Environment and Power

Issue Backgrounder: Enhancing Our Fish & Wildlife Resources

BPA

Bonneville Power Administration
U.S. Department of Energy

May 1984
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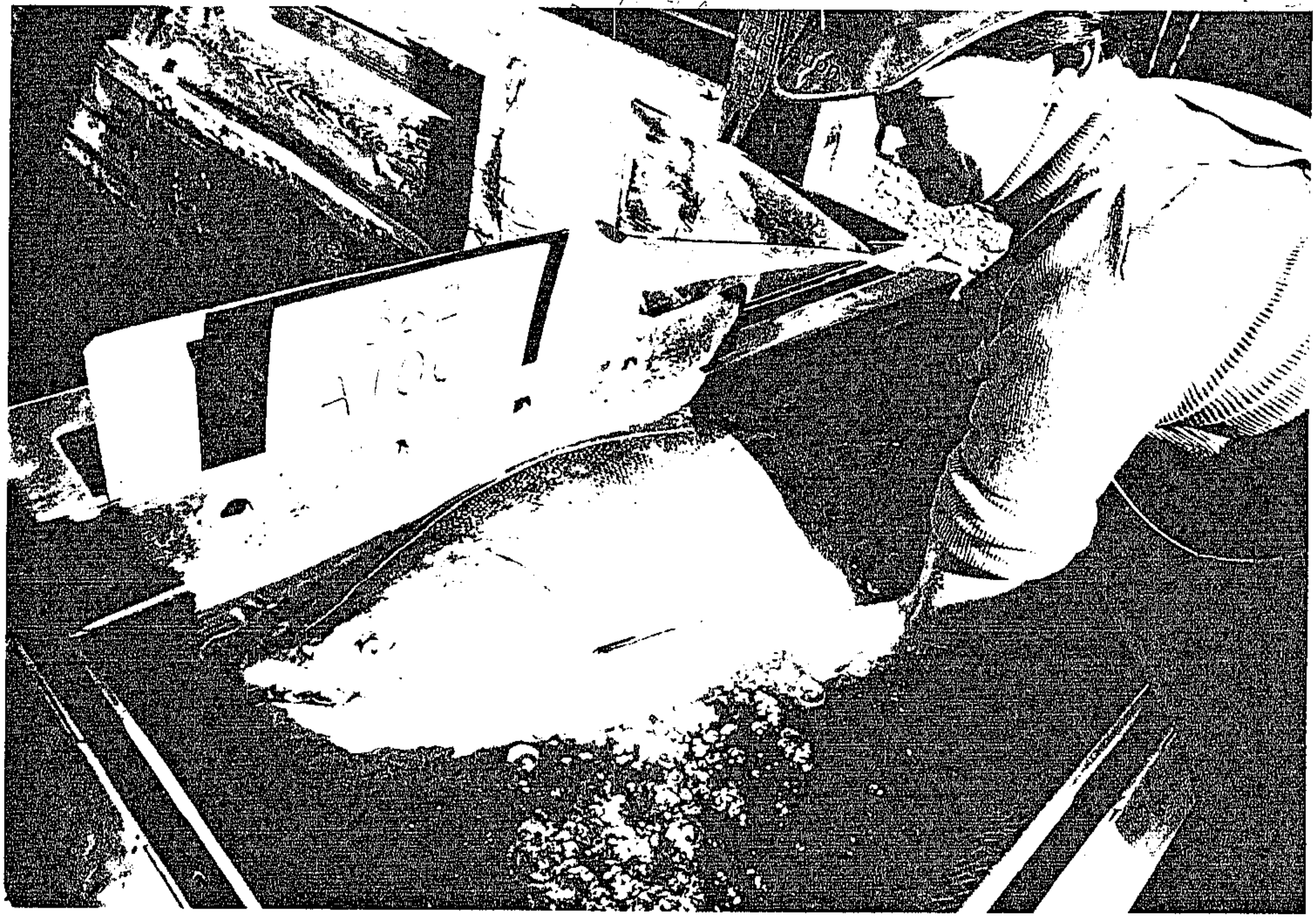


National Marine Fisheries technician places chinook salmon in recovery tank after insertion of radio-tracking transmitter.

Introduction

For years, BPAs only job was to market power from the 28 Federal dams on the Columbia River and its tributaries. Now BPA has a new assignment - to restore fish and wildlife damaged by the development and operation of the hydroelectric system.

This backgrounder outlines the over 100 projects BPA funds in the four states of the Columbia River Basin. Projects cover a wide range of activities such as:

— protecting young fish as they follow spring flows down the Columbia,

-improving the health of hatchery reared fish,

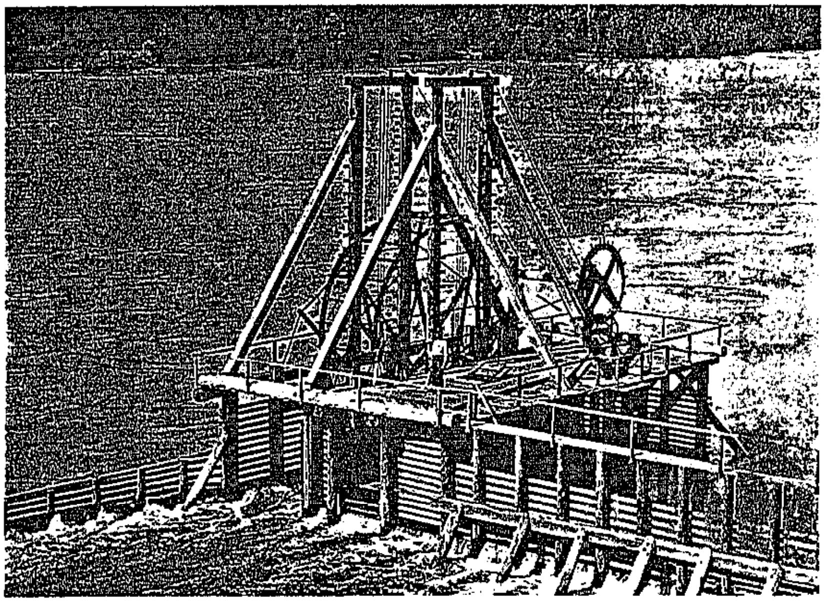
-improving habitat for fish spawning in the wild,

-watching the movements of geese nesting on reservoir shorelines in western Montana.

