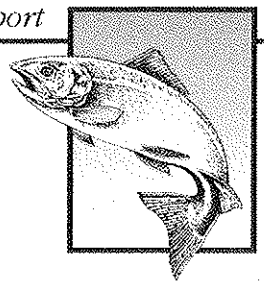


creation of fluvial habitat. This could include creating bank overhangs, installing logs or large boulders to break streamflow, anchoring root wads or snags within the stream channel, placing substrate materials (spawning gravels), installing tree revetments along banks to reduce water velocity and scouring, and other measures to provide fish rearing and resting areas. These techniques would be particularly appropriate near the mouths of tributary streams at the junction with the main river channel.

Some measures to accelerate recovery of macroinvertebrates could also be desirable. Suitable habitat for in-stream fauna can be created through the introduction of organic matter (litter). Otherwise, recovery is expected to occur through natural recolonization.

d. Powerline corridors. The powerline corridors will be restored by removing electrical lines and utility poles followed by hand-planting of trees. The used poles can be recycled into the reservoir restoration process as a source of woody debris. Below-ground portions of the poles, which have been creosoted, will be cutoff and separated for disposal following hazardous material guidelines.

e. Costs - Actions during dam removal. Depending on the final design of the restored river channel and the sediment management scenario, up to 370 acres would require treatment at an estimated cost of $2.013 million, of which $758,000 would be required for preparatory work. For Lake Aldwell, up to 200 acres would require treatment at an estimated cost of $1.488 million, including $450,000 for preparatory work.

6. Actions Following Dam Removal. The second phase of reservoir restoration would occur after dam removal; it would involve planting early successional species on areas stabilized using short-term measures described above. Nitrogen-fixing and typical pioneering species would be used for this phase of restoration, including red alder, willow, black cottonwood, several shrub species, and native herbs and forbs of natural seral successional stages.

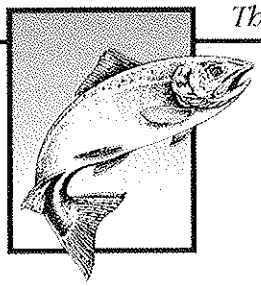
a. Habitat restoration. Planting density and plant spacing would be designed to replicate natural community species composition and structure over time. For each habitat type, a specific planting prescription would be developed using species selected for ease of seed collection, propagation, and ability to withstand handling and transplanting stress. Preliminary stocking requirements have been developed as follows.

(1) Lowland/Montane Forest

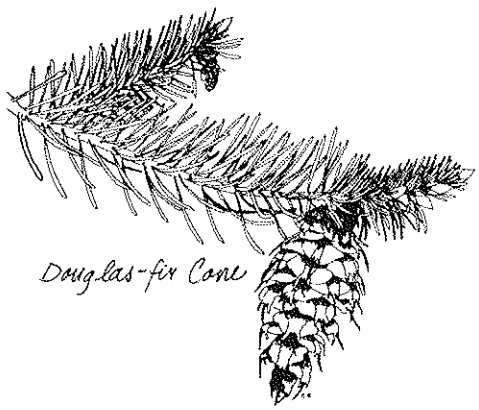
Uneven-age Douglas-fir seedlings mixed with smaller quantities of grand fir, western red-cedar, and western hemlock at a variable stocking rate of approximately 400-500 seedlings per acre for 270/55 acres (Lake Mills/Lake Aldwell).

(2) Mixed Conifer/Hardwood Forest

Douglas-fir, grand fir, red alder, black cottonwood, and bigleaf maple seedlings at highly variable stocking rates between 100 and 600 seedlings per acre for 50/100 acres (Lake Mills/Lake Aldwell).



(3) Riparian/Streamside
Willow/shrub and sedge/rush communities; these species are expected to naturally invade the area in a manner similar to pioneering vegetation on the delta. Supplemental planting might be used if natural establishment is slow on 35/35 acres (Lake Mills/Lake Aldwell).



(4) Rock Outcrops
Planting is not feasible on these steep areas totaling 10/5 acres (Lake Mills/Lake Aldwell).

(5) Special Communities
Narrow strip planting of red alder, sitka alder, willow, vine maple, or other moist-site tree, shrub, and herb species. Variable stocking rates depending on site characteristics for 15/5 acres (Lake Mills/Lake Aldwell).

Minus the 15 acres associated with rock outcrops, revegetation is expected to occur on a total of 570 acres within the currently inundated areas of Lake Mills and Lake Aldwell. Hand planting of these species is expected to occur over 1 year initially, followed by up to two additional years, if required. Overseeding by helicopter of some hand planted areas using other native species could be required to obtain near natural stocking levels. Natural stocking levels would help prevent invasion by exotic species and ensure that representative "indicator" species are reestablished. Additionally, this intensive planting effort would be supplemented by natural seeding of the area from adjacent undisturbed forests on the former reservoir shoreline, although this natural seeding would not substitute for active planting efforts.

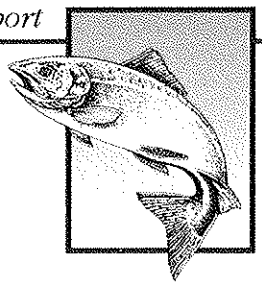
Aerial fertilization, broadcast applications of mycorrhizal inoculants, and measures to protect new seedlings from elk, deer, and rodent predation could be required. Control of exotic species invasion would also continue, as necessary.

b. Costs - Actions following dam removal. Costs for habitat restoration activities following dam removal are estimated to be $370,000 and $200,000 for Lake Mills and Lake Aldwell, respectively.

7. Long-Term Actions. Long-term actions would primarily involve monitoring of revegetation and potential follow-up treatment of problem areas. As vegetation becomes established and recovery proceeds, most areas of the former reservoir would become inaccessible except by foot. This would limit opportunities to repair areas of revegetation failure.

