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Draft Staff Paper

Methods of Economic Analysis for Salmon Recovery Programs

July 30, 1997

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Introduction

This paper recommends methods of economic analysis for evaluating and comparing fish and wildlife recovery programs. Developed by the staff of the Northwest Power Planning Council, the paper is intended in part to help the Council evaluate the economic dimensions of fish and wildlife recovery actions.

The Council draws guidance on the role of economics in its fish and wildlife decisions from the Northwest Power Act. Under the Northwest Power Act, the Council develops a Columbia River Basin Fish and Wildlife Program to "protect, mitigate and enhance fish and wildlife affected by the development, operation, and management of the [the basin's hydroelectric] facilities while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply." The Act contains procedures and standards to further guide the Council's development of the program, most of them biological (e.g., use the "best available scientific knowledge") or legal (e.g., consistency with legal rights of tribes). Economics and cost effectiveness enter directly into the Council's program amendment decisions in only two ways: First, as evident from the primary standard quoted above, the Council must be able to assure that the program assures the region an "economical" power supply.[1] Second, if "equally effective alternative means of achieving the same sound biological objective exist," the Council is to include in the program "the alternative with the minimum economic cost." [2]

In 1994, the Direct Service Industries, Inc. argued in a court challenge to the Council's adoption of program amendments that the Power Act required the Council to subject proposed program amendments to a cost-benefit analysis. The U.S. Court of the Appeals for the Ninth Circuit rejected this claim, noting that the Power Act does not require cost-benefit analysis, explicitly or implicitly.[3]

A 1996 amendment to the Northwest Power Act provides that when making project funding recommendations to the Bonneville Power Administration to implement the Council's Columbia River Basin Fish and Wildlife Program, the Council "shall determine whether the projects employ cost effective measures to achieve program objectives." This paper attempts to describe an approach or methodology that the Council will apply in making the cost-effectiveness determination called for in the legislation. The scope of this cost-effectiveness determination is limited to what is called the "direct program" portion of the Bonneville fish and wildlife budget. The direct program budget totals approximately $100 million out of an average annual budget for Bonneville fish and wildlife activities of $252 million. This direct program portion of the budget funds, among other things, a number of habitat, production, coordination and research projects that correspond to measures in the Council's program. It is these projects for which the Council

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[1] Northwest Power Act, § 4(h)(5); see the Council's Columbia River Basin Fish and Wildlife Program, Section 1.8 and Appendix C, "Assuring an Adequate, Efficient, Economical and Reliable Power Supply."
[2] Northwest Power Act, § 4(h)(6)(C).
[3] Northwest Resource Information Center, Inc. v. Northwest Power Planning Council, 35 F.3d 1371, **[add page cite]** (9th Cir. 1994).

must make the cost-effectiveness determination. The cost effectiveness determination required by the amendment to the Northwest Power Act excludes the remainder of the $252 million Bonneville budget and foregone power revenues as a result of changes in the operation of the river system. It is also important to remember that there are fish and wildlife activities in the basin not funded by Bonneville. These include Mitchell Act funding for hatcheries and diversion screens, land management activities to improve fish and wildlife conditions funded by the Forest Service, the Bureau of Land Management and others, and state investments in watersheds and harvest management, and more. One of the needs in the basin is to better understand and coordinate fish and wildlife activities of federal, state, and tribal entities.

The Council needs to develop a systematic approach to economic analysis of fish and wildlife measures to meet its obligations under the Northwest Power Act. Moreover, in order to make systematic judgments, the Council must consider a broad range of economic information. At a minimum, this broader economic perspective provides a context within which the more narrow cost-effectiveness determination called for in the Power Act amendment takes place. The broader context would include all areas of recovery actions and their implications including direct program funding, changes in operation of the Columbia River system, funding of production facilities outside the direct program, and capital investment appropriations for mainstem hydrosystem modifications undertaken consistent with the National Marine Fisheries Service's Biological Opinion on hydrosystem operations and the Council's Program. Thus, this paper has been developed in part to allow the Council's cost-effectiveness review to range broader than the direct program, even if these observations have less of a specific legal meaning for year-to-year funding decisions.

A broader economic perspective will help prepare the Council and other entities to understand and make the comprehensive programmatic decisions that will be called for in the next few years. Under consideration in a number of forums and processes, are proposals for major reconfigurations of the Columbia River hydroelectric facilities for the benefit of salmon and other fish and wildlife, including the possibility of removing or breaching a number of dams in the lower Columbia and Snake rivers or making other substantial and expensive, if less dramatic, modifications to the dams. Decisionmakers need to know how to develop the appropriate information on the economic implications of these proposals. This paper is intended as a guide to methods of economic analysis for this purpose.

Implementation and Funding of the Council Program

The Council does not implement or fund the implementation of its program. Instead, Section 4(h)(10)(A) of the Act requires the Bonneville Power Administration to use its fund -- its power revenues -- and other authorities to protect, mitigate, enhance fish and wildlife "in a manner consistent with" the Council's Program. Bonneville funds fish and wildlife projects and activities proposed by others -- primarily the state and federal fish and wildlife agencies, tribes, and federal operating agencies -- to implement the Council's Program as well as other fish and wildlife programs that are a funding obligation on Bonneville. With few exceptions, Bonneville does not implement the program itself. Bonneville directly funds many of these projects, especially certain production, habitat and research projects. Other projects, including capital investments for modification to Corps of Engineers and Bureau of Reclamation dams and other Corps

projects, are funded first by Congressional appropriations, and then Bonneville reimburses the share attributable to the hydropower purpose of the hydroelectric facilities.

In 1995, Bonneville, the National Marine Fisheries Service and the chairman of the Northwest Power Planning Council negotiated, and the Clinton Administration agreed to, a six-year (1996-2001) budget for Bonneville's fish and wildlife funding. Toward the end of 1996, Bonneville, the Corps of Engineers, the Bureau of Reclamation, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service developed, in consultation with the region's Indian tribes and the Council, a Memorandum of Agreement (MOA) for the Bonneville Fish and Wildlife Budget to implement the budget agreement.

Under the MOA, Bonneville's financial commitment is in two parts. First, Bonneville agreed to absorb the financial consequences of the current set of system operations, whatever the cost (with a few exceptions). These operations include implementing the Biological Opinions for Snake River salmon (NMFS) and Kootenai sturgeon (USFWS), as well as a few other system elements, such as the Lake Pend Oreille reservoir levels in the Council's program. The financial costs of these operational changes vary dramatically depending on year to year water conditions. Second, Bonneville agreed to provide an average of $252 million per year through fiscal year 2001 for expenditures in three categories:

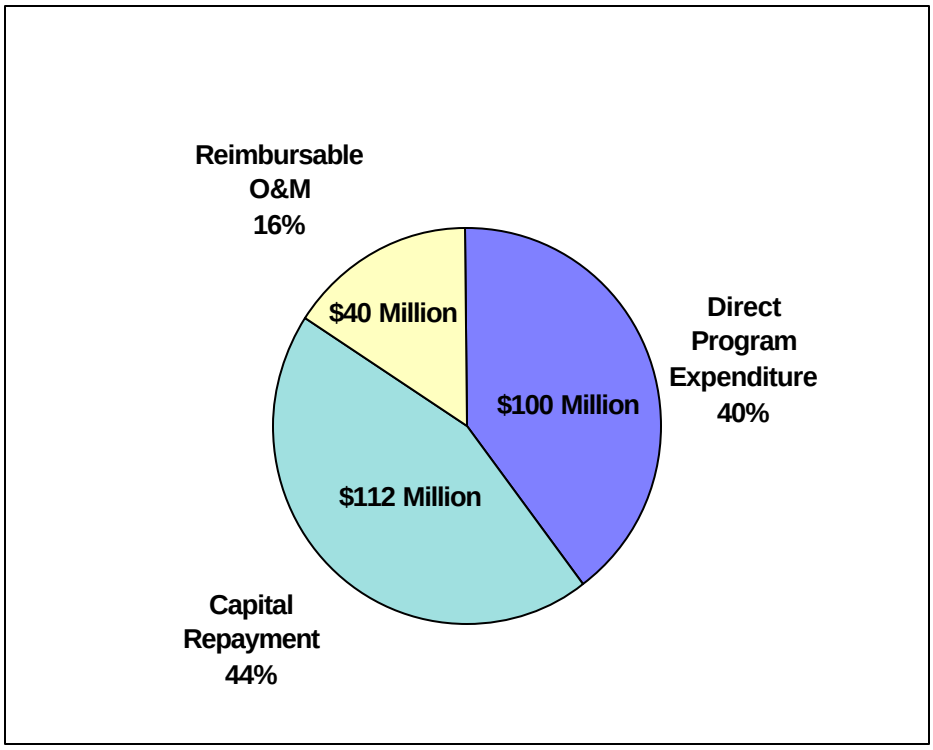
(1) Direct program expenditures. This category is to average $100 million per year and consists of direct expenditures by Bonneville for projects related to the Council's program and the two Biological Opinions, primarily habitat, production, research and coordination projects. These expenditures are primarily for operation and maintenance of recovery projects.

