.

It is interesting to note that within a Roman Catholic context of higher education the intellectual project of strategic interdisciplinarity is supported by the papal document, *Ex Corde Ecclesiae* (1990).[3] Unfortunately the legitimate concerns over the *mandatum* and implementation of the juridical norms has often overshadowed the insightful substance of the document. Nevertheless, from the perspective of interdisciplinarity *Ex Corde* supports and promotes the following:

- Dialogue between Christian thought and the modern sciences,
- The integration of knowledge,
- Concern for the ethical implications of scientific research,
- The significance of interdisciplinary studies within the mission of the university, and
- The responsibility of the Catholic University to relate to the academic, cultural and scientific world of its local region.

The following statement is a fine summation of the sentiments embodied in *Ex Corde* on the need for cooperation among disciplines: "In its attempts to resolve these complex issues that touch on so many different dimensions of human life and of society, a Catholic University will insist on cooperation among the different academic disciplines, each offering its distinct contribution in the search for solutions. . ."[4] Given these insights interdisciplinarity ought to flourish in the Catholic University where the collaborative search for solutions to complex issues can be endorsed and practiced. The effort to restore salmon populations in the Columbia Basin is a prime example and case study of such a complex issue that requires interdisciplinary analysis and engagement with a distinctive Catholic voice.

Salmon Restoration in the Lower Columbia Basin: A Preliminary Scientific, Theological and Ethical Analysis

The salmon of the Pacific Northwest have been depleted to a threatened remnant of their once diverse and numerous populations by a variety of human activities such as over-harvesting and habitat modification. The obvious diminution of salmon populations led in 1980 to the U.S. Congress passing the Northwest Electric Power Planning and Conservation Act, which established the Northwest Power Planning Council (NWPPC) charged with ensuring that both hydroelectric power and salmon remain part of the Northwestern milieu. However, the NWPPC did not manage to reverse what was in all probability a worse situation than anyone had realized, and salmon continued to decline in the Columbia River Basin. Much of the efforts promoted by the NWPPC involved hatchery production of fish, which in fact tends to mask ongoing habitat deterioration while adding what is essentially a factory product to the population of

wild salmon returning from the sea seeking disappearing spawning grounds. In 1991, Nehlsen, Williams, and Lichatowich, published a report entitled "Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington."[5] The report noted that of 214 native, naturally spawning runs of salmon, steelhead, and sea-run cutthroat trout, 101 were in extreme risk of extinction, 58 at moderate risk, and 54 of concern. They identified 106 runs that had already become extinct. It was with this background that the National Marine Fisheries Service (NMFS), having listed several threatened anadromous Northwestern fish, was required by the Endangered Species Act's mandates to develop salmon and steelhead recovery plans.

The Scientific Bureaucracy of Salmon Recovery

The listing of salmonid populations in the Columbia River Basin under the ESA began in 1991 with the identification of Snake River Sockeye as endangered. The following year Snake River Chinook (fall/spring/summer) where listed as threatened and to date twelve distinct native populations of salmon and steelhead have been listed throughout the Columbia River Basin. In order to manage recovery efforts within this large area, the NMFS has divided the Columbia River Basin into a series of geographic domains for the purpose of engaging in scientific and policy deliberations intended to prevent the extinction of threatened and endangered salmon and steelhead. The interdisciplinary analysis described in this essay focuses on the Lower Columbia Basin, which includes the Columbia River from the White Salmon River to the ocean, and its tributaries particularly the Willamette River Basin. The NMFS has established this geographic region as the Willamette/Lower Columbia (W/LC) domain. Each geographic domain has a panel of scientists selected to scrutinize the local situation and make recommendations that are

intended to prevent extinction of ESA listed salmon and steelhead and assist recovery efforts within that domain. These groups are designated as Technical Recovery Teams (TRTs).

Salmon and steelhead are anadromous fish, living part of their life cycle in freshwater, and after spawning and juvenile rearing has occurred they return to the ocean where they feed and mature to adulthood. Salmon biology is intimately adapted to patterns of river flow and morphology and, given the complex flow patterns characteristic of a year in the Pacific Northwest, resident salmon populations have separated over time in distinct seasonal runs (e.g. fall and spring Chinook, summer and winter Steelhead, etc.). With this scenario, discussing the nature of "species" or "populations" is not sufficiently nuanced to describe the anadromous salmon and steelhead of the region. The result was the creation of the scientific-policy concept known in salmon recovery circles as an Evolutionarily Significant Unit (ESU). An ESU is defined as a salmonid population or group of populations that is reproductively distinct and isolated from other populations of the same species and represents a significant component of the species' evolutionary legacy.[6] In the Lower Columbia and Willamette rivers five characteristic runs of salmon and steelhead have been identified as Evolutionarily Significant Units and are listed as threatened under the Endangered Species Act. They are: Columbia River Chum (listed in 1999), Lower Columbia River Steelhead (listed in 1998), Lower Columbia River Chinook (listed in 1999), Upper Willamette River Steelhead (listed in 1999), and Upper Willamette River Chinook (listed in 1999). Lower Columbia River Coho have been petitioned for listing under the ESA, and are presently considered a candidate species. The Willamette/Lower Columbia Technical Recovery Team (W/LC TRT) is therefore

responsible for analyzing the current status and future prospects of five salmonid ESUs. It is important to note that the concept of an ESU incorporates a unique use of the word "significant" in the scientific enterprise, and has important axiological implications that will be addressed later.