Restoration of haul roads, parking, and staging areas used during sediment stabilization would be necessary. Continued monitoring for and control of exotic plant species would also be required. The fate of planted areas and potential problems arising from disease, insects, or pest animals would require some level of monitoring and active management into the future.

Surveys to document recolonization of the former inundated areas by wildlife species



would also be conducted. Documentation of recovery and cooperation with research projects would continue throughout the restoration program.

a. Costs - Long-term actions. Totals of $265,000 and $108,000 would be needed for this phase for Lake Mills and Lake Aldwell, respectively. Additional details on these costs can be found in Appendix H.

b. Total costs. Total habitat restoration costs for the Lake Mills and Lake Aldwell areas are $3.6 million and $2.3 million, respectively.

I. Disposition of Project Lands

Pursuant to P.L. 102-495, the Secretary of the Interior was directed to identify:

> Specific proposals for management of all lands or interests therein acquired pursuant to this Act which are located outside the exterior boundaries of the Olympic National Park. The Secretary shall specifically address the suitability of such lands, or portions thereof, for addition to the National Wildlife Refuge System; National Park System; transfer to the Lower Elwha Klallam Tribe in trust for tribal housing, cultural, or economic development purposes in accordance with a plan developed by the Lower Elwha Klallam Tribe in consultation with the Secretary; and development and use by the State.

The Act further directs that all lands and interests within the exterior boundaries of Olympic National Park (approximately 160 acres) shall be managed pursuant to authorities otherwise available to the Park.

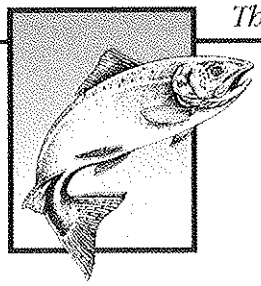
The following options for the disposition of the Elwha Project lands have been considered.

1. Addition to the National Wildlife Refuge System. The U.S. Fish and Wildlife Service (USFWS) has conducted a feasibility study on the suitability of the Elwha Project lands for the establishment of a National Fish and Wildlife Refuge. The conclusion of the USFWS feasibility study was that the Elwha Project lands do not encompass enough of the Elwha River corridor to support a refuge on Project lands. However, the USFWS is interested in pursuing a cooperative management arrangement whereby the USFWS would assist other entities (e.g., Federal and State agencies, the Lower Elwha S'Klallam Tribe, local governments, and other organizations) in fisheries and habitat management on Project lands.

Bald Eagle

2. Addition to the National Park System. Public Law 101-628 requires the National Park Service to apply certain specific criteria to proposed or potential boundary adjustments. For the Elwha Project lands to be added to Olympic National Park, the following conditions would need to be applied to determine appropriateness:

a. The lands provide significant resources or opportunities for public enjoyment related to the purposes of the park.



b. The lands address operational and management issues such as access and boundary identification by topographic or other natural features or roads.

c. The lands would protect park resources critical to fulfilling the park's purposes.

d. The added lands would be feasible to administer considering size, configuration, ownerships, costs, and other factors.

e. Other alternatives for management and resource protection are not adequate.

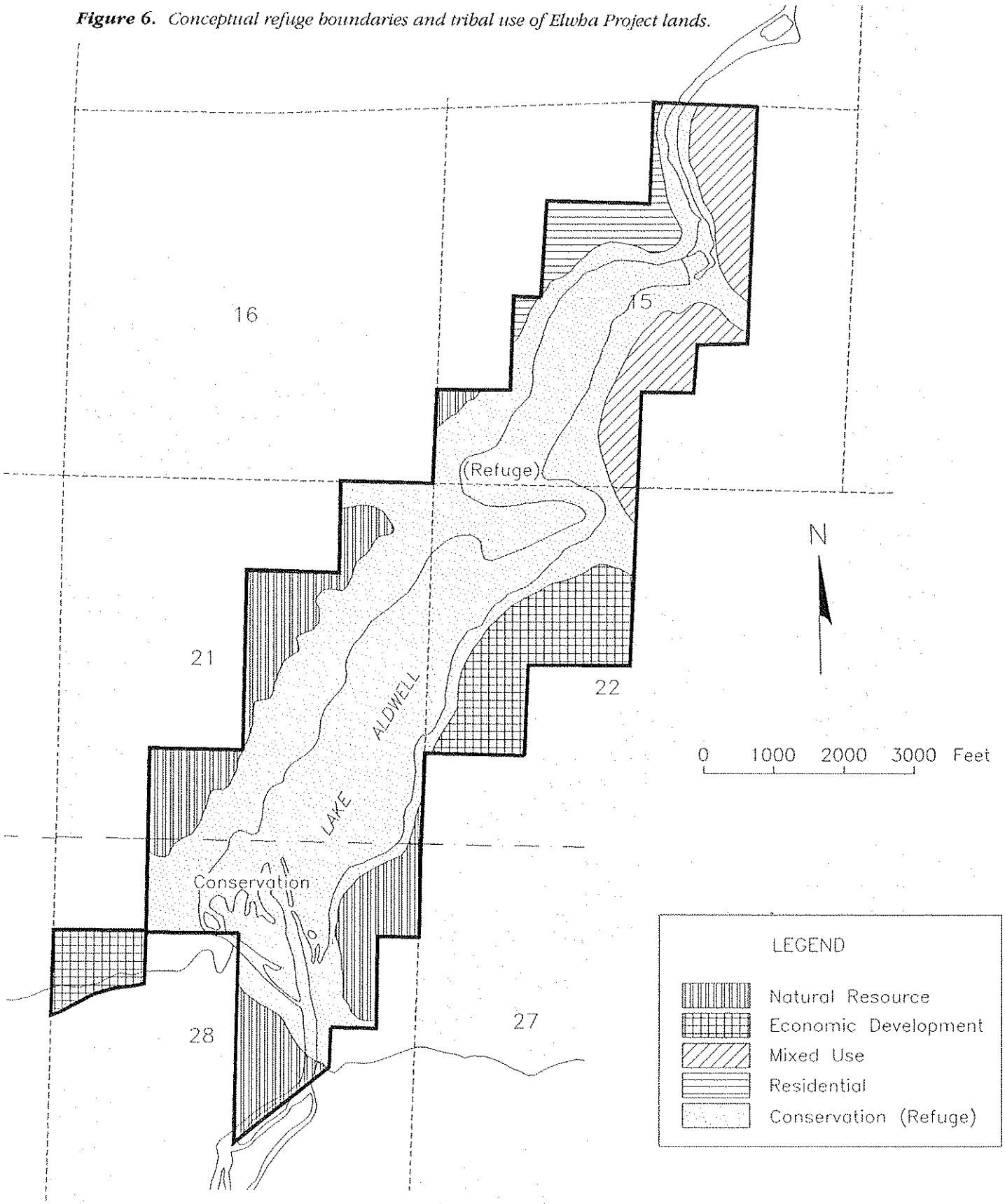
Based on the above criteria, it appears that the Elwha Project lands would be suitable for addition to Olympic National Park, provided full timber rights are also acquired. Such a boundary adjustment would require an act of Congress.

