Fish and Wildlife Annual Project Summary

Project Reviews
1982 - 1983

DOE/BP-258

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Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

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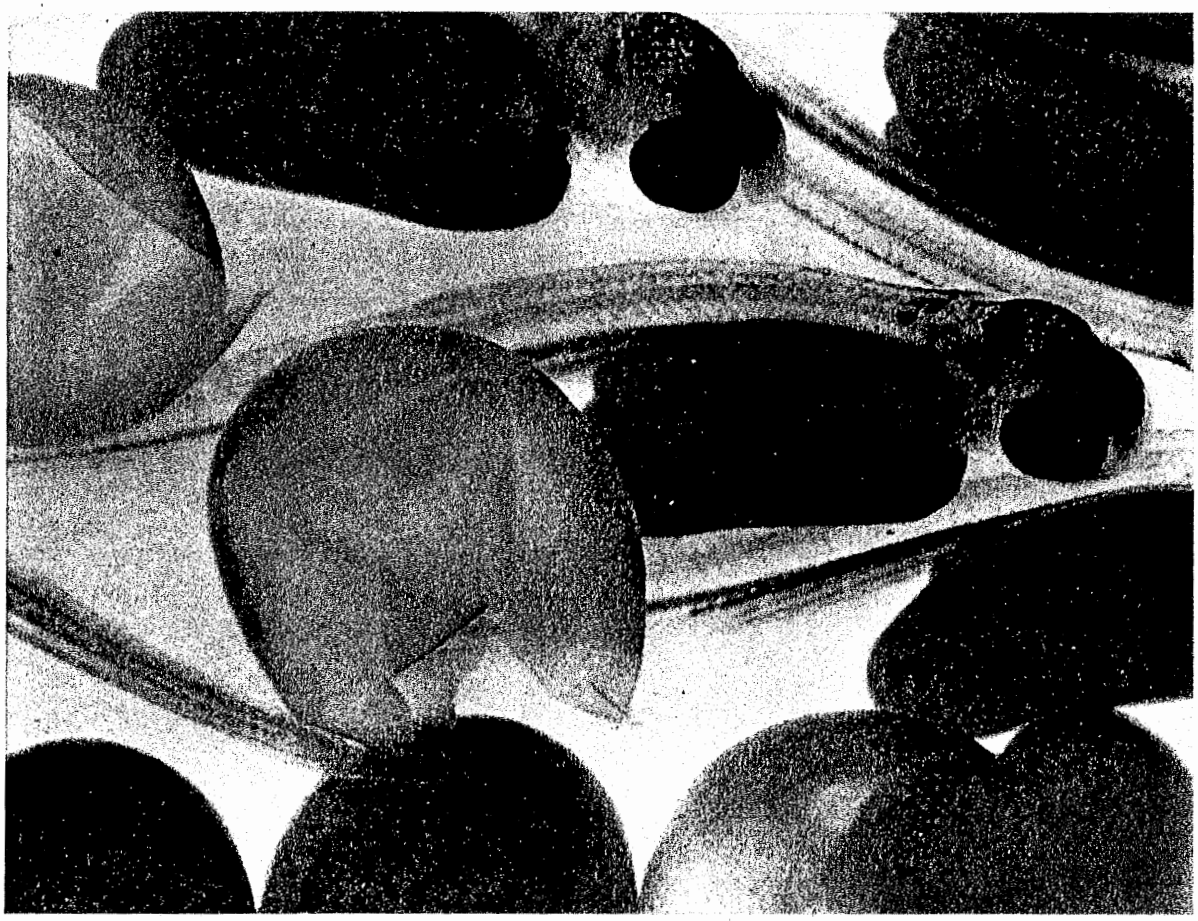


Newly hatched Kokanee Salmon.

Photo USFWS

Mission Statement

The Division of Fish and Wildlife acts to restore fish and wildlife resources affected by development and operation of hydroelectric power generation on the Columbia River and its tributaries. To resolve inequities, the Division has developed and will continue to manage a comprehensive program which includes:

- activities aimed at protecting, mitigating, and enhancing fish and wildlife resources;
- coordination with the region's state and Federal fish and wildlife agencies, Indian tribes, land management agencies and utilities;
- evaluation of hydro operations for fish and wildlife impacts;
- recommendations ensuring equitable treatment of fish and wildlife in BPA programs
- development of policies needed to carry out BPA's fish and wildlife responsibilities.

Fish ladders at Columbia River dams help migrating adults return to their natal spawning grounds.
COE

BPA's Fish and Wildlife Program Accomplishments and Directions

During fiscal year 1983, a major change occurred within the Bonneville Power Administration. A new element was added to its existing mission and programs. The Division of Fish and Wildlife initiated the first full year of its fish and wildlife restoration program.

The fishery program was first conceived in 1976 when the BPA Administrator signed a Memorandum of Understanding (MOU) with the Chairmen of the Confederated Tribes of the Umatilla, Warm Springs, Yakima and Nez Perce Indian Reservations and the governors of Oregon, Washington, and Idaho. The MOU established a cooperative effort between power and resources groups to restore Columbia River salmon and steelhead.

In 1978 BPA funded its first pilot fishery research projects. Over the next 5 years the infant fishery program grew, and so did the staff dedicated to this new effort-from a three person program office to the Division of Fish and Wildlife. Last year represented a major stage of that growth. Our budget and project activities more than doubled from the previous year.

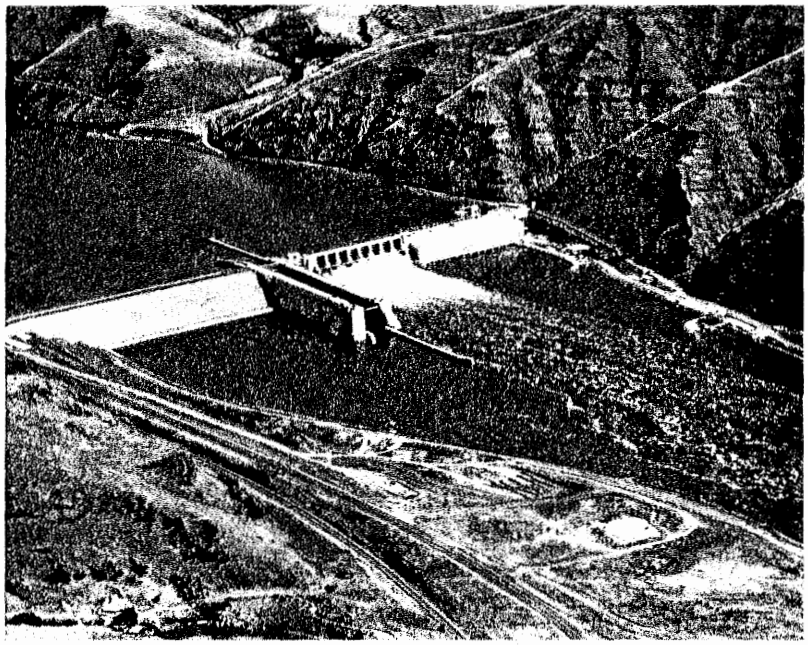
Between 1978 and 1983, BPA spent $20 million on fish and wildlife restoration projects. Half that was spent in FY 1983 alone. In 1982, 7 staff members managed 30 contracts. In 1983, 2 additional project managers were hired and handled a total of 93 contracts — covering all aspects of anadromous fish, resident fish, and wildlife restoration.

This annual report provides a comprehensive look at each component of that program. Report sections cover areas where we have initiated important actions and achieved major accomplishments.

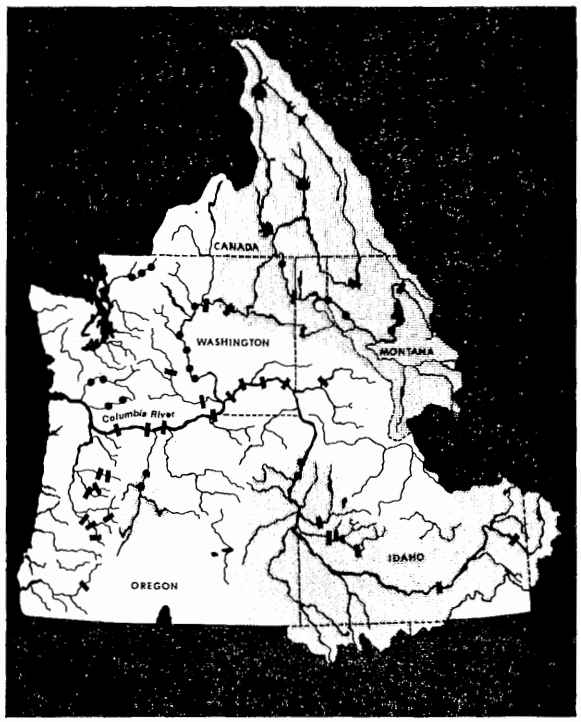
In addition to managing and coordinating this multifaceted program, staff members established new links with the fish and wildlife agencies and the Indian tribes of the Pacific Northwest. The Division also provides special expertise in planning BPA's marketing strategies and managing the hydroelectric system's operation in a manner that fully considers the needs of fish and wildlife.

The Northwest Power Planning Act of 1980 challenges BPA to protect, mitigate, and restore fish and wildlife resources impacted by Federal hydroelectric development in the Columbia River Basin. BPA's current Administrator, Peter Johnson, has expressed BPA's unequivocal commitment to fish and wildlife in directing us to meet that challenge. In 1983, the Division took major steps to implement such a fish and wildlife restoration program and to incorporate fishery considerations into power planning. Yet it was just a beginning. Our first year's effort shows our determination to meet the Act's continuing challenge.

John R. Palensky, Director
Division of Fish and Wildlife
Bonneville Power Administration



Lower Granite Lock and Dam — Snake River Washington & Idaho.



Setting the Stage for the Restoration Program

The completion of Bonneville Dam in 1937 ushered in an age of abundant hydroelectric power in the Pacific Northwest. One by one dams were built on the Columbia River and its tributaries. By 1975 the Federal Columbia River Power System consisted of 30 dams producing more than 13,000 megawatts of electricity with a total storage capacity of 20 million-acre feet. Besides producing electricity, these dams made arid land productive through irrigation and transformed the once tempestuous Columbia River into a navigable waterway. While enhancing some resources, the dams seriously damaged another—fish and wildlife.

Years of evolution adapted fish to conditions before dams were built. Those "perfect" conditions have several components important at each stage in a fish's life cycle and become constraints which regulate successful fish production and escapement.

The hydroelectric projects greatly altered the environmental conditions the fish enjoyed before the dams were built. Dams present insurmountable barriers to migratory fish, blocking the journey they must make upstream to spawn. They flooded shallow, sheltered areas along the streambanks where the fish spawned and the young reared. Over 1,000 miles of salmon and steelhead habitat beyond Grand Coulee Dam on the Columbia River, Dworshak Dam on Clearwater River, and Hell's Canyon Dam on the Snake River were lost.

Hatching fish, accustomed to swift currents to carry them to the sea, find their trip slowed by a series of reservoirs. Young fish had to struggle through placid reservoir waters unaided, often taking as long to get through a single reservoir as it used to take to go all the way to the estuary. Once the juveniles made it to through reservoir they had a slim chance of making it through the dams without falling victim to damage from tremendous water pressure changes or spinning turbine blades.

The Columbia River will never again support the number of anadromous fish it did before hydroelectric development, but the present situation can be improved. A long-term program to reverse declines in fish and wildlife populations is now underway.

The Northwest Power Planning Act and BPA

The survival of fish and wildlife in the Columbia River Basin went from a concern to a top priority with the passage of the Pacific Northwest Electric Power Planning and Conservation Act in 1980. That Act directed the Northwest Power Planning Council to "promptly develop and adopt . . . a program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries." The Council used recommendations from the Federal and State fish and wildlife agencies, the Indian tribes, and other public and private groups, incorporating their concerns to build the Fish and Wildlife Program. BPA was charged with carrying out a large part of the Program.

Project Highlights

In response to this challenge, the Bonneville Power Administration has taken on a wide variety of projects.

Nearly one-third of 1983's projects aim to restore spawning and rearing habitats in order to increase the natural production of migratory fish. Other projects rehabilitate spawning sites on tribal lands or seek to reestablish access to suitable habitat now unavailable to migratory fish.

At the hatcheries, biologists work on cures for deadly fish diseases and seek to improve fish health by developing more nutritious fish food. Researchers study the best time to release the young fish into the streams for their journey to the sea.

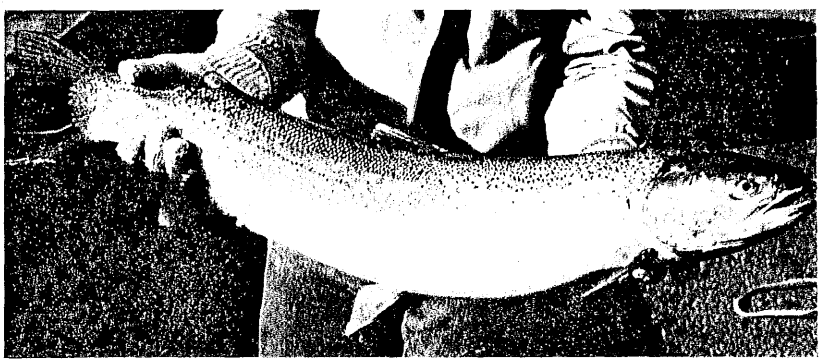
Other managers direct the "Water Budget" - a plan to aid fish in their downstream migration by releasing water from the dams into the river system at times when spring migrants need it the most. The managers monitor fish movement while examining spring runoff and existing streamflow in order to "shape" flows and create the best possible conditions.