"Our commitment to improving conditions for fish and wildlife is firm. The actions we are taking are far-reaching and effective. We will do much more for fish over time."

Peter Johnson, BPA Administrator

BPA's involvement in fish and wildlife results from decades of growing concern - concern that increased as these important resources decreased.



Columbia River fish-catching wheel circa 1917.

Sixty-one pound chinook caught in Oregon fish trap in 1920

History

In 1906, fish wheel No. 5, stationed near the present site of The Dalles Dam, was Seuffert Company's top producer. Four hundred eighteen thousand pounds of salmon surged up the Columbia - and ended up in the scoops of this one fish wheel.

In those times, the 76 wheels that worked both sides of the Columbia, hauled in a total average of 1,650,000 pounds of fish a year. Yet at their peak, these wheels took only 5 percent of the total Columbia River catch.

Historical estimates put the annual Columbia salmon and steelhead run as high as 350,000,000 eight decades ago.

In 1906, Eric Enquist, a fish wheel tender, caught *"the largest salmon he ever saw"* - an 64 pound chinook. Enquist sold that fish - the whole fish - for 30 cents.

At today's prices, that fish could sell for as much as $630. The total 1906 catch would sell for $240 million.

The fishing and canning industry at the turn of the century employed 24,000 people. At their peak, 55 canneries operated in Oregon alone. By 1910, machines to automatically fill, vacuum seal and label cans increased canned salmon production to 2000 cases a day per cannery.

A canning industry that productive today would bring $490 million per year to the Pacific Northwest.

Within three generations, these "magnificent hordes" thinned to a few stragglers. Through year of neglect and abuse, the Northwest lost a valuable aesthetic and economic resource.

Settlers seeking financial opportunity soon made their impact on the Columbia's fisheries and wildlife.

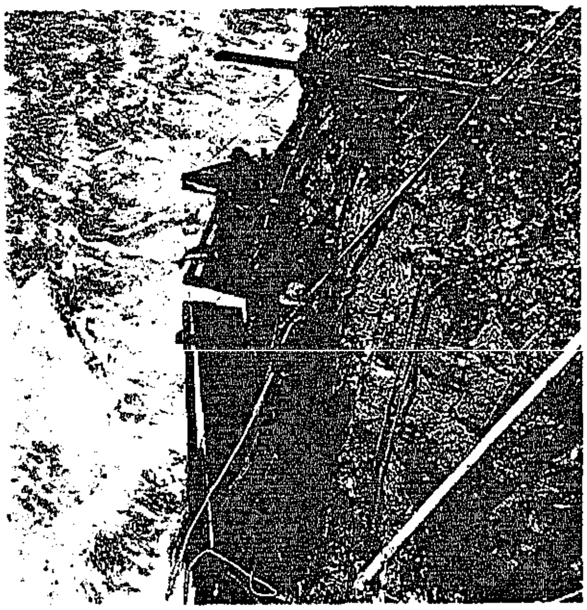
Indians spent hours on treacherous rocky /edges spearing and dipping individual fish. Easterners introduced the commercial fishery - gill nets, purse seines, and trollers - that lead to overharvesting.

farmers spoiled fish and wildlife habitats as they put thousands of acres under the plow and sent their cattle to graze streamside vegetation. In the semi-arid lands, irrigators demanded a larger and larger volume of water and returned it to streams full of silt, alkali, and agricultural chemicals.

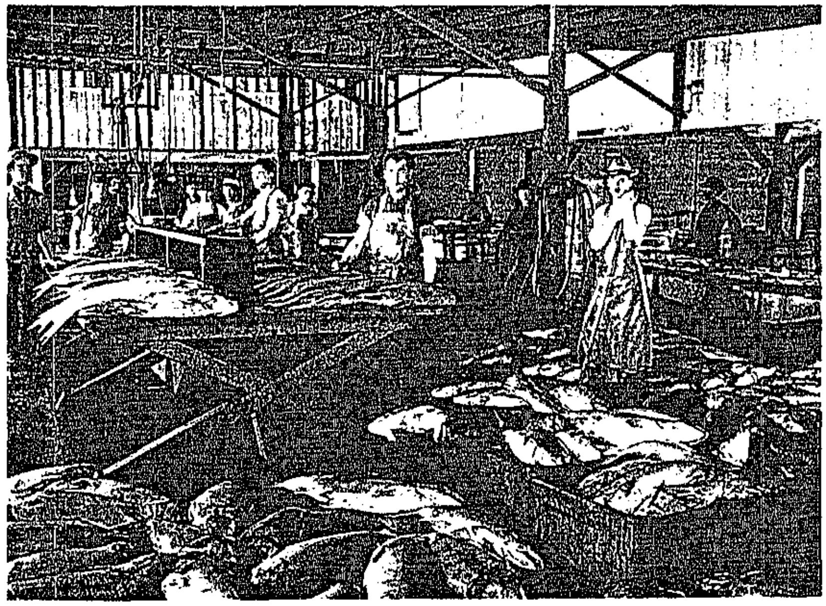
Clearcutting along with uncontrolled forest fires took away natural barriers to runoff, putting silt into streams. far/y lumber mills used streams to raft logs downriver, scouring out spawning grave/s and jamming the narrows.

Streams served as a sink for the noxious waste products of new industries. Economic develop ment in the Northwest further reduced fish habitat by converting valuable streamsides into roads, homes and waterfront businesses.

The Federal Reclamation Act of 1902 resulted in irrigation dams which often blocked access to upriver spawning grounds and decreased the water flows needed by migrating fish.



Indians fishing Celilo Falls, 1951.



Astoria, Oregon cannery, the Weister Company, circa 1920.