(2) Capital investment repayments. This category is to average $112 million per year, to cover the repayment stream for both past and expected future direct capital investments by Bonneville (mostly related to the Council program) and for past and expected capital investments made by Congressional appropriations (primarily for modifications to mainstem dams by the Corps of Engineers plus hatchery capital investments) that Bonneville is obligated to repay to the Treasury. The budget agreement assumes that the expected expenditures in this category reflect, in part, a further investment of Bonneville direct capital during the life of the budget agreement of $27 million per year and that Congress will also make available $565 million in new capital investments over the life of the agreement. The associated repayment obligations for the new capital investments are included in the $112 million.

(3) Reimbursable operations and maintenance expenditures. This category averages $40 million per year and consists of Bonneville reimbursements to the Treasury of Congressional appropriations for the operation and maintenance of artificial production facilities (and a few other matters) directly authorized by Congress, primarily through the Lower Snake River Compensation Program.

Figure 1 illustrates the distribution of Bonneville's $252 million of fish and wildlife expenditures under the MOA.

Figure 1: Bonneville's MOA Expenditures



The MOA assumes that the amounts allocated to the three categories will remain in those categories unless there is agreement by the federal agencies in consultation with the tribes and the Council to a re-allocation. The MOA also assumes that the regional sovereigns have developed and will continue to develop processes to prioritize and allocate the money assigned to each category. There is potential inconsistency, however, between Bonneville's interpretation of its legal funding obligations, which may be imposed by Congress or the Council's program, and the prioritization results.

It is in the prioritization processes that the region expects to find the necessary budget discipline to make the budget allocations work. The eventual aim is to include all Columbia River fish and wildlife mitigation activities in the prioritization process. At present the prioritization process has meant the development of prioritization groups that are prioritizing projects within one budget category or sub-category. Thus one group (the System Configuration Team) is developing prioritization criteria and ranking projects for the Corps of Engineers' capital investments. Within the direct program category, separate teams of fish and wildlife managers develop prioritization criteria and rank projects for resident fish activities, wildlife activities, and anadromous fish activities, including mainstem research measures, production and habitat activities.

With regard to the "direct program" portion of the Bonneville budget and including the amount of direct capital available, beginning in 1995, Bonneville, the Council and the agencies and tribes developed a more coordinated and annual process for recommending projects to Bonneville for direct funding. The fish and wildlife agencies and tribes review and prioritize projects proposed for funding. In a public review process, the Council then reviews the agencies and tribes' funding recommendations for consistency with

the program and forwards its own recommendations to Bonneville for funding. Bonneville has by and large deferred to the recommendations of the Council, agencies and tribes.[4]

Congress amended Section 4(h)(10) in late 1996 to add additional procedural and substantive requirements to this direct program funding process.[5] Congress sought to insulate the funding process from a perceived conflict of interest -- the agencies and tribes review and prioritize the projects for funding and are also the primary funding recipients. The new legislation creates an independent scientific review process to review funding recommendations. The amendment directed the Council to appoint an eleven-member Independent Scientific Review Panel "to review projects proposed to be funded through that portion of the Bonneville Power Administration's annual fish and wildlife budget that implements the Council's fish and wildlife program." The Council is also directed to appoint scientific peer review groups that are to "assist the Panel in making its recommendations to the Council." The Panel and any peer review groups are subject to the conflict of interest standards that apply to scientists "performing comparable work" for the National Academy of Sciences. The Panel and peer review groups are to review projects proposed for funding and make recommendations to the Council "no later than June 15 of each year." The Panel and review groups need not review each and every project, but a "sufficient number of projects to adequately ensure that the list of prioritized projects recommended is consistent with the Council's program." Recommendations of the Panel and the peer review groups are to be based on a "determination that projects: are based on sound science principles; benefit fish and wildlife, and have a clearly defined objective and outcome with provisions for monitoring and evaluation of results." The Panel and peer review groups are also to review annually "the results of prior year expenditures based upon these criteria," and to submit their findings to the Council.

The Panel's recommendations to the Council must be made available to the public for review and comment. The Council will make final funding recommendations to Bonneville "after consideration of the recommendations of the Panel and other appropriate entities." The Council must explain in writing if it decides not to incorporate a recommendation of the Panel. In making its funding recommendations, the Council also has two additional responsibilities. First, the Council must "consider the impact of ocean conditions on fish and populations. And second, and what is important here, the Council "shall determine whether the projects employ cost-effective measures to achieve program objectives." The legislation provided no further guidance as to the nature of the cost-effectiveness determination or the procedure for making the determination.

To implement the new Power Act amendment during this first year, the Council anticipates using the following process. The agencies and tribes are once again reviewing projects proposed for funding. The Council received a prioritized list from the agencies and tribes on June 5. Earlier this year, recognizing that many of the projects on the priority list are likely to be ongoing projects funded in prior years, the Independent Scientific Review Panel began reviewing information regarding those projects, and the prioritization process generally. The Panel received the prioritized list from the agencies and tribes and provided their own recommendation to the Council on July 15. After a public review process of the agency, tribal and Panel recommendations, the Council will make its recommendations to Bonneville, including a determination regarding their cost effectiveness.

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[4] See Council's Fish and Wildlife Program, Section 3.1B.
[5] Northwest Power Act, new § 4(h)(10)(D).

This paper is intended to explain the cost-effectiveness analysis the Council will use. The Council has appointed an Independent Economic Analysis Board for the purpose, in part, of providing guidance to the Council in making this determination. The IEAB reviewed and commented on earlier drafts of this paper.

Economic Effects of the Columbia River System

The Columbia River and its tributaries are linked to the regional economy in a number of direct and indirect ways. Many of those linkages were created or enhanced by the development of the system of dams that have changed the character of the rivers over the past 100 years. The dams have allowed development of an extensive hydroelectric system, permitted commercial water navigation as far inland as Lewiston, Idaho, supported irrigation of large areas of arid land, provided flood control, and created recreational opportunities in the many reservoirs created by the system of dams. All of these are generally considered positive economic effects in the Pacific Northwest.

Accompanying the positive economic effects of Columbia River development, were negative cultural and environmental effects. There were also some negative economic effects on the commercial and recreational salmon and steelhead fishing industry due to the declining populations of those species. The purpose of this section is not to advocate any balance of the various effects of the Columbia River development. It is simply to establish the nature of the economic linkages that must be accounted for in any cost-effectiveness analysis of fish and wildlife recovery actions.

Hydroelectricity provides about two thirds of the region's electricity supply even in the driest years, and has traditionally been much less expensive than alternative forms of electricity. Additional amounts of hydroelectricity can be generated when water conditions are above drought levels. Much of this so-called nonfirm electricity is used to displace thermal generation and thus reduces air pollution and the cost of electricity for consumers in California and the Pacific Northwest. As a result of the hydroelectric system, the Northwest enjoys electricity prices that are a little more than half of the average electricity prices in the nation. In spite of its negative effects on salmon, hydroelectricity is a renewable resource that does not pollute the air or water and thus has provided environmental benefits to the Northwest as well as low electricity prices.

Irrigation of agricultural land has created an important economic base for many arid areas of the region. There are about 7.3 million acres of irrigated land in the Columbia River Basin. The largest concentration of irrigated agriculture is in Idaho with about an equal amount in eastern Washington and Oregon. Nearly all of the region's production of potatoes, sugar beets, hops, fruit, vegetables and mint is from irrigated lands. A significant share of the production of hay and grain are also from irrigated land where yields are much higher than for dry land. In addition to irrigation, water is withdrawn from reservoirs to provide water supply for some municipal areas and industrial plants.

The system of dams and locks on the Columbia and Snake Rivers has made shallow draft barge transportation feasible from Portland to the Tri-Cities in Eastern Washington and to Lewiston, Idaho on the

Snake River. The river provides a competitive means to ship grain, as well as lesser amounts of wood products, containers and other agricultural products from inland areas to the port at Portland. About 36 percent of the wheat and barley arriving in Portland for export comes via barge down the Columbia/Snake river system. Barges are also used to ship petroleum products upriver from Portland to inland areas.

Salmon reared in the Columbia River system help to support a commercial salmon fishery as well as Indian subsistence and religious fisheries. The average annual gross value of commercial salmon fisheries from 1986 to 1990, for example, has been estimated at about $17 million (expressed in 1996 dollars).[6] Recreational fisheries were estimated to have a value of $14 million. Declining salmon populations have had an economic impact on fishing communities and Indian tribes as well as a cultural impact in the case of Indians. Recovery of salmon would likely have a positive financial impact for fisheries.