By examining the flows which stimulate a fish's natural capabilities to leap barriers, engineers design better fish ladders. BPA projects plan new passage facilities at several Columbia River Basin dams.

A rapidly growing budget shows BPA's commitment to fish and wildlife. In 1982 BPA spent $4 million on fish and wildlife projects. That figure more than doubled in 1983 to $9 million in addition to the annual average of $58 million spent on increased fish flows and operation, maintenance, and amortization for facilities already in place.

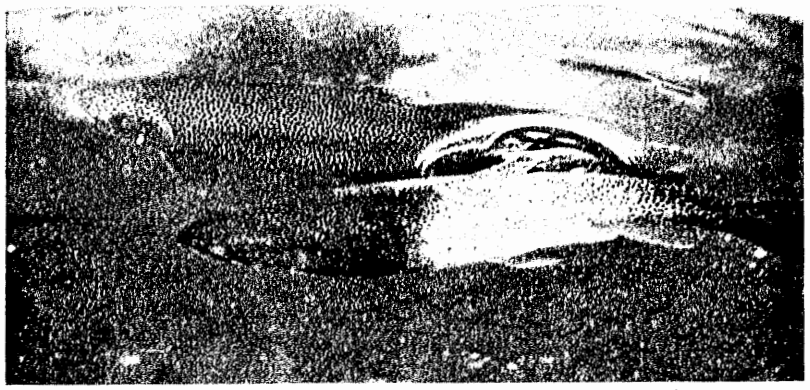
Chelan County PUD Biologists monitor the movement of young salmon for the Water Budget Center.

Wes Taft



Adult steelhead at Cowlitz (Washington) hatchery are examined for viral disease

Wes Taft



Steelhead trout do not die after spawning-some survive to spawn again.

ODFW

Newly hatched steelhead with their yolk sacs

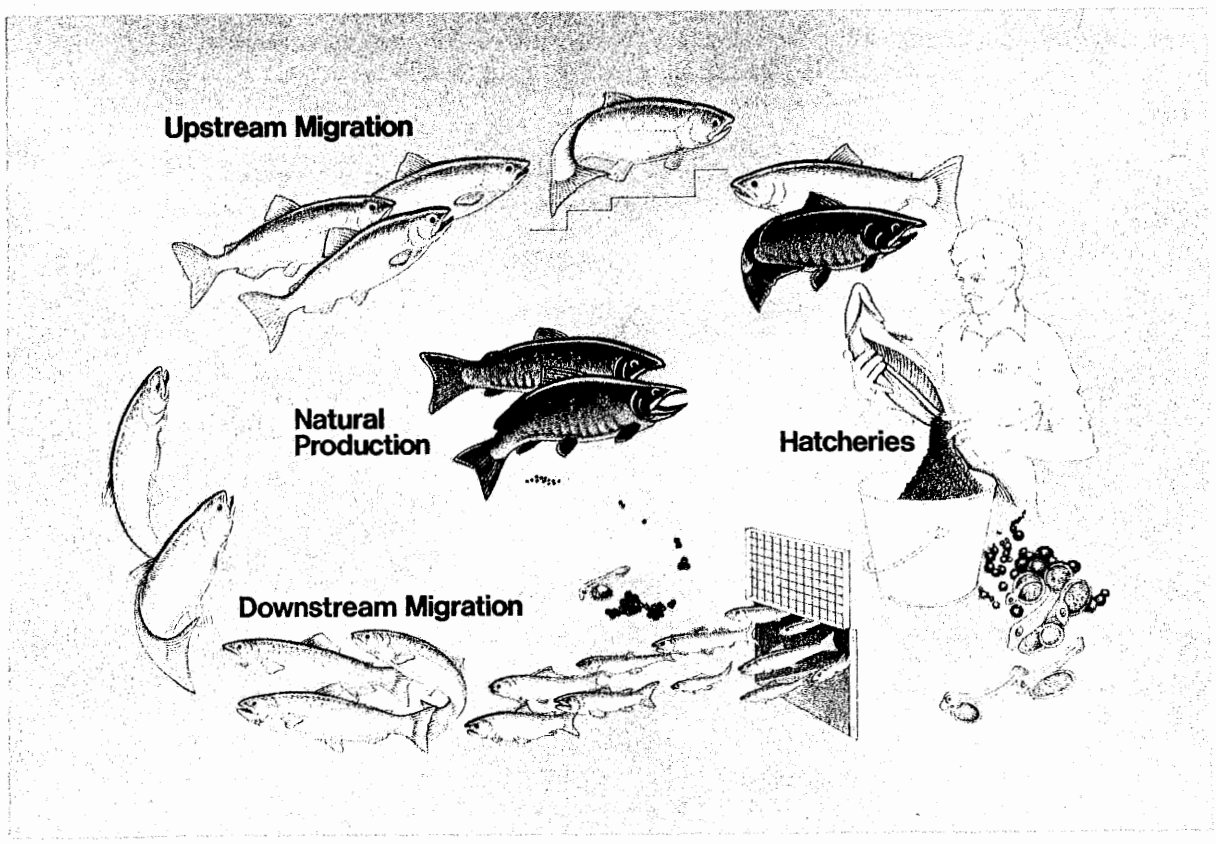
ODFW

"I would say the fishery program has been a success," said Peter Johnson, BPA Administrator, in a 1983 address to BPA employees. "With the various programs and the Water Budget, I think we are going to see in future years the re-establishment, in fact the enhancement, of the fishery resource in the Columbia River."

Life Cycle of Anadromous Fish

Anadromous fish migrate from the ocean to spawn in fresh water. Anadromous species include chinook, coho, and sockeye salmon and steelhead trout. Salmon and trout are collectively referred to as salmonids.

For centuries these salmonids have adhered to this precise life cycle. For all but some of the steelhead, spawning is the last act of their lives. When the time to spawn approaches, the adult fish leave the ocean to fight their way up a river. Although they do not actively pursue food on this journey, they summon enough strength to leap as high as 10 feet over rocks and rapids to get upstream. The fish seek their natal spawning areas. After depositing their eggs in gravel nests, or redds, salmon



die. Steelhead may spawn then return to the sea to make this journey as much as three more times.

The eggs hatch in spring. Fry grow in protected areas of the stream for up to 18 months before beginning their downstream journey. As they migrate, they undergo "smoltification," preparing physiologically to live in saltwater. Smolts typically migrate in the spring, after melting snow made the streams full and swift-flowing.

In the ocean the fish grow to maturity. When their time comes to spawn, the cycle begins once again. This life cycle varies with different fish species and conditions.

Downstream Migration

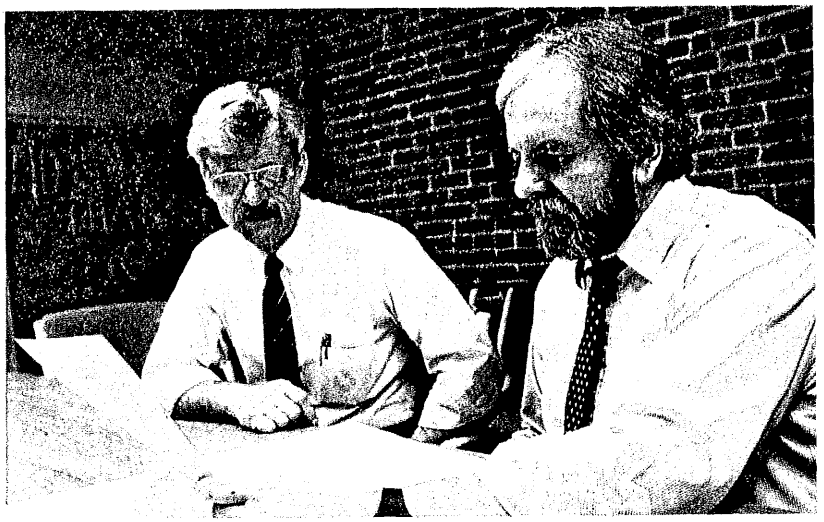
Hydroelectric projects cause a variety of problems for fish trying to migrate either up the rivers to spawn or down the rivers to the sea. Natural flows in the Columbia and Snake River systems have been greatly altered by the dams. Dams store spring runoff in order to generate power later in the year when runoff is low and energy demand is high. However, this practice changes the timing of river flows. It now takes juvenile salmonids longer to migrate from their spawning grounds to the ocean. The high water velocity that used to carry them seaward disappears in the broad, still reservoirs.

One of the critical periods in a salmonid's life cycle occurs when smoltification orrurs. Increased travel time impairs a salmonid's ability to make that transition. Reduced flows have other consequences. The fish must now deal with higher water temperatures, different water chemistry, and greater susceptibility to disease and in-river predation.

Smolts face other problems as they move downstream. When dams were first constructed, builders thought that providing passageways for the adult fish was enough to sustain salmon and steelhead runs. Since then, research has shown that when juveniles are drawn through the power turbines of the dams, they are exposed to potentially lethal conditions. Smolts face tremendous changes in pressure within the turbine housing as they move from the top of the dam through the turbine intake and out a tunnel at the base of the dam. The impact of the moving turbine blades and the shearing action of the water in the turbine can also cause injuries or death. Stunned and disoriented survivors make easy victims for predators waiting at the base of each dam.

Water Budget (83-491/536)

In an effort to mitigate for the reduction in flows, the Council's Fish and Wildlife Program first proposed a "Water Budget" approach to improving spring flows. Under this approach the fish and wildlife agencies and the tribes work with BPA and power system operators to shape flows during the critical migration period, April 15 to June 15, using a block of water especially budgeted for this purpose. Through use of the Water Budget, spring flows are increased to speed the migration of juvenile salmonids past the dams. The size and timing of the Water Budget were initially based on flow recommendations submitted by the fish and wildlife agencies and the tribes. These recommendations were based on information from several Columbia and Snake River smolt monitoring projects.



Managers Mal Karr (l) and Mark Maher examine water budget data.

Ron Smith

The Water Budget provides the current needed to carry young fish down the river, through the reservoirs, and out to sea.

Ron Smith

These projects continue in order to provide data on smolt movements and to refine the Water Budget concept. Prior to the Water Budget the National Marine Fisheries Service (NMFS) provided a liaison between the fishery agencies and the power and water management agencies during the smolt migration period. NMFS also provided the coordination necessary for optimum planning and implementation of river operation. They helped to integrate smolt migration flow needs with reservoir and power management activities, and improve smolt survival while minimizing loss of power.

In the past, NMFS submitted its annual summaries of smolt migration for inclusion in the Committee on Fishery Operations (COFO) annual report. The coordination function has now been assigned by the Fish and Wildlife agencies and Tribes to the Water Budget Center and its staff. The Pacific Marine Fisheries Commission provides fiscal management for BPA funds used to support the Water Budget Center and its staff.

Water Budget Center Activities Include:

- monitoring actual runoff and smolt movement to achieve maximum benefit from Water Budget and spill usage;
- coordinating hatchery releases with Water Budget releases;
- evaluating the effectiveness of flow, spill, and the use of structural bypasses in improving downstream migrant survival through collecting, evaluating, and correlating data on flows, travel time, smolt survival, and subsequent adult returns; and
- coordinating Water Budget usage and spill priorities with power production objectives.

BPA supports several other projects dealing with fish passage and smolt movement.

Coordination of Fish Monitoring and Power and Water Management for Fish Flows (80-1)

A number of Corps of Engineers and Public Utility District dams spill water to assist downstream migration of juvenile anadromous fish. Movements of fish are monitored at many Columbia River dams. This project calls for the National Marine Fisheries Service (NMFS) to coordinate systemwide monitoring efforts and, during spill periods, to work closely with BPA's and dam owners to ensure best flow and spill conditions consistent with energy operations. The project provides organization, leadership, and a liaison to supervise collection and synthesis of data on the movement of marked smolts. This information supports water budget center decisions.

Smolt Condition and Timing of Arrival at Lower Granite Reservoir (83-323A, 83-323B)

Millions of chinook and steelhead smolts outmigrate from Idaho hatcheries to the sea each spring. Two BPA contracts study downriver migration time, and the possible causes of descaling and other debilities observed in migrating fish.

In one study (83-323A), the NMFS built and installed traps in order to measure smolt condition and the timing of their arrival at Lower Granite Reservoir. They refurbished and installed a scoop trap on the Salmon River and a migrant dipper trap on the Snake River. Subsequently, NMFS turned operation and maintenance of the traps over to Idaho Department of Fish and Game (IDFG) personnel. In 1984, NMFS will construct a new scoop trap for use by IDFG on the Clearwater River.

The second study (83-323B) focuses on the timing of the smolts' migration and their physical condition during the trip. Outmigration of smolts can be inhibited by low river flows especially in the reservoirs. Researchers in this study want to document the arrival of major groups of smolts at Lower Granite Reservoir so that Water Budget managers can augment flows and move smolts downstream rapidly. Many smolts arriving at the Lower Granite bypass facility showed substantial

scale loss and other evidence of deteriorating health. Project biologists seek to determine what level of descaling occurs before the smolts get to the Lower Granite area.