In order to appreciate the bureaucratic complexity of salmon recovery in the Columbia River Basin a brief description of the participating entities is necessary. First there is the NMFS' Northwest Fisheries Science Center (NFSC) in Seattle whose staff composes part of the W/LC TRT, and a scientific oversight panel of distinguished university scientists called the Recovery Science Review Panel (RSRP). The RSRP was established to provide feedback to all of the TRTs on the West Coast. In addition to the NMFS staff scientists from the NFSC and elsewhere, NMFS policy personnel from the NMFS Portland office also provide input to the W/LC TRT. The scientific products of the W/LC TRT's analysis of salmonid recovery issues first goes to the NFSC in Seattle and is then passed to other scientists at federal and state agencies for comment. After W/LC TRT revisions incorporating the scientific reviews, the scientific findings of the Technical Recovery Team are again sent to the NFSC, which reviews the revised scientific materials and passes them on to the W/LC Executive Committee (ExComm). The ExComm was established for the Willamette/Lower Columbia domain and is composed of individuals representing various federal and state agencies, municipalities, and additional political constituencies, as well as a representative from the Columbia River Inter-Tribal Fish Commission (CRITFC). While the W/LC ExComm is charged with making policy decisions to promote salmon recovery in its domain, it is not the group actually proposed to implement these

recovery efforts. On the Washington State side of the Columbia River the W/LC ExComm has delegated local recovery efforts to the Lower Columbia Fish Recovery Board (LCFRB) an organization that was established during the ESA listing procedure by the State of Washington. On the Oregon side of the Columbia River no such single entity exists, but several candidates such as the Oregon Watershed Enhancement Board (OWEB), the Willamette Conservation Initiative (WCI), the Lower Columbia River Estuary project (LCREP), and various small sub-basin recovery groups will interact with the W/LC ExComm.

The role of the Northwest Power Planning Council adds an additional layer of complexity to salmon recovery efforts. As noted earlier, the NWPPC was created before ESA listings of Columbia River Basin salmon and was charged with the responsibility of balancing hydropower generation and salmon recovery. Furthermore, the NWPPC has the duty of overseeing a sub-basin planning process it initiated to promote the development of sub-basin plans that address salmon recovery. However, the sub-basin plans developed under the auspices of the NWPPC require NMFS' approval and adoption to ensure compatibility with the recovery goals of the ESA. The relationship of the NWPPC to the NMFS on the issue of Columbia River Basin ESU's is defined from the NMFS' perspective by two federal documents. They are the *Federal Columbia River Power System Biological Opinion* (2000 FCRPS BiOp) and *The Conservation of Columbia Basin Fish, Final Basinwide Salmon Recovery Strategy*, also known as the Federal All-H paper (The H's refer to Habitat, Hydropower, Hatcheries, and Harvest).[7] The 2000 FCRPS BiOp specifically requires the Bonneville Power Administration (BPA) to work with the NWPPC to develop and fund sub-basin

and watershed plans from 2001 to 2006. The NWPPC also interacts in significant ways with the Corps of Engineers, which constructed and now operates the hydroelectric dams, and the Bureau of Reclamation, which is responsible for water issues related to agricultural irrigation.

In addition to the Northwest Power Planning Council and the federal agencies within the Columbia River Basin, four Native American Tribes of the region (Yakama, Umatilla, Nez Perce, and the Confederated Tribes of Warm Springs) are also significant participants in salmon recovery. Represented by the CRITFC, the Tribes have sought to ensure that their treaty rights of 1855, which granted them access to "all usual and accustomed fishing place," were observed. As a result of a series of court decisions (Sohappy v. Smith/U.S. v. Oregon, 1969 and U.S. v. Washington, 1974), tribal fishing rights were legally upheld and granted the tribes entitlement to fifty percent of harvestable fish. Consequently the CRITFC, responsible for managing the Tribal fishery, has a reasonable expectation that salmon will be present in their historical locations. Moreover, in an attempt to promote and guide salmon recovery the Tribes produced their own salmon recovery plan in 1995—*Wy-Kan-Usu-Mi Wa-Kish-Wit* (Spirit of the Salmon)—the first comprehensive "gravel-to-gravel" salmon recovery plan for the Columbia River Basin.[8]

This description of the overlapping responsibilities and concerns of various state, federal and tribal entities involved in preventing salmonid extinction raises four issues that are immediately apparent. First, the complexity of the situation makes a consistent and concerted effort to apply science-based plans for salmon recovery very difficult. For example, in the summer of 2001 the BPA declared a power emergency due to

energy shortages in California (now understood to be the product of illegal manipulations of power transactions by “energy traders” of the Enron Corporation). This emergency declaration allowed the BPA to operate its hydroelectric dams in a fashion inconsistent with the normal operating procedures according to the agreement between the NMFS and the BPA, which were intended to provide adequate river conditions (in terms of water flow, temperature, and other parameters) for salmon survival. Although there are no clear estimates of the damage caused to ESA-listed salmon by this action of the BPA, the effects can only have been negative. A good example of the potential for a direct negative impact would be Columbia River Chum. This is a particularly vulnerable ESU, one population of which spawns directly below Bonneville Dam in the area of Ives Island. Only a few known populations of these fish are left. As a result of BPA action, more water passed through hydroelectric turbines and less was released through other routes intended to facilitate safe passage for juvenile salmon and adequate spawning habitat maintenance.

Second, the division of the Columbia River Basin into geographic domains artificially separates water that flows from one domain into another and impacts salmon recovery in terms of scientific and policy oversight. For example, the Interior Columbia domain is separated from the W/LC domain at White Salmon River. Salmon must pass through the W/LC domain to reach the interior Columbia River, so decisions made about influences like water pollution, estuarine development, or channel deepening will influence the river environment through which returning adult fish and juvenile out-migrants from the Interior Columbia domain must pass. This scenario is further exacerbated by the fact that interest groups that will have a voice in the

ExComms for the Lower Columbia/Willamette and Interior Columbia domains, like the CRITFC, have no voice in the scientific deliberations of the W/LC TRT. Due to the NMFS definition of the TRT's task, the Columbia Basin Tribal salmon recovery plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit (Spirit of the Salmon)* can not even be viewed as a possible scientific alternative by the W/LC TRT, through whose domain the fish must pass on their way to the upper reaches where tribal peoples harvest salmon. These geographic divisions separate science along borders that are ill suited to the reality of the continuous migration corridors salmonids must navigate in order to survive.

Third, the asynchronous sub-basin planning process and the hurried adoption of readily available scientific tools pose another challenge to salmonid recovery. In 2000, the NWPPC issued a report on Fish and Wildlife (Council document #2000-19) that recognized the need for a major regional planning effort.[9] This report connected regional planning to funding legally required of the BPA to help remediate the adverse impacts of the Columbia River hydroelectric system on fish and wildlife. The NWPPC followed this with a detailed design for the planning process (Council document #2001-20), which produced a template for sub-basin reports to be funded by the NWPPC using BPA resources.[10] The desired outcome was to ensure that every sub-basin of the Columbia River system will have a sub-basin plan completed between May 1 of 2003 and May 1 of 2004. The NWPPC sub-basin planning process attempted to incorporate the varied and ongoing local processes already underway. The difficulty this poses is that the sub-basin planning process began prior to the TRT process initiated by the NMFS. TRT analyses must therefore choose to attempt to integrate with ongoing sub-

basin plans or risk producing duplicated, parallel, and perhaps incompatible recommendations.