Recreation and tourism are important economic activities although they are not always thought of in those terms. Recreational fishing is an important aspect of this. It not only applies to salmon and steelhead, but to other types of resident fish and wildlife as well. Recreational activities support local businesses such as motels, restaurants, tackle shops, and guide services.

In the past, resource based, or extractive industries were the dominant economic force in the Pacific Northwest. Industries such as lumber and wood products, paper, agricultural products and, fisheries were the focal point of economic policy and concern. In 1970, these industries accounted for half of the region's manufacturing employment. They are still important activities, especially in small communities where they may be the main source of employment and a way of life. However, the largest manufacturing sectors in the region are now electronics and transportation equipment, the latter being dominated by the Boeing Company. In addition, the non-manufacturing or service sector accounts for the bulk of employment in the region. A high quality environment and recreational opportunities are seen as important qualities that make the region an attractive location for high technology, service, and recreational industries.[7] The economic interest of the region is shifting toward preservation of these amenities. During this transition, both extraction and preservation are important economic concerns and that creates substantial conflict within the region on appropriate resource policies.

Past efforts to mitigate the damage to anadromous fish including, passage facilities at dams, hatchery programs, and barging of juvenile salmon have failed to reverse the decline of most species. The General Accounting Office estimated that prior to 1981 the region had spent nearly $500 million on salmon recovery.[8] Following the Northwest Power Planning Council's first recovery program, the recovery efforts intensified. The General Accounting Office found that between 1981 and 1991 $1.3 billion (in 1991 dollars) were spent on salmon recovery. The expenditures further intensified following the listing of Snake river salmon under the Endangered Species Act. These recovery efforts have been largely funded by the Bonneville Power Administration and, thus, by consumers of electricity in the region. The region is still searching for policies that will be successful in restoring anadromous fish runs and repairing wildlife damages

[6] Olsen, Darryll, Jack Richards and Richard Turner. The Economic Costs of Fisheries Management Actions for the Columbia River. Northwest Irrigation Utilities. January 1992.
[7] See Economic Well-being and Environmental Protection in the Pacfic Northwest: A Consensus Report by Pacific Northwest Economists, Economics Department, University of Montana, 1995.
[8] U.S. General Accounting Office. Endangered Species: Past Actions Taken to Assist Columb ia River Salmon. GAO/RCED-92-173BR. July 1992.

from the dams. Each action taken to help salmon will have effects on the other users of the river. Economic effects will ripple through all of the industries mentioned above and possibly others.

The restructuring of the electricity industry is having a dramatic effect on the Bonneville Power Administration's finances. Changes in federal regulation of the wholesale power markets have exposed Bonneville to a highly competitive market for wholesale power. In essence, this means that Bonneville can no longer simply add costs into its power rates and be assured of recovering those costs. Bonneville's customers are able to find less expensive power in the open market and cannot be expected to pay above market costs for very long. These factors affect Bonneville funded programs, including fish and wildlife mitigation.

This growing competitive pressure on Bonneville's costs has elevated the issue of cost effectiveness of fish and wildlife programs, as evidenced by the new requirements for the Council in making decisions on funding of fish and wildlife projects, discussed above. The following section discusses the Council's legal requirements and the decision process for determining fish and wildlife project priorities and funding.

Economic Analysis for Resource Programs

Levels of Economic Assessment

Economic assessment of projects can occur on many levels. There is general agreement among economists about what constitutes various types of economic analysis. Some of those types of analysis will be described and compared in this section. It is useful to distinguish three levels of economic analysis that could be applied to project evaluation. These are (1) cost analysis, (2) cost-effectiveness analysis, and (3) cost-benefit analysis. Each of these involves an analysis of costs, but they combine the cost analysis with various degrees of benefit or effectiveness assessment.

Cost Analysis

Cost analysis simply addresses the question, *What are the costs of doing this?* The benefits or desired effects of the project are left unmeasured although they may be described in detail in qualitative terms or are understood or assumed implicitly. This analysis may be appropriate where the benefits cannot be quantified or even measured by any objective indicator.

Costs should be calculated according to the economic principles described in the following section on measuring costs. The costs can be displayed in various ways to facilitate decision maker's use of the information in making a policy judgment about the desirability of the proposed actions.

Cost analysis can contribute to improved decision making. However, at this level, decisions would be based on qualitative assessment of the effects or benefits of the project. This may be the only feasible analysis for some types of projects, but the approach does not facilitate review of the decision process, measurement of the effects for purposes of adaptive management, or accountability of the project implementors for achieved results. On the other hand, trying to quantify and value benefits in an attempt to

avoid these problems may lead to a false sense of certainty about the outcome, or an over- or undervaluation of the benefits.

Cost-Effectiveness Analysis

Cost-effectiveness analysis addresses the question, *Which is the best way to do this?* Cost-effectiveness adds to cost analysis a quantification of the effects of the project. The quantification of effects is in terms of some physical measure, not in terms of dollar value of the effects or benefits. To date, the most common effectiveness measures applied in the analysis of salmon recovery program actions have been returning adult fish, water particle travel time, or the smolt to returning adult ratio. Cost-effectiveness analysis results may then be expressed in terms of the ratio of the effectiveness measure to the cost of the project.

Cost-effectiveness analyses take different forms. The simplest case is where two or more proposed projects have exactly the same effects. They are just alternative ways of achieving the same thing. This is the application of cost-effectiveness that is authorized for the Council in the Northwest Power Act; "...utilize, where equally effective alternative means of achieving the same sound biological objective exist, the alternative with the minimum economic cost." In practice, this type of cost-effectiveness reduces to a simple cost analysis since it is not necessary to quantify the effects at all. Since the effects are the same, it is simply a matter of comparing costs.

A next level of cost-effectiveness analysis involves alternative projects all of which have different impacts on the same measure of effectiveness. Here projects can be compared based on the ratio of the effect to the cost, for example, increase in returning adult fish per dollar spent. The project with the highest fish to dollar ratio would be the most cost-effective. However, this is not likely to be an adequate analytical result for most fish recovery decisions. It is likely that the most cost-effective of the projects alone would not provide adequate fish recovery and that additional projects would be needed as well. In addition, there may be other objectives that are important to decision makers, such as life history diversity of salmon (not just gross numbers) or desired habitat characteristics. Also, there is likely to be an overall budget constraint to stay within. These situations complicate the cost-effectiveness analysis further.

Consider first the case where there is only one objective being considered, but there is a minimum level of effect to be achieved and a maximum budget available to spend. If the effect of each project is independent of whether any other project has been implemented, then you would simply implement the projects in the order of cost-effectiveness until the overall goal is met or the budget is exhausted.

The nature of the analysis changes, however, if the effects of the projects are not independent, a case that is more likely for fish and wildlife programs. The interactions between projects are likely to be numerous and complex and groups of projects are likely to fit together into strategies. For example, many projects that would be appropriate to a transportation strategy would not apply if permanent drawdown were the basic strategy. In cases such as this, alternative strategies, or related groups of projects, would need to be compared for their cost effectiveness.

Finally, there are cases where there are multiple objectives to be met. This is most likely to be the situation for fish and wildlife programs. At a minimum there are different stocks of fish in different stream reaches. Some of these are healthy and some are endangered. Some objectives may relate to harvestable

adults returns and some to long-term habitat quality and genetic strength of the species. Cost-effectiveness analysis cannot help select among projects that affect different objectives unless those objectives can somehow be reduced to a common measure or at least converted to some kind of common index.

Multiattribute analysis is one means of addressing this class of decisions. Multiattribute analysis applies evaluation techniques to facilitate comparison of actions based on their effects on several indicators of merit. The indicators can be quantitative, such as costs or modeled effects on smolt to returning adult ratios, or they can be qualitative, such as a notation of the species of fish affected, or the river reach affected, or even a positive or negative cultural effect on particular groups. At least two such studies have been attempted for salmon recovery actions in the region. The first was done by Linda May for the Northwest Power Planning Council[9], and the second was done by Resources For The Future for Bonneville[10].

The Resources For The Future study used a variety of measures of benefit. Biological measures were separate for spring, summer and fall chinook and consisted of increased survival relative to the base case and recovery criteria. Other measures of effectiveness included the lead time to biological effects, the degree to which a strategy is restorative of natural conditions, the geographic distribution of adverse impacts, and the degree of institutional change required. These various characteristics were arrayed against costs in various graphic and tabular forms. The results cannot all be summarized here, but no one alternative or combination of alternatives scored high on all attributes. The Linda May study used a wide array of indicators to evaluate the multiple attributes of various actions. Included in the attributes were state, subbasin, stocks affected with classifications of their status, costs and their time distribution, and genetic ratings. By sorting alternative projects according to different indicators of merit, comparisons among alternatives can evaluate many characteristic together. Such studies do not yield one determinate solution for the best alternative unless all attribute indicators are quantitative and can be aggregated into a single index. To do this, explicit weights would have to be accepted for each of the attributes and the results would tend to be very sensitive to such weights.