Monitoring Juvenile Salmonid Migrations at Priest Rapids Dam (83-406)

Part of an ongoing program to acquire data on the downstream movements of summer migrant juvenile salmonids, this project will determine the timing of migration for mid-Columbia fish. BPA contracted Grant County Public Utility District #2 and BioSonics, Inc., to provide magnitude and timing estimates for summer migrants at Priest Rapids Dam. Results of this monitoring could be used to develop water allocation strategies and to modify operating procedures at the dam.

Team leaders will offer data summaries and analyses in their final report, due in late 1984.

Flow and Spill Requirements for Juvenile Fall and Summer Chinook Salmon in John Day Reservoir (81-1)

Past research shows that during most of the year large numbers of summer migrant juvenile chinook salmon "holdup" for long periods of time in John Day Reservoir. Fishery managers believe that this delay may adversely affect the smolts' survival. This NMFS project will determine the effect of reservoir delay on the juvenile chinook salmon stocks and establish whether flow enhancement is needed.

NMFS researchers at McNary Dam will define the effects of instream flow, and periodic flow reductions, on the passage time of smolts in John Day Reservoir. They will determine how instream flow levels affect the distribution and passage behavior of the smolts, and specifically how reservoir passage time affects smolt survival.

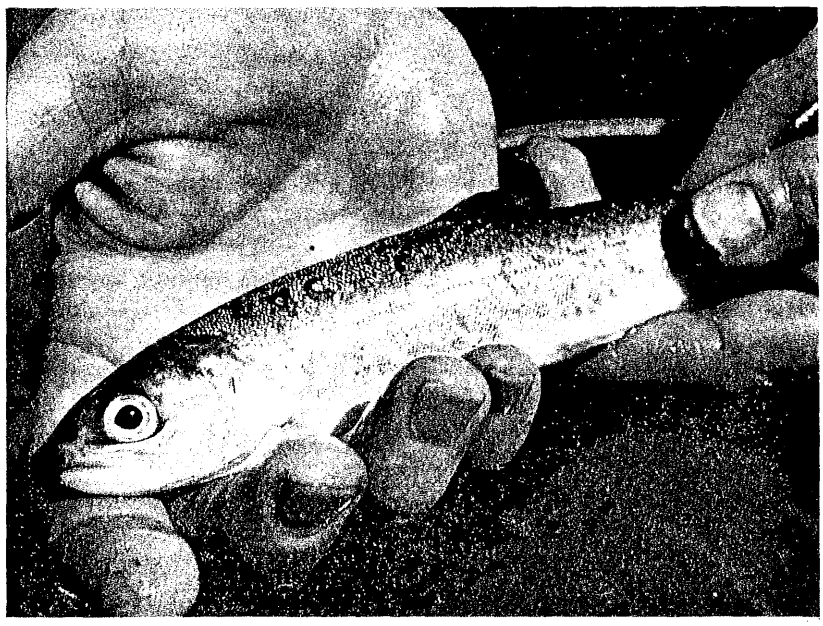
This project began in 1981. Researchers have marked and released fish, and conducted preliminary sampling of juvenile salmon using purse seines. In 1984 they will write a final report on the first phase of the project dealing with juvenile fish migration. In the last phase of the project, NMFS will monitor returns of adult fish.

The Water Budget depends on information from several smolt monitoring projects. At Wells Dam, a U.S. Fish & Wildlife Service technician selects a chinook smolt...

Wes Taft

...and freezes a special brand to mark the fish.

Wes Taft



Young branded steelhead provide vital information for several of BPA's anadromous fish restoration projects.

Wes Taft

Effects of Stress on the Viability of Chinook Salmon Smolts Transported from the Snake River to the Columbia River Estuary (82-5)

Smolts not transported by truck or barge can suffer high mortality rates during downstream passage, particularly in low flow years. The Idaho Cooperative Fishery Research Unit of the University of Idaho, will test the theory that the physiological effects of stress experienced during collection and transportation cause poor post-release survival of transported smolts.

To examine these physiological effects, researchers monitored key stress indices during collection and transportation, and established a baseline response to stress for spring chinook. Besides the effects of stress on smolt adaptation to life in seawater, researchers have determined correlations between stress and predation vulnerability.

Project objectives include evaluation of current collection and transportation systems, and techniques used to avoid or mitigate stress. Researchers also plan to determine the effect of pre-release stress on the return rate of adult fish. In 1984 they will publish a final report on the project.

Columbia River Salmonid Outmigration: McNary Dam Passage and Enhanced Smolt Quality (82-6)

This study examines the stress on smolts migrating downstream at McNary Dam -- those who go by way of the dam's bypass system as well as those that are collected and transported past the dam. The Cooperative Fishery Research Unit of Oregon State University will evaluate the actual stress imposed by the passage or collection at McNary, as well as determine the cumulative stress resulting from passage versus collection and transportation. The researchers will also evaluate the effects of anesthetics, as well as handling and marking, on smolt survival.

Project leaders plan to develop methods for minimizing the trauma caused by bypass, collection, handling and transportation. This project began in 1982. In 1984 BPA will transfer the project to the U.S. Army Corps of Engineers (Corps).

Smolt Passage Behavior and Flow-net Relationships in the Forebay of John Day Dam (82-8)

By studying operations at John Day Dam, NMFS aims to make the best use of special flows and spills at Columbia River dams and improve the migrating juveniles' survival rates.

Researchers will first describe how the flow-net in the forebay of the dam works under given levels of flow, spill, and various modes of turbine operation. Next the researchers will define the relationship between observed forebay flownet patterns and smolt passage behavior.

Should this study successfully identify operational conditions required for smolt survival, researchers will offer the equipment and methods needed to extend this project to other Columbia River dams. They will also expand their methods to include other portions of the reservoirs besides the forebay flownet. Such an effort may help define more clearly the flow requirements needed to improve smolt survival, while minimizing losses in power production and the flexibility of the power system as a whole.

Researchers have completed two years of flow-net monitoring, one season of purse seine sampling and one season of smolt radiotracking. The final season for field study is underway. Researchers will present results of preliminary data analysis in their 1984 annual report.

Tagged Salmonid Recovery Program (82-13)

The recovery of coded wire tags is critical not only to research sponsored by BPA, but to other groups such as the Corps, the region's several fishery agencies, tribal researchers and fishery biologists in both the United States and Canada. The tags are also used in an effort to determine the contributions of various stocks of salmon and steelhead to ocean and river fisheries.

The Pacific Marine Fisheries Commission organized this recovery effort. BPA contributed a "fair share" to ensure the success of the project. Recovery and decoding of tags is essential to the many BPA sponsored efforts using this tool to measure research results.

New Fish Tag System (83-319)

Researchers will take advantage of the latest in computer technology by implanting computer chips into young fish. Miniature antennae wrapping the chips will help scientists identify the fish as they migrate to the ocean and back. The chip is called the "passive integrated transponder" or PIT tag. With the PIT tag, a single scientist aims a decoder or data scanner at a dam's fishway and retrieves information on the same fish at several stations. One person can sample up to 70 percent of the fish in the river without ever handling them. Researchers using other tags must kill the fish in order to remove the tag and obtain information. Information from the PIT tag will be most useful in monitoring migration.

Computer chips and antennae-capable of holding 34 billion different codes-will reveal much about the fish carrying it.

Phil Clark

Imprinting of Hatchery-Reared Salmon and Steelhead Trout for Homing of Transported Fish (78-1)

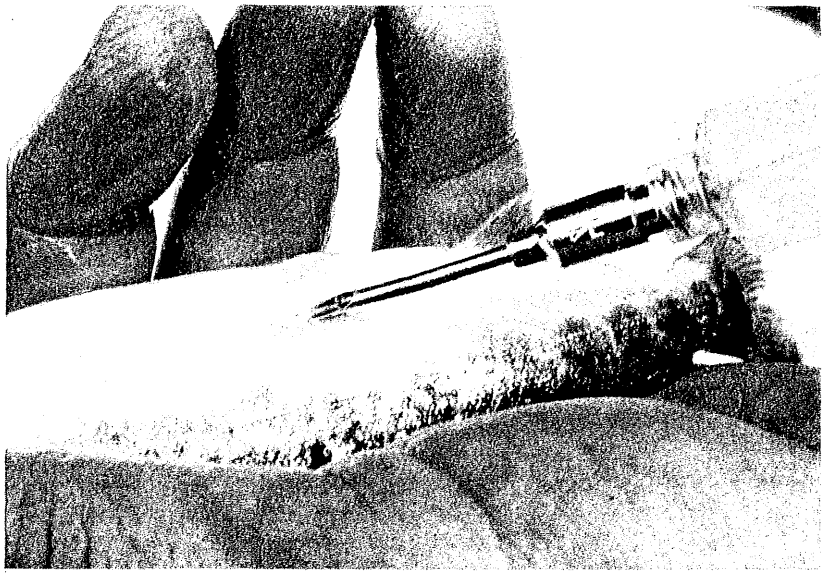
Use of a Fish Transportation Barge for Increasing Returns of Steelhead Trout Imprinted for Homing (82-2)

NMFS researchers believe their studies indicate that fish transported by truck or barge past the dams of the upper and middle Columbia River have a better chance of survival than do fish released at the hatchery to make the journey on their own.

Their preliminary data suggest that survival was increased substantially. More than one and one-half times as many fish barged from the hatchery returned to that hatchery as adults than did fish in the control (naturally migrating) group.

These two NMFS projects also compared the homing abilities of fish who have been transported from hatcheries over the dams by truck to those transported by barge. Both these studies focus on "imprinting", the physiological and behavioral process by which migratory fish assimilate environmental cues to aid return to their stream of origin as adults. Researchers discovered that the fish in the barge group homed—returned to their natal hatchery—particularly well.

In the last year of Project No. 78-1, investigators will determine whether a single imprint or a series of stimuli (sequential imprints) are necessary to assure homing for various salmonid stocks. They will look for a triggering mechanism to activate the homing imprint in salmonids, and will study the relationship between the physiological condition of the fish and their ability to imprint.

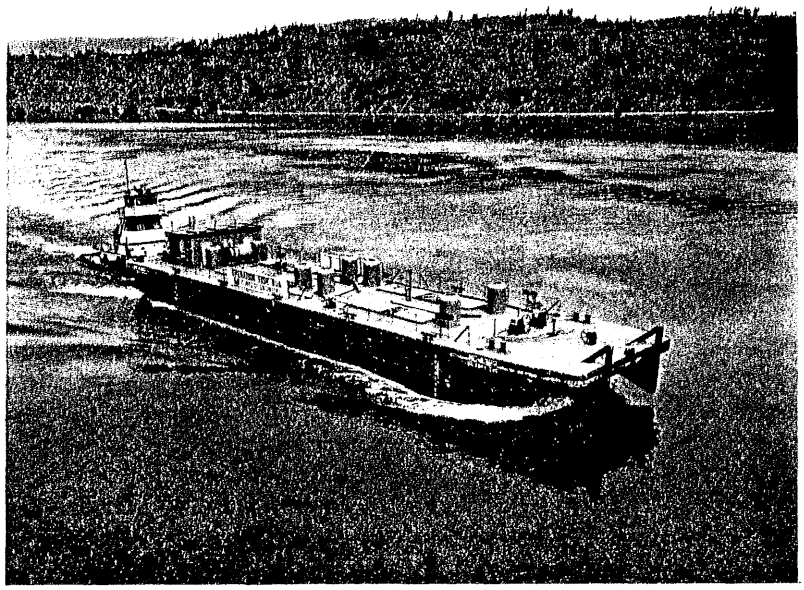


NMFS scientist injects computer chip tag into young salmon

Earl Prentice

The study will also attempt to develop methods to assure that transported fish will return as adults to a desired location, either a hatchery or a particular stream. To evaluate their work, the researchers will monitor adult returns to hatcheries, homing sites, spawning grounds, and commercial or sport fish catches.

This study began in 1978. So far researchers have marked and released over 4 million juvenile fish in 23 experiments. They recovered returning adults from the first experimental group in October 1983. The final data analysis and report will be presented in 1984.



Biologists study the stresses on fish transported by barge around Lower Columbia River Dams.
courtesy COE

In the second project (82-2), NMFS researchers study the use of a fish transportation barge and homing imprints to increase the returns of steelhead trout. Biologists rear and imprint steelhead at Dworshak NFH for transport by truck to nearby Lewiston, Idaho. The fish are then transferred to a barge and released below Bonneville Dam. Investigators monitor adult returns to see if these fish return to Dworshak or to the fishery in Idaho in greater numbers than the fish who were simply released into the river at the hatchery. As in the first project, the relationship between the physiological condition of the fish and their ability to imprint is being examined. Investigators will determine the proportion of fish that have accepted a homing imprint in each release group.

This study began in 1982. So far NMFS has marked approximately 500,000 steelhead smolts. Researchers released these fish after recording and analyzing juvenile smoltification measurements and disease profiles of selected test fish. Until the project ends in 1986, NMFS will monitor adult returns to determine the project's success.