This problem is exacerbated by adoption of the Ecosystem Diagnosis and Treatment (EDT) approach by the NWPPC, as a model for scientific description of current river conditions and their productive potential for salmonids in the regions' sub-basins. EDT is described in Council document 2001-20 as "able to link habitat condition to responses in salmon and bull trout populations, and may be adapted for terrestrial wildlife."[11] However, the Recovery Science Review Panel, the NMFS' scientific oversight committee, reviewed EDT unfavorably as a primary scientific tool. According to the RSRP

> The current version [of EDT] which uses 45 habitat variables might be a useful list of things to consider, but the incorporation of so many variables into a formal model renders the predictions of such a model virtually useless. Even more vexing is that EDT depends upon a large number of functional relationships that are simply not known (and cannot be known adequately) and yet they play key roles in model dynamics. The inclusion of so much detail may create an unjustified sense of accuracy; but actually introduces sources of inaccuracy, uncertainty and error propagation. Subjective efforts to quantify these models with "expert opinion" compound these ills.[12]

The selection of EDT by the NWPPC is not ethically neutral. It is an in-stream analytical tool that describes the potential of a part of a river system to produce salmon, on the basis of numerous variables (water flow, water temperature, availability of gravel for spawning, etc.) as either measured or estimated by professionals. However, these are in-stream variables that relate to the river condition easily, but to human activities affecting water quality only indirectly. There are alternative landscape-based scientific approaches to habitat analysis that would directly relate to informed discussions of land use activities and their effects on salmonid populations.[13] The

choice of EDT provides a guaranteed impediment to an easy transition from a discussion of current and potential stream conditions to a discussion of conflicting claims of different user groups on the river. What sound like unimportant timing issues and scientific minutae have, from a strategic interdisciplinary perspective, implicit ethical dimensions that require reflection.

Fourth, time is short and that is leading to acknowledged critical uncertainties in the ongoing scientific process. Factors that are being placed to one side include inexorable processes like regional population growth, and authoritatively predicted environmental changes like global warming and climate change. In October of 2002, the National Marine Fisheries Service, recognizing the need for some attempt to better integrate the efforts being made in divided geographic domains, issued the document titled, "A Strategy for Integrating Out-of-Subbasin Conditions into Subbasin and Recovery Planning Within the Anadromous Zone of the Columbia River Basin."[14] This document indicates that there is a need for sub-basin recovery plans to be informed by conditions outside the sub-basin in question (e.g., in the estuary at the mouth of the Columbia River and in the ocean itself). However, it also indicates that there is too little time for "future scenarios" (things like land use shifts associated with population growth, ocean condition shifts with climate change, etc.) to be developed with any degree of specificity. Individual sub-basin planning teams are empowered by this document to consider what future scenarios might be like. Nevertheless the timeline developed for salmon recovery via sub-basin planning is incompatible with any attempt to project the crucial future conditions with any degree of accuracy. Our current understanding of

processes like the effects of increasing atmospheric CO_2 levels would require more time to allow for a measured scientific appraisal.[15]

The Columbia River Pastoral Letter Project

While salmon continued to be listed under the Endangered Species Act, and the political-bureaucratic conundrum of salmon recovery was well underway, another significant and unexpected development occurred in the Columbia River Basin. The Roman Catholic Bishops of the region decided to undertake what came to be known as the Columbia River Pastoral Letter Project (CRPLP). Led by Bishop William Skylstad of Spokane, the Project Steering Committee sponsored a series of "Readings of the Signs of the Times" and "Listening Sessions" which began in November, 1997 at the University of Portland and culminated in November 1999 with a session at Salish-Kootenai College in Pablo, Montana. The results of this regional input led to a series of drafts that eventually became public as an international pastoral letter called *The Columbia River Watershed: Caring for Creation and the Common Good* (January, 2001).[16]

Divided into four major sections, the letter provides an interdisciplinary pastoral reflection on the major social, economic, ecological and theological-ethical issues in the Columbia River Basin. In Part I, "The Rivers of Our Moment" the letter surveys the problems of the basin acknowledging that "The endangerment and possible extinction of the area's animal and fish species are of notable concern in our day. The specific causes of, and remedies for, salmon endangerment and extinction are hotly debated in the region."[17] In Part II, "The Rivers in Our Memory" the pastoral provides the theological-ethical foundation for ecological and social responsibility. Grounding this

ethical responsibility for the Columbia River in the concept of biblical stewardship, creation theology and concern for the common good, the Bishops of the region seek to create an inherent connection between social and ecological justice.

"The Rivers of Our Vision," the third section, provides a future horizon of hope by offering a spiritual, social and ecological vision for the Columbia River Watershed. It is apt to note that

> In the vision fish populations are abundant, responding to human ingenuity and mutual cooperation. Commercial, recreational and private fishers continue to enjoy opportunities for providing a family meal, family livelihood or a family outing. People realize the interconnectedness of rivers and ocean, and understand their individual and community responsibilities to exercise proper stewardship for both. Negative impacts on fish populations from irresponsible commercial and industrial operations are no longer seen.[18]

The final section of the letter, "The Rivers in Our Responsibility" produces an ethical framework for action by offering ten "Considerations for Community Caretaking." These ten considerations maybe interpreted as general norms or ethical guidelines and are stated as:

- Consider the Common Good
- Conserve the Watershed as a Common Good
- Conserve and Protect Species of Wildlife
- Respect the Dignity and Traditions of the Region's Indigenous Peoples
- Promote Justice for the Poor, Linking Economic and Environmental Justice
- Promote Community Resolution of Economic and Ecological Issues
- Promote Social and Ecological Responsibility among Reductive and Reproductive Enterprises
- Conserve Energy and Establish Environmentally Integrated Alternative Energy Sources
- Respect Ethnic and Racial Cultures, Citizens and Communities
- Integrate Transportation and Recreation Needs with Sustainable Ecosystem Requirements[19]

These ethical guidelines, along with the content of the entire document, signifies several important developments. First, the concept of the common good, a

longstanding anthropocentric aspect of Catholic social teaching, is expanded to include ecological exigencies and is applied to a specific geographic-ecological region and not only to people. Second, the Bishops resist the predominant viewpoint that there must be tension or antipathy between human needs and the needs of other species. In doing so the letter seeks to integrate human oriented social justice with ecological justice and indicates a new emerging ethical perspective that links justice for people with justice for creation. Third the document intentionally promotes the idea of sustainability in the notion of "sustainable ecosystem requirements." This represents a new direction and horizon for ethical reflection and action that has important implications for salmon recovery in the Columbia River Basin. Finally, the pastoral letter provides a novel baseline document for ethical analysis of a complex regional problem from a theological perspective, which in part is one aspect of this essay.