Beginning in the 1930's the hydroelectric projects of the New Deal era added to the fishery's decline.

In 7938, the year Bonneville Dam was completed, the fish harvest from *the Columbia Basin was ha/f that of 1920. By 1953, when McNary* Dam *was completed, it was down three-fourths. By 1980, after completion of the Columbia River federal Power System, the now heavily regulated fish harvest was just 6.8 million pounds, one-sixth of the 1920 catch.*

Grand Coulee eliminated habitat for the "June hogs," the forty to seventy pound spring chinook once spawning in streams inundated by the dam. Several stocks of upriver chinook and coho are now extinct.

Dams and Fish

Chinook once traveled as many as 1200 miles to spawn in the Columbia's Canadian headwaters. Now dams effectively block off the upper half of the Columbia.

Dam construction changes the relationship between fish and their environment in many ways . some obvious and some not so apparent.

Dam impoundments cut off nearly two-thirds of the area where salmon and steelhead originally spawned. Hydro operations flooded many other spawning sites.

Builders of hydroelectric dams on the lower Columbia and Snake Rivers incorporated fish ladders to allow upstream passage for adult fish. Despite the difficulties of passage at many of these structures, a significant number of fish managed to reach spawning grounds.

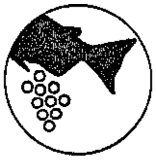
Downstream migration presented major problems to juvenile fish. Rapidly spinning turbine blades or negative pressures created within the turbine housing killed or injured thousands of smolts. Many of the uninjured fish emerged dazed and disoriented, easy prey for waiting birds and other fish. A series of Fish and Wildlife Service studies estimated losses of 15-20 percent at each dam.

Biologists discovered another, more subtle, problem associated with dams. The dams slow spring flows by storing water in headwater reservoirs for power generation later in the year. Slow waters and large reservoir lakes could compromise the critical migration schedule.

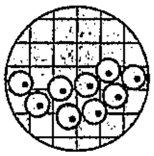
Smolts must reach the ocean within about 30 days of beginning their downstream migration or they will have difficulty adapting to salt water. High temperatures in the slack waters of reservoirs increase exposure to diseases for both adults and juveniles.

As early as 1939, even before major dams were built, the Oregon Fish Commission warned that, without a major restoration effort, the salmon fishery would dwindle disastrously.

Will the Pacific Northwest lose the salmon? Some biologists say its too late; there's no hope of recovery. They agree with the late Senator Richard L. Neuberger who wrote: *"prevalent throughout the principal salmon-*

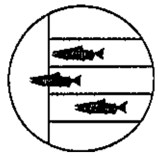


31 projects to find new or improve existing spawning and rearing habitat for wild fish and to rehabilitate spawning areas on tribal lands. Contractors have already completed nearly 25 percent of these projects. As a result, several hundred stream miles are now available to migratory fish.

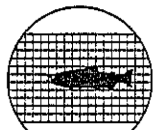


17 studies to improve hatchery (artificial) pro. duction. Scientists, using BPA funds. seek to improve fish health through developing higher protein fish food and finding cures for several major diseases. Other research will identify stocks suitable for transfers to new/y opened habitat.

17 projects to aid young fish during downstream migration. Some projects track the movements of these juveniles in order to plan water releases from dams. This extra water will move fish out to sea more quickly Biologists a/so invest/gate the food habits of predatory fish in the river Others develop special techniques to transport fish past the dams in barges. Some projects "tag" fish. Project money was used to develop a computer chip that, once planted in a fish, allows it to be tracked by strategically p/aced sensors at certain times in its life cycle.



4 projects to monitor adult fish and enhance their upstream passage.



18 projects to rebuild or install new fish screens and ladders at Yakima Basin irrigation and hydroelectric facilities.

9 projects to investigate the impact of hydroelectric operation on white sturgeon and resident or non-migratory game fish.

4 studies to examine the effects of hydroelectric development on wildlife.

Salmon embryo in its 24th day of growth

The Salmon Life Cycle

The group "salmonids" includes most Pacific salmon and steelhead or sea-running trout. These fish are anadromous, that is, they hatch in freshwater, spend their adult years in the sea and, when mature, return to freshwater to spawn. Thus salmonids are strongly affected by the natural ups and downs of river flows brought with the changes of season.

Salmonids have similar life cycles. About 50 days after the parent fish lay and fertilize their eggs, embryonic fish or *"alevins"* emerge. Alevins live on nutrients stored in their yolk sac until they grow large enough to find food on their own.