The other solution to this class of problems is to reduce all of the benefits to their dollar values. This is the approach used in cost-benefit analysis.

Cost-Benefit Analysis

Cost-benefit analysis addresses the question, *Is this worth doing?* In cost-benefit analysis the effects of a project are evaluated in dollar terms. The dollar value of the benefits are then compared to the cost of implementing the project. Typically if the value of the benefits is less than the cost, or the ratio of benefits to costs is less than one, the project should not be undertaken.

When dealing with environmental issues and especially with endangered species the question of whether the benefits should be pursued has already been answered by law. Society has decided through the legislative process to achieve certain goals and the question, "is this worth doing?" has already been

[9] May, Linda. A Multattribute Model: To Assist in Ranking Strategies For Salmon and Steelhead. Washington State Energy Office. 1991.
[10] Paulson, Charles M., Kris Wernstedt, and Jeffrey B. Hyman. Recovery Planning For Endangered Salmon: A Multiple Attribute Analysis. Resources For The Future. Washington D.C. December 9, 1993.

decided. The law has made it difficult to use economic costs as a reason for not pursuing the objective of preventing extinction of species. The Endangered Species Act made no provisions for doing cost-benefit analysis for recovery actions. In fact, the Northwest Power Act also contains no requirement to do cost-benefit analysis on the Council's fish and wildlife recovery programs. The fact that cost-benefit analysis is not required by law does not preclude its application, but the task of quantifying the value of preserving endangered species in dollar terms may be hopelessly difficult.

Review of Existing Studies

A large literature of methods and applications of economic analysis for public policy decisions has been developed over the years. Many studies have been done relating to fish and wildlife recovery issues in the Pacific Northwest and other areas. The Appendix contains a partial bibliography of these studies. Most studies deal with specific aspects of economic analysis or with specific issues. However, there have also been a number of relatively comprehensive studies of the economic effects of salmon recovery programs in the Pacific Northwest. The Council's Independent Economic Analysis Board reviewed a number of these studies and the discussion below draws partially on that analysis.[11]

The most comprehensive analysis of the economics of fish recovery alternatives was done by Bonneville Power Administration, the U.S. Army Corps of Engineers, and the Bureau of Reclamation. It is entitled "The Columbia River System Operation Review".[12] This study was aimed at balancing the various competing uses of the Columbia River System and involved many interested parties through its extensive work groups. The economic analysis in the Columbia River System Operation Review generally followed guidelines for analysis of federal water projects that were specified by the U.S. Water Resources Council. These guidelines are embodied in a document published by the U.S. Water Resources Council in March 1983 entitled Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies.[13] The President of the United States approved this set of economic and environmental principles for federal agencies to follow in makings water policy and project recommendations. The document prescribes step by step analysis procedures for federal agencies to follow. These will be referred to as the WRC guidelines. Because the WRC guidelines play such an important role in federal agency decision making, it is worth understanding something about how they work.

The WRC guidelines focus on the economic effects of any water project from a national economic perspective. That is, the evaluations prescribed calculate benefits and costs from an aggregate point of view as effects on national economic development. Costs and benefits are to be presented as annualized constant dollar values, similar to the levelized costs that the Council uses in its power planning analyses. There is no need to describe the WRC guidelines here, but it is interesting to list the areas that are to be considered in the analysis of water resource projects. These include:

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[11] Independent Economic Analysis Board. Lessons from Existing Studies of the Economics of Fish and Wildlife Recovery Measures in the Northwest. Presented to the Northwest Power Planning Council, July 15, 1997.

[12] Bonneville Power Administration, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation, Columbia River System Operation Review: Final Environmental Impact Statement, DOE/EIS-0170, November 1995. (The document includes a summary and Appendices A through T.)

[13] Water Resources Council. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. U.S. Government Printing office. March 10, 1983.

- Municipal and Industrial Water Supply
- Agriculture
- Urban Flood Damage
- Power Production
- Inland Navigation
- Deep-Draft Navigation
- Recreation
- Commercial Fishing
- Other Direct Effects

For each of these areas of effect, the WRC guidelines provide detailed analysis procedures that should be followed by federal agencies.

Although the national economic development perspective represents a traditional economic evaluation of the effects of water resource actions, the WRC guidelines recognize that there are other relevant considerations in evaluating projects. There are three other types of analysis recommended; regional economic effects, environmental effects, and other social effects. These may be addressed as additional considerations for an overall project evaluation, but they are not directly part of the economic evaluation or cost/benefit calculation.

Regional economic effects evaluate the regional or local incidence of any national economic effects. Many actions can have the effect of shifting economic activity from one area to another. Decision makers often want to take these regional or local effects into account when designing policies intended for regional application or implementation. From a national perspective, there may be no effect on income or employment but there may be a relocation of economic activity. Such shifts in economic activity occur all the time in response to changing economic conditions, and the ability of people and communities to adapt to such changes is crucial to maintaining a vital and competitive economy.

Environmental and other social effects are those which cannot be evaluated easily in dollar terms. These may include effects on ecology, cultural resources, aesthetic qualities, income distribution, fiscal condition of local government, life, health, and safety. These are clearly important policy considerations, but are not typically a direct component of economic analysis. Although methods have been proposed and developed to quantify such values, they remain highly uncertain.

For various reasons the full application of WRC guidelines is often not feasible or desirable. One reason is that such analysis is very expensive and time consuming as indicated by the cost of the Columbia River System Operation Review study. Although no one has specifically estimated the cost of the economic analysis done for the Columbia River System Operation Review, it is probably in the range of $1 to $2 million dollars. It is common practice to perform abbreviated studies in the early stages of project evaluation and to move on to more detailed analysis as a project comes closer to realization.

Key components of data and information are often missing or unquantifiable as discussed above. In such cases, techniques of risk and uncertainty analysis can help explore these areas and develop policies that are more flexible to changes in information that may develop during the implementation of policies.

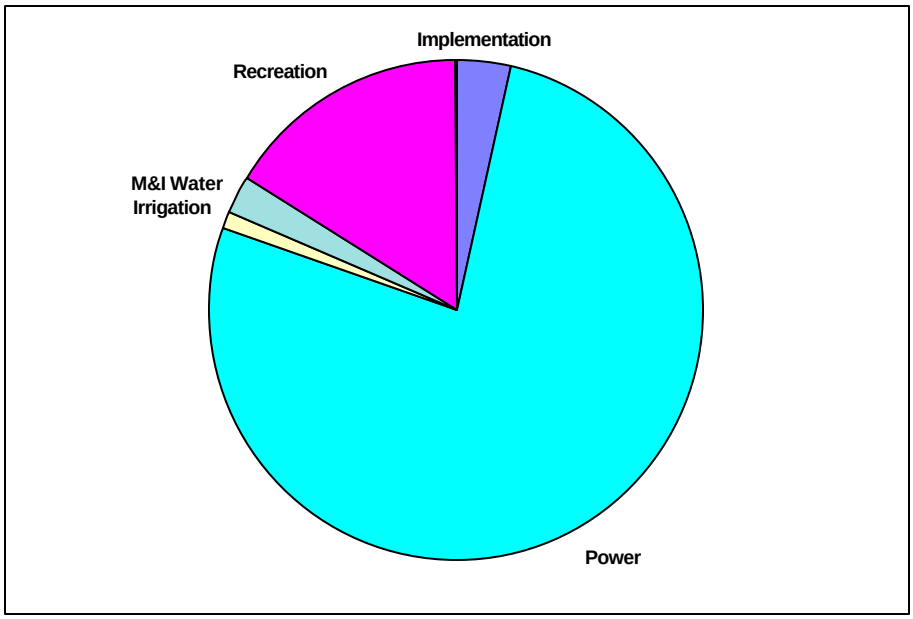
Nevertheless, the inability to reliably quantify the economic value of some human values should be accepted as a limitation of economic analysis as applied to natural resource decisions, and probably for other areas of analysis as well. Economic analysis is only one of several considerations for policy makers, but it is an important one. Ignoring the economic implications of policy decisions is likely to result in ineffective policies and failure to meet objectives.