The consideration for community caretaking that is particularly relevant for this analysis is the norm to "Conserve and Protect Species of Wildlife." Recognizing the keystone status of salmon the Bishops state that "The presence and health of salmon and other species of fish in the Columbia-Snake system, in particular, is a sign of the health of the entire region."[20] In the debate over salmon recovery this section on conserving wildlife indicates that "decisions must consider scientific studies" and, while these decisions are ultimately political, they ought to "stem from a spiritual and ethical base."[21] Moreover the Bishops urge that "serious discussions and serious scientific research continue in order to assure the presence of a habitat suitable for the native fish of the region."[22] The on-going scientific research associated with salmon recovery is supported by the pastoral letter. A notable example of this research is the

attempt to genetically assess historical populations of salmon and steelhead in the Columbia River Basin by the NMFS and the Washington and Oregon State Departments of Fish and Wildlife. A complex process, this research addresses such criteria as geography, migration rates, genetic attributes, life-history patterns and phenotypic characteristics, population dynamics and environmental and habitat characteristics. While this research is in its nascent stage it holds great potential for unlocking the complex nature and life cycle of salmon. Another example that has significant policy implications and is central to current salmon recovery efforts is the concept known as Viable Salmonid Population or VSP.

The Viable Salmonid Population Concept

The basic document written by NMFS scientists that guides the W/LC TRT and NFSC scientific process intended to promote salmon recovery is entitled "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" hereafter referred to as the VSP paper.[23] It indicates that while salmonid listings are at the level of the ESU, that recovery actions will need to take place at the smaller scale of independent populations. An independent population is a geographically defined group of salmon or steelhead that is genetically isolated, and has population dynamics, such that its risk of extinction over a 100-year period is considered independent of what happens to any surrounding populations. The goal under the VSP paper is to identify independent salmon or steelhead populations, and to establish population growth and abundance guidelines for the populations selected for conservation so that their risk of extinction over a 100 year period is considered negligible. Mathematically this is being interpreted by the NMFS as an extinction risk of 5% or less over a 100 year period in the formal modeling that is the

fundamental tool of the VSP paper. The approach of the VSP paper is based on a combination of instrumentalization of the fish using a very simple metric (numbers of fish present and their population growth rates, not more complicated fish-habitat relationships or descriptions of habitat quality) and a minimalist level of population recovery as a goal (i.e., not going extinct as opposed to restoring abundance).

The VSP paper gives us other things to consider. It calls for the extinction risk being calculated on the basis of naturally spawning salmon and steelhead, rather than the masses of fish released from hatcheries to buoy up the availability of fish for the commercial, tribal and sports fisheries. While this does insist upon some natural productivity, it leaves unaddressed the issue of genetic dilution of wild salmon and steelhead populations due to the release of hatchery fish, derived from other geographic areas, in numbers far outstripping those of the remaining natural spawners.

The VSP paper also calls for some degree of geographic spread of populations within an ESU, and some level of population life history diversity so that not all returning natural spawners arrive synchronously to face the same temporary negative environmental fluctuation (e.g., a period of unusually low water levels). It additionally calls for a consideration of potential catastrophic risks, and an avoidance of a plan in which all the populations identified as crucial for ESU perpetuation share the same catastrophic risk (e.g., not all of them would be decimated by one volcanic eruption or pesticide tank truck accident). However, the definitions of life history diversity and catastrophic risk assessment are vague in the VSP document, and these considerations take the back seat to population abundance and growth modeling under the VSP approach. According to the NMFS, the relationship between habitat and the four viability

criteria is clearly articulated in the VSP paper when it states that

> Several potential parameters, notably habitat characteristics and ecological interactions, are not components NMFS uses to define population status, even though they are unquestionably important to salmonid viability. The reason these attributes (and others) are not part of the viability criteria is that their effects are ultimately reflected in the four primary parameters we do examine.[24]

The VSP document departs from the emphasis on habitat in the Federal All-H paper and the Endangered Species Act (which lists habitat loss as a first consideration) by giving primacy to population and abundance criteria, and placing habitat considerations in a secondary tier of concerns. The argument made here is that if fish populations are growing and at acceptable levels, then habitat conditions must be favorable. This is a crucial point of reference and is worth quoting the VSP paper itself:

> Although viable salmonid populations clearly require high quality freshwater habitat, this paper focuses on population processes and does not attempt to establish the relationship between particular habitat attributes and population viability. This is appropriate given the goals of this paper, since we are providing a foundation for setting recovery goals of listed ESUs. These goals will be based on current and projected status of fish populations, not on the presence or absence of particular habitat attributes.[25]

To fully understand the VSP approach, it is necessary to consider the meaning of "recovery goals" under the ESA as interpreted by the NMFS as its scientific mandate. It is not what a typical person's view of recovery might be. "Recovery" as interpreted here does not mean a return to historical levels of abundance now impossible in many areas due to irreversible habitat loss. Nor does it refer to what many people in the Columbia River Basin call "broad sense recovery," which would mean a level of abundance that provides satisfactory salmon and steelhead populations well above their minimal threshold for risk of extinction. In a companion document, "Recovery Planning Guidance for Technical Recovery Teams" (hereafter the RPG document), the NMFS states that

there are actually two types of “recovery” that it has a legislative mandate to implement.[26] The RPG document interprets recovery in the first instance to mean that a listed species can be removed from ESA protection because it is no longer in jeopardy of extirpation in “all or a significant portion of its range.” This requires that the number of populations and their growth rate would allow for delisting of the ESUs, because ESU risk of extinction over a one hundred year period would be 5% or less.

