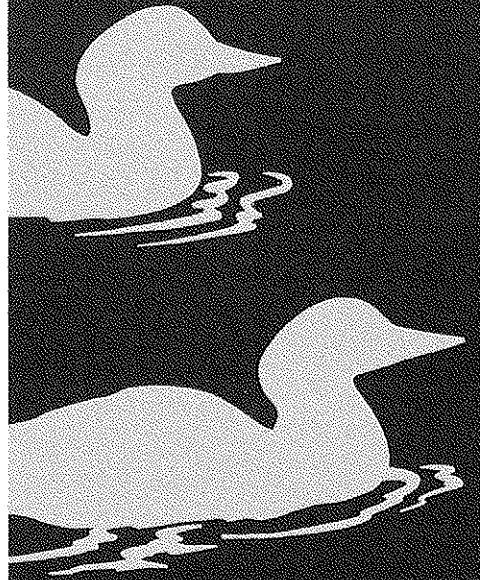
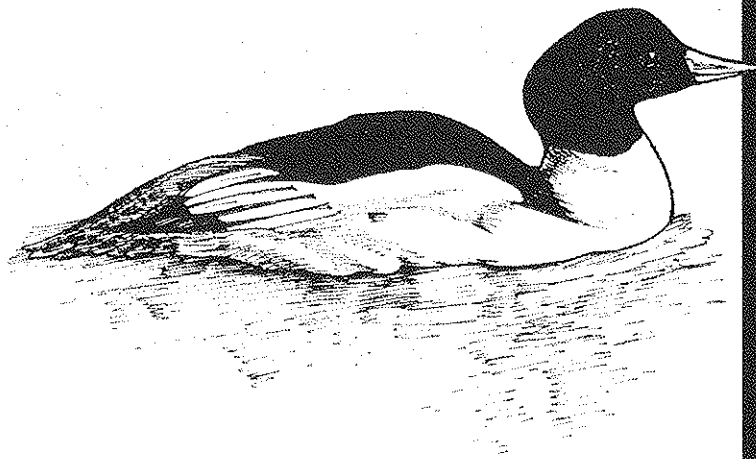
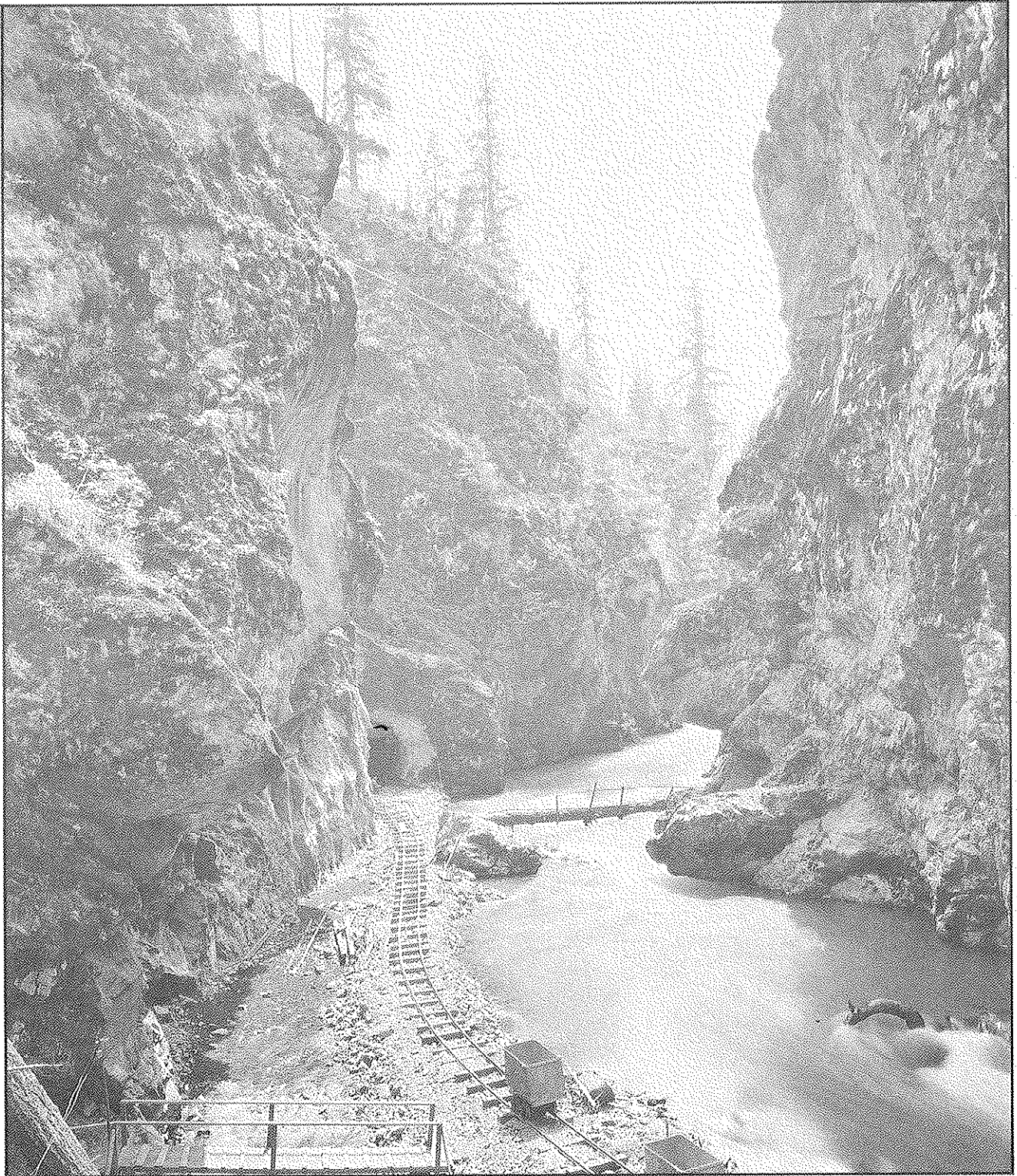
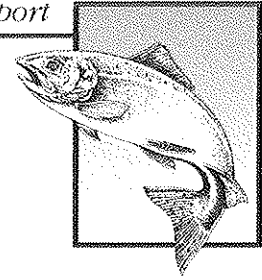


II.
Background
of the
Problem





*Excavating for diversion
tunnel, Glines Canyon Dam
site, June 15, 1926.
(Northwestern Power & Light
Company photo)*



II. Background of the Problem

A. History of the Projects

The Elwha Valley, with its river and tributaries rich in salmon, was used by Native Americans for thousands of years before the first European explorers reached the Northwest coast. The Lower Elwha S'Klallam Tribe based much of its culture and economy on the multiple runs of salmon in the Elwha River. Ethnographic accounts identify as many as 12 residential and camping sites on the lower river, including major villages on the west bank at the confluence of the river with both Indian Creek and Little River (Wesson and Welch 1987).