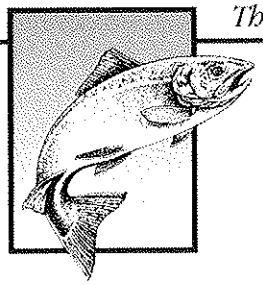
3. Transfer to the Lower Elwha S'Klallam Tribe. The Lower Elwha S'Klallam Tribe is interested in trust ownership of land that will sustain limited development for badly needed housing and economic development. Residential and economic development of project lands outside of the central river corridor (and outside of the external boundaries of Olympic National Park) could help meet long-term Tribal objectives without adversely impacting restoration of the ecosystem and the fisheries. The Tribe has proposed general land use designations for the Lake Aldwell project lands, based on environmental constraints, natural, environmental and cultural resources, environmental carrying capacity and tribal development objectives (Figure 6). Development activities on these lands would be guided by a tribal land use plan currently in progress. Land use planning efforts would focus on methods to determine and manage an appropriate quantity and density of development, while protecting the river ecosystem and maintaining the scenic attraction of the area.

Protection of the river and restoration of the fishery is of the utmost importance to the Elwha Tribe. The Tribe fully supports management of the central river corridor to protect the fish and wildlife resources of the Elwha River. These lands also contain traditional and cultural properties of great significance to the Elwha Tribe. The Tribe is interested in management of these lands for cultural purposes, including hunting, fishing, spiritual practices and sustainable gathering of resources. Creation of a conservation or refuge area would preserve the area and help to fulfill river restoration objectives. At this time, the Tribe does not have sufficient financial or technical resources to assume full responsibility for restoration and management of conservation lands. However, the Tribe is willing to explore the possibility of a cooperative venture to restore and manage the river corridor, and could eventually assume management responsibility for the project lands outside the park. Additional information on the Tribe's proposal is provided in Appendix I.

4. Development and Use by the State. The Washington State Department of Natural Resources (WDNR) has stated that WDNR is "disinterested in acquiring or managing the upland that would be exposed when the existing reservoirs are drained." No other State agency has formally commented, although

Figure 6. *Conceptual refuge boundaries and tribal use of Elwha Project lands.*





informal discussions indicate that the State is not interested in managing or using the Elwha Project lands.

The above analyses focused on the suitability of managing the Elwha Project lands, consistent with the provision that the "Federal investment in restoration" be protected, by a single entity. Cooperative management approaches with multiple entities (i.e., National Park Service, Fish and Wildlife Service, Tribe, and/or State) may be more practical. Further analysis and discussion would be necessary during the EIS/advanced planning stage to identify the preferred option.

5. Management of Glines Canyon Project Lands. In contrast to the Elwha Project, the Glines Canyon Project lies within Olympic National Park. Public Law 102-495 specifies that,

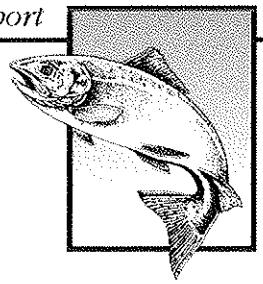
> Upon acquisition, all lands and interests therein within the exterior boundaries of the Park shall be managed pursuant to authorities otherwise applicable to the Park.

A number of options for the management of lands associated with the Glines Canyon Project, consistent with National Park Service authorities, are available and can be found in Appendix I. Generally, these lands would be managed for natural processes while accommodating recreational interests. Ultimately, restored areas could receive Wilderness designation by Congress.

J. Interpretation of Dam Removal

1. Need for Interpretation. Removal of the Elwha and Glines Canyon dams would be of national interest resulting in wide publicity. For years to come, curiosity could increase visitation to the park by people who want to get a firsthand view and the inside story of this historic event.

2. Interpretive Themes. Interpretation of the removal of the dams would be complex, incorporating viewpoints of several agencies, governments, and public interest groups at several sites. Consequently, the interpretive program should consist of diverse biological, cultural, governmental, and technical information. Issues to address could include (1) a description of the physical and operational characteristics of the dams, (2) a description of the processes associated with the removal of the dams, (3) an objective and nonjudgmental discussion of society's changing values as scientific knowledge has increased and resources have become more scarce, (4) the cultural impacts, especially the Tribe's traditional dependence upon the Elwha River for subsistence, the S'Klallam Creation site under Lake Aldwell, the history of S'Klallam Village at the confluence of Indian Creek and the Elwha River, (5) the hydrological and geological dynamics and changing landscape associated with the construction and removal of the dams, (6) the interdependent biological responses of fish, wildlife, and plants to the foregoing, (7) the obligations and objectives of the agencies managing these resources, and (8) the extensive interagency cooperation and coordination required for this effort.