The second type of “recovery” that the NMFS describes in the RPG document is based on the Magnuson-Stevens Fishery Conservation and Management Act of 1976 and tribal treaty rights of 1855. In this context recovery is interpreted to require a harvestable surplus of fish for consumption. The Magnuson-Stevens Act and tribal treaties have led to widespread hatchery operations, which are essentially factories, designed to replace natural production lost to human environmental degradation with artificial propagation of fish. According to the NMFS’ RPG document, “Neither” the minimalist ESA-mandated recovery or the harvestable surplus based “concept of salmon recovery is intrinsically better.”[27] Furthermore neither of these definitions of “recovery” would require a commitment to a wide-ranging restoration of salmonid habitats in the Northwest that is necessary to achieve what this article means by “broad sense recovery.”

It is worth saying that the ESA was never written for anadromous fish in particular. It is a piece of legislation that is well worded for a species with a limited geographic range and finite economic impact on human development (e.g. a butterfly found only on one meadow). It had already been stretched to its limit of acceptability to many people in the Pacific Northwest by the listing of the Northern Spotted Owl, a highly mobile species that nonetheless has very specific nesting requirements, which effectively placed much of

the Northwestern old growth forests off limits to logging. The salmon and steelhead listings raised this to a new level of concern for the region. Consider a threatened ESU that must transit through hundreds or thousands of miles of rivers and streams to spawn, and whose habitat requirements include abundant cold clear water diminished by conventional logging, road construction, hydroelectric dam operation, irrigated agriculture, urban industrial development, and many of the other activities we relate to the Northwestern economy. In addition there are powerful regional voices requiring a harvestable surplus of fish for human consumption. It is not surprising that the NMFS, forced to make decisions with great economic impact on the region with inevitable political repercussions, has chosen to prioritize defining a minimum number, distribution, and makeup of fish populations required to prevent extinction. This defers the discussion of more contentious habitat related issues and what a "harvestable surplus" means until a later stage in the recovery process when policy decisions are debated. The eventual disposition of the "allowable harvest" issue becomes more worrisome when the RSRP comments on this topic. In the report of their August 27-29, 2001 meeting the RSRP states that

> Models used to set allowable harvests are notoriously inaccessible and impenetrable to ecologists. Presentations to the RSRP panel did little to dispel this impression, and we felt the presenters were unnecessarily defensive, and at times even obfuscatory. Despite hours of presentations and numerous probing questions from the RSRP panel, we remain somewhat mystified concerning the scientific justification for current allowable harvests, especially the continuation of substantial or high allowable harvests on listed salmonid ESUs…..it became apparent that NMFS, state and tribal personnel involved in setting allowable harvests were not making use of basic theories of harvesting fluctuating populations, in which stochasticity and uncertainty in population dynamics strongly support the precautionary principle for setting conservative allowable harvests…[28]

In dealing with the question of requisite numbers of salmon and steelhead populations

and the diversity of life histories needed for narrow-sense ESA recovery (to levels where delisting might occur), the W/LC TRT developed the concept of “strata”. Each life history and geographic location is defined as a “stratum” (e.g., the fall run and the spring run of Cascade Region Lower Columbia River Chinook are two strata). The stratum concept allows a requisite number of populations to be defined for each life history of each ESU that must reach VSP levels before delisting can occur. The historical populations for each stratum are defined, often with difficulty. For example the spring run of Cascade Region Lower Columbia River Chinook are believed to have had seven historical populations. The W/LC TRT carried out an informal risk analysis trying to determine how many populations each stratum must have in narrow sense recovery planning, and it was determined that 50% of the historical populations, or 2 populations (whichever is greater) would be needed for sufficient risk reduction to have occurred. For the remaining extant populations, “some level of natural origin returns” of spawning fish is defined as the requirement. The decision to adopt a numerical definition of acceptable risk before delisting can occur (5% risk of extinction over 100 years) inevitably led to this sort of “how many populations do we really need” approach to salmon and steelhead. Consequently not only the fish themselves but also their habitats are instrumentalized in the NMFS process of attempting to describe what viable populations might be like.

Viable Salmonid Population and Habitat Criteria

The four Viable Salmonid Population criteria—population growth rate, population abundance, life history diversity, and spatial structure—have been given preferential importance over habitat criteria in the NMFS recovery planning process. The first two VSP criteria, population growth rate and abundance, have been expressed as

mathematical models of considerable sophistication. However the modeling ignores human decisions about land use and user conflicts, by the process of abstraction and simplification of assumptions that is fundamental to mathematical modeling. The latter two VSP criteria—life history diversity and spatial structure—have explicit in them the assumption that not all existing salmon populations ought to be protected in the recovery process. Consequently, a minimal number of life history diversities and spatial distributions of salmon and steelhead populations are to be identified, with a goal of preventing extinction over the next 100 years, rather than a broader scale recovery that would correspond to what an intuitive mental picture of "species recovery" would be.

One way that the primacy of VSP criteria over habitat is expressed is the distinction made between Phase I (scientific recommendations) and Phase II (policy implementation) of the NMFS recovery planning process. The use of habitat criteria in Phase I is described by the NMFS in a 2002 document entitled "Ecosystem Recovery Planning for Listed Salmon: An Integrated Assessment Approach for Salmon Habitat.[29] This document, released two years later than the VSP paper, calls for Phase I habitat analyses to be carried out in order to determine how land use patterns have affected the four VSP criteria, and to help set "biological delisting criteria" for each ESU. The distinction between the delisiting criteria in Phase I "biological delisting criteria" and Phase II "administrative delisting criteria" is crucial. Phase I "biological delisting criteria" emerge from the NMFS' consideration of TRT scientific recommendations, and have scientific content unaltered by political compromise and practicalities. Phase I planning for recovery under the ESA is, as noted above, interpreted in the RPG document as fulfilled when a listed species can be removed from ESA protection because it is no longer in

jeopardy of extirpation in "all or a significant portion of its range." The development of scientific criteria to assess when this has taken place is described in the RPG document as "largely a technical exercise, with policy input."[30] However, the VSP document notes that "because the process of determining what constitutes a "significant portion" of a species' range is only partially based on biological considerations, the technical definitions of these terms are of limited use".[31] We are left therefore with a "technical" process without "technical definitions of …terms" to rely upon. Phase II "administrative delisting criteria" are to be generated by a group that includes ExComm and some level of TRT input. In the RPG document, the NMFS indicates that Phase II planning for recovery is "largely a policy exercise, with technical input."[32]By making numbers of fish and their growth rates primary, and stating that not all populations in all places will be recovered, the NMFS has shaped the discussion of "broad sense recovery" goals in the Phase II process by establishing a narrow scientific foundation for those deliberations.[33]