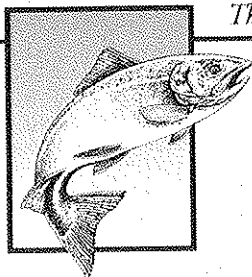
In 1889, a young Canadian named Thomas Aldwell arrived on the peninsula and began purchasing land on both sides up and downstream of the narrowest gorge on the Elwha river. By 1908 Aldwell had succeeded in buying all the land he needed for a dam and its reservoir. Aldwell convinced George A. Glines, a wealthy Canadian, to help finance power development on the Elwha. With Glines' financial backing, Aldwell was able to purchase a half interest in the site where the Glines Canyon Dam would be built and form the T. T. Aldwell Company (Adamire and Fish 1991). In 1910, Aldwell formed the Olympic Power and Development Company and obtained the financial backing of Chicago capitalists to begin construction of the Elwha Dam. Despite repeated contacts from the Washington State Fish Commissioner, reminding Aldwell of the legal requirement to provide passage for migrating fish and the complaints from local salmon cannery officials, no accommodation for fish passage was made. The State Game Warden, even before the dam closed its gates, complained that the fish were blocked from migrating. On the last day of October 1912, the dam foundation blew out, taking with it the downstream bridge. The blow out was the result of a failure to provide a secure foundation down to bedrock under the gravity dam.

Aldwell obtained the financing to repair the dam. State and local fish commissioners thought they saw a new chance to provide for the fish, but their efforts were ignored. When the project became operational in 1913, supplying power to Bremerton Navy Yard, Port Angeles and Sequim, the fish question remained unsettled. Ultimately, a compromise was reached allowing Aldwell to construct a fish hatchery at the dam in lieu of a fishway. The hatchery was unsuccessful and finally abandoned in 1922 due to the scarcity of salmon making their way upriver.

Although all of the power generated by the Projects since 1920 has been used by the Mill (except for emergencies), the power provided by the Elwha Project helped fuel the growth of Port Angeles. In 1949, power provided by the Bonneville Power Administration reached the Olympic Peninsula.

When Glines Canyon Dam, located upriver from Elwha Dam, was licensed in 1926 by the Federal Power Commission, impacts to the fisheries were not considered; the

The Elwha Valley, with its river and tributaries rich in salmon, was used by Native Americans for thousands of years before the first European explorers reached the Northwest coast.



traditional fishing grounds at the confluence of Indian Creek and the Elwha had been flooded by Lake Aldwell and fish migration had already been blocked. Over the next decade, ownership of both the dams and the land surrounding the Glines Canyon Project changed. Crown Zellerbach Corporation, which had purchased the Elwha Project in 1919, received permission from the Federal Power Commission to purchase the Glines Canyon Project in 1937. The following year, with the establishment of Olympic National Park, most of the lands inundated by Lake Mills became part of the park, although ownership of the facilities and the land upon which they were constructed remained with Crown Zellerbach.

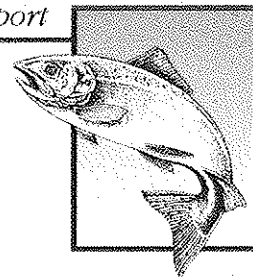
Applications for licensing the Elwha Project and relicensing the Glines Canyon Project were filed by Crown Zellerbach in 1968 and 1973, respectively, initiating more than two decades of debate ranging from jurisdictional disputes to fisheries issues to the weakening of Ediz Hook, the breakwater creating the Port Angeles harbor which was partially fed by the littoral drift pushed downstream by the Elwha River before the dams' construction. James River II, Inc. (currently James River Paper Company), which purchased both dams and power plants in 1987, became Crown Zellerbach's successor in the center of the controversy.

As a result of the obvious adverse impacts of the Elwha and Glines Canyon projects on the salmon populations of the Elwha River (primarily blockage of adult salmon migration and frequent, rapid, and dramatic stream flow fluctuations for power generation purposes), the Washington Department of Fisheries (WDF) entered into a settlement agreement with the Crown Zellerbach Corporation (CZC) on April 25, 1975. In return for WDF's commitment not to oppose licenses for the Projects, CZC agreed to operate the Elwha Project in a run-of-the-river mode and to provide 23.6% of the construction and operating costs for a rearing facility to produce a maximum of 360,000 pounds of juvenile chinook salmon. Disease problems (e.g., *Dermocystidium salmonis*) have limited chinook salmon production at the facility. No other species have been produced at this facility.

In an attempt to replace a small portion of its economic base, the Lower Elwha S'Klallam Tribe obtained Federal funds to construct a hatchery on Reservation lands near the mouth of the river. The hatchery began operation in 1976 and produces coho and chinook salmon and steelhead but is not considered mitigation for the Projects.

B. Description of the Projects

After initiating construction in 1910, the Olympic Power and Development Company (Olympic Power) began operation of Elwha Dam in 1913. The dam is a concrete structure consisting of a central gravity-type section with an adjacent buttress-type intake section and flanked by spillways at each abutment. It is approximately 450 feet long at its crest and is about 105 feet high. Lake Aldwell, the 2.5 mile impoundment created by the dam, has a total storage capacity of about 8,100 acre-feet with a maximum drawdown of 7 feet, as limited by the surface intakes. However, the 1975 settlement agreement with the Washington Department of Fisheries requires that the Elwha Project be operated in a run-of-the-river mode, necessitating a stable



water surface elevation (see Section II.A). The total installed power generation capacity is 14.8 MW.

The Northwestern Power & Light Company began operation of the Glines Canyon Project in 1927. The structure is a varied radius, single arch concrete dam that is 210 feet high and varies in width from 55 feet at its base to 270 at its crest. The Lake Mills reservoir provides about 30,000 acre-feet of active storage, although operations since the 1975 agreement with WDF have involved drawdowns of 10 feet or less, corresponding to about 4,000 acre-feet of storage. The total installed capacity is 16.0 MW.