3. Scale of Interpretation. To achieve the objectives in an effective manner, interpretive design and duties must be shared between the various participating agencies and governments. Towards that end, a single, comprehensive interpretive plan should be cooperatively developed.

Interpretation of the Elwha Project would involve programs at several sites. Because individual visitors may not visit each site, interpretation at each site should include elements of each of the points enumerated above. However, each site would have a unique message.

4. Benefits of Interpretation. Development of a program and facilities to provide interpretation of dam removal and river restoration would provide important information to local citizens and visitors to the Olympic Peninsula. An interpretive program would contribute to environmental education efforts surrounding river restoration, and provide an opportunity to foster public awareness, understanding, and support for restoration and the many reasons behind it.

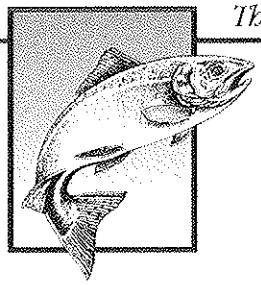
5. Costs. Capital costs would vary from $600,000 to $7 million depending upon the facility options selected (see Appendix J). Ongoing salary and benefits and 5% support operating costs would be $135,000 in 1992 dollars.

K. Living Laboratory

Removal of the Elwha and Glines Canyon dams provides a unique opportunity to study and evaluate the physical removal of two large dams and the resulting restoration of physical, hydrological, and biological processes. Although a number of dams have been removed in the Pacific Northwest, they were not as tall as the Elwha and Glines Canyon dams (Winter 1990). Even though no efforts were made during the removal of those dams to manage the accumulated sediments (the structures were simply dynamited), the removals had less potential for impacts, positive or negative, to anadromous fish.

There is great interest in making use of the Elwha River basin as a "Living Laboratory" because it provides a unique opportunity to develop and evaluate watershed and ecosystem restoration techniques that would have value elsewhere. This would be expected to lead to greater efficiencies in restoration efforts throughout the Pacific Northwest. To fully explore this concept, an expert panel consisting of fish and wildlife biologists, ecologists, silviculturists, hydrologists, soil scientists, and other specialists would be convened to develop a study plan to monitor changes to the ecosystem resulting from dam removal. The expert panel would be drawn from, among others, the National Biological Survey, U.S. Fish and Wildlife Service, National Park Service, National Oceanic and Atmospheric Administration, Forest Service, Bureau of Reclamation, universities, Washington State agencies, and Tribes. The National Park Service and/or Fish and Wildlife Service would provide oversight for this effort and would disseminate the information collected.

Given the interest in studying the restoration of the Elwha River following dam



removal, cost-sharing could be available for many studies. Although further identification of needed studies and the associated costs is necessary, a preliminary estimate of the costs to the Federal Government to oversee this effort and provide some level of financial support for participants is in the range of $400,000 to $500,000 per year. Ideally, the study program would continue for about 10 years following dam removal. A general list of proposed studies is provided in Appendix K.

L. Impacts to Cultural Resources

1. Types of Cultural Resources. The Elwha and Glines Canyon projects are both listed on the National Register of Historic Places. Additional cultural sites include Indian homesteads, seasonal camps, and the remains of a cable ferry. These sites have not been evaluated for the National Register.

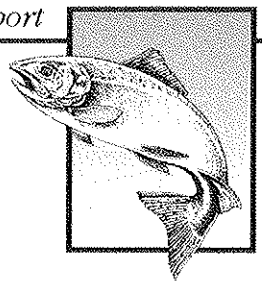
The Elwha S'Klallam lived in and utilized the Elwha River basin for thousands of years. Villages and fish camps, archaeological treasures, traditional cultural properties, tribal history and tribal culture are all integrally connected to the watershed and river system. Although there are several areas of particular significance to the S'Klallam within the Elwha valley (and particularly within the Lake Aldwell project area), the S'Klallam inhabited the entire area and have strong cultural and spiritual ties to the entire ecosystem. The river system was accorded immense respect. In addition to providing the resources necessary for daily living, it formed the S'Klallam's ceremonial, cultural and spiritual values. Because it was the heart of the culture and the economy, the whole river is a cultural resource. See Appendix L for a further discussion of cultural resources.

Significant archeological and ethnographic resources include homesteads, village sites, seasonal camps, and spiritual places. Anthropologists contracted by the National Park Service and the Lower Elwha S'Klallam Tribe are conducting further site identifications.

2. Status of Cultural Resources. The river ecosystem itself is a cultural resource of immense value to the Elwha S'Klallam. Restoration of the free-flowing river and its attendant wildlife and fish habitat would mean a revival of the cultural values that were impaired by dam construction. The cultural resource that is the Elwha River ecosystem would be restored as restoration projects are implemented, and as the Elwha S'Klallam are able to return to the area to practice traditional activities upon which their culture was formed, including fishing, gathering of natural resources and the practice of their traditional, resource based spirituality.

The majority of known archeological and ethnographic resources have been severely impacted by the Elwha and Glines Canyon projects as they are either inundated or buried by the silt that has accumulated behind the dams. The rapid release of water in 1912, as a result of the failure of the Elwha Dam foundation, would have further reduced the number and integrity of sites in the valley.

Both Projects were listed on the National Register because they retained a high degree



of integrity from the original construction. They would be destroyed during dam removal, an "adverse effect" under the 36CFR800 regulations implementing Section 106 of the National Historic Preservation Act.