The "Ecosystem Recovery Planning" document proposes a process in Phase II of prioritizing actions likely to have a major impact on anadromous fish recovery. It recognizes five major types of actions that might be taken: habitat reconnection, road improvement, riparian restoration, in-stream habitat restoration, and nutrient enrichment. These recovery actions are ones whose impact, especially if prioritized on the basis of probable efficacy of each in a given location, might have transforming effects on the habitats through which salmon and steelhead move and in which they reproduce. However, a strategic interdisciplinary analysis indicates that the critical decision to target specific populations for recovery before the prioritization and implementation of these actions guarantee minimized impact of these sound measures. If a 5% chance of

extinction for an ESU over 100 years is the recovery goal, no set of habitat recovery actions can transform the region except in specific and limited locations and to limited extents. The ecology of recovery planning that considers habitat criteria fundamental to the process has therefore been circumscribed *a priori* in the recovery planning process that the NMFS has defined. This has important scientific as well as ethical implications.

An Axiological-Ethical Analysis: Salmon Recovery and Creation Theology

One approach in assessing salmon recovery efforts is to engage in an axiological analysis, that is, an analysis of the values that are driving the process. Ethically this is significant because from the standpoint of a de-ontological ethic, values hold the capacity of generating moral obligation and duty. In other words, humans are compelled to act ethically in relationship to that which they value. Salmon and steelhead carry a spectrum of value for the people in the Columbia River Basin ranging from scientific to sacred value. Consider for a moment the concept of the Evolutionarily Significant Unit. As a scientific-policy designation, the concept of the ESU was developed specifically to assist in the recovery of salmon under the legal framework of the Endangered Species Act. While the validity of the concept could be debated, it clearly represents the scientific valuation of salmon because an ESU "represents a significant component of the species evolutionary legacy." Consequently from the view of evolutionary biology the concept of the ESU represents location specific species-diversity and genetic-diversity value. All the more reason salmon species and their native habitat ought to be preserved because—as Holmes Rolston aptly states—"In an evolutionary ecosystem it is not mere individuality that counts; the species is also significant because it is a dynamic life form maintained over time by an informed genetic flow."[34] The extinction of a species

therefore forecloses the evolutionary generative-creative matrix that is the essence of biodiversity on this planet.

Moreover salmon carry a panoply of additional values some of which are economic, culinary-nutritional, recreational, aesthetic, and cultural-religious. The latter is particularly important to the indigenous peoples of the Columbia River Basin. What these values have in common is that they are essentially instrumental in nature, that is, they reflect the use-value salmon hold for humans. There is nothing necessarily disturbing about this, as all species enjoy an instrumental relationship with their biophysical environment. Simply put survivability requires it. Nonetheless what concerns our analysis of salmon recovery—as outlined above—is that the social context and process of recovery appears to accentuate and perhaps even accelerates the instrumentalization of salmon.

If the institutional apparatus of salmon recovery is examined, it becomes clear that the social context is largely scientific-bureaucratic wherein the technological rationality of the empirical-analytical sciences predominates. An underlying interest in technical control is revealed, the hallmark of which is the reduction of salmon recovery to the numerical viability of population statistics as evidenced by the VSP concept. That scientific analysis should have a major role in salmon recovery efforts is not the issue or the debate here. However, when those who represent the empirical-analytical sciences hold the exclusive position of asking the questions, setting the parameters and the goals of salmon recovery, the instrumentalization of salmon is inevitable. The viability of salmon, calculated as an extinction risk of 5% or less over a 100 year period and a recovery plan that seeks to preserve 50% of historical populations or 2 populations

(whichever is greater) within an ESU reduces salmon recovery from an axiological perspective to a minimalist bottom line "lowest common denominator" standard. Stated differently the targeted recovery goal of the Viable Salmonid Population standard undercuts the axiological horizon of salmon for many in the Columbia Basin. In light of this narrow standard a number of recovery-value questions arise. For example, will the targeted goal of salmon viability resurrect a wild salmon river fishery in the Columbia and rejuvenate a seriously curtailed salmon ocean fishery off the coast of Oregon and Washington? Will the NMFS' recovery goal for wild stocks of salmon and steelhead reduce or eliminate the need for the inefficient and expensive hatchery system—that is biologically, ecologically, and economically disputed by many—and has dominated the technologically based numerical valuation of salmon for nearly 100 years? From a theological perspective will the recovery goal of viability allow salmon to flourish where, in the vision of the Columbia River Pastoral Letter, "fish populations are abundant" and "Negative impacts on fish . . . are no longer seen?"

If the theological vision of the *Columbia River Watershed* is included in this analysis the axiological discourse is raised to another level. As noted above the CRPLP grounds ethical responsibility for restoring salmon in the concept of stewardship, creation theology and the common good. Theologically the centerpiece of this approach is creation theology. While space prevents a full blown discussion of creation theology, suffice to say that it forms a significant component of the biblical tradition and is frequently utilized in the pastoral letter in the sub-sections titled "Religious Traditions," "The Columbia and the Common Good," and "Living Waters." Stewardship—a technical biblical term meaning the care or management of something owned by another—defines

the role or vocation of humanity within creation as its caretaker. The axiological milieu of creation theology is perhaps best exemplified by the creation accounts of Genesis 1-2. Noting this the pastoral letter states, "Created in the image of God (Genesis 1:26-27), humans are to recognize that all of God's works and creatures, as they emerge from God's creative loving power, are "very good" (Genesis 1:31)."[35] The frequent poetic refrain, "and God saw that is was good" of Genesis chapter one is key to this analysis and signifies that the value assigned to creation is not generated by creation itself or humanity but is rooted in creation's direct relationship to the artistic creativity of God. The value of creation is therefore profoundly theocentric and suggests a theocentric axiology. This moves the conversation in the direction of what some environmental philosophers, like Holmes Rolston, have called intrinsic value—the value of the natural world independent of human use. The U.S. Catholic Bishops capture this sentiment in *Renewing the Earth* (1991) when they write ". . . it is appropriate that we treat other creatures and the natural world not just as means to human fulfillment but also as God's creatures, possessing an independent value, worthy of our respect and care."[36] This ethical perspective qualitatively raises the axiological ante of the value of salmon and indicates that the current recovery goal of population viability is inadequate and inconsistent with a religious axiological horizon wherein "Each portion of creation can be a sign and revelation for the person of faith, a moment of grace revealing God's presence to us."[37] Under current environmental conditions, the recovery of salmon in the Columbia River Basin to historical population numbers is impossible, but what this essay means by "broad sense recovery" is a more adequate target for salmon restoration in keeping with the ethical demands of stewardship and the value of creation.