The two projects provide about 18.7 average MW to the Daishowa America Mill in Port Angeles, which equals about 38% of the power needs of the mill. The rest of the mill's power is supplied by the Bonneville Power Administration (BPA) through the City of Port Angeles (City). A power line connects the Glines Canyon and Elwha projects. A power line 6 miles in length transmits energy directly to the mill. Additional Project descriptions can be found in Appendix F.

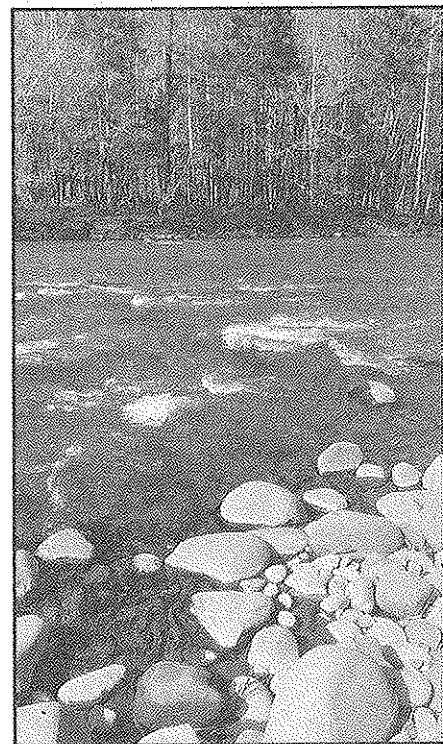
C. Affected Environment

The Elwha and Glines Canyon hydroelectric projects are located on the Elwha River on the Olympic Peninsula in northwest Washington (Figure 1). The Elwha River has a north-south orientation and is 45 miles long with over 100 miles of tributary streams. With a drainage area of 321 square miles, of which 267 square miles (83%) are located within Olympic National Park, the Elwha River is the fourth largest river by drainage area on the peninsula and comprises 19% of total Park lands.

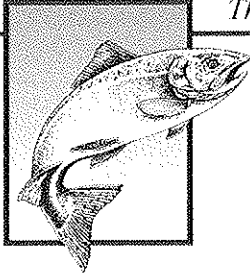
1. Fluvial Processes and Conditions. Because the Elwha River basin above Lake Mills lies within Olympic National Park, it is pristine. The Glines Canyon and Elwha projects have, however, dramatically altered the landscape. The Projects have inundated over 5 miles of riverine and 684 acres of lowland habitat beneath Lake Mills and Lake Aldwell.

About 11.3 million cubic yards of sediment are trapped in Lake Mills (known as Smoky Bottom before inundation). At an estimated rate of 180,000 cubic yards per year, Lake Mills would be expected to fill with sediment in 260-300 years. Estimates of the amount of sediment trapped in Lake Aldwell vary between 2.6 and 4 million cubic yards. Most of these sediments accumulated prior to construction of Glines Canyon Dam. At an estimated rate of 31,000 cubic yards per year with the retention of Glines Canyon Dam, it would take about 400 years to fill Lake Aldwell with sediments.

With the trapping of bedload (cobbles, gravel, and sand) in Lake Mills and Lake Aldwell, the greatly reduced supply in the middle (between Glines Canyon Dam and Lake Aldwell) and lower (below Elwha Dam) Elwha River reaches has resulted in a coarser surface pavement when compared to the upper (above Lake Mills) reach and other rivers in the region. With limited bedload transport from the Elwha River basin, the lower river channel is primarily reworking older river deposits and locally eroding



Large cobbles on Elwha River below Glines Canyon Dam. (Janis Burger)



the high banks of the glacial outwash. For additional information on Elwha River sediments, please see Section VI.C.

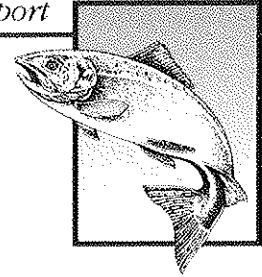
Except for the blockage of anadromous fish with the associated impacts (e.g., lack of salmon carcasses, reduced wildlife populations) and the local deposition of sediments at the mouths of Indian Creek and the Little River, the over 100 miles of tributary streams (Williams et al. 1975), including stream reaches above areas of historic salmon use, have been largely unaffected by the Projects. Most of these streams lie within Olympic National Park, so are, in other respects, pristine and offer significant fish and wildlife restoration opportunities.

The Glines Canyon and Elwha projects have altered the nearshore marine environment by reducing the sediment supply by about 280,000 cubic yards annually (James River II, Inc. 1989). Because of this loss of sediment replenishment, the shoreline has both receded and steepened, and the intertidal and shallow subtidal zone now has a bottom dominated by large cobbles instead of sand. In addition, the formation of Ediz Hook is closely linked with the Elwha River (Galster 1989). The cause of erosion of Ediz Hook is the decrease in sediment supply brought on by construction of water supply pipeline protective works along the base of the sea cliffs and the dams on the Elwha River (USACE 1971, Galster 1989). As a result of the reduction in the sediment supply, the offshore area of sand and gravel deposits has been reduced in volume leading to over-steepened beach slopes, landslides, and exposure of Ediz Hook to greater erosion (Galster 1989).

2. Water Quantity, Quality, and Use. The average instantaneous discharge of the Elwha River at the McDonald gauge, representing the upper 269 square miles (84%) of the drainage basin, is 1,507 cubic feet per second (cfs). With the majority of the watershed in pristine condition and the trapping of sediments in the two reservoirs, the waters of the Elwha River are classified by the State of Washington Department of Ecology as having Class AA waters. Water quality degradation is minimal and is primarily limited to effects of logging and agriculture that occur in the lower portion of the watershed outside Olympic National Park. However, increased water temperatures occur in the middle and lower reaches of the river in late summer and early fall from storage of heat in Lake Mills and Lake Aldwell. Water is withdrawn from the river for municipal, industrial, domestic, irrigation, and fish propagation purposes. Water quantity, quality and use is discussed in detail in Section VI.E.

Lake Mills and Lake Aldwell prevent nutrients and organic matter transported by the upper river from reaching the middle and lower river reaches, as reservoirs are known to block the downstream transport of these materials (Webster et al. 1979, Newbold 1987). The lack of this organic material in the middle and lower river has likely limited benthic invertebrate production in the middle and lower river, which in turn limits the growth and survival of fish.