Development of an Effective Transport Media for Juvenile Chinook Salmon (82-4)

Researchers at the U.S. Fish and Wildlife Service (USFWS) National Fishery Research Center (NFRC) will attempt to develop an improved liquid transporting medium for use in barging and trucking juvenile salmonids. This transport medium should ease the stress of hauling for the salmonids, while minimizing equipment corrosion problems.

Under field conditions, researchers have found that a balanced ion transport medium reduces stress of hauling for both single and mixed stocks of spring and fall chinook, and steelhead. The fish transported in the balanced ion medium have significantly better rates of seawater survival, health and growth than juveniles transported in Columbia River water alone.

This 2-year project began in 1982. NFRC scientists have tested the transport medium formula and will develop procedures to further eliminate hauling stress. A final report is due in September, 1984.

Feeding Activity, Rate Consumption, Daily Ration, and Prey Selection of Major Predators in the John Day Reservoir Pool (82-3)

Estimate Abundance and Growth Characteristics of Squawfish and Walleye in John Day Reservoir and Tailrace (82-12)

Some species of resident fish prey on smolts. BPA funded two complementary contracts: one with USFWS; and the other with the Oregon Department of Fish and Wildlife (ODFW), to quantify this major source of smolt mortality. The predator-prey subcommittee of the Columbia River Fishery Council chose the John Day Reservoir in eastern Oregon as a model site for predator-prey relationship studies.

The first study, by USFWS, will determine food habits, rates of consumption, daily ration, feeding activities, prey selection patterns, and gastric evacuation rates (the amount of time it takes food to move through the intestines) for major predators. Pumping predator fish stomachs will provide much of this information. Study leaders have mapped the reservoir habitats in which predation is the most intense, and identified the major predators using those areas. Biologists will compare results from initial evacuation experiments to determine feeding rates. In 1984, researchers will continue collecting field data, conducting lab experiments, and reviewing predation control literature. This project will end in 1986.

The second study, by ODFW, will estimate population sizes for significant predatory species in the reservoir—northern squawfish, walleye, and smallmouth bass. Biologists will determine the distribution of these fish in the reservoir, and their community structures,

growth, and mortality rates. This 6-year study began in 1982. Biologists first designed and evaluated predator sampling techniques, such as radiotelemetry, to determine localized patterns of movement for predators at McNary Dam. At the same time, they surveyed anglers catching marked fish from each of the target species. In 1984 biologists will surgically implant radio transmitters in walleye and northern squawfish in order to begin an aerial and boat monitoring program. Analysis of these field sampling efforts should provide important data on the population dynamics of major resident predators in John Day Reservoir.

Investigation of the Process for Registration of Squoxin for Control of Squawfish (83-428)

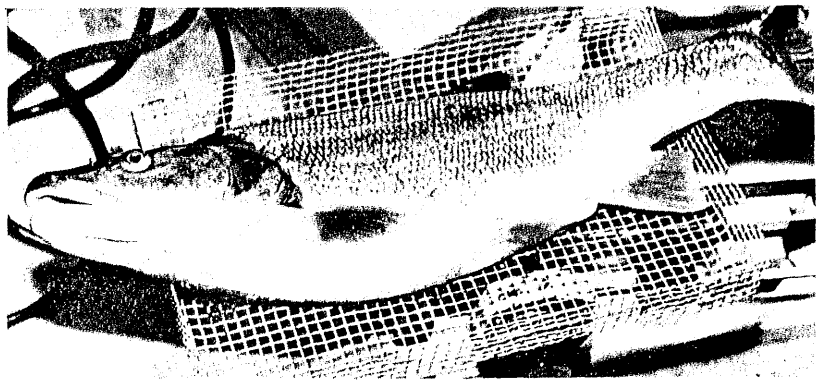
Squawfish thriving in the turbulent water of the dam tailrace, prey on migrating salmonids. Some fishery managers believe pesticides offer the only means to control this predator. This study investigates the process of registering squoxin, a pesticide specific to squawfish.

BPA contracted a private consulting firm, R. L. Rulifson, to review both published and unpublished information on the application of squoxin in squawfish control. He compiled information on the chemistry and toxicology of squoxin and the Federal requirements for pesticide registration. He will offer, in 1984, a final report on squoxin including a recommended approach for registration of the pesticide.

Upstream Migration

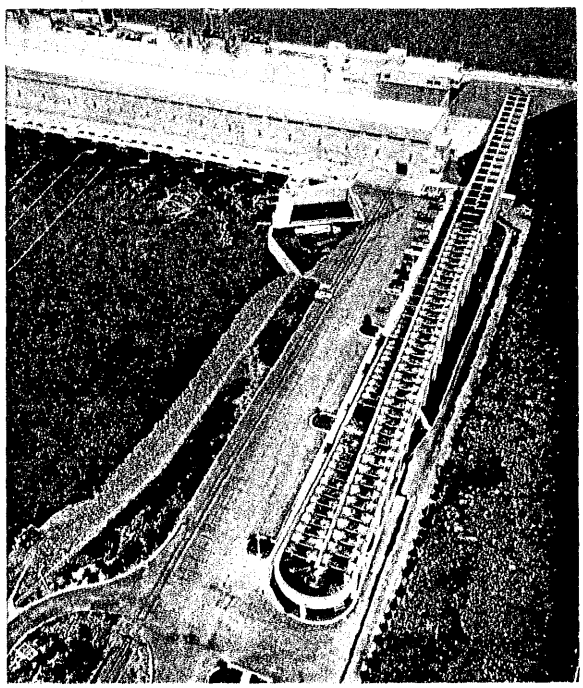
Adult fish also have passage problems at the dams. To anadromous fish the dams present concrete barriers between them and their spawning grounds. To solve this problem, engineers designed "fishways" — fish ladders and other fish passage facilities—at many of the dams. Dam operators were to regulate flows and spills at dams in order to attract fish and provide passage over fishways.

Not all of these efforts were successful. Many fishways were not designed with sufficient care. For example, spill conditions at the base of some mainstem Columbia and Snake River dams discouraged fish movement upstream or masked the flows intended to direct the fish to the fish passage facility. Other fishways were never properly maintained and suffered from



USFWS biologists weigh and measure squawfish before examining its stomach for salmon.
USFWS

Smallmouth bass, a predatory game fish found in many Columbia River Reservoirs.
USFWS



Fish ladders were built alongside most Columbia Basin Dams.
COE

Scientists at Washington State University study waterfall geometry and fish leaping ability to design new fish ladders.
Jack Orsborn, COE

ineffective ladders, mechanical failures of auxiliary water pumps, and inoperative screens. These facilities, inadequate by current standards, often represent ideas made obsolete by new technology.

Development of New Concepts in Fish Ladder Design (82-14)

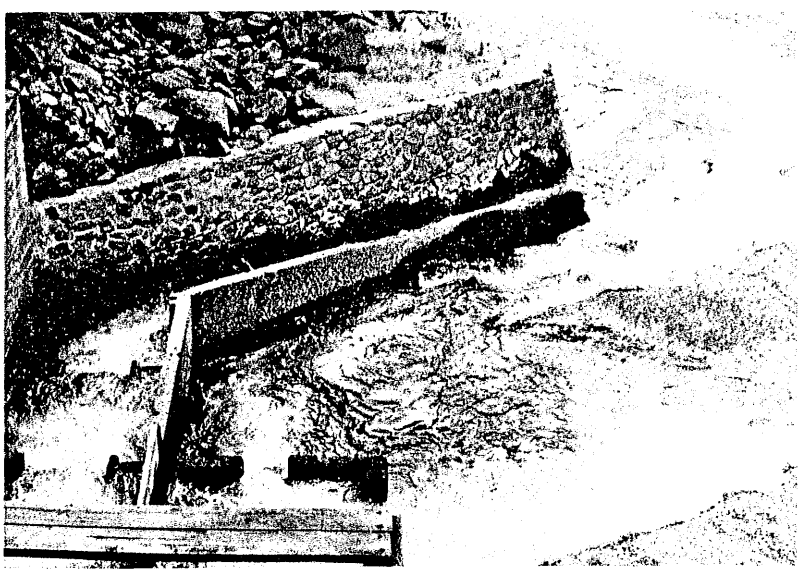
Interest is growing in the development of small-scale hydroelectric dams in the region. With that interest comes a need for small-scale fish passage facilities that are both adequate and economical.

This two-year Washington State University (WSU) study will develop new concepts in fish ladder design. Researchers reviewed literature on the current state-of-the-art in fish ladders, in order to author a manual on fishway design. This manual will also present an analysis of the fluid mechanics of fish passage. After laboratory tests, WSU will install a prototype ladder to see how it works in the field. They will base future modifications on prototype test results.

This project began in 1982. Researchers have completed an extensive literature review and developed alternative fish ladder designs. The first phase of fish ladder testing at the hatcheries began in 1983. Project plans involve more tests of the new ladders, including tests of chamber size, weirs, and baffles to dissipate water energy in passageways. These tests will use full-size salmon and steelhead; tests on a smaller scale in the laboratories will use trout and chinook smolts. Researchers have limited their hatchery tests to coho and chum salmon at a study site on Johns Creek, a tributary of the Washougal River in eastern Washington.

BPA will replace the aging fish ladder at Tumwater Falls Dam near Wenatchee, WA.

Lee Miller



Researchers will also plan tests for steelhead at Washington Department of Game's Washougal Hatchery.

Tumwater Falls and Dryden Dam Fish Passage (83-446)

Fifteen miles up the Wenatchee River from the town of Wenatchee, engineers are working on skirting two major barriers to fish passage. by providing passage at Tumwater Falls and Dryden Dams, increased numbers of sockeye, Chinook, coho and steelhead will be able to return to historic spawning areas. BPA contracted Ott Water Engineers, Inc., to develop alternatives and prepare a preliminary passage design.

Ott first ran field tests to determine a practical design. These tests included a range of flow conditions and turbulence. Using test results, Ott will recommend the passage method judged best for long-term success. After completion of engineering, economic, and environmental analyses, Ott will submit project plans for BPA and Council approval.

The 1984 final report will also offer assessment of the quantity and quality of anadromous habitat above the dams, and an estimate of the area's smolt production potential.

Biologist inserts radio transmitter in throat of chinook passing Bonneville Dam.

courtesy COE

Radio Tracking Study of Unaccountable Losses Between Bonneville and McNary Dam (82-17)

In this study NMFS tried to account for the loss of large numbers of chinook salmon between Bonneville and McNary Dams. Fish counting stations upstream at McNary see substantially fewer adults than at Bonneville.

Researchers used radiotracking devices to follow the fish. They also used radiotelemetry information to estimate the fish passage time through the reservoirs and at the dams. Several automatic surveillance monitoring stations were set up at the dams within the study. Biologists analyzed data from the surveillance activities and presented their results in a final report in late 1983.

Three Mile Fish Passage Facilities, Umatilla River (83-436)

The Umatilla River is a critical migration corridor controlling the number of steelhead and fall chinook moving from the Columbia to their natal upriver spawning ground. Three-Mile Diversion Dam, located at Umatilla River mile 3, poses significant passage difficulties for upstream migrant salmon and steelhead. The spill flow pattern creates false attraction that draws fish away from fish ladder entrances.

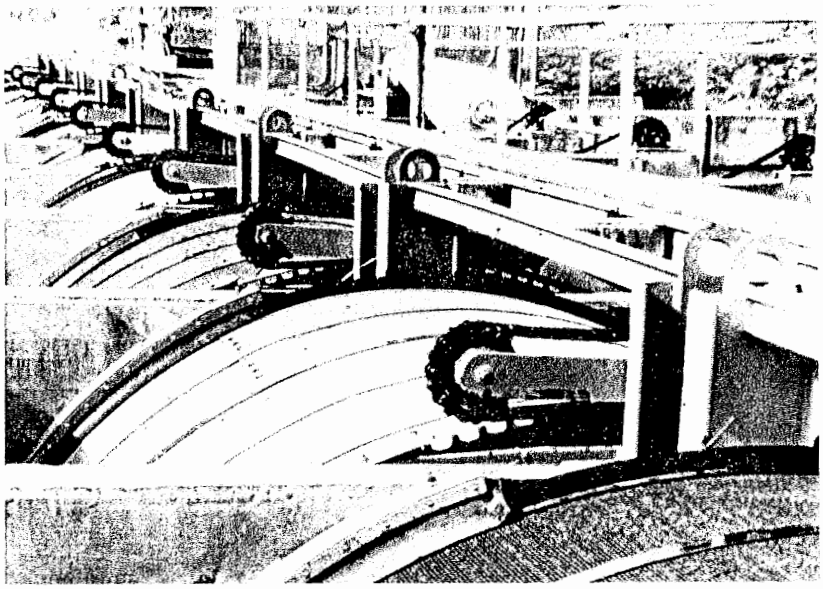
In low water years, the resulting migration delay, stranding, poaching, and poor water quality conditions presently are the most significant in-river factors limiting summer steelhead production on the Umatilla River Basin. Additional problems, which result in significant mortality to downstream migrating smolts, are caused by improperly screened diversions.

The U.S. Bureau of Reclamation, in coordination with the appropriate Fish and Wildlife agencies and Indian tribes, is developing preliminary designs for resolving both upstream and downstream passage problems as well as designs for adult collection and counting facilities at the dam. Final designs are scheduled to be completed by the end of FY 1985 with construction activities to begin early in FY 1986.