There is an additional issue in the NMFS' salmon recovery process that warrants examination. This is the disconnection between a viable salmon population and habitat and the relegation of habitat de-listing criteria to secondary status as "administrative criteria." This matter is at once a scientific and an ethical problem. Scientifically the attempt to separate the recovery of a species from its habitat requirements is a violation of ecological principles and a failure to acknowledge that a threatened or endangered species means a threatened or endangered habitat. Threatened salmon and steelhead are Evolutionary Significant Units precisely because their evolution is inextricably related to their generative ecosystem—the Columbia River Basin.

The ethical dimension of this matter is reminiscent of Aldo Leopold's pioneering reflection in "The Land Ethic." Drawing upon the insights of ecology Leopold sought to extend ethical consideration to the land, which he called a "biotic community." For Leopold "The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."[38] Leopold's notion of land as community highlights the inter-relatedness of a species with its ecosystem. From an axiological standpoint the value of salmon is bound-up with its habitat. Rolston puts it this way: "It is not preservation of *species* that we wish but the preservation of *species in the system*. It is not merely *what* they are but *where* they are that we must value correctly."[39] Furthermore he argues that "The full integrity of the species must be integrated into the ecosystem. This species-environment complex ought to be preserved because it is the generative context of value."[40] In the case of salmon the fish-habitat relationship is the vehicle through which the ESUs were generated. Losing that not only means losing fish but also the potential inherent in the process itself cutting the future off

from a long history measured in millenia.

Theologically this perspective is validated by biblical creation theology. While it is true the biblical authors knew nothing of the scientific terms like habitat and ecosystem, one could argue—at the risk of sounding anachronistic—that there is an intuitive ecology in their understanding of creation. One must remember that the biblical world-view of the Old Testament originates in a tribal social structure where relationship and community are primary. This experience of relationship and community extends to all creation. This is best exemplified in the second chapter of Genesis where all life—human, botanical and zoological—share the organic relationship of coming "out of the ground (Gen. 2: 7,9,19). In other words all creatures share a common fundamental bond that is inextricably related to the earth. The theological extrapolation of this biblical view of creation to the current species-habitat question seems to justify the valuation of salmon-in-their-habitat and the ethical obligation to preserve and restore both. The scientific and theological argument outlined here would require the re-alignment of the National Marine Fisheries Service's VSP concept with habitat science and the elevation of habitat de-listing criteria as primary to the preservation and recovery of Columbia River Basin ESU's. This might, in the words of the Columbia River Pastoral Letter, "ensure a habitat suitable for the native fish of the region."

Conclusion: Salmon Recovery and the Ethical Horizon of Sustainability

In the final analysis of salmon recovery in the Columbia River Basin, it would appear that the scientific-bureaucratic driven process lacks broad imagination; it lacks a moral vision and an ethical horizon capable of moving the inhabitants of the region in a new direction—a direction that compels human beings to live differently in their watersheds.

For lack of better language, this new vision and paradigm is best referred to as sustainability—a way of living that balances the needs of humans with the legitimate and appropriate eco-systemic needs of salmon. Admittedly sustainability is a potentially "loaded" term and can in fact be used to obscure the truth. It does not mean sustainable fisheries where the harvesting of salmon is propped up by technological fixes like hatcheries, barging and other artificial means. Sustainability, as it applies to the Columbia River Basin, is a broad-based social-institutional shift in the way people live on the land. It is a new model of human existence that, according to environmental scientist, Daniel Chiras includes the following principles:

- Stabilizing population growth
- Better growth management
- Efficient use of resources
- Renewable energy
- Recycling
- Ecological restoration
- Sustainable resource management[41]

These general principles of sustainability reveal science at its most powerful, as a synthetic process that assembles disparate data. This level of scientific input is required to bring reductionistic and instrumentalizing scientific approaches into a cogent whole.

From a theological perspective sustainability can be understood as the ethical praxis of restoring and maintaining the integrity of creation as that has become manifest in the diverse species and habitats of the Columbia Basin. It reflects the ethical obligation to do justice and righteousness for human and earth. This will necessitate an alteration in specific unsustainable behaviors that we humans have institutionalized in the name of economic progress. Moreover, it will require—in the words of Pope John Paul II and Patriarch Bartholomew I—

> an act of repentance on our part and a renewed attempt to view ourselves, one another, and the world around us within the perspective of the divine design of creation. The problem is not simply economic and technological; it is moral and spiritual. A solution at the economic and technological level can be found only if we undergo, in the most radical way, an inner change of heart, which can lead to a change of in lifestyle and of unsustainable patterns of consumption and production.[42]

Until we recognize that habitat destruction, caused by human population density and the over-consumption of resources, is the root of the salmon's decline, the attempts to restore these magnificent species will be little more than a Band-Aid on the festering wound of extinction. This critique is not intended to deprecate the efforts of the National Marine Fisheries Service and all involved in the politically contentious process of recovering salmon. It is, on the other hand, an appeal to expand the boundaries of recovery planning discourse and action to include voices and perspectives from other disciplines and sectors of society who possess an ethical vision of what ought to be. What is needed is a convergence of science and theology, as well as other humanistic disciplines, in order to broaden the scope of what we in the Pacific Northwest mean by salmon recovery. This paper is an invitation to create strategic interdisciplinary approaches to salmon recovery that recognizes sustainability as the ethical horizon for the Columbia River Basin's future.