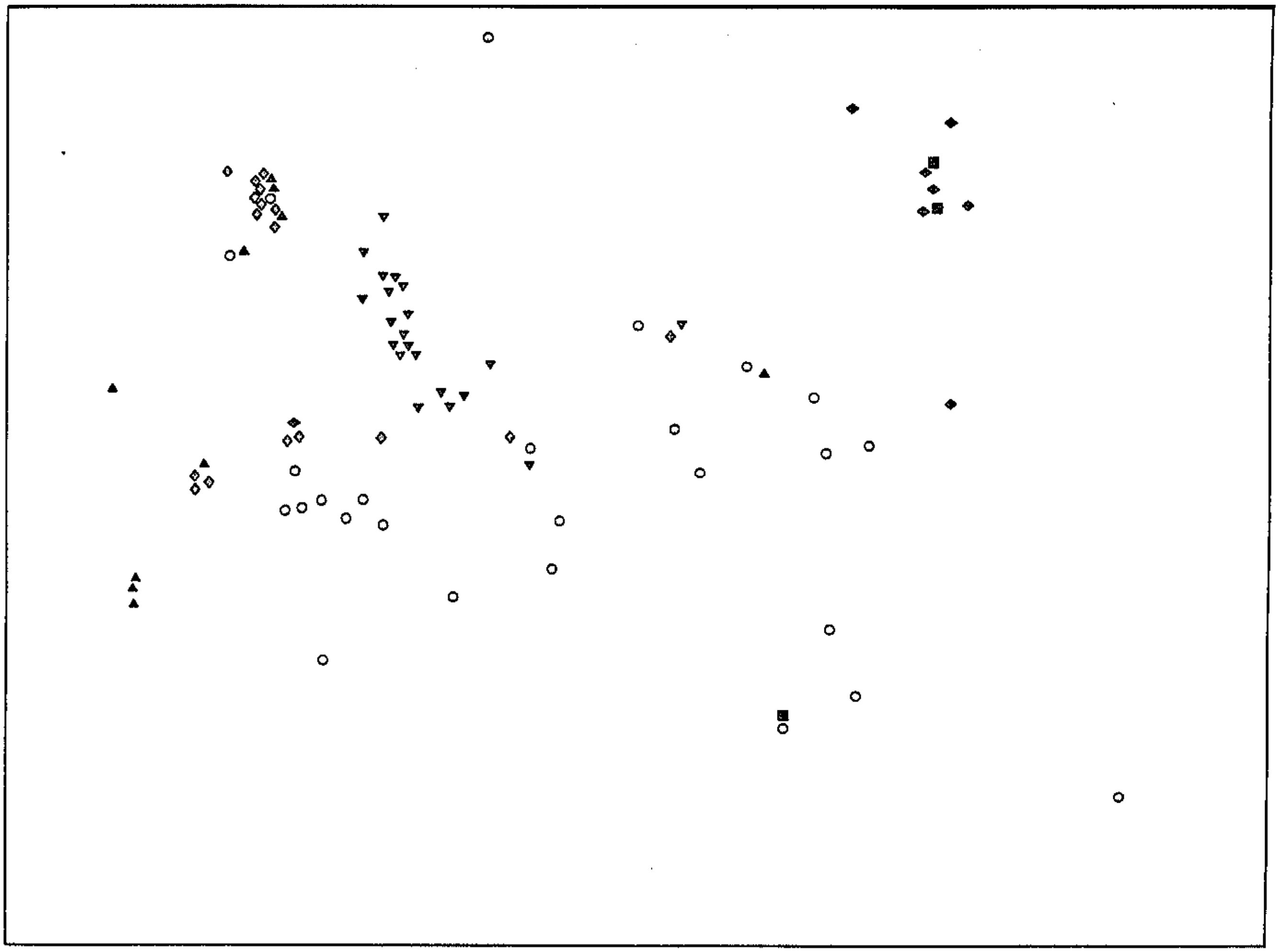
These infant fish, known as *"fry",* eat insects and organic matter floating downstream on the current. In a few more months, they grow to the 'fingerling' size of several inches in length, and seek sheltered spots to overwinter.

As winter ends, the fingerlings undergo a transformation, called smoltification, which enables them to survive life in seawater. The young fish, or *"smolts"*, swim downriver on the spring floods to the ocean.

Two to five years later, the fish begin their return journey. They surge upstream to spawn, leaping seemingly impossible barriers.

Fish and Wildlife Projects

(FY 1933)



- ▼ Adult Passage and Yakima Projects
- ◆ Resident Projects
- ■ Wildlife Projects
- ○ Habitat Projects
- ▲ Hatchery Projects
- ◇ Downstream Migration Projects

Reaching the peak of sexual maturity, the males and females pair off and fertilize their eggs in a shallow nest, called a *"redd"*, dug into the gravel of the stream bottom.

The basic anadromous life cycle has a number of variations. Some chinook and steelhead smolts move downstream in summer or winter. Adult chinook salmon migrate upstream in identifiable runs in every season. Sockeye runs start in spring, peak sharply in July and continue through early fall. Coho runs start in the late summer, peak in October and continue through late autumn.

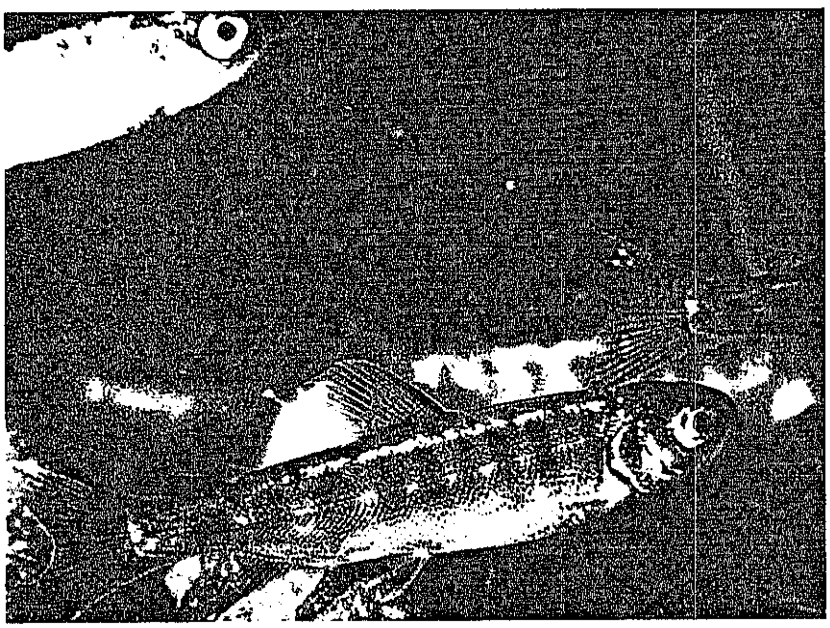
All salmon die after spawning - not true for steelhead trout. About 10% of the steelheads' summer and winter runs survive to spawn again.

Some salmonids are not anadromous. Land-locked sockeye salmon (called *kokanee*) migrate through lake and river systems. Fresh water species of trout migrate more modest distances in streams and lakes.

Salmon are not the only anadromous fish found in the Columbia system. White sturgeon migrate up and down river systems and into the ocean regularly.

Just hatched young salmon with yolk sacs.