3. Recommendations for Treatment/Mitigation. If the dams are removed, an initial archeological survey and ethnographic survey and ethnohistorical study would be needed to document resources within the Project area. Following this work, the recommended course of action to protect archeological sites during and after dam removal would be to monitor the reservoir as the river cuts through the sediments that layer the bottoms of the reservoirs. Archeological materials would be tested if they are encountered. Recommended mitigation for removal of the dams is documentation according to Level I standards for the Historic American Engineering Record (HAER) and interpretation of the dams on-site and at other sites to be determined. Also recommended is documentation of the dam removal by regular-interval photographs. Additional details are provided in Appendix L.

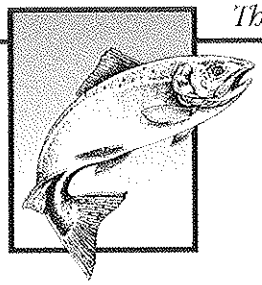
Ethnographic sites would be documented and evaluated for National Register eligibility. Those areas that are significant would be nominated to the National Register, pending approval by the Tribe. Those sites that have the potential to be affected by dam removal would be avoided. Any mitigation would be carried out in full consultation with the Tribe.

Restoring traditional cultural properties is a different task than conducting archaeological surveys or documenting characteristics of a physical entity such as the dams. It is an undertaking that would occur as the area itself recovers from the ravages of the last century of development and habitat destruction. Interpretive programs that help foster a cultural exchange among visitors to the area, tribal members, and other local residents would also help to increase recognition of the diversity of values represented by the river.

4. Costs. The total costs for an initial archeological survey, an ethnographic survey and ethnohistorical study, documentation of the dams to HAER standards, and documentation of dam removal is estimated at $204,400. The costs of monitoring during dam removal would be $15,000 per year for about 5-10 years.

M. Impacts on Regional Power Supply

The Pacific Northwest is currently facing an electric power deficit. Though future loads are not known with certainty, current load forecasts show new resource requirements in 1997 of 1,700 average megawatts (aMW) under medium-low load growth rates to about 2,900 aMW under medium-high load growth (1991 baseline). These firm energy deficits are a result of recent economic growth, early shutdown of the Trojan nuclear plant, and reductions in the generating capability of the Columbia River hydropower system to support fishery mitigation. Because of this continuing need for new resources, replacement resources will need to be acquired if the dams are removed. Hence, the value of lost power from removal of the Elwha Projects would be equal to the cost of replacement power. In order to meet the Pacific Northwest's future need



for firm energy, Northwest utilities and the Bonneville Power Administration (BPA) are aggressively pursuing conservation and generating resources.

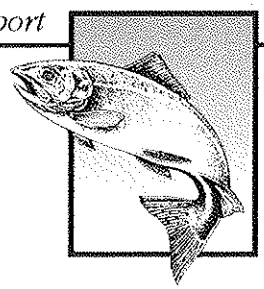
1. Available Replacement Resources. The Northwest Power Planning Council (Council), BPA, and the major Northwest utilities use least-cost integrated resource planning methods to determine future resource needs. These planning efforts, and actual resource acquisition experiences consistently indicate that energy-efficiency improvements (conservation), certain renewable resources and natural gas generation and cogeneration are the most promising resources for meeting future Northwest electrical needs. The cost and availability of these and other resources are described in the following paragraphs. These estimates are from the regional power council and are based on economic potential adjusted for constraints to development (i.e., the actual amount of the resource expected to be available for development over the next two decades):

End-use Conservation: Measures to improve the efficiency of residential, commercial, industrial and agricultural end uses of electricity. Included are building thermal shell improvements and high efficiency lighting, refrigeration, motors and pumps. From 1,500 to 3,000 megawatts of energy is available from end-use conservation at 2.6 to 11 cents per kilowatt-hour. Incentive programs, codes and standards are used to secure end-use conservation because the acquisition decision is generally in the hands of the end user, not the utility, and the benefits are often spread between the end user and the utility. Though the process of conservation acquisition is difficult, Northwest utilities have been successful in meeting regional end-use conservation goals.

Utility System Efficiency Improvements: Measures to improve the efficiency of power generation, transmission and distribution. These include improved hydropower turbine runners and governors, improved steam turbine blading, high-efficiency transformers, higher-capacity transmission and distribution circuits and improved voltage regulation. An estimated 370 megawatts of energy is available from such measures at 0.1 to 13 cents per kilowatt-hour. Utilities have been successful in meeting regional goals for system efficiency improvements.

Biomass: Combustible organic residues of forest products and agricultural operations, and energy crops. Small (5 to 50 megawatt) boiler-steam turbine generation or cogeneration plants are typically used to generate electricity from biomass. An estimated 670 megawatts of energy is available from biomass at costs of 5.9 to 15 cents per kilowatt-hour. Few new biomass plants are being developed, largely because of the low cost of competing gas-fired combined-cycle power plants and more productive use of materials formerly considered as residue.

Geothermal: Heat contained within the earth, often available as hot water or brine. Various technologies, many well-established, are used to generate electricity from geothermal fluids. Considerable geothermal potential is thought to exist in the Northwest, but the extent and nature of specific resources are not well understood. Though the environmental effects of geothermal development can be managed, the



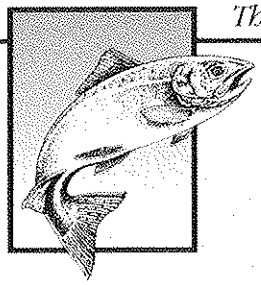
environmental sensitivity of the areas in which geothermal resources are located is expected to add to the difficulty of development. Pilot generation projects are underway to improve understanding of the resource and effects of its use. An estimated 350 megawatts of energy is available from geothermal power plants at costs averaging 11 cents per kilowatt-hour. Low temperature geothermal fluids are used for space and water heating in several Northwest communities.