3. Fisheries Resources. Written documentation concerning pre-dam run sizes of Elwha River native anadromous fish is largely unavailable. However, recollections of local residents, fragmentary written records, and the testimony of



Indian elders are supported by post-dam data. Indian residents who fished the river in the years before Elwha Dam was built have testified that salmon and steelhead stocks were abundant and that fishing occurred year-round, all along the river. In fact, the Elwha River was historically noted as one of the largest producers of salmon and steelhead on the Olympic Peninsula (WDF 1971).

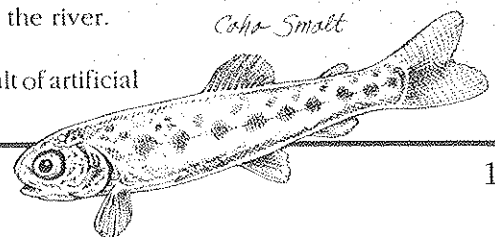
Current runs are only a small portion of their former size, largely because of the Elwha and Glines Canyon dams. In addition to blocking anadromous fish passage to over 70 miles of mainstem and tributary habitat, the Projects were historically operated (primarily in the 1930's and 1940's) in a way that resulted in frequent and extreme stream flow fluctuations downstream, stranding juvenile and adult fish (Maib undated, WDF undated). Other adverse impacts have resulted from the inundation of 5.3 miles of riverine habitat, trapping of bedload with the consequent loss of spawning substrate below the dams, the retention of a portion of the nutrients and woody debris in Lake Mills and Lake Aldwell that would normally pass downstream, and the elevation of water temperatures.

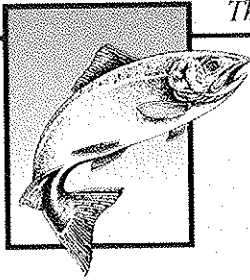
Anadromous fish historically included stocks of spring and summer/fall run chinook salmon, coho, pink, chum, and sockeye salmon, summer and winter runs of steelhead, sea-run cutthroat trout, and native char (Dolly Varden and bull trout). Perhaps the best-known salmon was the run of chinook that produced fish of very large size, some exceeding 100 pounds. These fish were "easily the largest on the Olympic Peninsula" and apparently persisted in the lower river until at least 1930 (Brown 1982). Unfortunately, fish of this size are no longer observed. The last exceptionally large fish was gaffed by a Washington Department of Fisheries (WDF) biologist in 1946 and weighed 70 pounds. Although fish up to 50 pounds still occasionally return to the river, the size of the fish now appears to be typical of most other Puget Sound and Washington coastal rivers.

a. Spring Chinook Salmon. Unfortunately, few, if any, spring chinook salmon still return to the Elwha River. Spring chinook are upriver spawners, and lack of access to habitat in the upper Elwha as a result of the dams has undoubtedly had a major adverse impact on their abundance. Any spring chinook that may remain in the river are probably dependent upon natural spawning, although WDF may collect eggs for the Channel from "early returning" fish.

b. Summer/Fall Chinook Salmon. Summer/fall chinook salmon populations in the Elwha River are currently supported by both natural and artificial propagation. Chinook salmon spawn naturally in the river below Elwha Dam, but returns are largely the result of production at the WDF Rearing Channel, and to a lesser extent the Lower Elwha S'Klallam Tribe's hatchery. The WDF facility annually releases up to 4 million fingerling and yearling chinook salmon, while the tribal hatchery releases up to 400,000 fingerling chinook each year. The resulting combined annual returns to the river have averaged about 4,000 fish since 1982. However, diseases (e.g., *Dermocystidium salmonis*) have limited chinook salmon production in the river.

c. Coho Salmon. Coho salmon returns to the river are primarily the result of artificial





propagation, with approximately 800,000 yearling coho produced at the tribal hatchery. Since 1977, coho returns have ranged from about 5,000 to 16,000 fish annually, and they represent about 16% of runs returning to four major North Coast rivers. However, during the past few years, coho salmon run sizes have declined throughout the Strait of Juan de Fuca region with returns to the Elwha River as low as 1,100 fish in 1991.

d. Chum Salmon. Although chum salmon were produced at the tribal hatchery from 1978 to 1987, that program has been terminated. Now, all chum salmon returning to the Elwha River are the result of natural production. The total annual chum salmon returns to the river are measured in the hundreds.

e. Pink Salmon. Pink salmon have never been artificially produced in the Elwha River. It is estimated that less than 50 pink salmon return each odd year¹. The current substrate composition (primarily boulders and large cobbles) is not conducive to pink and chum salmon spawning.

f. Sockeye Salmon. Sockeye salmon have never been artificially produced in the Elwha River. A few sockeye are observed each year in the river, but these fish are believed to be strays from other systems. The Elwha sockeye stock is thought to be extinct because the fish cannot reach Lake Sutherland².

g. Winter Steelhead. Winter-run steelhead are produced in the tribal hatchery, and represent the largest steelhead run in the Strait of Juan de Fuca. Since 1981-82, the hatchery winter run has averaged about 3,800 fish annually. A stock of naturally produced winter-run steelhead enters the river generally following the return of the hatchery fish.

h. Summer Steelhead. Approximately 20,000 summer run steelhead used to be planted annually in the Elwha River by the Washington Department of Wildlife, with average annual returns of 439 fish. Currently, there is a small but unknown number of naturally produced fish each year.

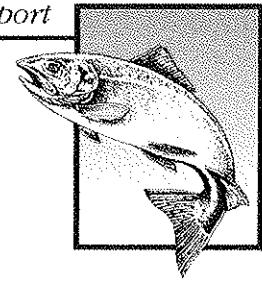
i. Sea-run Cutthroat Trout and Native Char. Sea-run cutthroat trout and native char (Dolly Varden and bull trout) are present in the river below Elwha Dam in low numbers. These fish are the progeny of natural spawners. Bull trout are Category 2 species under the Endangered Species Act.

j. Resident Fish. Resident sport fish in the Elwha River system above Elwha Dam are dominated by rainbow trout and, to a lesser extent, native char. A small number of cutthroat trout and brook trout are also present. Additionally, based on surveys conducted in similar rivers in Washington, the Elwha River probably harbored, and continues to harbor, fish species such as dace, peamouth, squawfish, largescale sucker, threespine stickleback, sculpins, whitefish, and marine species such as flounders. White sturgeon and smelt are also occasionally observed in the river.

k. Shellfish. The most commonly pursued shellfish in intertidal areas are hardshell

¹ Puget Sound pink salmon only return in odd years.