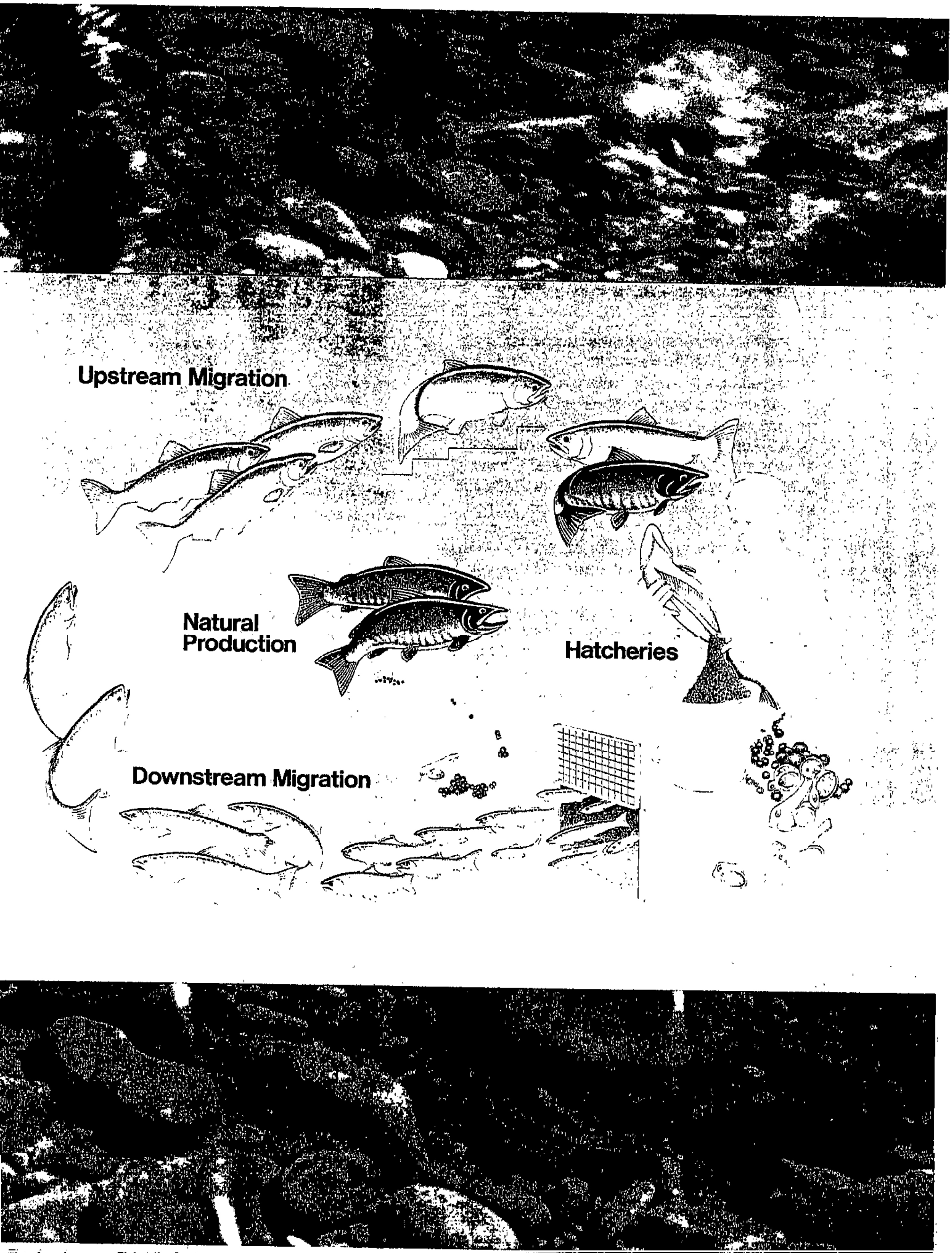
Steelhead negotiates falls.



Young chinook ready to migrate downstream.

Spawning Kokanee in the Lower Flathead River, Montana.

A well graveled streambed, an excellent spawning-ground for salmon.



The Anadromous Fish Life Cycle.

Downstream Migration

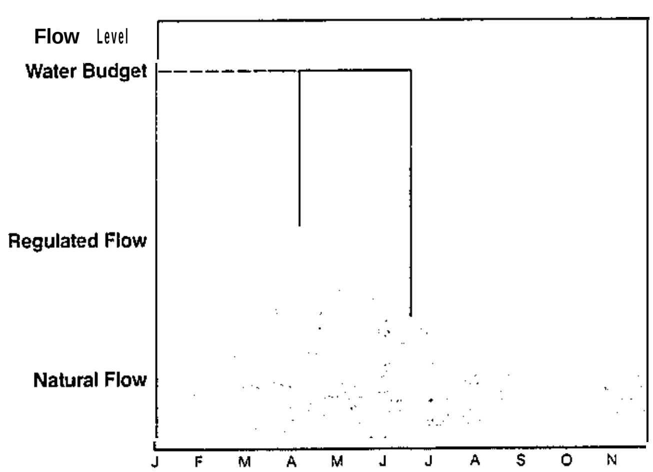
The anadromous fish that live in the Columbia adapted to conditions that existed for thousands of years. Their lives became locked into the seasonal variations in the Columbia River basin's hydrologic cycle. Dams essentially eliminated the spring freshets which speeded downstream anadromous migration.

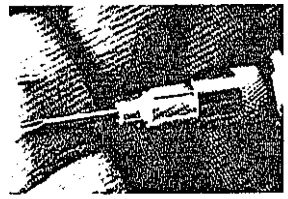
The Fish and Wildlife Program provides an innovative plan to move smolts rapidly through the reservoirs. Under the plan, a Water Budget staff budgets a block of water each spring to provide flows for fish. This staff, supported by BPA funds, represents the Columbia Basin fishery agencies and Indian tribes. To make best use of water, the Water Budget Center works cooperatively with power production managers to "*shape*" river flows during the critical migration period from April 15 to June 15 to assure highest possible smolt survival.

Projects keeping track of smolt movement often have multiple objectives. A sophisticated hydroacoustic listening system at Priest Rapids Dam monitors migration not only to help time spring water budget releases, but for taking counts during summer migration. Other monitoring projects look for signs of deteriorating health or abnormal behavior while pinpointing smolt locations on the Snake and Columbia Rivers.