It may be useful to point out another perspective on economic analysis that does not match any of the WRC concepts. That is a perspective of budgetary analysis; the allocation of a fixed budget to alternative uses. Clearly, there are aspects of this type of problem in the Council's mandate from the Gorton Amendment, given the Bonneville spending agreement and the limited scope of activities to be included in the Council's cost-effectiveness determination. In this perspective, the scope of the costs to be considered would be limited to Bonneville's budgetary expenditures and whether those funds are being used to obtain the maximum progress on a measure or measures of effectiveness. Such a limited analysis might have the potential of biasing the actions toward those that are funded through sources other than Bonneville or toward actions whose costs fall outside the budget agreement, such as decreased power revenues due to changes in system operation. It is important to recognize that there may be some differences in expectations regarding the scope of cost-effectiveness analysis.

With that background we now return the Columbia River System Operation Review. This large study took six years to complete and cost in the neighborhood of $20 to $30 million. In the final report, 13 alternative strategies were evaluated, but these were selected through an initial screening of 90 alternative strategies. Appendix O of the study contains the economic and social impact analysis. The economic analysis identified both the direct costs of alternatives and the indirect economic impacts. Most subsequent studies have relied to some degree on the economic cost estimates done for this study. The effectiveness of the alternatives were measured in changes in fish harvest, both commercial and recreational. Changes in fish harvest were also expressed in dollar value so that a benefit-cost analysis could be done. At the time the study was started Snake River salmon stocks had not been listed under the endangered species act.

The Columbia River System Operation Review utilized several complex models to evaluate effects and costs in various sectors. Some interesting results emerged from the analysis. First, the study established the concept that, for most alternative measures designed to aid salmon recovery, the costs tend to be dominated by the hydroelectric system costs. The second most significant cost was usually lost recreation opportunities, although those estimates are controversial. Figure 2 below shows an example of costs in various areas for the preferred alternative case. It represents the effect of moving from the base case (Corps 1993 Supplemental EIS) to the 1995 biological opinion. Another result of the analysis is that, given the models and assumptions used in the study, very few of the alternatives actually benefit fish compared to the base case. In the few alternatives that do offer improved fish runs, the value of the increased harvest is small compared to the costs required to achieve the increase.

Figure 2: Major Costs Changes for 1995 Biological Opinion



An earlier study was done for the Bonneville Power Administration by Resources for the Future.[14] This study included a very ambitious modeling exercise intended to demonstrate that cost-effectiveness analysis that can contribute to a more justifiable and accountable decision-making process for fish and wildlife planning. The study focused on alternative ways of meeting harvest and escapement goals for 26 subbasins in the Columbia and Snake River system above Bonneville dam. The study linked four models that captured (1) water storage, flow and hydropower, (2) downstream migration mortality, (3) the number of adult fish to compare to harvest and escapement goals, and (4) minimization of cost of meeting subbasin goals. The study did not address opportunity costs beyond hydropower. Although the study was intended to be a demonstration of feasibility, and serious problems with identifying the biological effects of various actions were noted, the authors, nevertheless, asserted some suggested conclusions. They found that many of the subbasin goals were over-optimistic and could not be achieved with the recovery actions considered in the study. They also concluded that flow augmentation and drawdowns did not appear to be cost effective.

Daniel Huppert and David Fluharty from the School of Marine Affairs at the University of Washington did a study for the National Marine Fisheries Service.[15] The authors worked with an advisory committee called the Economics Technical Committee to bring a variety of expertise to bear on the project. The study addressed the seven elements of the March 1995 National Marine Fisheries Service proposed recovery plan for Snake River salmon stocks. The authors found that there was insufficient information about the effects of the proposed measures to do a cost-effectiveness analysis and settled for an accounting

[14] Paulson, Charles M, Jeffrey B. Hyman, and Kris Wernstat. Above Bonneville Passage & Propagation Cost Effectiveness Analysis. Submitted to Bonneville Power Administration by Resources for the Future. Washington D.C. January 1993.
[15] Huppert, Daniel D and David L. Fluharty. Economics of Snake River Salmon Recovery: A Report to the National Marine Fisheries Service. October 1996.

of the costs. Roughly two thirds of the total annual costs of between $253 million and $389 million (1993 dollars) were due to hydroelectricity. The remaining costs were primarily related to habitat improvement and harvest management. The range of cost is largely due to uncertainty about whether flow augmentation or drawdown strategies are pursued. The study found that a flow augmentation and minimum operating pool strategy, which cost between $192 to $249 million a year depending on the cost of supplemental water, had higher economic cost than a strategy that relied on drawdown of the 4 lower Snake reservoirs to near spillway crest for four and a half months ($168 million a year). Although the study did not attempt a cost-effectiveness or cost-benefit determination, it did discuss possible benefits. Two types of benefits are noted, increased direct use of salmon for commercial and recreational harvest, and increased indirect use, or existence value. A plausible range of direct benefits was estimated from a negative $68 thousand dollars to positive $19.7 million dollars. The authors noted a range of existence value estimates for Pacific Northwest salmon from $86.7 to $204 million, but no studies have been done for Snake River salmon alone.

The biological opinion issued in March 1995 by the National Marine Fisheries Service required additional study of alternatives to improve survival of Snake River endangered salmon stocks. The U.S. Army Corps of Engineers (COE) is required to make a recommendation by 1999 for a preferred alternative. The study leading to this recommendation is called the "Lower Snake River Juvenile Salmon Migration Feasibility Study". Two reports have been produced by this effort so far, and additional analysis continues.[16] The economic evaluation portion of the continuing analysis is being undertaken by a Drawdown Regional Economics Workgroup involving many regional organizations. This work is essentially an updating of the Columbia River System Operation Review analysis, but with a more restricted scope of analysis. Each of the interim studies has a section that addresses economic considerations.

The first product was a study by Harza Northwest, Inc. for the Corps of Engineers entitled "Salmon Decision Analysis: Lower Snake River Feasibility Study". This study developed a decision analysis framework that was based on biological objectives first and then economic considerations and risk. Fifteen specific measures or tools were considered for their effects on Spring and Summer Chinook in the Lower Snake. The measures were grouped into major paths or strategies which included transportation, in-river, and combinations of both. In the end, the study concluded that the biological effects information was too uncertain to rely on the decision analysis framework to select among alternatives. Nevertheless, interesting results were obtained regarding costs and estimated recovery measures. The recovery measure used was percent increase in survival and costs were based on cost estimates from the Columbia River System Operation Review. The alternative measures have a wide variety of costs relative to the base of the 1995 biological opinion and also a wide range of effects. The study showed that permanent drawdowns had both large benefits and large costs. However, the cost-effectiveness (costs per 1% survival improvement) of drawdowns were poorer than most other alternative measures. However, most of those alternatives also had relatively small benefits for salmon. Table 1 is taken from the Harza study and illustrates the variation in costs from a 1995 biological opinion base case.

[16] US Army Corps of Engineers. Lower Snake River Juvenile Salmon Migration Feasibility Study: Interim Status Report. December 1996.
Harza Northwest, Inc. Salmon Decision Analysis, Lower Snake River Feasibility Study: Final Report. Submitted to U.S. Army Corps of Engineers, October 4, 1996.

Table 1: Annual Equivalent Cost of Tools

Transportation	- $200 Million
Baffled Spillways (4)	- $ 10 Million
Sluices (4)	- $ 6 Million
Sound Repulsion	$ 1 Million
Fish Guidance Curtain	$ 1 Million
Juvenile Bypass Fix	$ 1 Million
Extended Screens (2)	$ 4 Million
Surface Collectors (4)	$ 9 Million
Minimum Operating Pools	$ 20 Million
Permanent Drawdown (4)	$ 153 Million

The 1995 biological opinion required an interim status report from the Corps of Engineers by 1996 to contain a preliminary decision regarding drawdown alternatives for the lower Snake River. The Corps of Engineers issued their interim status report in December 1996.[17] This study evaluated 3 alternative drawdown approaches; seasonal spillway crest, seasonal natural river, and permanent natural river. Evaluating the alternatives against five evaluation criteria consisting of (1) technical feasibility, (2) biological effectiveness, (3) environmental effects, (4) cost effectiveness and (5) regional acceptability, the Corps eliminated the seasonal drawdown alternatives from further consideration. Cost effectiveness played a role in the decision, but the primary factors seemed to be biological effectiveness and other environmental effects, including adverse impacts of seasonal drawdowns on adult upriver migration. The economic analysis did not include power system costs and was based on results from the Columbia River System Operation Review. The base case for the interim status report was the 1995 biological opinion or the preferred alternative from the Columbia River System Operation Review. The permanent natural river drawdown had higher recreation and navigation costs, and possibly power costs, although they weren't estimated, but it had lower construction costs, a shorter implementation time, biological benefits for fish, and less severe environmental effects compared to the seasonal drawdown alternatives.