² A lake or lake-like environment is necessary for sockeye salmon to complete their freshwater rearing phase.



clams, specifically littleneck clams, butter clams, and horseclams. The Elwha River intertidal area should support populations of hardshell clams although the beaches are depleted of gravel and finer sediments and have steep slopes that reduce the intertidal area. The composition and abundance of shellfish prior to dam construction are not known. However, hardshell clams may have been more abundant than at present because of the change in sediment composition from sand-gravel-cobble to a more coarse gravel-cobble mix, and possibly because the intertidal area is smaller than it once was.

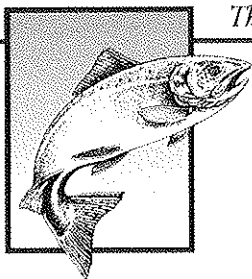
1. Harvest Management. The Washington Departments of Fisheries and Wildlife (WDF and WDW) along with the Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha S'Klallam and Makah Tribe (SJF Tribes) cooperatively manage the fisheries in the Strait of Juan de Fuca (SJF) region. The four tribes share the responsibility for managing tribal marine fisheries in the SJF, while the Point No Point Treaty Council (PNPTC), a consortium of tribes comprised of the three S'Klallam Tribes and the Skokomish Tribe, administers the marine fisheries for the S'Klallam Tribes. The Makah Tribe, WDF, and WDW communicate regularly with the PNPTC to facilitate cooperative management in the SJF. Primary management responsibilities of tribal freshwater fisheries within the SJF are further broken down geographically, with the Elwha Tribe administering the area from the Hoko River to Morse Creek, including the Elwha River.

In addition to the State and tribal management agencies, the Fraser Panel of the Pacific Salmon Commission (PSC), by order of the Pacific Salmon Treaty first ratified in 1985, is responsible for the management of both Canadian and U.S. fisheries occurring in the SJF targeting Fraser origin sockeye and pink salmon stocks. The Fraser Panel consists of four voting representatives each from the U.S. and Canada. Fisheries under the jurisdiction of the Fraser Panel are managed in accordance with policies set forth in short-term species specific annexes to the Treaty which are mutually adopted and agreed to by the two countries.

Finally, the Pacific Fisheries Management Council (PFMC) is responsible for the management of all intercepting U.S. salmon fisheries occurring in the Conservation Management Zone along the coastal marine waters of Washington, Oregon, and California that potentially impact SJF origin stocks. Each year, management guidelines are adopted by the PFMC based on projected run-sizes and fishery objectives.

The Elwha River is one of the production components of the SJF region. Chinook salmon and coho salmon populations in the river are presently managed to achieve the objectives of the two Elwha hatchery facilities, as the Elwha and Glines Canyon dams severely limit natural production. These objectives include the full harvest of all surplus hatchery production and the maintenance of brood sources for future fisheries restoration efforts. Pink and chum salmon populations in the river are specifically managed for natural production. Steelhead are managed to protect the remnant wild run while providing recreational and commercial harvest through hatchery releases.

With the exception of the Dungeness River Hatchery coho salmon stock and the



artificially augmented Hoko River chinook salmon stock, the remainder of the U.S. portion of the SJF region is managed for the natural production of all salmon species. Long-term regional harvest and habitat management planning in U.S. waters is being jointly developed by WDF, WDW, and the SJF tribes and will be incorporated in the "Salmon and Steelhead Management Plan for Strait of Juan de Fuca Terminal Areas" (Strait Plan). The draft Strait Plan recognizes the present management priority of hatchery stocks in the Elwha River but further identifies a phase-in to a natural production priority once the dams are removed. In addition, the draft Strait Plan reemphasizes the priority status of all naturally reared stocks throughout the rest of the SJF region.

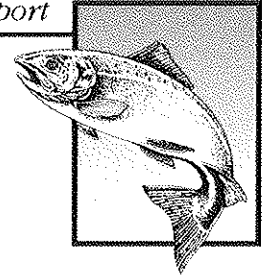
Natural stocks in the SJF region have been generally experiencing a decline in production. In the past 10 years, wild coho salmon returning to SJF streams have not met management's aggregate escapement goals for this species. A few individual stocks have declined to critically low levels. Beginning in 1994, in accordance with the management objectives for the region, the PFMC will be requested to begin taking specific management actions during ocean fisheries to ensure that the SJF wild coho salmon are protected in order to facilitate their restoration.

m. Marine Harvests. Marine harvests of Elwha River and other SJF salmon stocks can generally be broken down into four categories: (1) Alaskan interceptions; (2) Canadian interceptions; (3) U.S. coastal interceptions; and (4) SJF and Puget Sound catches. All data presently available indicate that all SJF salmon stocks west of the Elwha River are subject to similar interception and harvest rates as the Elwha River salmon stocks.

The best available data indicate that approximately 58% of the total Elwha River chinook run is harvested prior to entering the SJF (U.S. coastal - Canadian combined). An additional 3% are taken in the SJF, primarily in nontreaty sport fisheries, although limited treaty commercial setnet and subsistence hook-and-line fisheries also take a few fish in Freshwater Bay, immediately adjacent to the mouth of the Elwha River.

The total harvest rate of Elwha River origin coho salmon from the years 1984 through 1991 was 77%. Just over 38% of the combined return was taken in Canadian fisheries while a similar amount was taken in U.S. fisheries (marine and freshwater combined). Of the U.S. harvests, 70% occur in marine waters with just over 20% of the catch coming in U.S. coastal areas. The remainder of the marine harvest was taken in the SJF or Puget Sound. It should be noted that the percentage of the harvest that is taken in different fisheries varies from year to year, depending on run size and harvest strategies.

As chum salmon stocks in the Elwha River and SJF are relatively small, very little is known about their catch distribution. Although there are fisheries in the SJF targeting chum salmon ("directed" fisheries), their present impact is likely very limited. It is estimated that less than 5% of the total run is harvested in U.S. coastal and Canadian waters combined, while an additional 10% might be taken in SJF and Puget Sound fisheries.



It is estimated that between 15% and 49% of the SJF and Elwha River pink salmon run may be taken in Canadian and U.S. coastal fisheries prior to entering the SJF. An additional 10% to 15% may be taken in directed pink salmon net fisheries and recreational fisheries in the SJF and Puget Sound.