The water budget boosts spring flows during the critical migration period.

Natural vs. Regulated Flows





Scientist prepares to inject computer chip transmitter tag in a young salmon.

Water Budget Managers Mark Maher (R) and Mal Karr review smolt monitoring data.

One of the first projects funded by BPA seeks to determine whether hatchery reared salmon transported downstream by truck or barge return in higher numbers than those not transported. Other projects aim to lessen the stress of these operations through improved handling techniques or by altering the chemistry of the water used in transport.

Several studies examine the northern squawfish, smallmouth bass and walleye which prey on migrating juveniles in dam reservoirs. Studies of their feeding patterns and habits will determine whether they can -- and should -- be controlled.

Researchers also tag smolts. When recaptured as adults, coded information on the tags determines the success of migration aids and other enhancement efforts. Through BPA funding, scientists take advantage of the latest computer technology to track fish. Computer chips implanted in young fish will provide instant information on fish - as juveniles and adults - when they pass through dam fishways. This information will help correct juvenile passage problems and clear up many questions regarding upstream migration.

Upstream Migration

Another BPA-backed project studies a significant question regarding returning adult migrants. Past counts of fish moving upriver suggest that large numbers disappear between dams. The reason may be one of accounting. Perhaps more fish spawn in reservoirs than previously thought.

The study seeks to refine adult monitoring methods and reporting, and to provide a sound statistical base for future fish counts,

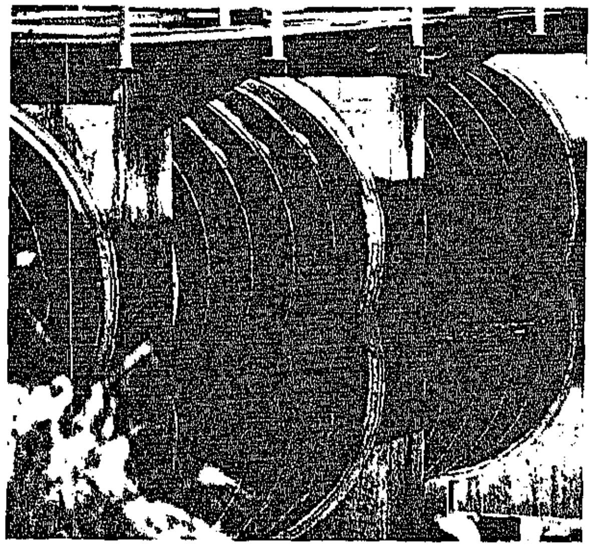
Four decades of experience revealed problems in some early fish ladder designs. Spills and flows cause strong currents and turbulent water at the base of some dams, masking fishway entrances. Some fish ladders cannot accommodate variation in flow - they become raging torrents in the spring and offer thin trickles in the fall. Many fishways are now inoperable, victims of inadequate operation or maintenance. Adult migrants waste precious energy trying to leap over obstacles created by the very structures built to aid their journey.

Through a BPA-financed investigation, scientists examine the flow and waterfall geometry that will best stimulate anadromous fish and create optimum passage conditions. Scientists apply a salmon's natural instincts and capabilities in leaping over barriers to design new ladders.

EPA is also improving existing fishways by rehabilitating or replacing them with state-of-the-art designs. These efforts will provide greater access to historic anadromous fish habitat throughout the Columbia River Basin,

SPA funds several projects to open additional spawning and rearing habitat throughout the region. Contractors design passageways to help fish move over waterfalls. Other project leaders replace log jams and boulder cataracts with rock and log structures, which break up torrential chutes into ladder-like steps.

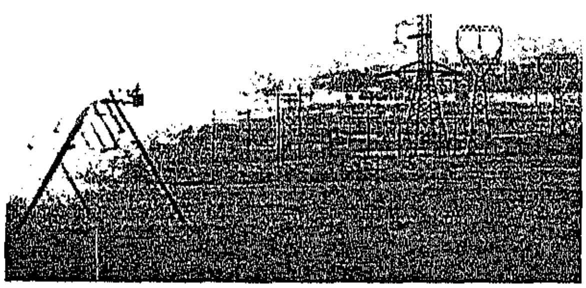
Biologists inventory other areas in the Basin, especially the upper reaches of the Snake in Idaho, to identify new sites with potential for spawning and rearing habitat,



The Ellensburg fish screens, a prime example of fish passage improvement in the Yakima Basin.

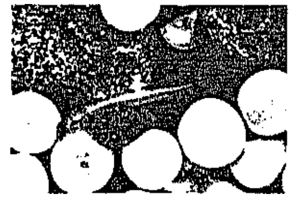
The Yakima Basin serves as a prime example of our upstream fish passage efforts. The arid soils of the Basin bloomed due to irrigation water diverted from the Yakima and its tributaries. BPA, the Bureau of Reclamation, the Bureau of Indian Affairs, and Washington Department of Ecology have begun restoring or building new fish ladders and irrigation canal screens at 18 of these Yakima Basin hydroelectric and irrigation facilities, When these projects are completed, the Yakima Basin may again prove to be a prolific breeding ground for anadromous fish.

Washington State University examines flows that stimulate adult salmon's natural leaping instincts.



Waler provides irrigation and power for the Yakima Basin

Wild or Natural Propagation



BPA habitat restoration can increase wild fish production as much as 400%.

Propagation of wild fish now commands the largest single bloc of funds in BPA's fish and wildlife budget. BPA's rehabilitation efforts will help re-establish spawning sites and restore natural populations while helping to make up for losses caused by hydroelectric development.

BPA-funded propagation research began in 1978 with a study in the John Day, today the most extensively studied and improved of Columbia Basin streams. The John Day attracts special attention because it contains the last sizable run of wild spring chinook in the Pacific Northwest. Successful habitat improvements on the John Day could serve as models for future stream improvement projects.