In 1995 ECO Northwest did a study for the Confederated Tribes of the Umatilla Indian Reservation.[18] This paper contains a critique of the Columbia River System Operation Review's economic analysis and a defense of a specific recovery proposal advanced by the Confederated Tribes of the Umatilla Indian Reservation. As such this paper is not so much an economic study as a critique of economic studies. It raises many methodological issues which are well known issues for economic analysis. These included the short-term and static nature of impact analyses, the limitations of economics for assessing intrinsic or existence values, potential quantification bias, a tendency to focus on quantity rather than quality, and the issue of subsidies to affected industries and activities. It also raises issues about defining the base case and the importance of property rights and legal obligations. It also stresses the dynamic and changing nature of the Pacific Northwest economy. As an alternative perspective on economic analysis the paper presents

[17] US Army Corps of Engineers. System Configuration Study - Phase II, Lower Snake River Juvenile Salmon Migration Feasibility Study: Interim Status Report. December 1996.

[18] Neimi, Ernie, Ed MacMullan, and Ed Whitelaw. Economic Consequences of Management Strategies for the Columbia and Snake Rivers. Submitted to The Confederated Tribes of the Umatilla Reservation by ECO Northwest. July 1995.

some important issues, but it also raises issues that, while not essentially economic in nature, are nevertheless part of the overall fish recovery policy debate.

In 1995 the Environmental Defense Fund did a report for the Northwest Power Planning Council.[19] This study evaluated 26 alternative approaches to recovery of endangered Snake River salmon. The measure of effectiveness used was water particle travel time from Lower Granite dam to below Bonneville dam. The study found dry-year water leasing and basin wide fallowing to be cost-effective ways to speed water particle travel time under a variety of assumptions. Like some other studies, the diversity of costs for attaining a single objective were large, ranging from a cost per hour of reduced water particle travel time in the base case of $523 thousand to an increase of $30.2 million dollars. The base case was similar to 1992 operations and the same as the Columbia River System Operations Review base case.

Measuring Costs

Costs are the common element of all of the economic analyses discussed in the previous section. The relevant types of cost that should be considered in an economic analysis are more inclusive than common usage. There are two categories of cost to be considered in economic analysis from a societal perspective, and a third category that relates to local or regional impact studies.

Direct Project Costs

Direct costs of a project are the actual costs incurred by the project sponsor. They are sometimes called implementation costs or budgetary costs. Direct costs include the capital, operating, and maintenance costs directly associated with the project. These direct costs are pretty straightforward and match the usual non-economists conception of financial costs.

For example, the direct costs of a surface collector at a lower Snake River dam would include the cost of purchasing and installing the equipment plus any ongoing annual cost required to operate and maintain it, and to periodically replace its components. The capital costs should include any costs incurred for interest during construction as well as for interest required to repay the debt incurred for the project. Direct project costs are currently reported for proposed fish and wildlife projects and are, therefore, readily available.

Other Direct Costs

Many projects undertaken for one purpose will have direct effects on other activities. In an integrated system like the Columbia River, there are several activities that rely on the river and its water.

[19] Willey, Zach and Adam Diamant. Water for Salmon: An Economic Analysis of Salmon Recovery Alternatives in the Lower Snake and Columbia Rivers. Report by the Environmental Defense Fund to the Northwest Power Planning Council, 1995.

These were described in the background section and included such categories as power production, navigation, irrigation, industrial and municipal water supply, and recreation. Some of the activities that could be directly affected by salmon recovery projects may not be considered to be water using activities, but rather may affect the river habitat or the quality of water. Examples of these would be logging and cattle grazing.

Any given project may affect a number of these other areas of activity. The effects can be positive or negative. It is the net cost, negative and positive, that is the appropriate measure of other direct costs. An example will illustrate this concept and also serve to discuss some principles of how these cost should be calculated. The example of reservoir drawdown is used here because it has a rich array of effects to illustrate. However, the discussion below is not at all comprehensive. It simply describes a couple of illustrative economic effects.

Reservoir drawdowns have been proposed on the lower Snake River to help speed the trip of salmon smolts to the ocean. Depending on the depth and duration of drawdown, there will be some direct project costs associated with modifying the dams and their associated fish passage facilities to operate at lower reservoir elevations, or to eliminate these facilities in the permanent natural river drawdown case. In addition, there may be direct effects on other fish programs. For example, if the drawdown is deep enough, the downstream barging of smolts would have to be discontinued. The direct operating cost of the fish barging programs would be reduced and this would be considered a cost saving associated with the drawdown. Similarly, planned future costs, such as surface collectors and turbine upgrades, that won't be necessary with a permanent drawdown will offset the direct project costs of the drawdown.

The other direct costs of drawdowns can be quite extensive. There are likely to be effects in most of the areas listed above. For example, power generation would be affected by the loss of hydroelectric head behind the dams. This means that less electricity can be generated by the turbines at the dam. If drawdown is to the natural river there would be no power generated. The net cost of this loss should be calculated as the increase in cost that results from replacing the electricity generation in the most economic manner available. This may be purchasing on the spot market in the short term, and the eventual construction and operating costs of electricity generating plants or new conservation measures. If the price of electricity were to increase as a result of drawdown, the demand for electricity may be reduced and, therefore, reduce the need for replacement electricity.

Another activity affected would be irrigation. The intake for irrigation pumping may be left high and dry by a drawdown. This would leave the farmer with some alternatives to consider. He could extend the irrigation intake to the new river level, incurring capital costs for the modifications and in addition paying more electricity cost for pumping a greater vertical distance. He could also convert to dryland farming by changing crops. His decisions should be based on the discounted future value of his expected net income under the different decisions. If the expected net earnings are greater for dryland farming than the expected net income for irrigated farming including the costs of extended intakes and increased pumping costs, then the economically more efficient of those two choices would be dryland farming. The net cost to the economy in this case would be the difference between the expected net earnings of the farm before drawdown minus the expected net earnings from dryland farming. There may also be alternative uses for the land that would generate a greater expected net income than farming. If that were the case the farmer

would presumably be able to sell the land for an amount that exceeded his expected net income if he continued to farm it.

There are some other factors that should enter into the irrigation example as well. They are mentioned here just to give an indication of the potential scope of an economic analysis. The expected net income of a farm will depend on the costs incurred to move products to market. If the farmer was using river barges to transport his product, and the drawdown eliminated that option for all, or portions of, the year, then the farmer's transportation costs may be increased by shifting to alternate forms of transportation.

All of the effects listed so far are directly felt by the irrigator. There may also be some indirect costs or benefits to society. For example, there have been policies in this country that subsidize farming and irrigation in various ways. To the extent there are such subsidies to irrigated agriculture, and the drawdown policy results in a decrease in irrigated agriculture, there would be some offsetting savings in reduced subsidy costs. If the costs of agricultural commodities increased as a result of the drawdown, this would create some valid costs to consider. However, for most crops, small changes in production in one area will be readily offset by substitution of production in some other place with no effect on the commodity price.

To the extent that shifts occur in the location, but not the overall level or cost of economic activity, it is not a concern for traditional economic analysis. It is simply a redistribution of economic activity among regions or sectors of the economy. However, for the affected communities this can be a big issue. This leads to the third type of cost information and to another form of economic analysis.

Indirect Costs and Regional Impact Analysis

Indirect costs refer to the likelihood that direct economic changes will ripple through to affect related economic activities. To continue using the farming example, changes in farm operation will have an effect on businesses that supply farm equipment and supplies, and businesses that provide product transportation or other marketing services. Eventually such changes will affect most aspects of a local economy including stores, restaurants, insurance agencies, and other types of services that derive their business from serving the local population.

The traditional tools for accomplishing regional economic impact analyses include regional economic base studies, input-output studies, and computable general equilibrium models. Each of these approaches evaluates relationships among the various sectors of economic activity in a region. For example, Input-output matrices lay out the relationship among all economic sectors and the final demand of consumers for products. It contains the amount of purchases one sector would make from each of the other economic sectors in order to produce a given amount of product. Thus, if the production of one sector is affected by some fish recovery project, input-output analysis can trace the effect into each of the other economic sectors that provides products and services to the affected industry. Further, because the model contains relationships among all industries, the additional indirect effects on all other industries in the local economy can be estimated.

Local economic impact studies have been used for a long time to justify regional development projects on the basis of their direct and indirect benefits to the locality of the project. Local impact analysis has also been used extensively to fight changes that might have a negative impact on particular industries or communities. A couple examples are provided below the clarify the nature of regional impact analyses and to illustrate how they differ from economic analysis from a societal perspective.