Yakima Basin

Without irrigation, the Yakima River Basin is an arid desert. Thanks to a series of irrigation diversion dams, canals, and ditches, that arid land blossomed into one of the most agriculturally productive regions in the nation. Three of Yakima's dams also provide hydroelectric power for the basin.

But all this good news for the farmer means bad news for the basin's fish. In low water years the demand for water can exceed supply and storage capacity. Irrigation, livestock, and power production often claim all available water.



Rotary screens guide young fish out of irrigation canals and back into the main river channel.

Sharon Blair

The Bureau of Reclamation will build a new fish ladder and replace fish screens at Prosser Dam in the Yakima Basin.

Sharon Blair

Don Moos (Washington DOE) left, Peter Johnson (BPA), Bill Yallup (Yakima Indian Nation) meet to discuss details of the Yakima Basin Plan.

Jim Normandeau

Below the diversion dams, the river turns into a series of standing pools. In many years, sections of the river below the diversion dams dry up completely during late summer, making fish migration impossible. Water temperatures in the remaining pools reach 75 to 80 degrees, too high for coldwater fish species. Irrigation water returns to the Yakima carrying sediment and agricultural chemicals—to the further detriment of the fish.

Deteriorating fish screens and passage facilities at the various irrigation and hydroelectric dams cause another problem. Screens should block entrances to irrigation canals to keep fish in the river. Fish ladders should help fish move over the dams with a minimum of effort. While some of the dams have no screens or ladders whatsoever, many of the Yakima's existing facilities are now outdated and inadequate.

Despite these problems, most fishery experts consider the Yakima River Basin an area of great anadromous fish production potential.

To improve conditions for anadromous fish in the Yakima River Basin, Bonneville joined forces with the Bureau of Reclamation (BOR), the Bureau of Indian Affairs, the Yakima Indian Nation, the Washington Department of Ecology, the city of Yakima, state and Federal fish and wildlife agencies, and various irrigation districts. In late 1983, BPA and BOR signed an interagency agreement under which BPA will fund BOR for predesign work and subsequent fish passage improvements throughout the basin.

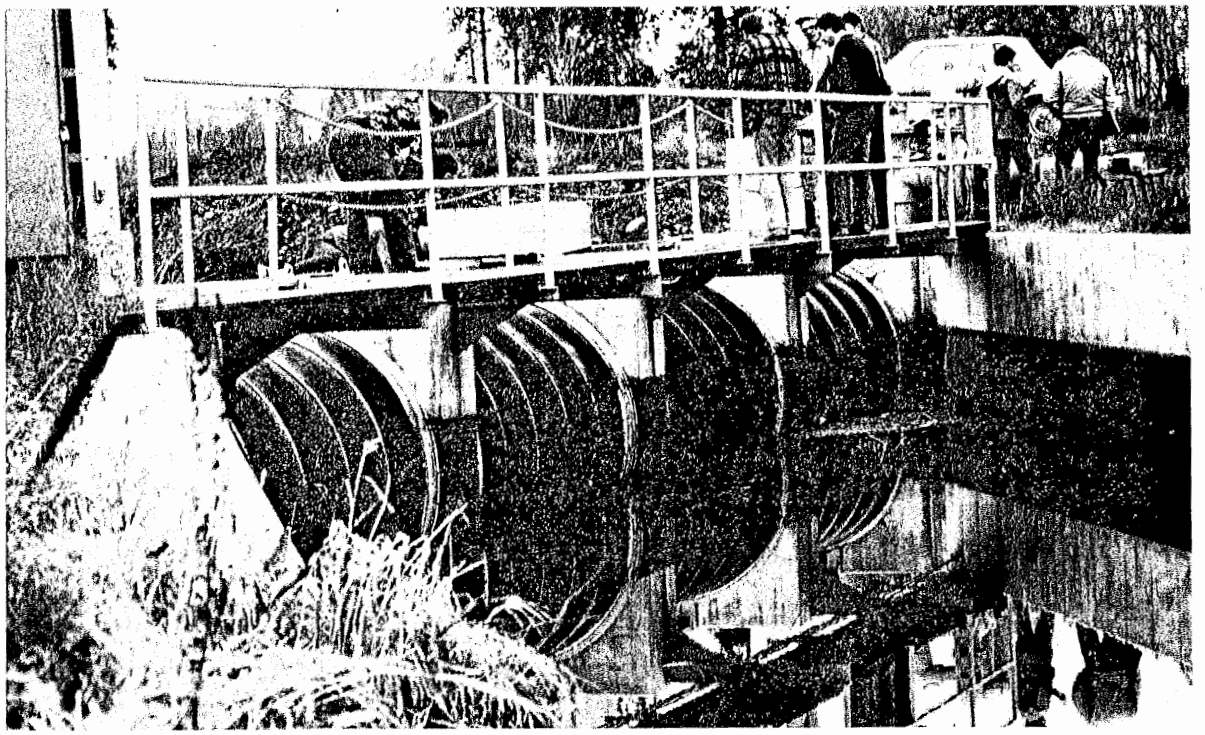
Under the BPA contract, the BOR will complete fish passage predesign work at the following seven Federal projects:

- -Roza Diversion Dam
- -Roza Powerplant Waterway
- -Sunnyside Diversion Dam
- -Easton Diversion Dam
- -Wapato Diversion Dam
- -Toppenish Creek/ Status Unit Divesion
- -Old Reservation Canal

At the same time, the Bureau will fund modifications at Prosser Diversion Dam.

Predesign work includes general configuration and layout; National Environmental Policy Act compliance; a plan to handle the long-term operation and maintenance of improvements; information on necessary permits before construction; a detailed construction schedule; cost estimates for construction, operation, and maintenance; and an endorsement of the planned modifications from all the affected parties.

A technical work group composed of representatives from Federal, state, and local agencies and the Yakima Indian Nation will assist the Bureau in this predesign work. Members of this group use their skills in the design and construction of fish ladders and screens in reviewing flow and passage criteria and facility design.



Members of the Yakima Basin study team examine the Cascade Canal fish screen at Ellensburg, Washington.

Sharon Blair

Under the Interagency Agreement, BOR has delivered an interim report on the Wapato, Toppenish Creek/Status Unit, Sunnyside Diversion, and Old Reservation Canal projects and will issue quarterly progress reports to BPA on the other projects. BOR will submit a final report on all predesign work in October of 1984. Team leaders will select the final design and schedule construction on Sunnyside in 1984 and on the others beginning in 1985.

The fish passage improvements being planned may cost up to 33 million. BPA will spend as much as $ 13.5 million for project design and construction. The BOR, builders of many of the original irrigation projects, will invest approximately $17 million. These amounts are subject to Congressional approval. BIA, state and private local funds will make up the balance.

BPA plans to improve fish passage at Three-Mile Dam in the Umatilla Basin.

Owen Schmidt

Habitat Restoration

Increased natural salmon and steelhead propagation figures prominently in BPA's fish and wildlife restoration program. In 1983, the Division of Fish and Wildlife funded 29 habitat restoration and related projects in order to reestablish wild areas.

Fish that spawn naturally are subject to constant selective pressures, and strong, resilient, diverse stocks evolve as a result. The

Rock berms and weirs break up streamflows into a natural series of pools and riffles.
US Forest Service

Wire cages hold the rocks in place.
ODFW

maintenance of this genetic diversity of stocks is essential to the vigor and survival of a species.

Unfortunately, hydroelectric development eliminated much of the natural spawning and rearing habitat in the Columbia River. Reservoirs created by the dams flooded nearly all of the spawning habitat in the mainstream of the river.

Some areas of the river, such as the Hanford Reach of the Columbia River and the Hells Canyon area of the Snake River, do remain freeflowing. However, water-level fluctuations caused by power-peaking operations at the dams have made much of this area unsuitable for spawning.

Potential spawning and rearing habitat does exist in number of Columbia River tributary streams. Some streams with good habitat are not used because of natural or man-made obstructions. In other areas, habitat improvement projects can bring many streams up to their full propagation potential.

BPA-funded projects will stimulate natural propagation by rehabilitating spawning and rearing habitat. Other projects seek to provide fish access to suitable existing spawning and rearing areas by designing and constructing passage structures.

Forest Service Natural Propagation and Habitat Improvement Projects (83-384, -385 -386, -392, -394, -395, -415, -416,. -501, -502, -522,)

Many potential spawning and rearing streams lack the proper habitat for anadromous fish. Often the original habitat of these streams was altered as a result of hydroelectric development or other activities such as logging or farming. To remedy this situation, BPA contracted with the U.S. Forest Service and other cooperating agencies for eleven of its seventeen FY 1983 habitat improvement projects.

Natural Propagation

Salmon spawn in a wide variety of stream habitats. The type and location of streambed gravels needed for successful spawning can vary from species to species. However, anadromous fish typically select streambed gravels trapped in pools above the riffles, or the shallow, fast water of a stream. The gravel must be stable and permeable, relatively free of sediment, and washed with a sustained flow of well-oxygenated water. The boulders of the riffles make a world where aquatic insects, food for the young fish, can grow and hide—and a world where juvenile fish can escape predators. Undercut streambanks with overhanging vegetation shade the spawning and rearing areas, cooling the stream in summer, providing an insulating thermal blanket in winter. Additionally, insects which live in the trees and grasses along the streambank, drop into the water to become food for the juvenile fish. Plants along the streamside, or riparian zone, prevent erosion. Their roots act as sponges, filtering out pollutants, absorbing rain to prevent flooding and releasing water in dry periods.

During the 1983 field season the Forest Service completed five projects:

- At Murderer's and Deer Creeks in Malheur National Forest (83-384), workers installed log weirs and boulders to create self-cleaning pools. The tailwaters of each pool created spawning habitat as a side-product. Biologists estimate a 200 to 300 percent increase in total steelhead smolt capacity as a result of that work.

- At Lake Branch Creek in Mt. Hood National Forest (83-386) crews removed log jam debris and installed 11 channel structures to trap spawning gravel in the streambed and enhance rearing pools. Because of this work, available habitat for coho and winter and summer steelhead could double.

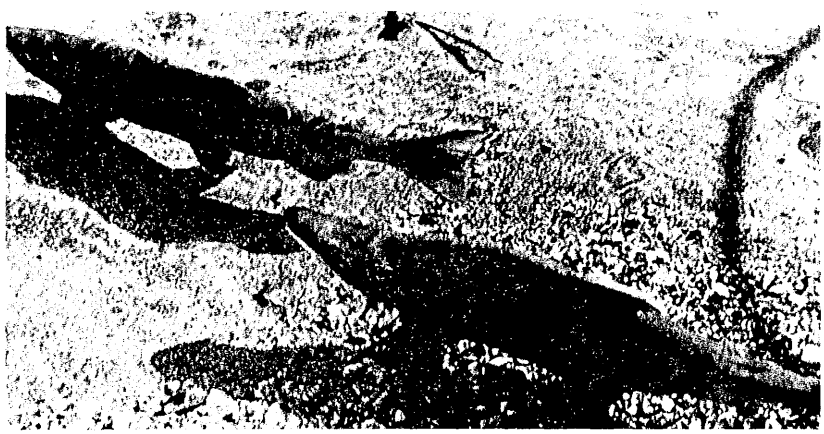
- Wallowa-Whitman National Forest workers fenced and planted riparian areas to protect them from grazing animals, and built 23 in-stream channel structures at Peavine Creek (83-392) to optimumize spawning and rearing habitat on 4.6 miles of stream.

- Forest engineers replaced an existing culvert with a pipe arch on Crooked River in the Nez Perce National Forest (83-502) to allow anadromous fish passage into upstream spawning habitat. Foresters estimate a possible 64 percent increase in chinook and steelhead smolt production as a result.

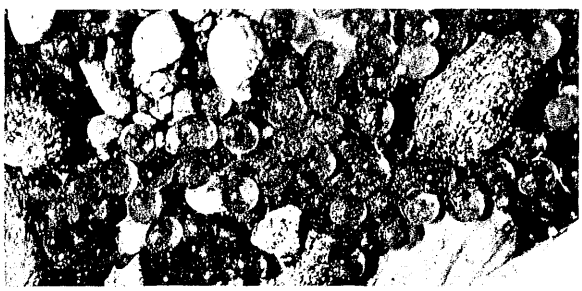
- On Lolo Creek in the Clearwater National Forest (83-522) workers rearranged boulder clusters, built log dams, and planted trees in the riparian zone to create cover for adult spawners and rearing pools for juveniles. Biologists hope for a 50 percent increase in smolt production in Lolo Creek.

Three other projects began in 1983:

- Mount Hood National Forest biologists moved ahead on spawning and rearing habitat improvements for coho salmon, and winter and summer steelhead at Fish and Wash Creeks (83-385). Forest Service personnel re-established an off-channel coho rearing pond, and built eleven structures in the creeks to trap gravel moving through the stream. They planted trees on 15 acres of riparian area.



Adult chinook pair, ready to spawn...
ODFW



...deposit their eggs in a gravel bed.
ODFW

- Six blocked side channels were opened to fish rearing in the Umatilla National Forest's North Fork, John Day River (83-395). Rock and log weirs were installed to increase the number of pools, and boulders strategically located to provide cover and increase the amount of quality pool habitat for rearing. Enhancement work involves the cooperation of the Oregon Department of Fish and Wildlife in monitoring project results.