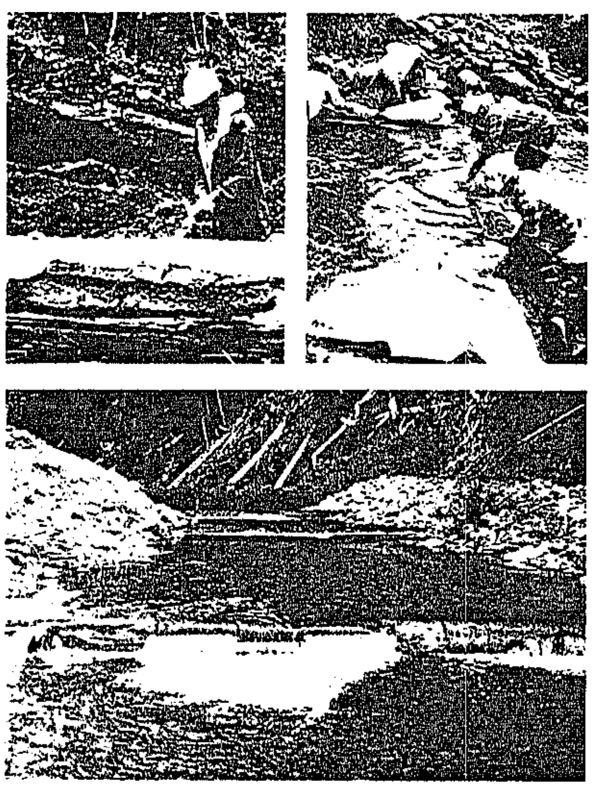
The Nez Perce Indians and the Shoshone-Bannock Tribes are both researching sites for habitat improvements on the Snake, Grande Ronde, and Clearwater Rivers.

Improvements involve recreating a natural series of riffles and pools in damaged streams. Log weirs and boulder berms cause riffles which mix oxygen into streamwater and provide whitewater hiding places for juveniles. Behind the weirs, gravels needed for spawning collect in the pools.

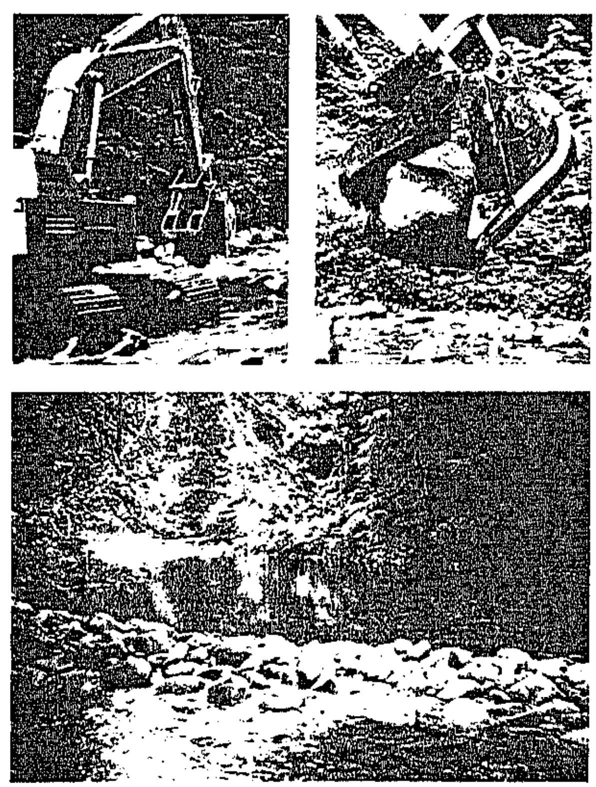
With BPA support, crews replant streambanks. Overhanging branches shade and cool the stream in summer and provide an insulating thermal blanket in winter. Roots act as sponges, filtering out pollutants, absorbing rain to prevent flooding and releasing water in dry periods.

Crews also construct side channels and backwater ponds, to provide year-round nurseries for migratory fish. These prime rearing sites provide refuge for juvenile fish from the high water velocities of winter and spring.

Project biologists predict the additional spawning and rearing habitat will increase smolt production by as much as 400 percent.



Log weirs in Eastern Oregon streams breakup stream flows into a natural series of pools and riffles.



By rearranging scattered boulders into a series of berms, Forest Service workers improve habitat in Lake Branch Creek, a tributary of Hood River.

Artificial Propagation

Despite disease problems and questions regarding genetic effects, hatcheries remain an important part of the Program. Hatchery stocks contribute significantly to present day fish runs while offering the potential to restock streams newly-opened to spawning and rearing.

With SPA support, researchers are developing standard tests to detect five major fish diseases in less than one day. Other biologists are attempting to find ways to prevent the spread of the deadly virus - IHN - through better egg-collecting techniques such as spawning individual breeding pairs in one bucket. Scientists will test anti-viral drugs to block water-borne infections. Scientists also search for clues to break the life cycle of a parasite which kills enormous numbers of both juvenile and adult fish.

Nutrition and its relation to both disease and adult survival has attracted SPA financing. If researchers can produce a hardier smolt, through better nutrition, they can also expect more fish to return as adults. Hatcheries could subsequently raise and release fewer smolts. Raising fewer fish not only means a cost saving for hatchery managers. Smaller releases also mean less competition between hatchery and wild fish for limited habitat and food supply.

Researchers would also like to develop better means of distinguishing hatchery from wild fish. An easy means of identification would allow greater fishing of hatchery fish without harming natural stocks.

Easy identification would also allow managers to select races of both wild and hatchery fish most suitable for stocking existing or new habitat.

In hatcheries biologists closely examine fish at all life stages.

Fish & Wildlife Service scientists collect tissue samples from adult fish at Leavenworth (WA) National Fish Hatchery in order to test for IHN virus.

Fish scales reveal much about the fish's age and health.

Low-Cost *Salmon Production*

More appropriately called low-capital or low-technology propagation, LCSP calls for hatcheries on a small scale - without the expense of building and maintaining any large buildings.