Consider a policy action that has the effect of increasing the irrigation costs for a community to the point that some local farmers cannot continue to operate profitably and go out of business. The immediate effect is to create a direct loss of farm income and employment to the community. In addition, there would be some indirect effects on local businesses that provide products and services to the agricultural sector and eventually the effects will ripple through the whole community. It is safe to say that the agricultural setback in this one community will not affect the price of agricultural commodities and therefore will not affect the overall national demand for agricultural products. The same amount of products will be provided to meet demand, but they will be produced in another region or community. In these other communities, there would be similar direct and indirect effects on the local economy but in a positive direction. From a national economic perspective, these effects would largely offset one another. Further, the local impacts will not be permanent. The economy is dynamic and continually adjusting and changing and creating opportunities. People find new jobs in the same community or other communities so that most of the effect is transitional.[20]

Another example could be a case where a policy change eliminates the barging of products on a section of river. This may result in the loss of several up-river ports and the need for shippers to find alternative modes to ship their products. The losses of barging business and port jobs and income in the affected area will be partly offset by increased business for the trucking and rail industry and may result in increased business for some down-river ports. To the extent that total costs of delivering products to markets increases as a result of this change there could be an adverse national economic impact which reflects the net effects, positive and negative, on various communities. The magnitude of that impact will depend on the farm responses to the increased cost. Such adjustments are similar to those discussed in the preceding paragraphs for a change in irrigation costs.

The analysis of regional economic impacts can be biased by the fact that it is much easier to identify and thus quantify the effects on the regions or communities directly affected by the action than it is to identify the many and dispersed offsetting effects in other areas. Large economic effects, as contrasted to large local effects, are most likely to be generated by actions that create or destroy a uniquely efficient or low cost way of providing some product or service. Local impact analysis is most relevant for helping communities understand the adjustments they will need to make if certain policies are followed. The directly affected communities are where the changes will be most concentrated, while the offsetting effects and economic adjustments are likely to be widely spread and have far less noticeable impacts on other regions or communities. From an national or societal economic perspective it is the net effect of all of these adjustments that is relevant.

[20] See, for example, Hamilton, J.R., N.K. Whittlesey, M.H. Robison, and J. Ellis. "Economic Impacts, Value Added, and Benefits in Regional Project Analysis". American Journal of Agricultural Economics. May 1991.

The Role of Economic Analysis in Fish and Wildlife Programs

As discussed earlier, national policy as embodied in the Endangered Species Act and the Northwest Power Act actually provides for quite limited roles for cost-effectiveness considerations in determining fish and wildlife programs. The Council has always considered economic and other impacts on the power system, as the Northwest Power Act provides. However, the role of economic analysis of fish and wildlife programs in now growing. This is partly a reflection of growing competition in the wholesale power market, and partly a result of the growing economic implications of alternative fish and wildlife measures. These pressures are evidenced by the negotiation of the 1996 federal memorandum of agreement on Bonneville fish and wildlife funding, and by the passage of the Gorton amendment requiring a prioritization process and a cost-effectiveness determination for projects to be funded under the Council's Fish and Wildlife Program.

The next section discusses several types of economic analysis that might be considered in implementing these requirements and the availability of data and information to carry out such analyses.

Individual Project Evaluation

Both the Northwest Power Act and the Gorton amendment seem to require a cost-effectiveness analysis at the individual project level. The Northwest Power Act says that the "Council shall include in the program measures which ... utilize, where equally effective alternative means of achieving the same biological objective exist, the alternative with the minimum economic cost." [21] The Gorton amendment specifies that, in making its funding recommendation to Bonneville, the Council "shall determine whether the projects employ cost-effective measures to achieve program objectives." [22] Both of these statements direct a type of analysis that focuses on individual projects and seems most applicable to project design and implementation review.

If the Council received two project proposals that had exactly the same effects, satisfaction of the requirements of the Northwest Power Act would be straightforward. The costs of the two proposals could be compared and the least costly one picked. In practice, however, project proposers currently provide direct project cost estimates, but do not provide other direct cost information. The Council has relied on its rulemaking process to generate information on other direct costs but with limited success.

This does not mean, however, that individual project cost effectiveness cannot be addressed. There is a more efficient approach to help ensure that project proposals will be more cost effective. That approach involves putting in place prioritization and project evaluation processes that more naturally lead to the most cost-effective approaches being proposed. Such approaches borrow from the concepts of the private market place to establish comparable incentives in the public sector, and are in keeping with the efficiency in government initiatives of vice-president Gore. Such incentives should be effective at the project proposal stage as well as throughout the project's implementation.

[21] Public Law 96-501, Section 4.(h)(6)(C).
[22] 16 USC Section 839 b (h)(10)(D), as ammended in 1996.

There are several dimensions to be considered in instilling efficiency incentives and accountability into the fish and wildlife recovery process. These include the project proposal stage, the project evaluation and prioritization stage, and project implementation, evaluation and accountability. Three principles should be followed to the extent possible:

1. Inject competition into the process where it is feasible.
2. Remove or neutralize any conflicts of interest from the selection and prioritization process.
3. Strive to ensure that project sponsors and implementers are held accountable for performance throughout project implementation.

There is currently no one organization that takes full responsibility to ensure that fish and wildlife recovery funds are spent cost-effectively. This has resulted in a fish and wildlife program that lacks a comprehensive system of management controls. Because of this existing process, introduction of competition into the project funding process, for example through competitive bidding, may be difficult to implement. However, as the funding and contracting agency for implementation, Bonneville is in a position to implement many of these management systems, and can also advise the Council and agencies and tribes of problems that need to be addressed earlier in the selection and prioritization process.

In the meantime, consideration of alternative ways to achieve specific effects will need to be introduced on an ad hoc basis. When alternative approaches to achieving the same effects are identified during the project review process funding can be delayed until the alternative approaches can be evaluated for both their cost and ability to achieve the intended effect. Sponsor's should be encouraged to explore innovative approaches to their projects that utilize more cost-effective means to the same end.

At the project implementation stage, accountability for performance and review of achievements could be introduced. Management audits are a typical way of achieving this accountability. There are two different objectives to be accomplished in this area. The first is to track the dollar flows for the project. This is more of a financial audit and is standard practice in many government and private agencies. The questions addressed are: Are billings and payments properly documented and approved? Is the money being spent as intended? Is the work accomplished consistent with the billings? Is the project staying within time schedule and budget and achieving the stated objectives in the proposal? A second type of audit would be to evaluate the contract management process itself to determine whether there are ways that the process for management and oversight of project implementation could be modified to improve incentives and accountability. Issues are: Are the statement of work, performance work schedule, and budget consistent with the project proposal? Are changes in scope, objective, or methods supported by proper justification and approvals? Are competitive bids utilized whenever feasible?

It should be understood that such improvements in the process are not intended to point fingers at the responsible parties or find fault with the current process, but rather to instill into the whole process a structure that leads inherently to more efficient and cost effective use of public funds. It is impossible to imagine a situation where fish and wildlife activities will not be subject to budget pressure for the foreseeable future. In that environment, more effective use of funds means that more can be accomplished for the resources. In addition, the electricity rate payers and tax payers will be more supportive of recovery programs if they are convinced that funds are being used responsibly and effectively.

Economic Comparisons among Projects

Economic judgments involved in implementing the fish and wildlife program with a limited budget are different from the economic judgments involved in the program's development. Program implementation requires project prioritization and cost-effectiveness analysis under the new section 4 (h)(10) (D) adopted in 1996. These judgments require economic comparisons among projects.

Comparison among projects adds a new dimension to the cost-effectiveness analysis: the measurement of effects. Here the Council encounters real difficulty because there is limited ability to measure the effects of many fish and wildlife projects. Further, there is no agreement on a set of objectives that projects should be oriented toward. As will become clearer in the discussion below, the identification of a framework for the fish and wildlife program that formalizes the objectives, strategies, and priorities is indispensable to making significant improvements to the role of economics in fish and wildlife decisions.

There are a number of approaches to increased consideration of economic factors when many different projects are being compared and prioritized. Only one of these would be considered traditional cost-effectiveness analysis. The first applies to a situation in which the effects and their relative importance to achieving overall goals are not understood or agreed to. In this case, there is little that can be done to formalize the consideration of the effects of various projects. The second approach applies to the situation where all effects can be reduced to a single quantitative measure. When this is possible, then a traditional cost-effectiveness analysis can be attempted. The final approach applies to a case where the goals and objectives are clear and they can be ranked in some type of prioritization scheme that shows their relative importance. Each of these approaches is described in the following sections.

Providing Improved Cost Information

In situations where the objectives of the fish and wildlife program are not formalized, not agreed to, or the effects of projects are not well understood, there is no hope of accomplishing any form of cost-effectiveness analysis among projects. This problem applies to the current situation in the fish and wildlife program. Although important progress has been made in the last few years to improve project information and to organize it into data base form, the program objectives are not systematically described or ranked in importance. The Council's effort to develop a program framework holds the hope of remedying this situation, but the process will not yield useful results during this year.