- At Pole Creek in Sawtooth National Forest (83-416), workers constructed a rotary drum screen and fish return system to prevent juvenile downstream migrants from entering irrigation diversion channels.

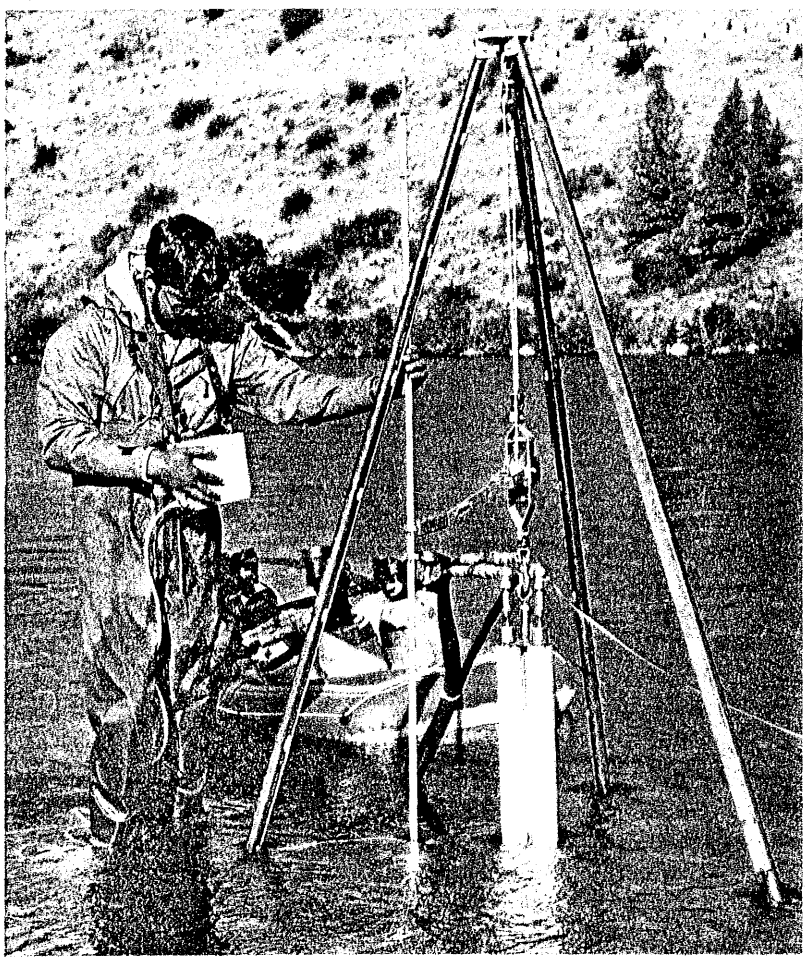
Foresters continued work on three other projects:

At Alturas Lake Creek, the Sawtooth National Forest (83-415) plans to augment instream flows below the Alturas Lake Creek diversion dam. These efforts should increase the production potential of chinook and sockeye salmon. More water flowing in the stream will make it possible for fish to reach suitable upstream spawning habitat, and will increase both the quantity and quality of spawning and rearing habitat for chinook below the diversion dam.

The Umatilla National Forest (83-394) continued repairing dredging damage in Granite and Clear Creeks. Dredging operations began in the 1920's and continued intermittantly until 1954. The Forest's rehabilitation project began in 1979. Foresters concentrated on a four-mile stretch of Clear Creek, where spawning area was increased by the addition of 7100 cubic yards of gravel. Instream structures, log and boulder weirs, increased the number of gravel-collecting pools. Streambanks were stabilized. Nearby Blackjack mine was plugged and its seepage diverted to reduce the toxic waste leaking into the stream. Future work in Clear Creek includes planting shrubs and relocating more boulders. For Granite Creek, foresters plan rearing habitat expansion and more bank stabilization work.

Biologist examines flow conditions in the Deschutes River.

Jim Buell



The Forest Service, in cooperation with the Idaho Department of Fish and Game, hopes to improve habitat on Red River in the Nez Perce National Forest (83-501). Both agencies will install stream structures to stabilize the riverbanks and to increase rearing and spawning cover. They will plant trees and shrubs to prevent erosion and provide shade. Fencing the riparian areas will protect the plants from grazing animals. This project could increase the potential habitat capacity in Red River three to four times.

Cottonwood Creek Summer Steelhead Habitat Improvement (83-473)

The Bureau of Land Management (BLM) hopes to increase summer steelhead production at Cottonwood Creek, a tributary of Oregon's John Day River, by 100 to 200 percent. By reducing water velocities the project can provide additional spawning and rearing habitat, and add more instream cover. BLM personnel will construct a series of log weirs to slow water velocities and capture gravel. Weirs and boulders will scour pools and increase gravel deposits downstream.

Deschutes River Spawning Gravel Degradation Study and Rehabilitation Plan (83-373)

In this year-long study, a private consulting firm will determine the present quantity, quality and distribution of spawning habitat in the lower Deschutes River and compare results to those of a similar study conducted in the mid-1960's by ODFW. Through this comparison, the firm will be able to assess the nature and magnitude of any changes in the spawning habitat of anadromous fish in the Deschutes River. Data collected will create a new "state-of-the-art" baseline against which any future changes can be compared. The project will also compare the distribution of available spawning habitat with the distribution of spawning fish. Finally, the project report will make recommendations for the rehabilitation or improvement of spawning habitat.

Trout Creek Riparian Habitat Restoration (83-423)

Northwest Biological Consulting will develop recommendations for the restoration of the spawning and rearing habitat in Trout Creek, a tributary of the lower Deschutes River. After listing all known riparian rehabilitation programs in the creek, they will develop solutions which will increase streamflows, provide cooler water, and maximize anadromous natural production. They will coordinate their plans with the appropriate agencies. Site specific riparian restoration projects will begin within the next two years.

Study of Wild Spring Chinook in the John Day and Deschutes Rivers (79-4)

The John Day River system hosts one of the last completely wild spring chinook runs existing in the Columbia Basin — an important fact to many biologists studying the natural production of fish in a native environment. In 1978 the National Marine Fisheries Service began evaluating natural production in the John Day River. Oregon Department of Fish and Wildlife has since taken over this study. Study objectives include:

- a decision on how many returning spring chinook will produce the largest number of fish for harvest;
- recommendations for harvest regulations that will still allow enough adults to "escape" or succeed in returning to spawn;
- a determination on the need for adjustment in Columbia River dam fish passage operations to increase the survival of John Day migratory fish;
- recommendations for future habitat improvements; and
- recommendations changing hatchery operations in the basin in order to maintain the spring chinook run.

So far researchers have determined the timing of smolt migration throughout the upper John Day River and down the Columbia. They have also counted spawning chinook and determined the number of smolts migrating from the John Day system. In 1984 the researchers will review and update their sampling plan and sample juvenile fish for distribution and growth. They will complete spawning surveys as well.

Umatilla Forest replaces Granite Creek's dredging piles with suitable spawning gravels.
U.S. Forest Service

Habitat Improvement: John Day River (82-9)

How much will habitat improvement increase anadromous fish production on the John Day River? The Oregon Department of Fish and Wildlife seeks to answer that question in this five-year study. Researchers will also determine how habitat improvement projects built by the U.S. Forest Service change physical stream characteristics.

During the construction phase of this project, forest workers installed log weirs and emplaced boulders to create riffles and pools needed for spawning and rearing. They fenced riparian zones to prevent bank erosion on the stream sides. They completed these improvements on Camp Creek (Middle Fork, John Day River) Clear Creek (North Fork, John Day) and Deer Creek (South Fork, John Day). In the coming year researchers will review and update their sampling plan, complete field sampling and prepare a progress report.

Offsite Mitigation Credit (83-7)

The Idaho Department of Fish and Game will weigh the costs of habitat improvement projects against subsequent changes in chinook and steelhead juvenile production.

Biologists will measure basic parameters, such as numbers of fish per mile, then relate these figures to construction and operating costs per mile over the project's life expectancy. Projects under study include:

-Lolo Creek	-Clearwater River Basin
-Crooked Fork Creek	-Alturas Lake Creek
-White Sand Creek	-Bear Valley Creek
-Red River	-Pole Creek
-Salmon River Basin	-Crooked River

all built by the U.S. Forest Service or the Shoshone-Bannock Indian Tribes in cooperation with the Idaho Department of Fish and Game.

A Biological and Physical Inventory of the Streams within the Nez Perce Reservation (82-1)

Before biologists can take steps to increase the number of andromous fish in a given stream, they must know how many are already there. With this in mind, the Nez Perce Indian Tribes of Idaho will prepare, over the next three years, a complete biological and physical inventory of the streams within the reservation.

This inventory will provide information on the number of species in reservation streams and the level of natural production for existing anadromous salmonid populations. They will compare data collected on the standing crops—-fish now living in the streams—to a potential standing crop number that should exist, according to the projections of a standard Habitat Quality Index. They will estimate population densities using mark-recapture techniques and fish weight data.

Information obtained in this project will be the basis of future programs to enhance or restore anadromous fish production in Nez Perce streams. By pinpointing limiting factors on fish production, such as heavy sedimentation, high summer water temperatures, low flows, and migration barriers, biologists can identify streams which may best respond to enhancement efforts. They can then estimate the total amount of stream habitat suitable for salmonids. Data from this project will also aid in the selection of the most appropriate enhancement efforts for each stream.

Biologists have inventoried all the major and minor streams within reservation boundaries and the major streams adjacent to the reservation. In 1984 the tribe will assess habitat and sample adult and juvenile steelhead for density and production.

Establishment of Baseline Information for the Warm Springs Reservation (81S-8)

The Natural Resources Department of the Confederated Tribes of Warm Springs, will aim to improve the habitat for spawning salmonids on the Warm Springs Indian Reservation in this 10-year project. As a first step, the tribe will quantify the spawning and rearing habitat available to anadromous species. Researchers will also determine the best "escapement" levels for each stream; that is, how many adults must escape fisherman and predators to restock natal spawning grounds. The tribe will then undertake instream and streamside habitat improvement projects to increase available spawning and rearing habitat.

This study began in 1983, and during that year tribal biologists completed a Habitat Quality Index (HQI) on three reservation streams. Biologists also completed a preliminary engineering survey for a possible fish passage facility at Strawberry Falls, 7 miles upstream of the Warm Springs River on Mill Creek. All 1982 brood year spring chinook fingerlings at Warm Springs National Fish Hatchery were finmarked for release. Researchers acquired a floating Humphrey scoop trap from the Oregon Department of Fish and Wildlife to monitor these migrants.

In 1984 the researchers will complete an HQI on the remaining three streams in the reservation. They also plan to begin installing the Strawberry Falls passage facility, finmark all 1983 brood year spring chinook for hatchery release, and begin hydrological and riparian zone surveys of Quartz and Coyote Creeks.

Shoshone-Bannock Tribes' Proposal to Reestablish Their Anadromous Fisheries Resources (83-357)

The Shoshone-Bannock Tribes will evaluate the feasibility and potential regional role of using on-reservation water resources for salmon and steelhead artificial propagation programs. Tribal biologists will identify, evaluate and rate alternative off-reservation sites for low technology facilities as well as initiate a joint tribal/Idaho Fish and Game habitat improvement commission. Strategies for fisheries reestablishment will be coordinated with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Forest Service, U.S. Bureau of Reclamation, and Lower Snake River Compensation Plan.

Rehabilitate and Protect Critical Anadromous Salmonid Spawning and Rearing Habitat in Bear Valley Creek (83-359)

Bear Valley Creek is a valuable salmon and steelhead natural production area which has suffered from mining and dredging operations. The Shoshone-Bannock Tribes will form an interdisciplinary core team of tribal, state and federal representatives to evaluate and select alternative remedial measures. The team will prepare designs and cost estimates, implementing activities to arrest lateral channel movement, sedimentation and further degradation of habitat due to past dredging and mining activities. The team will coordinate its work with Federal and private land owners.

Stock Assessment of Anadromous Salmonids of the Columbia River Basin (83-335)

Anadromous salmonids have an unvarying drive to return as adults to their natal waters. For that reason, eggs are often transferred from one hatchery to another, enabling adult fish to repopulate other stream systems.

This transfer of stocks is a common practice; however, it can be counterproductive if the stocks do not fit their new environment. Fish selectively bred by nature to spawn in a large, swift-flowing river close to the sea may not survive if their new home is a small, secluded stream hundreds of miles from the ocean. Such unsuitable transfers could actually reduce fish populations rather than increase them.

Investigators from the Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Washington Department of Game, and Idaho Department of Fish and Game want to improve the success and reliability of transfer efforts. Through this 1-year study, they will assess a variety of fish stocks and develop guidelines for efficacious transfer of these stocks. Team members will examine salmon and steelhead in order to identify discrete stocks according to their characteristics and management usefulness. They will summarize this information, recommend interim transfer guidelines, and pinpoint the additional information needed to improve current knowledge of fish stocks.

Snake River Fall Chinook Brood Program (82-7)

Snake River fall chinook have been reduced to critically low levels. It is important that the unique genetic qualities of this upper river run be preserved. This project will develop an egg bank for the Snake River stock through creation of an experimental fish farm. The object is to produce eggs needed by Snake River hatcheries. Researchers will also determine the nutritional requirements of captive chinook salmon brood stock in seawater. They aim for a commercial-scale production of 8.5 million eggs by 1987.