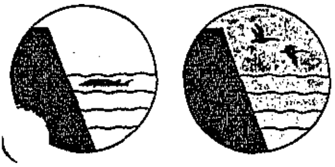
Project leaders rear small numbers of fish in earth ponds, As in larger hatcheries, workers take eggs from females and mix in sperm from the males. Fertilized eggs incubate in streamside boxes. Once alevins become fry, they are released into the ponds. As the fry grow, workers open more ponds so the young fish have room to feed and hide. Workers eventually open outlets, releasing smolts to migrate downstream.

LCSP duplicates natural propagation more closely. In fact, if more than enough adults return, researchers allow them to pass into habitat available upstream from the facility.

Rather than several thousand fish returning to a few hatcheries, LCSP would have a few hundred return to each of several locations. Some researchers feel that this would create numerous individual fish populations and help reestablish genetic diversity in the Basin.

Biologists collar adult Canada Geese and track them to their nests. By studing the geese during the brooding and rearing periods, biologist can determine the impacts of hydroelectric operations on nesting success and gosling survival.

LCSP ponds mimic natural spawning and rearing situations.



Resident Fish and Wildlife

Resident fish develop, mature, and reproduce without migrating out of the Columbia River Basin. They include coolwater game fish, such as walleye and northern pike; warmwater game fish, such as the large and small mouth bass; salmonids, such as kokanee and rainbow trout. Hydroelectric dams have produced both positive and negative effects on resident game fish.

To determine these effects, project biologists identify fish species and how they interrelate in the Flathead River and at Hungry Horse and Libby Dams. They follow the fish through their life cycles, and determine what man-made or natural factors limit populations. Their research also determines the vulnerability of spawning beds to variable water levels, the effects of hydro operations on the production of small aquatic insects, and riverflow effects on spawning site selection and reproductive success.

By studying the sturgeon life cycle, biologists can determine what effects hydroelectric development has had on their reproduction and behavior. Biologists study which areas sturgeon use in the reservoirs, where they spawn, and what they eat. By answering questions about the sturgeon's natural history, researchers will learn how to sustain and enhance sturgeon populations.

Through BPA funding, biologists throughout the Northwest seek to determine the impacts of hydroelectric development and operation on wildlife and wildlife habitat. This determination helps project leaders develop meaningful wildlife mitigation plans and provides the basis for future wildlife projects.

One investigation concerns the effects of hydroelectric operations on the breeding success of Canada geese. Tribal biologists in western Montana radio-monitor the movements of geese in order to identify important nesting and rearing habitat. Biologists will determine the effects of water level fluctuations on key areas essential for gosling survival.

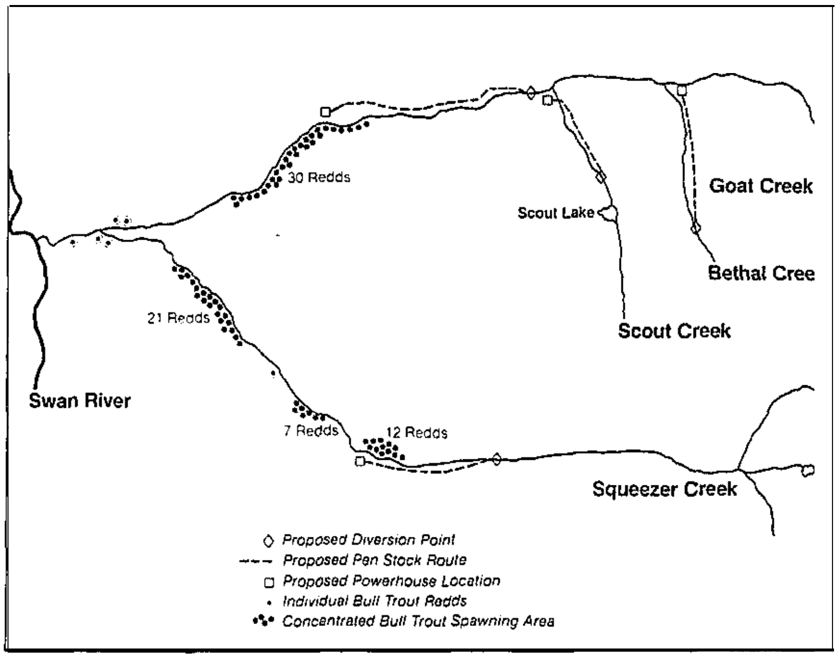
Aquatic insects form an important part of a young kokanee's diet.

Hydroelectric development and operation eliminated wintering grounds for elk and other big game species,

Future Hydro

Small hydroelectric dams offer the potential to increase electrical power supplies in the Pacific Northwest at low cost. When considered individually, these projects may have little effect on fish and wildlife. But as a group, impacts may be much greater.

To assess the potential impact, biologists examine the effects of a small diversion dam on habitat, fish migration and resident fish populations. At the same time, BPA is developing methods to assess the cumulative effects of multiple projects and to protect critical habitat from additional hydro development.



Several small hydroelectric projects are planned near important trout spawning sites in the Swan River Valley.

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How This Program Affects You

Fish and wildlife concerns have been building in the Pacific Northwest for more than 50 years. Salmon and steelhead issues have been particularly prominent as commercial, tribal, and later, sports fishermen competed for declining numbers of returning fish.

For decades, irrigation and power production, not fish and wildlife, governed dam operation. SPA intends to mitigate fish and wildlife damage attributable to the power system.

BPA's Division of Fish and Wildlife now manages and coordinates a broad-ranging program of activities. This program includes over 100 projects throughout the Pacific Northwest. Projects restore and protect fish and wildlife, reducing damage caused by the development and operation of the Federal hydroelectric power system.

"Our commitment to improving conditions for fish and wildlife is firm. The actions We are taking are far-reaching and effective. We will do much more for fish over time," states BPA Administrator, Peter Johnson.

BPA's program to reverse declines in fish and wildlife populations will directly benefit all of us - through greater opportunities to enjoy the vast recreational resources of the Pacific Northwest. BPA aims to reconcile the region's economic needs for hydroelectric power with the region's cultural and economic needs for fish and wildlife - we look to success in our restoration efforts.

Seattle — 206-442-4130

Spokane — 509-456-2518

Missoula — 405-329-3860

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