Hydropower: Expansions of existing hydropower projects, small (one to five megawatt) projects on irrigation and other offstream water systems and small headwater diversion projects. From 120 to 900 megawatts of energy is available from new hydropower projects at 2.4 to 13 cents per kilowatt-hour. Hydropower licensing is prolonged and difficult because of public concerns arising from the environmental effects of existing hydropower development. However, utilities and developers have been successful in meeting regional goals for new hydropower development.

Natural Gas: Combustion gas turbines (similar to jet engines) in simple cycle or the more efficient combined-cycle configuration are used to generate electricity from natural gas. In a combined-cycle plant, the hot gas turbine exhaust is used to generate steam to drive a secondary steam turbine-generator. Combined-cycle plants range from about 100 to 500 megawatts capacity. Continued low gas costs, low capital costs, high efficiency, short development times, operational flexibility and modest environmental impacts have led to natural gas-fired combustion turbines becoming the generating resource of choice in the Northwest and elsewhere. To date, little difficulty has been experienced in developing gas-fired power plants, particularly cogeneration plants jointly producing electricity and useful thermal energy for industrial processes. There is no obvious limit on the number of gas-fired plants that could be built, but utilities hesitate to rely exclusively on natural gas for new energy requirements because of fuel price risk, air quality considerations and global warming concerns. An estimated 4,200 megawatts of energy could be secured from natural gas-fired power plants at 5.9 to 12 cents per kilowatt-hour.

Nuclear Power: An estimated 1,700 megawatts of energy could be secured from the partially-completed WNP-1 and WNP-3 at 8.5 to 9.3 cents per kilowatt-hour. These units have been preserved as insurance against high load growth, rapid increases in fossil fuel prices or other conditions requiring large new resources. Because of the continuing availability of competitively priced natural gas, moderate load growth rates, the economic risk associated with these large plants, and recent retirement of the Trojan nuclear plant, it is increasingly unlikely that WNP-1 or WNP-3 would be considered when seeking new power supplies. It is highly unlikely that new nuclear plants would be considered until nuclear waste disposal issues are resolved and smaller, less expensive and more reliable nuclear designs are available. These issues will be not resolved for many years.

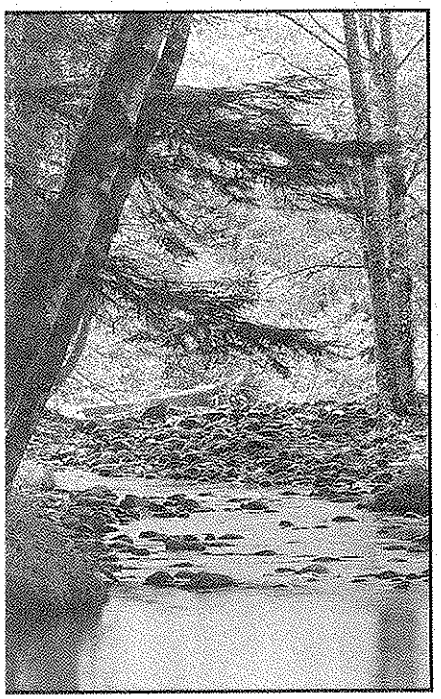
Ocean: Various forms of ocean energy, including that of waves, tides, currents and salinity and thermal gradients have been proposed for generating electric power. Only wave energy currently offers significant potential in the Northwest, perhaps several hundred megawatts of energy. The commercial development of wave energy power



plants is limited by immature technology, harsh maritime conditions and likely aesthetic objections to coastal wave power plants.

Refuse Fuels: Combustible solid refuse and landfill gas. Small (5 to 25 megawatt) boiler-steam turbine power plants are used to generate electricity from solid refuse. Small (1 to 5 megawatt) engine-generators are used to generate power from landfill gas. Although fuel is available in the region to support several hundred megawatts of solid waste generation, these plants have been exceedingly difficult to develop because of public concerns regarding air quality and local waste transportation. In contrast, development of generating plants using recovered landfill gas has been relatively easy. An estimated 120 megawatts of energy are available from new solid refuse power plants at costs averaging 8.1 cents per kilowatt-hour.

Solar: Electricity can be generated from solar energy using boiler-turbine thermal power plants or by photovoltaics. Photovoltaics is commercially available, but expensive (15 to 30 cents per kilowatt-hour). It is widely used for kilowatt-scale remote applications. Some solar thermal technologies are in commercial service and others are under development. Costs range upward from 16 cents per kilowatt-hour. Good solar potential is available in southern Idaho and Eastern Oregon, but is more limited elsewhere in the Northwest. Solar development in the Northwest is complicated by the non-coincidence of the summer solar peak and the winter peak electric loads.

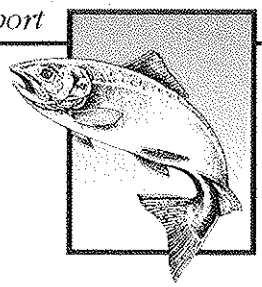


Side channel of Elwha River. (Janis Burger)

Wind: Electricity is generated from wind by tower-mounted wind turbines in groups of up to several hundred machines. This is an established technology, but one that has economic difficulty competing with gas-fired combined-cycle power plants. Some proposed windpower plants have met with significant public opposition, primarily becaue of aesthetic concerns. An estimated 660 average megawatts of energy is available from new wind power plants at costs ranging from 9.5 to 17 cents per kilowatt-hour. Because of recent technology improvements, these costs are thought to have declined by 15 percent or so.

One of the ways BPA is addressing the uncertainty associated with resource development is its Resource Contingency Program. This program will allow BPA to complete the permitting and environmental work on a selected number of resources so they will be available to the region for development in a more timely fashion. Unfortunately, Northwest utilities and BPA are in the early stages of their generating resource development plans and it will only become clear what types of projects and how many megawatts are actually feasible at a reasonable cost and in a reasonable time frame as the region gains more experience.