[1] Ian Barbour, *Religion and Science, Historical and Contemporary Issues*, (San Fancisco: HarperCollins, 1997), 77-105.
[2] Ibid., 84.
[3] For full text of *Ex Corde Ecclesiae* see www.ewtn.com/library/papaldoc/.
[4] John Paul II, Apostolic Constitution of the Supreme Pontiff John Paul II on Catholic Universities, (Vatican City: Libreria Editrice Vaticana, 1990), 27.
[5] Nehlsen, W., J.E. Williams, and J.A. Lichatowich. "Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington." (*Fisheries* 16 (2), 1991), 4-21.
[6] Jim Lichatowich, *Salmon Without Rivers: A History of the Pacific Salmon Crisis*, (Washington D.C.: Island Press, 1999), 204.
[7] For the full text of the 2000 FCRPS BiOp see www.nwr.noaa.gov/1hydrop/hydroweb/docs/Final/2000Biop.html. For full text of the Federal All-H Paper see www.salmonrecovery.gov/strategy.shtml.
[8] For information regarding *Wy-Kan-Usu-Mi Wa-Kish-Wit* see www.crtitfc.org/text/trp.html.
[9] "Fish and Wildlife Program, Subbasins", Northwest Power Planning Council, Council Document 2000-19. For documents of the Northwest Power Planning Council see www.nwcouncil.org/library/Default.htm.
[10] "Technical Guide for Subbasin Planners", Northwest Power Planning Council, Council Document 2001-20.
[11] Ibid., 4.
[12] R.T. Pain, chair; T. Case; F. James; S. Levin; R. Lande; B. Murdoch; B. Sanderson, Salmon Recovery Science Review Panel Report for the meeting held December 4-6, 2000, Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, WA.
[13] Three landscape-based approaches to salmon conservation that incorporate human activities and habitat relationships as core elements from the outset, are: (1) *A Coarse Screening Process for Evaluation of the Effects of Land Management Activities on Salmon Spawning and Rearing Habitat in ESA Consultations*, CRITFC Technical Report 94-4, 1994, J.J. Rhodes, D.A. Mcullough, and F.A. Espinosa, Jr., (2) *Monitoring Protocols: Effectiveness Monitoring of Physical/Environmental Indicators in Tributary Habitats*, a technical report prepared for the Bonneville Power Administration, 2002, T. W. Hillman and A. E. Giorgi, BioAnalysts, Inc., and (3) *An Ecosystem Approach to Salmonid Conservation*, 1996, B.C. Spence, G.A. Lomnicky, R.M. Hughes, and R. P. Novitzki, ManTech Environmental Research Services Corp. These documents have significant potential for facilitating ethical reflections on habitat and land use issues.
[14] *A Strategy for Integrating Out-of-Subbasin Conditions into Subbasin and Recovery Planning Within the Anadromous Zone of the Columbia River Basin*, an unpublished document of the NMFS, October, 2002.
[15] Recent scientific analysis strongly suggests that "critical uncertainties" like global climate change could have significant impact on snow-pack, water resources and salmon recovery in the Pacific Northwest. See *Degrees of Danger, Health Effects of Climate Change and Energy in Oregon*, Physicians for Social Responsibility, Oregon Report, Feb. 2002 (www.psr.org) and A. Hamlet, *Climate Change in the Columbia River Basin*,

University of Washington: JISAO Climate Impacts Group, 2001 (www.ce.washington.edu/~hamleaf/Hyd_and_Wat_Res_Climate_Change.html).
[16] *The Columbia River Watershed: Caring for Creation and the Common Good*, An International Pastoral Letter by the Catholic Bishops of the Region, January 8, 2001. For complete text see www.columbiariver.org.
[17] Ibid., 3.
[18] Ibid., 12.
[19] Ibid., 13-17.
[20] Ibid., 14.
[21] Ibid.
[22] Ibid.
[23] P. McElhany, M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units*, 2000, U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 156 p. Most NOAA Technical Memorandums NMFS-NWFSC are available on-line at www.nwfsc.noaa.gov.
[24] Ibid., 11.
[25] Ibid., 36.
[26] "Recovery Planning Guidance for Technical Recovery Teams", unpublished document, National Marine Fisheries Service, September 1, 2000 draft.
[27] Ibid., 2.
[28] R.T. Pain, chair; T. Case; F. James; S. Levin; R. Lande; B. Murdoch; B. Sanderson, Salmon Recovery Science Review Panel Report for the meeting held August 27-29, 2001, Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, WA, 7-8.
[29] T. J. Beechie, P. Roni, and E. A. Steel, editors, *Ecosystem Recovery Planning for Listed Salmon: An Integrated Assessment Approach for Salmon Habitat*, 2002, Northwest Fisheries Science Center, Seattle, WA.
www.nwfsc.noaa.gov/ec/wpg/documents/OnlineReview.pdf.
[30] "Recovery Planning Guidance for Technical Recovery Teams," 1.
[31] P. McElhany et al. 34.
[32] "Recovery Planning Guidance for Technical Recovery Teams," 1.
[33] It is possible that the discussion of broad sense recovery goals in the Phase II process could move the conversation to a definition of recovery that does not separate habitat criteria from growth and abundance criteria. The policy process deliberations are, at this time, in their nascent stages.
[34] Holmes Rolston, III, *Environmental Ethics*, (Philadelphia: Temple University Press, 1988), 143.
[35] *The Columbia River Watershed*, 6.
[36] "Renewing the Earth: An Invitation to Reflection and Action on Environment in Light of Catholic Social Teaching," A Pastoral Statement of the United States Catholic Conference, November, 1991, in *Pastoral Letters and Statements of the United States Catholic Bishops*, Patrick W. Carey, ed. (Washington, D.C.: United States Catholic Conference, 1998, 397-418), 406.
[37] *The Columbia River Watershed*, 7.
[38] Aldo Leopold, *A Sand County Almanac and Sketches Here and There*, (New York: Oxford University Press, 1960), 204.

[39] Rolston, 153.
[40] Ibid., 153-154.
[41] Daniel D. Chiras, *Envrionmental Science, Creating a Sustainable Future*, (Sudbury, MA: Jones and Bartlett Publishers, 2001), 53.
[42] Common Declaration by Pope John Paul II and the Ecumenical Patriarch Bartholomew I, Rome-Venice, June 10, 2002. See www.rsesymposia.org/symposium_iv/themes_declaration.htm.