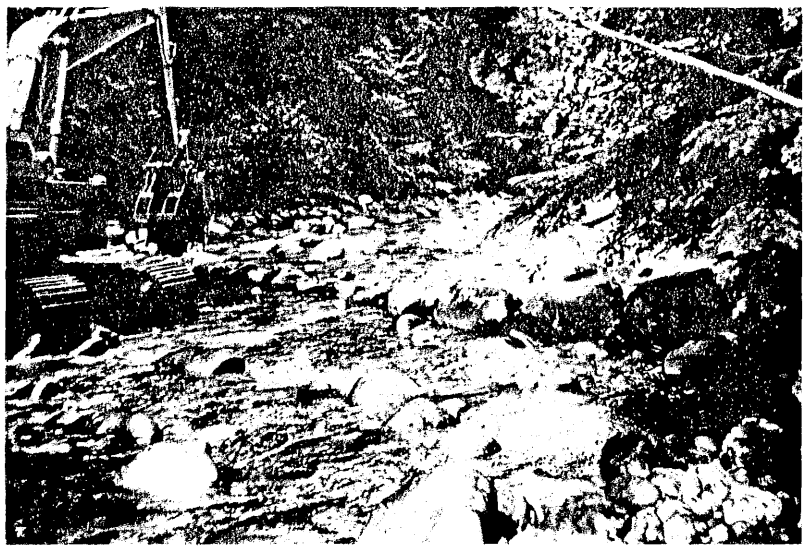
Developing a Brood Stock Stock of Native Snake River Coho Salmon (83-441)

This project hopes to boost coho salmon populations by developing a native coho brood stock. The Oregon Department of Fish and Wildlife plans to collect adult coho salmon at Ice Harbor Dam. The adults will be held at Wallowa Hatchery until they mature and spawn. Their eggs will be used to supplement natural production in the Grande Ronde system.

Juveniles will be reared to smolt size at Wallowa, coded-wire tagged, and released. When these tagged fish return as adults, they will be collected at Wallowa and Ice Harbor. Researchers will follow the process for two full cycles (6 years).

Yakima River Spring Chinook Enhancement Study (82-16)

Yakima River spring chinook salmon stocks have been reduced to extremely low levels as a result of several factors which include irrigation withdrawals of water, overharvest, and mortality associated with mainstem Columbia hydroelectric facilities. The Yakima Indian Nation has decided that the careful introduction of hatchery-reared fry into the natural environment is the method of choice in rebuilding stocks. Researchers will first determine the abundance and distribution of naturally-produced fry and smolts in the Yakima River. They will then evaluate different methods of fry and smolt supplementation into the natural rearing environment. After locating and defining areas in the watershed which may be used for the rearing of spring chinook, they will develop strategies for enhancing spring chinook in the Yakima River.



In Lake Branch Creek, Mt. Hood National Forest rearranged scattered boulders into berms.

US Forest Service

Gravels trapped by downstream berms invite spawning steelhead and salmon into new areas.

Wes Taft

Hood River Passage (83-341)

Dams are not the only barriers to fish trying to migrate upstream. Nature can block a route to a potential spawning area just as effectively.

ODFW engineers plan to build a fish passage structure at West Fork Hood River Falls. Such passage will provide fish access to more than 23 miles of spawning and rearing habitat, doubling the production potential of spring and fall chinook, and summer steelhead.

Engineers will also modify a cataract partially blocking Lake Branch Creek to provide long-term anadromous fish passage there. This project began in 1982 and will end in 1985.

As a preliminary step to constructing the passage structure, engineers have studied the geotechnical stability of the West Fork Falls site. In 1984 ODFW will award a contract for the final design of the structure, planning to complete construction of the passage facility in 1985. Concurrently, agency workers will remove the obstruction at Lake Branch Creek.

White River Falls Fish Passage (83-450)
White River Habitat Inventory (83-440a, 83-440b)

Like Hood River Falls, White River Falls acts as a natural barrier to fish migration. In these three contracts the U.S. Forest Service, Oregon Department of Fish and Wildlife, and Ott Water Engineers work closely in concert in order to move fish beyond the falls into new spawning and rearing areas. This project could greatly increase the natural production of anadromous fish in the Deschutes Basin.

Project leaders have divided work into two phases. First, they will study the cost and benefits of various passage methods at the falls. During the course of this study they will also look at the potential of the river's habitat to produce anadromous species, the effect that anadromous fish will have on the river's resident fish, and the chances for juvenile migrant survival. Researchers may also consider installing fish screens at the various irrigation diversion channels along the river.

Results of Phase I will determine the focus of the project's second phase—the introduction of anadromous fish. ODFW biologists will select species deemed best suited to the area. They will subsequently evaluate how well the fish adapt to their new environment. Ott Water Engineers will, at the same time, evaluate a number of fish passage schemes suitable for the falls. Ott Water will coordinate project work with the Bureau of Land Management, the Confederated Tribes of the Warm Springs Indians, Northern Wasco County PUD, and private landowners.

Similkameen River Salmon Habitat Inventory (83-477)

Did anadromous fish ever populate the Similkameen River basin? Would it be worthwhile to correct the passage problems at Enloe Dam and introduce anadromous species there now? These are some of the questions that this study, lead by the private consulting firm IEC Beak, addressed.

In the summer of 1983 IEC Beak assessed the aquatic habitat of 4 major tributaries and 59 stream reaches in the main stem of the Similkameen River. Biologists sampled resident fish at 77 stations, covering over 26 miles of stream. Streamflows were measured, and water samples analyzed for contaminants.

From this data biologists will develop production estimates for steelhead and rainbow trout, and chinook salmon. They have determined mean and extreme flows by updating historic streamflow data and will develop a regional streamflow analysis.

Biologists plan to devise a strategy for introducing anadromous fish species in the Similkameen basin as a result of this work. They theorize that fish passage installed at Enloe Dam would allow anadromous fish now spawning at the base of the dam to migrate past it. A final report on this project will be written in 1984.

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

In reply refer to: PJ

AUG 24 1984

To Interested Parties:

The Northwest Power Act assigned to the Bonneville Power Administration (BPA) important responsibilities for the protection, mitigation, and enhancement of fish and wildlife affected by hydroelectric facilities in the Columbia River Basin. The Act required the Northwest Power Planning Council to develop and adopt a comprehensive program to protect, mitigate, and enhance Columbia River Basin fish and wildlife. The Act also directed BPA and other Federal agencies responsible for managing, operating, and regulating Federal and non-Federal hydroelectric facilities in the Columbia Basin to take into account the Council's program to the fullest extent practicable. The Act gave to the region's fish and wildlife agencies and Indian tribes an important role in the program's formulation.

There is consensus that the basin's fish and wildlife resources cannot be restored to their original state prior to settlement. However, by systematic planning and the implementation of a coordinated array of measures to protect, mitigate, and enhance fish and wildlife resources supported by the deliberate and business-like expenditure of funds, significant rehabilitiation can be achieved.

FY 1983 was a watershed year in the realization of this purpose. Early in the fiscal year, the Council formally adopted the Columbia River Basin Fish and Wildlife Program. While earlier efforts, though substantial, had been largely fragmented and unfocused, the Council's program provides a comprehensive, systematic approach to protecting, mitigating, and enhancing the seriously depleted salmon and steelhead runs of the Columbia River Basin. It also began to address the impacts of hydroelectric development on resident fish and wildlife. BPA, which had begun direct funding of salmon and steelhead mitigation research and development in FY 1978, began funding fish and wildlife agencies and Indian tribes to undertake projects implementing specific measures contained in the Council's program. Funding levels were substantially increased.

The enclosed Fish and Wildlife Annual Project Summary for FY 1983 describes the 83 fish and wildlife projects BPA funded in FY 1983. Many projects were initiated before the Council adopted its Fish and Wildlife Program. Some were begun even before enactment of the Northwest Power Act. Although earlier projects shared the objectives of the Council's program, some were not specifically contemplated by program measures. As these projects are completed and new projects undertaken, the relationship between the Council's Fish and Wildlife Program and BPA's funding will become even closer and more apparent.

FY 1983 is also the first year for which BPA has issued a separate report on fish and wildlife projects. The report is designed especially to provide information to the many persons working to sustain and improve these resources. We hope the project summary, which BPA intends to publish annually, is useful to you. Immediately following the close of FY 1984 on September 30, 1984, we will begin preparing the report on projects funded in the current fiscal year. Your comments or suggestions on the format or level of detail in the enclosed report will be appreciated.

Also enclosed for your interest is a summary of expenditure levels by State and Federal fish and wildlife agencies and Indian tribes in the Pacific Northwest. The summary, which BPA recently assembled, spans fiscal years 1983, 1984, and 1985. It demonstrates the region's high level of commitment to preserving and managing its fish and wildlife resources.

Sincerely,

Janet McLennan

Janet McLennan
Assistant Power Manager for
Natural Resources and
Public Services

Enclosures

Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

In reply refer to: PJ

Dear Interested Parties:

The attached report "Environment and Power; Fish and Wildlife Annual Project Summary: 1983" provides information on fish and wildlife projects funded by the Bonneville Power Administration (BPA). The report depicts the problems addressed by FY 1983 projects. Detailed descriptions relate each project's objectives, work activities, research methods, and results achieved in FY 1983.

The Pacific Northwest Power Planning and Conservation Act of 1980 gave BPA major authority to reestablish fish and wildlife populations hurt by hydroelectric development and operation. The Act also directed the Northwest Power Planning Council to author a Fish and Wildlife Program. Last year, BPA completed the first full year of its fish and wildlife effort since the issuance of the Program.

In 1983, BPA spent $9 million on 83 fish and wildlife projects. Project activities included the monitoring of smolts making their downstream journey. This information was used to manage Columbia River spring flows and spills for fish passage. Other projects researched disease problems and reviewed hatchery practices in order to develop better methods of artificial propagation. Fish habitat improvement - and efforts to increase wild runs - figured largely in our 1983 budget. In all, BPA funded 29 such projects on tributaries throughout the Columbia Basin, making up for losses on the mainstem Columbia and Snake Rivers. BPA's efforts extended to the game fish in western Montana reservoirs and the wildlife downstream from those reservoirs. Several projects inventoried resource loss in areas throughout the Columbia River Basin. Inventories would be subsequently used to develop restoration program goals and identify future project needs.

In every case, projects sought to reestablish fish and wildlife populations using the best scientific knowledge available while giving the best value for ratepayer dollars. Through activities funded by the Division of Fish and Wildlife, BPA intends to mitigate the fish and wildlife damage attributable to the Federal Columbia River Power System dams. 1983 represents a major first step in that direction.

Sincerely,

John R. Palensky

John R. Palensky, Director
Division of Fish and Wildlife

8/9/84

STATE AND FEDERAL EMPLOYEE AND EXPENDITURE COMMITMENT TO FISH AND WILDLIFE IN THE PACIFIC NORTHWEST

SUMMARY
States and Indian Tribes

Fiscal Year	Employees (FTE) 1/	Total Budget	Fees and Other	State General Fund	Federal (Including BPA)
1983	2,717-3,243	117,713,600	58,033,336	20,643,926	39,036,338
1984	3,013-3,399	147,241,601	66,924,281	24,254,975	57,012,689
1985	2,945-3,346	148,095,313	65,813,735	25,274,975	57,006,603

Federal Agencies Other Than Bonneville Power Administration

Fiscal Year	Employees (FTE) 1/	Total Budget	Appropriation	BPA Contracts	Other
1983	824-834	89,349,770	79,573,300	3,992,670	5,783,800
1984	832-842	92,604,970	80,255,100	6,731,970	5,617,900
1985	813-823	102,438,900	86,845,000	9,879,000	5,714,900

Bonneville Power Administration 2/

Fiscal Year	Employees (FTE)	Total Budget	Appropriations	Revenues	Capital Borrowing
1983	19	10,200,000	0	10,200,000	0
1984	19	22,100,000	0	26,100,000	0
1985 3/	24	34,100,000	0	25,900,000	8,200,000

1/ Seasonal range.

2/ Most but not all of BPA's direct expenditures for fish and wildlife will be reflected in the budgets of the State and Federal fish and wildlife agencies and Indian Tribes. Additionally, BPA contracts with universities and some private consultants for fish and wildlife protection, mitigation and enhancement activities. BPA also reimburses the U.S. Treasury annually for the O&M costs sustained by the COE, USF&WS and BR from appropriated funds as well as for the $500 million capital investment in fish facilities at the dams in the FCRPS. For example, during FY 1984 it is estimated that BPA will pay between $11 – $12 million for operation and maintenance of fish and wildlife facilities at FCRPS projects operated by the COE, USF&WS and BR. BPA also participates in providing a "Water Budget" to help speed the downstream migration of juvenile anadromous fish in the spring at costs of $58,000,000 in lost revenues in an average water year when the system has a firm surplus, and arguably a significantly greater cost when replacement resources must be provided.

3/ Based on FY 1985 Energy and Water Development Appropriations Bill and associated Congressional committee reports.