Is there any way that economic information can contribute to better decision making in this condition? The answer is, yes. The improved data base that Bonneville has developed can be utilized to provide more and better organized information to the project selection and prioritization process. In particular, the project direct cost information could be arrayed against various measures of project effects provided in the project proposal information. It would also be possible to supplement the direct project cost information in the data base with information about the other direct costs that might be expected from various projects. This information would probably be fairly general and based on studies that have already been performed on similar proposed actions in the region.

Creative displays of such information can help decision makers evaluate the economic effects of projects, lead to improved decision making, and increase consideration of the relative costs of alternative projects. For example, the allocation of dollars to various program areas, fish stocks, or geographic areas would help evaluate program balance. Some displays of cost information have been included in both the "Draft FY 1998 Annual Implementation Work Plan" and the evaluation of that plan by the Council's

Independent Scientific Review Panel.[23][24] However, much more detailed cost analyses of various components of the programs is possible from available information. The progress that has been made to put project information into a computer data base facilitates this type of analysis.

The more formal consideration of costs should improve fish and wildlife decisions over the current process. However, the decisions will still reflect an implicit balancing of effects against an informal conception of the goals and objectives of the overall program. Such a process may lead to improved decisions, but they still will be decisions that are difficult to document and describe.

Single Measure of Effects

If there is a single measure of effect that is agreed to be the dominant program consideration, and if all proposed projects' contributions to this measure can be quantified, then a traditional cost-effectiveness analysis could be attempted. In fact, some of the studies discussed earlier in this paper have evaluated mainstem passage alternatives in terms of single effectiveness measures including, water particle travel time, returning adult salmon, value of commercial and sport harvest, and percent increase in survival. It is clearly not the case at this time that the region agrees on any single dominant measure of effect that adequately describes the goals of the fish and wildlife program. However, some parties in the region are willing to make such a designation and have advocated that the Council perform cost-effectiveness analysis based on single measures of effectiveness.

It is unlikely that the region would agree on a single measure of effectiveness that could be used to select and prioritize all projects. And even if it did, it would turn out to be impossible to measure the effects of all projects on the single effectiveness measure. However, there may very well be groups of alternative projects that affect essentially the same quantifiable objective. In these cases cost-effectiveness studies may provide useful information for selecting among and prioritizing such projects.

Multi-Attribute Analysis

In cases where there are multiple objectives to be considered, and those objectives can be prioritized, more formal types of decision making may be possible. This type of analysis is generally called multi-attribute analysis. Where alternative projects or actions have effects on several objectives, or attributes, multi-attribute analysis makes use of expressed rankings of those objectives to display numerical or non-numerical ranking of proposed projects based on their effects on the various objectives. Two such studies were referenced earlier in the paper.

This method is usually applied during the preliminary planning stage when benefits and costs are not available. It, therefore, requires considerable judgment. As a result, the outcomes are very sensitive to judgmental weights assigned to performance measures, and to the specific objectives included in the evaluation. It is often used to reduce alternatives to a manageable number which are then given a more thorough evaluation.

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[23] Columbia Basin Fish and Wildlife Authority. Draft FY 1998 Annual Implementation Work Plan. Submitted to the Northwest Power Planning Council, June 4, 1997.

[24] Independent Scientific Review Panel. Review of the Columbia River Basin Fish and Wildlife Program: As Directed by the 1996 Amendment to the Power Act. Report to the Northwest Power Planning Council, July 15, 1997.

The multiattribute approach is similar to the first approach discussed above where information on costs and effects are displayed to help decision makers. However, multi-attribute analysis is a more formal and quantitative approach. This, in turn, requires a more formal system of goals, objectives, and priorities. The Council's framework development may eventually lead to such information and improve the feasibility of doing this type of analysis. Ranking objectives and placing relative importance of them may prove a very difficult task for the region. However, the gain would be a more objective and reviewable decision making process.

Recommendations

For This Year's Determination

As discussed above, the most immediate task is the cost-effectiveness determination required by the Gorton amendment. We propose several strategies for reaching a cost-effectiveness determination for fiscal year 1998 funding recommendations, which recognize limitations in current information and programs.

Strategy 1: Ensure Biological Effectiveness

The best assessment of the effectiveness of fish and wildlife recovery measures proposed for fiscal year 1998 will come from the prioritization and the Independent Scientific Review Panel (ISRP) process. The ISRP will evaluate projects to ensure that they have significant benefits for fish and wildlife and address the objectives and policies embodied in the Council's fish and wildlife program. The ISRP's recommendations should address the risks associated with actually realizing the benefits of projects and the logical order and timing of projects. An example in which there may be a presumed risk to realizing the benefits of a project is when the research necessary to establish the effects of actions proposed in the project has not been completed. Another case would be a project which is complementary to another strategy which has not yet been selected. An example would be investments whose benefits are associated with either a drawdown strategy or a transportation strategy. Until the region chooses one strategy or the other, investments in related projects face a high likelihood of providing little benefit while incurring a debt that will limit budgetary flexibility in the future.

In the process of reviewing projects, alternative approaches to achieving the objectives of a project may be identified. In cases where such alternatives may hold promise for a less costly way of achieving the same objectives, the ISRP or the Council may recommend delaying implementation until the alternative is analyzed.

Strategy 2: Increased Use of Cost Analysis

A second strategy brings cost information into the decision process. For reasons explained earlier in the paper, it is not currently feasible to do a formal cost-effectiveness analysis for fish and wildlife projects. However, existing project information can be used to display direct project costs along with other project characteristics in a manner that will help inform funding and cost-effectiveness decisions. Tabulations can make clear how funds are allocated among program areas, sub-basins, fish stocks, recovery strategies, and other dimensions that may help decision makers. Such tabulations can provide perspective about whether funding levels are consistent with the policies and priorities expressed in the Council's fish and wildlife program.

Special cost analyses in specific areas of program activity can help compare the various projects that target common program subobjectives. In specific areas, such as artificial production or habitat enhancement, it may be feasible to identify a relatively limited set of objectives to compare against costs. Such analysis can identify projects that seem to be higher in cost than other similar projects. Explanations for such differences may justify the project, but a lack of explanation can verify the need for changes in the project plan or a reduced priority.

This approach to introducing cost considerations into the decision process is less rigorous than may be ultimately attainable, but it does provide a positive step forward in increasing the role of cost-effectiveness considerations in the prioritization and funding process. More formal applications of cost-effectiveness analysis will become possible as the program framework develops and provides more common structure to the overall program goals, objectives and strategies.

Strategy 3: Evaluate Project Histories

A third strategy is to evaluate the record of existing projects over the past. Projects that have been ongoing for some time should have yielded some measurable effects or have contributed some concrete addition to the region's knowledge about fish and wildlife problems. A sampling of projects should be evaluated to determine what benefits they have yielded for the money expended. This exercise will introduce some accountability into the process, but more importantly can provide a better understanding of how to specify measurable effects in future project proposals. An improved ability to hold project sponsors and implementors accountable for results requires progress in this area. Further, such measurements are essential for an adaptive management approach to program design and implementation. As the project manager for the implementation of the fish and wildlife program, the primary responsibility for this activity should be Bonneville's.

Strategy 4: Audit and Implement Improvements to Contract Management Procedures

A fourth strategy is to introduce selective audits on projects. These audits would be oriented toward determining whether the contracting process contains the procedures necessary to manage the project's cost and effectiveness. This audit would be characterized as a General Accounting Office style of audit, rather than the financial audits that generally characterize contracting procedures. It should ensure that a project is holding to its schedule and cost estimates and that it is providing results consistent with the project proposal. Such procedures are intended to establish accountability for project implementors and clear responsibilities for contract managers.

Specifically, the contract management review process would include procedures for examining the project proposal documentation and reviewing the initial contract documentation, including the statement of work, budget and schedule. It would also include a review of contract expenditures to determine if they were consistent with the project budget and statement of work as well as dispersed only for payment of work which was completed. The procedure would include a review of contract amendments to determine if there was proper documentation providing justification for changes in statement of work, budget or time schedule. It would also examine whether contract amendments tended to change or broaden the original objectives and methodologies from those contained in the project proposal. A review of contract monitoring and evaluation requirements would be necessary in order to ensure that there was a method for periodic reporting on the overall progress or status of the project.

While the contract management review would not address an evaluation of the contractor's performance nor the degree to which project objectives were being achieved, it would serve the purpose of highlighting the extent to which a project does or does not clearly define objectives, remain consistent in those objectives, develop procedures to monitor and evaluate whether objectives are being achieved, and report to Bonneville and others the results of that monitoring and evaluation.

For Future Determinations

Finally, with the help of the Independent Economic Analysis Board the Council will identify gaps in the information base that have precluded a more rigorous cost-effectiveness method. A plan will be developed to remedy that information gap if it is feasible. This establishes an evolutionary cost-effectiveness method that will improve over time to enhance the Council's decision process and the documentation of its choices.

Appendix

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