The marine harvest of steelhead is extremely limited and inconsequential. It is estimated that no more than a few Elwha River steelhead are taken in marine waters.

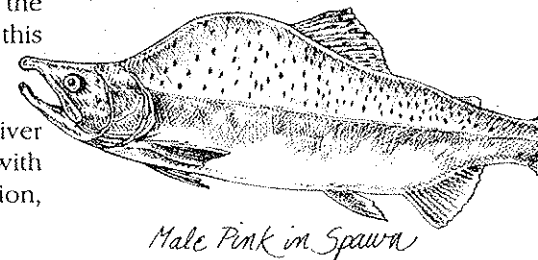
n. Freshwater Harvests. In-river harvests of chinook salmon have been restricted in the Elwha River, sometimes in response to significant prespawning mortalities associated with fish diseases (e.g., *Dermocystidium salmonis*). Catches by the Lower Elwha S'Klallam Tribe (Tribe) have generally been limited to less than 100 fish per year taken incidental to coho fisheries. However, the Tribe did conduct directed chinook salmon test fisheries from 1988 to 1991 resulting in a harvest of 200 to 400 fish per year. A limited entry commercial chinook fishery was implemented by the Tribe in 1992 which took about 150 fish. It is anticipated that the Tribe will continue to conduct a limited commercial fishery for chinook in the Elwha River, as run size dictates. There are no nontreaty fisheries for chinook salmon in the Elwha River.

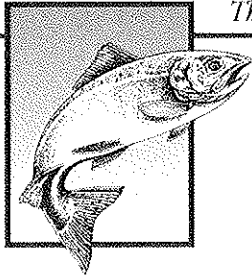
The Tribe has annually conducted a directed in-river commercial fishery targeting hatchery coho salmon since 1977. Catches of these fish have been as high as 15,000 but were usually 6,000 to 10,000 fish; catches have not exceeded 2,000 fish since 1989. In addition to the tribal commercial fishery, there is also a small but significant nontreaty sport fishery for coho in the river.

During the years the Tribal hatchery produced chum salmon, the Tribe conducted a limited commercial chum fishery in the river. Since abandonment of the chum program, chum harvests in the river have been limited to incidental catches taken during late season coho salmon fisheries and early steelhead fisheries. These incidental catches have averaged just over 100 fish per year since 1988. Although the sport harvest of chum salmon is permitted in the Elwha River, participation in this fishery is very limited and is likely insignificant.

There have never been directed commercial pink salmon fisheries in the Elwha River and there have been no reported incidental harvests of pinks since at least 1980, with the exception of a few pink salmon taken during the chinook test fisheries. In addition, there are no sport fisheries for pink salmon in the river.

Winter and summer steelhead in the Elwha River are managed as a single unit for harvest allocation purposes, although separate run sizes and harvestable numbers are estimated for each stock. The Tribe concentrates its commercial fisheries on the hatchery portion of the winter run from mid-December through early March. The sport fishery targets only hatchery steelhead from June 1 through November 30 while the river is open for the harvest of both hatchery and wild fish from December 1 through April 15. Tribal harvests of steelhead have averaged about 1,600 fish per year (mostly winter-run fish) while a similar number are taken each year by sport fishers (winter-





The Elwha River basin supports a wide variety of wildlife, although populations have been adversely impacted by the lack of salmon carcasses in the middle and upper river . . .

and summer-run combined). The harvest of summer-run fish has averaged about 460 fish per year.

4. Vegetation. The maritime climate of the area is characterized by mild, wet winters and relatively cool, dry summers. Rainfall averages 60-80 inches per year. The relatively cool climate of the Elwha Valley represents a gradient between drier conditions to the east and wetter climate to the west. Consequently, the valley supports a unique mix of vegetation with over 167 vascular plant species transitional between vegetation communities occurring to the east and west.

Douglas-fir dominated communities with Pacific madrone, manzanita, and grand fir occur on dry, well-drained sites and represent eastern peninsula vegetation types. Forests dominated by western hemlock occur on moist sites throughout the valley and are more characteristic of western peninsula vegetation.

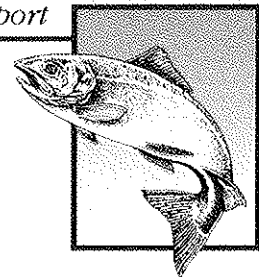
Most of the area surrounding Lake Mills consists of a lowland/montane forest type dominated by Douglas-fir, with an understory of swordfern and Oregon grape. Mixed communities of conifer/hardwood occur in riparian areas, including Douglas-fir, grand fir, western redcedar, red alder, black cottonwood, and bigleaf maple. Streamside vegetation consists of alder, cottonwood, and willow species mixed with grass/sedge communities. Upland areas are characterized by moderate to heavy accumulations of downed woody material, with lighter buildups in riparian zones.

There are no Federally-listed plant species within the Glines Canyon Project area. However, six State-listed species have been documented in the area or are suspected to occur there. Additionally, 15 locally rare species (plants with very limited distributions or very small population size) have been designated by the National Park Service.

Some 64 exotic/adventive (non-native) plant species are established in the Elwha Valley within the park. Sixty-five percent of these species are perennials and are known to be difficult to control or eradicate. Several species are considered noxious and a serious threat to native plant communities, including Scot's broom, reed canarygrass, and tansy ragwort. Many species of introduced grasses are found in old fields and near former habitation sites. Canada thistle, curly dock, sheep sorrel, and other nonnative species are established on the delta.

5. Wildlife. The Elwha River basin supports a wide variety of wildlife, although populations have been adversely impacted by the lack of salmon carcasses in the middle and upper river and the inundation of lowland valley habitat by Lake Mills and Lake Aldwell. The bottomland floodplain and riparian areas inundated by the reservoirs once provided important habitat for grazing, shelter, and reproduction for a variety of species (see Section V.D.6 Wildlife).

Roosevelt elk and black-tailed deer are found throughout the drainage and are year-round residents. Primary elk travel routes cross the Lake Mills delta between the mouth of Cat Creek and the Whiskey Bend road to the east. Another important route



traverses the slopes between Glines Canyon Dam and Altaire Campground along the lower spur ridges of Happy Lake Ridge. Important elk calving areas are located near the mouth of Cat Creek and in hardwood flats near the river in the vicinity of Altaire Campground.