Because of cost-effectiveness and environmental attributes, acquisition of cost-effective conservation has been accorded the highest priority by the Council, BPA, and the region's utilities. The Council's goal for regionwide acquisition of at least 1,500 aMW of conservation over a 10 year period has been adopted by BPA, the state utility commissions, and the principal regional utilities. Evidence to date indicates that actual rates of conservation acquisition are consistent with this goal. However,



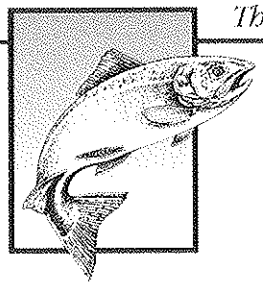
conservation resources, though abundant, are not sufficient to meet expected regional needs. To meet needs in excess of that provided for by energy-efficiency improvements, utilities are acquiring generating resources either through development of utility-owned generating projects or by contracting for independently-owned facilities. Overall, these efforts have been successful to date, leading to the conclusion that replacement of power output of the Elwha Projects is feasible.

Electricity lost due to the retirement of one or both of the Elwha Hydroelectic Projects could be supplied by either Daishowa or Port Angeles City Light. Daishowa could choose to develop replacement resources itself, or to purchase from independent power producers, other utilities or power brokers. Port Angeles, likewise, could choose to develop replacement resources itself, to purchase from independent power producers, other utilities or power brokers or to place additional load on the BPA. Because P.L. 102-495 requires the BPA to deliver replacement power through the local preference customer (Port Angeles City Light), this study assumes that replacement power would be supplied by the BPA.

The replacement energy could be supplied by locally-developed conservation and generating resources to the extent that cost-effective local resources are available, or could be supplied from BPA general system resources. Because locally-developed resources may offer distributed system benefits, it would be prudent for BPA to assess avoided transmission costs and other distributed system benefits, and to undertake an assessment of local opportunities for development of replacement resources, considering distributed system benefits. Resources that should be considered include end-use and utility conservation measures, biomass generation and cogeneration, direct-use geothermal, small hydropower, solid refuse generation, landfill gas generation and wind power.

If replacement energy is secured from BPA's system, it is unlikely that BPA would undertake specific actions to replace the lost power. Rather, the ongoing acquisition of projects would be slightly advanced in time to cover the need created by the Elwha retirements. These acquisitions would likely include conservation, natural gas generation and cogeneration, small hydropower, and other renewables and would be secured through BPA's Customer Billing Credits Program, negotiated exchanges and other interregional transactions, BPA's Resource Contingency Program, or unsolicited proposals.

2. Cost of Replacement Power. The cost of securing replacement power for the Elwha Projects was estimated by calculating the present value of future costs of the Northwest power system for two cases. The base case assumed continued operation of both Projects until 2047. The alternative case assumed retirement of both Projects in 1997. The present value difference in costs between these two cases is the estimated cost of securing replacement power. Uncertainties regarding future load, fuel price, and annual hydropower were explicitly modelled. Replacement resources were drawn from the stack of resources expected to be available to regional utilities in order of cost-effectiveness. No mitigation costs for licensing Elwha or Glines Canyon were included in the base case and no decommissioning costs or foregone



operation and maintenance costs were included in the alternative case. The present value of these costs can be separately calculated (using a 7.12% (nominal) discount rate) to determine the net cost of a specific alternative.

The present value cost of replacement power for the two projects over a 50 year period following retirement is estimated to range from $20 to $300 million (1990 dollars), with an expected value of $125 million. The range is attributable to the uncertainties cited in the above paragraph.

Mean annual incremental replacement power costs are estimated to be $4.1 million (1990 dollars) immediately following retirement. Annual replacement power costs will likely gradually increase over the life of replacement resources because of anticipated natural gas price escalation. The average mean annual replacement power cost over the 50 years following retirement of the Elwha Projects is estimated to be $6.3 million. Year-to-year variations will occur because of short-term fluctuations in load growth, fuel prices, and hydropower availability.

3. Environmental Consequences. The environmental consequences of securing replacement power for the Elwha Projects, other than conservation, includes the incremental air, water, and land effects of constructing and operating replacement resources. The resulting releases of key air pollutants and carbon dioxide can be estimated. Other environmental effects would be largely project-specific and can only be generally described prior to the identification of specific replacement resources. Potential adverse environmental impacts could be offset by the positive environmental consequences of removing the Elwha Projects (see Section V(D)). The quantitative estimates of environmental effects that follow are based on replacement power being secured through ongoing BPA resource acquisition activities. Replacement through local resource development may result in a greater proportion of energy efficiency, renewables and cogeneration. This might reduce the resulting magnitude of environmental effects.

a. Air Quality Effects. The estimated annual average incremental air emissions from replacement resource development, other than conservation, are shown in Table 12. These emissions are attributable to the combustion of natural gas in replacement generation or cogeneration plants and the interaction of new plants with existing combustion-based power plants. These estimates of air pollutant emissions (particulates, nitrogen oxides, sulfur dioxide, and carbon monoxide) were based on typical mid-1980s pollution control technology. Newer control practice is expected to substantially reduce pollutant emissions. Similar to replacement resource costs, year-to-year variations in estimated air emissions would occur because of short-term fluctuations in load growth, fuel prices, and hydropower availability.