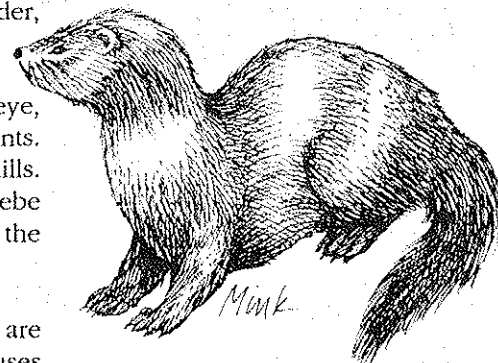
Other mammals include black bear, cougar, bobcat, coyote, raccoon, muskrat, mink, long-tailed weasel, river otter, pine marten, beaver, snowshoe hare, mountain beaver, spotted skunk, and striped skunk. Fisher is a species which historically occurred in the Elwha but is now rarely observed and its status is uncertain. Smaller mammals include Douglas squirrel, northern flying squirrel, Townsend's chipmunk, bushy-tailed woodrat, deer mouse, shrews, shrew-mole, and several species of bats. Most of these species are dependent on forested habitat; some are dependent on old-growth forest.

Reptiles and amphibians include the western garter snake, Pacific chorus frog, red-legged frog, tailed frog, ensatina, rough-skinned newt, Olympic torrent salamander, Van Dyke's salamander, northwestern salamander, and others.

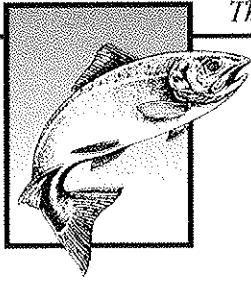
The reservoirs provide habitat for a variety of waterfowl. The common goldeneye, bufflehead, common merganser, and mallards are common year-round residents. Trumpeter swans routinely winter on Lake Aldwell and often visit Lake Mills. Harlequin ducks breed in this area. Common loon, western grebe, and horned grebe are occasionally observed. Spotted sandpipers have been observed nesting at the delta.

Marine bird species such as double-crested cormorants and various gulls are occasionally seen on the river or reservoir. The Federally-listed marbled murrelet uses the Elwha Valley as a flight corridor, and it may nest in forests along Stukey, Boulder, and Cat Creeks, and in the vicinity of Altaire Campground.

Other representative bird species in the area include the blue grouse, ruffed grouse, and band-tailed pigeon, which are common breeding residents in forest habitats. The American dipper breeds along the river and tributary streams. Violet-green swallows are common in areas near Glines Canyon Dam, bridges, and buildings. The robin, Townsend's warbler, dark-eyed junco, winter wren, and brown creeper are common breeding residents of conifer and hardwood forests of the area. The hairy woodpecker, warbling vireo, evening grosbeak, and olive-sided flycatcher are found in deciduous forests of riparian areas. Old-growth in the area provides habitat for pileated woodpecker, red-breasted nuthatch, golden-crowned kinglet, varied thrush, and chestnut-backed chickadee. Open habitats support the MacGillivray's warbler, white-crowned sparrow, and rufous hummingbird. Other species include belted kingfisher along the river and streams, Stellar's jay, gray jay, American crow, and raven.



6. Threatened and Endangered Species. The U.S. Fish and Wildlife Service has documented the occurrence of three Federally protected species in the Elwha/Glines Canyon study area, the bald eagle, northern spotted owl, and marbled murrelet. A petition to list the bull trout has been received by the U.S. Fish and Wildlife



Service, initiating a status review of that species. Other species of concern, several of which are proposed for state-listing, include the northern goshawk, Vaux's swift, osprey, great blue heron, barred owl, and turkey vulture, as well as the pileated woodpecker. A number of other plants and wildlife potentially occurring in the study area are state-listed by the WDW or Washington Natural Heritage Program (WNHP) as endangered, threatened, sensitive, or monitor species. In addition, the National Park Service maintains a list of plants, including several WNHP-listed species, that are considered unique within Olympic National Park.

7. Cultural Resources. 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. Because it was the heart of the culture and the economy, the whole river is a cultural resource.

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.

8. Other Resources. Olympic National Park is designated a mandatory Class I area under the Clean Air Act. Although air quality is generally excellent, there is potential for occasional temporary impairment of visibility during temperature inversions as a result of industrial emissions in Port Angeles and from local point source pollution such as wood smoke from prescribed fires.

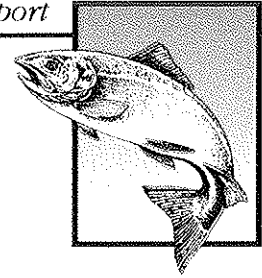
Some of the area bordering Lake Mills is within designated wilderness. The park has also received special international designation as a United Nations International Biosphere Reserve and World Heritage Site.

Recreational facilities include secondary roads to several popular trailheads, several foot trails leading to the Lake Mills shoreline and upper watersheds, and boat launch facilities. Two automobile campgrounds are maintained nearby. Developed recreational opportunities are limited in the Elwha Valley, and dispersed, primitive types of recreation are emphasized. Hiking, fishing, river rafting, and camping are the most popular visitor activities.

The river itself, along with numerous sites, objects, and practices in the river corridor, are traditional cultural properties at the heart of the Elwha S'Klallam culture. These cultural resources are central to the identity and well being of the Elwha S'Klallam people. An assessment of cultural and historical resources of the Elwha Valley is contained in Section VI.L and Appendix L.

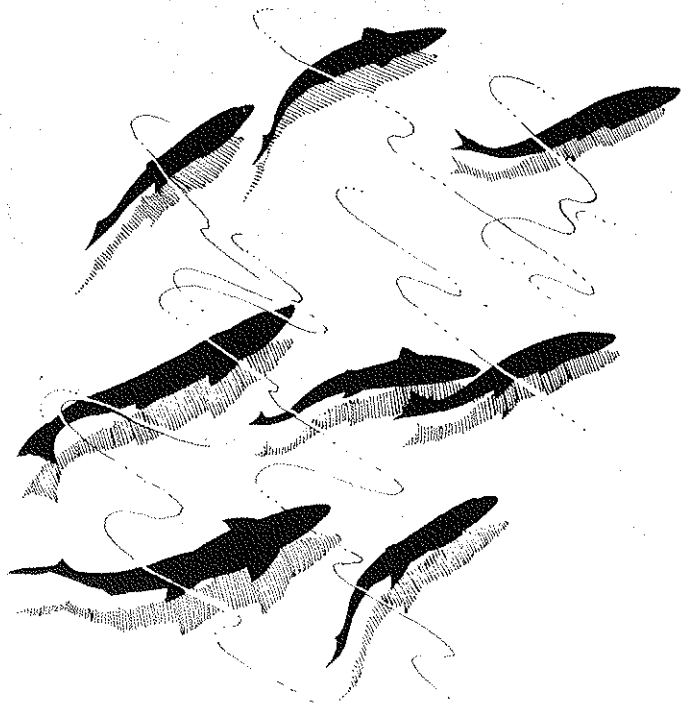
D. Fisheries Restoration Efforts in the Pacific Northwest

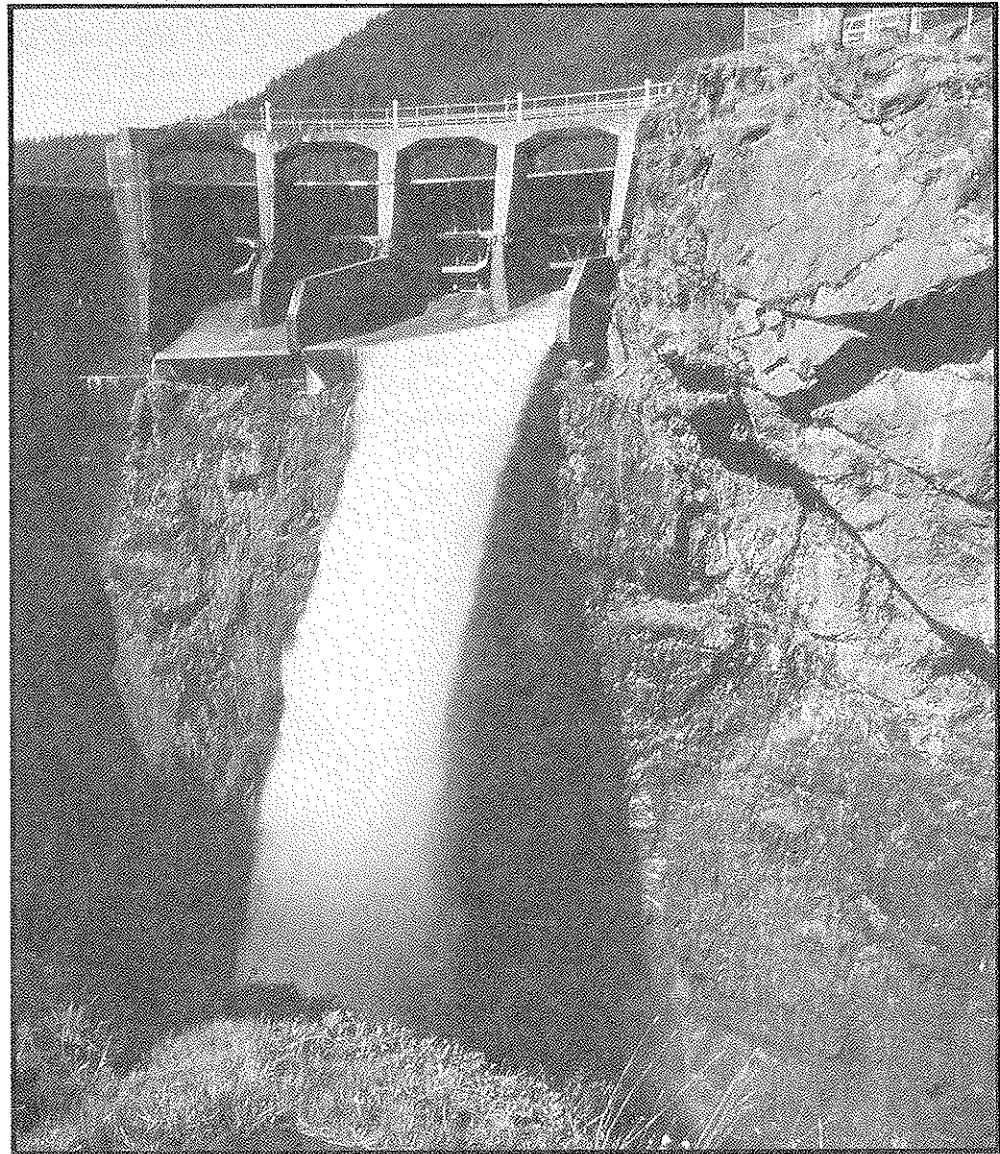
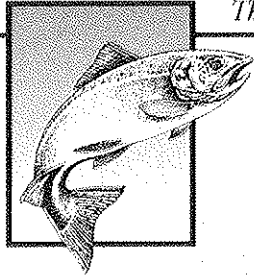
Salmon and steelhead are important biological, commercial, recreational, and cultural resources in the Pacific Northwest. Unfortunately, many of these fish runs are in



decline (Nehlsen et al. 1991, WDF et al. 1993). Hydropower projects, as in the Elwha River, are often significant contributors to declines (Tyus and Winter 1992). With important Federal support, regional efforts are attempting to reverse the trend. For example, a conservative estimate of the cost of actions taken since 1981 to maintain and improve salmon runs in the Columbia River Basin alone exceeds \$1.3 billion (GAO 1992), and over the next decade and a half may exceed \$7 billion (Buck et al. 1993). Federal salmon and steelhead restoration projects in the Umatilla River basin will total \$80 million over 15 years while similar efforts in the Yakima River basin will total about \$70 million for at least 20 years. In northern California, Congress has authorized salmon and steelhead restoration efforts in the Klamath (\$21 million over 20 years), Trinity (\$57 million over 10 years), and Sacramento (provisionally \$30 million over 10 years) rivers. In southwest Washington, salmon habitat restoration proposed for the Chehalis River basin would amount to \$20 million over 20 years. These efforts are important economically since salmon and steelhead support \$1.2 billion annually in personal income and sustain more than 60,000 jobs in the Pacific Northwest (Buck et al. 1993).

In the context of these restoration efforts, the Elwha River is unique because 83% (267 square miles) of the basin is in pristine condition, lying within Olympic National Park and designated as wilderness. As a result, restoration of the Elwha River ecosystem and native anadromous fish should not be significantly threatened by future land use practices, in contrast to the other streams noted above.





*Glines Canyon Dam.
(Pat O'Hara)*