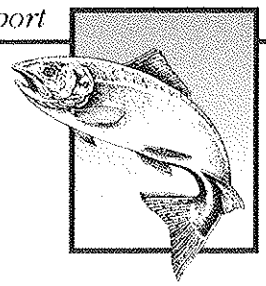


Table 12. *Annual average air emissions from replacement resource development.*

Emission	Quantity (tons/year)
Total suspended particulates	3.2
Nitrogen oxides	61
Sulfur dioxide	38
Carbon monoxide	34
Carbon dioxide	47,300

Though not a regulated pollutant, carbon dioxide is of concern because of its role in contributing to possible global climate change. The carbon dioxide estimate (Table 12) assumes no carbon offsets. The cost and effectiveness of carbon offsets through biotic sequestering are being explored.

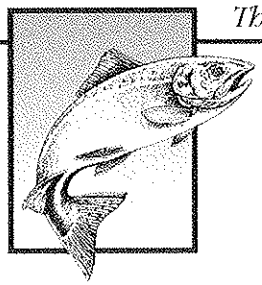
Since Elwha River fish are harvested from Alaska to Oregon, restoration of the runs will benefit numerous fishermen, but perhaps none more than the Elwha S'Klallam Tribe located at the mouth of the river.

b. Water-Related Effects. Replacement thermal resources would consume large amounts of water, largely through evaporation in condenser cooling towers. The consumption of water has the potential of being the most controversial aspect of thermal resources given the current concerns in the region over water supplies and discharge. Makeup water would be obtained from ground or surface water sources. Other water impacts could result from the damming or diversion of streams for new hydropower development. Because of the project-specific nature of these impacts, specific water quality effects cannot be described in advance of identifying specific replacement projects. However, current policy and regulation largely precludes the development of new hydropower facilities at sensitive sites, and closely regulates the impact of any new facility on water flows and quality. For this reason, the water quality effects of replacement resource development can be expected to be acceptable.

c. Land Effects. Because most thermal plant development now occurs at sites dedicated for industrial use, significant land-related impacts from these resources are not expected (though incremental land impacts will occur in areas of natural gas production). The land-related impacts of new hydropower and other renewable resources are highly project-specific. New hydropower development could result in displacement of non-critical habitat. Wind or geothermal development could result in the conversion of fairly large areas of land from rural to power plant-related uses. Some aesthetic impacts could result from wind or geothermal development and from transmission interconnections of new power plants to the grid.

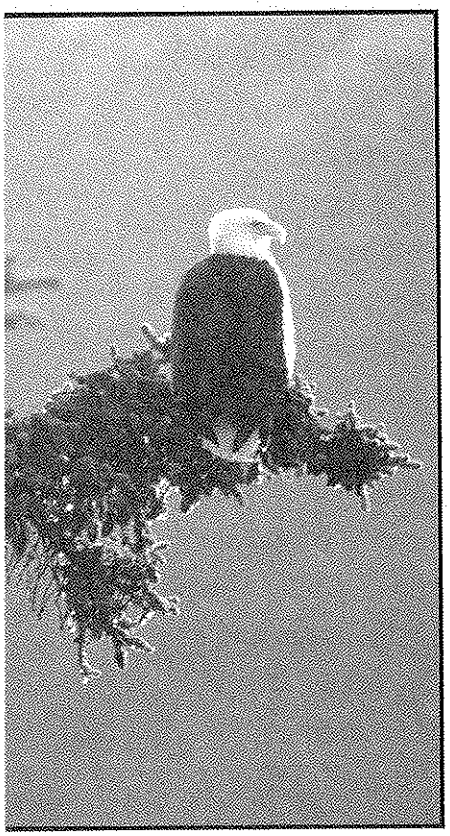
N. Cost-sharing

Restoration of the Elwha River ecosystem and native anadromous fisheries would result in benefits to a broad spectrum of public and private interests. Consequently, P.L. 102-495 directed the Secretary of the Interior to identify cost-share possibilities among the various beneficiaries, ". . . if the Secretary believes that such parties or entitites should assume some portion of the cost involved in the restoration, together with the specific cost-share provisions which the Secretary deems necessary and reasonable."



The reduction of anadromous fish runs in the Elwha River following construction of the Elwha and Glines Canyon dams resulted in fewer fish for treaty and nontreaty fishermen. Since Elwha River fish are harvested from Alaska to Oregon, restoration of the runs will benefit numerous fishermen, but perhaps none more than the Elwha S'Klallam Tribe located at the mouth of the river. However, Section 3(c)(5) specifically excludes any "Federally recognized Indian tribes" from cost-share provisions.

Other potential harvesters of restored Elwha River anadromous fish include non-Indian recreational and commercial fishermen, primarily within the State of Washington. Harvest rates of anadromous fish in marine areas can be estimated for many Elwha fish stocks, but they are based on current hatchery releases. Harvest rates would have to be refined once natural stocks are restored to better estimate benefits to Washington fishermen. Also, harvest benefits accruing from each stock will vary according to the amount of time required for restoration of that stock.



Bald eagle. (Pat O'Hara)

Tourists visiting Olympic National Park (designated a World Heritage Site and International Biosphere Reserve by the United Nations) will be attracted by the actual removal of the dams and the resulting habitat, wildlife, and fish restoration. These tourists would provide much needed economic stimulus to Port Angeles and Clallam County. Cost-shares could arise from the participation and contributions of public and private entities, similar to that stipulated in P.L. 100-406 (Section 7).

There are a number of Federal statutes -- both generic and project-specific -- that address the issue of cost-sharing for fish and wildlife mitigation, enhancement, or restoration at Federal water resources development projects of the Army Corps of Engineers, Interior's Bureau of Reclamation, and the Department of Agriculture's Soil Conservation Service.

While these statutes do not apply directly to the removal of the Elwha and Glines Canyon dams, there is certainly precedent to require as much as 25 percent non-Federal cost-sharing for certain fish and wildlife resource activities.

Appropriate cost-sharing terms will be explored during the development of the advanced planning report and NEPA compliance process. Based on the results of this review, a formal cost-sharing agreement would be negotiated prior to initiation of the selected alternative.