JMcLennan:bp (WP-PJ-3447N)

STATE AND FEDERAL COMMITMENT (Continued)

Federal Agencies Other Than Bonneville Power Administration 9/

Fiscal Year 1983

Agency 10/	Employees (FTE)	Total Budget	Appropriations	BPA Contracts 12/	Other
BLM	79-89 11/	3,335,163	3,316,800	18,363	0
COE	Not Available	41,068,000	41,068,000	0	0
BR	Not Available	1,075,000	1,075,000	0	0
NMFS	279	15,939,007	13,058,900	2,656,707	223,400
USFS	252	8,669,219	6,770,000	639,219	1,260,000
USFWS	214	19,263,381	14,284,600	678,381	4,300,400
TOTAL	824-834	89,349,770	79,573,300	3,992,670	5,783,800

Fiscal Year 1984

Agency 10/	Employees (FTE)	Total Budget	Appropriations	BPA Contracts 12/	Other
BLM	77-87 11/	3,074,082	3,052,200	21,882	0
COE	Not Available	40,498,325	40,119,000	379,325	0
BR	Not Available	1,879,000	1,275,000	604,000	0
NMFS	287	14,669,648	11,695,600	2,697,648	276,400
USFS	249	10,553,070	7,665,000	1,285,070	1,603,000
USFWS	219	21,930,845	16,448,300	1,744,045	3,738,500
TOTAL	832-842	92,604,970	80,255,100	6,731,970	5,617,900

Fiscal Year 1985

Agency 10/	Employees (FTE)	Total Budget	Appropriations	BPA Contracts 12/	Other
BLM 13/	77-87 11/	3,202,200	3,052,200	150,000	0
COE	Not Available	44,457,000	44,457,000	0	0
BR	Not Available	8,358,000	4,258,000	4,100,000	0
NMFS	270	12,921,900	10,706,500	1,939,000	276,400
USFS	247	12,063,000	7,923,000	2,440,000	1,700,000
USFWS 13/	219	21,436,800	16,448,300	1,250,000	3,738,500
TOTAL	813-823	102,438,900	86,845,000	9,879,000	5,714,900

9/ Total budget figures for tribes on page 2 include Bureau of Indian Affairs funds ($5,405,700 in FY 1983, $9,744,600 in FY 1984, and $10,325,600 in FY 1985).

10/ See agency key on page 4.

11/ Seasonal range.

12/ Includes only amounts for signed contracts; does not include reimbursement to U.S. Treasury for construction or operation and maintenance of fish and wildlife mitigation facilities.

13/ Estimate; assumes same levels as FY 1984 except for BPA contracts.

JMcLennan:bp (WP-PJ-3447N)

STATE AND FEDERAL COMMITMENT (Continued)

RELATED STATISTICS
(1983)

	Population	Licensed Resident Fisherman	Number Nonresident Fisherman	Number Licensed Resident Hunters	Number Nonresident Hunters
Idaho	979,000	292,629	153,464	227,473	21,855
Oregon	2,635,000	494,321	212,942	364,700	10,336
Washington	4,285,100	565,995	37,249	309,086	2,184
Western Montana	127,376	224,410	131,722	213,298	23,189
12 Tribes & Indian Nations under the Regional Act	112,000	0	0	0	0
TOTAL	8,138,476	1,577,355	535,377	1,114,557	57,564

Agency Key:

IDF&G	Idaho Department of Fish and Game
ODF&W	Oregon Department of Fish and Wildlife
WDF	Washington Department of Fisheries
WDG	Washington Department of Game
MDFW&P	Montana Department of Fish, Wildlife, and Parks
BLM	U.S. Bureau of Land Management
COE	U.S. Army Corps of Engineers
BR	U.S. Bureau of Reclamation
NMFS	National Marine Fisheries Service
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

JMcLennan:bp (WP-PJ-3447N)

Artificial Propagation and Fish Health

Artificial propagation serves a key role in the anadromous fish restoration program. Even if other program measures achieve extraordinary success in restoring natural runs, hatchery releases would still be vitally important in sustaining salmon and steelhead runs.

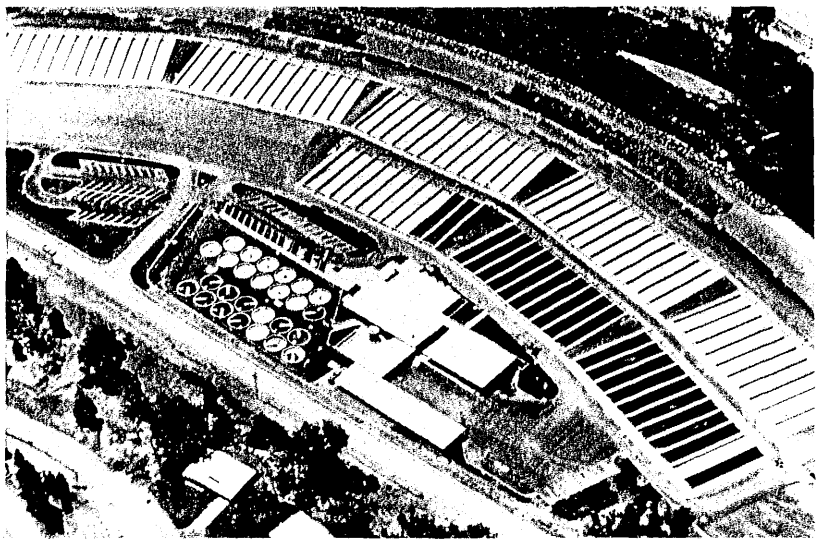
Large numbers of fish have been successfully produced at Columbia River Basin hatcheries. Yet many serious problems still confront artificial propagation experts. Using BPA funds, researchers are seeking answers which will benefit all hatcheries on subjects such as nutrition, fish diseases, stress, smolt hardiness, and timing of smolt releases. Biologists seek to better integrate hatchery releases with wild runs. Too many hatchery fish in a stream can be harmful because they compete with wild fish for limited food supply and habitat.

In 1983, BPA undertook or continued a series of projects dealing with these hatchery issues.

An Evaluation of the Contribution of Chinook Salmon Reared at Columbia River Hatcheries to the Pacific Salmon Fisheries (79-2)

This analysis will reveal how well hatcheries are mitigating the effects of the dams on salmon runs in the Columbia River. Investigators from the National Marine Fisheries Service (NMFS), contractor for this study, focus on fall chinook salmon raised at Columbia River hatcheries. They examine the distribution of these fish by sampling salmon harvested on the Pacific Coast. Subsequently they determine the contribution, and the value, of each hatchery's production of fish to the overall Pacific Salmon Fisheries. Regulatory bodies such as the Pacific Fish Management Council (PFMC) will use study results in conjunction with other information in negotiating, setting, and adjusting fishing seasons, locations, and limits.

NMFS began this nine-year study in 1979. So far investigators have coded-wire tagged and released 13.6 million fall chinook from 20 Columbia River hatcheries over 4 brood years (1978-1981). They have maintained records on tagged fish from three broods (1978-1980) recovered from Pacific Coast salmon fisheries from Alaska to California for three-catch years (1980-1982). They have maintained the same records on tagged and untagged fish returning to Columbia River hatcheries and tributary streams over the same three-year period.



Hatcheries play an important role in sustaining migratory fish runs.
(BPA file photo)

Better egg-collecting techniques prevent the spread of deadly viral and bacterial diseases.
Wes Taft

During 1984 researchers will begin analyzing additional catch and return data for tagged fall chinook.

If research can produce hardier smolts, we can expect more to return as adults.
Wes Taft

Bioenergetics of Juvenile Salmon During the Spring Outmigration (82-11)

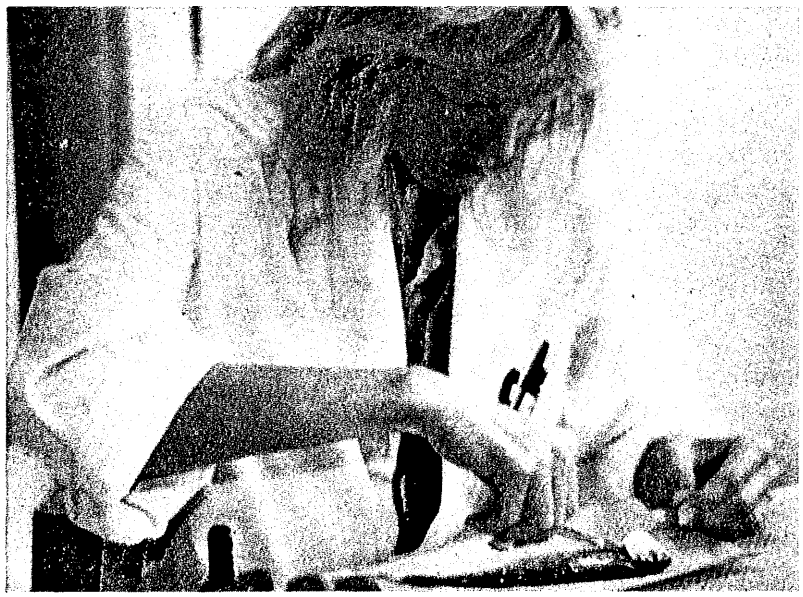
Dams and their impoundments have greatly stressed downstream migrants.

A study by the U.S. Fish and Wildlife Service explores the theory that smolts now need to expend greater energy in migrating downriver. The subsequent physical drain on the fish

results in a lower survival rate. Researchers in this study evaluate the effects that different water temperatures, river flow levels, and types of available food have on the fitness of migrating smolts.

Researchers began this project in 1982, and will submit their final results in 1985. Through lab experiments and subsequent analyses, researchers have ascertained the energy reserves of the smolts both as they start and conclude their trip downstream, and how that level of energy relates to their overall fitness. Researchers have also determined how water temperature affects smolt fitness and how the type of food consumed by smolts during their migration affects their energy level.

In 1984 and 1985 USFWS will conduct more field and lab experiments. They will develop a bioenergetics model for juvenile salmon to simulate smolt energy levels under different river flow and temperature conditions. Such information could be used in planning Water Budget flows.



USFWS Biologist examines fish tissues for presence of IHN virus.

Sharon Blair

Rapid Diagnosis of IHN Virus Infection in Salmon and Steelhead Trout (82-20)

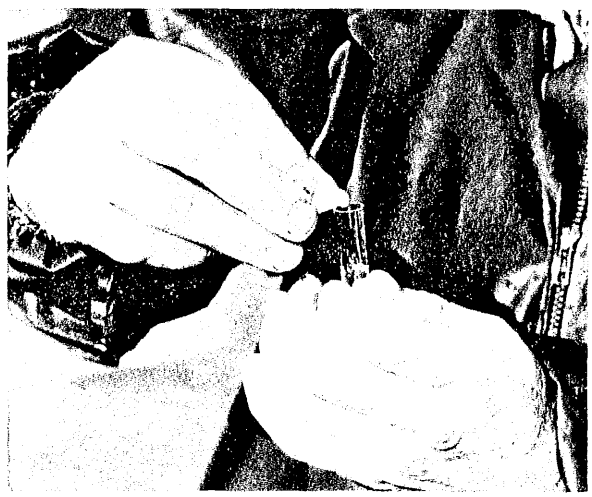
Since 1980 Infectious Hematopoietic Necrosis (IHN) virus infection has destroyed over 14 million juvenile fish in the Columbia River Basin. All salmon, as well as cutthroat, rainbow, and steelhead trout are susceptible to this disease. Transmission apparently occurs in two ways: (1) vertically from parent to progeny at fertilization; and (2) horizontally through the water from infected to uninfected fish. In theory IHN virus can be transmitted by the eggs. Noting this and the fact that fish can carry IHN without showing symptoms, scientists theorize that indiscriminate movement of fish or eggs can introduce the disease to environments where previously it did not exist. An epidemic of the virus in a hatchery can destroy the fish production at that hatchery during any given year.

In this 2-year study, Oregon State University (OSU) researchers will devise laboratory methods for culturing the virus from affected fish populations. Their primary goal is to reduce the time it takes to identify a strain or type of virus. Tests now take 25 to 40 days. OSU hopes to reduce that to 5 days or less.

By typing the IHN virus strains, biologists can eventually determine origins of diseased stocks and segregate infected fish to prevent spread of the disease. This research has revealed, to date, 27 characteristic strains within the Pacific Northwest.

Project work began in 1982. Researcher have now gone beyond characterizing the different strains of IHN virus to begin segregating the strains by fish species, geographic area, age of fish, and date of isolation. They have used two different assays, radiolabel and radioimmune in their attempts to develop a more rapid method of diagnosing IHN virus infection.

In 1984 the researchers will test an artificial subunit vaccine made by replicating small portions of IHN virus genetic material in beneficial bacteria. As a final step, project leaders will draw up recommendations for best use of study results.



Hatchery workers collect tissue and fluid samples from adult fish at Cowlitz (WA) fish hatchery in order to test for IHN virus.

Wes Taft

Development of Rapid Seriodiagnostic Tests for the Detection, Surveillance and Diagnosis of Five Important Pathogens of Fishes in the Columbia River Basin (83-304)

Control of IHN by Broodstock Culling and Antiviral Drugs to Control IHN Virus in Sockeye and Chinook Salmon and Steelhead Trout (82-21)

Through two related projects, the U.S. Fish and Wildlife Service seeks to improve detection, and control five major fish diseases, diseases that can ravage whole hatchery populations.

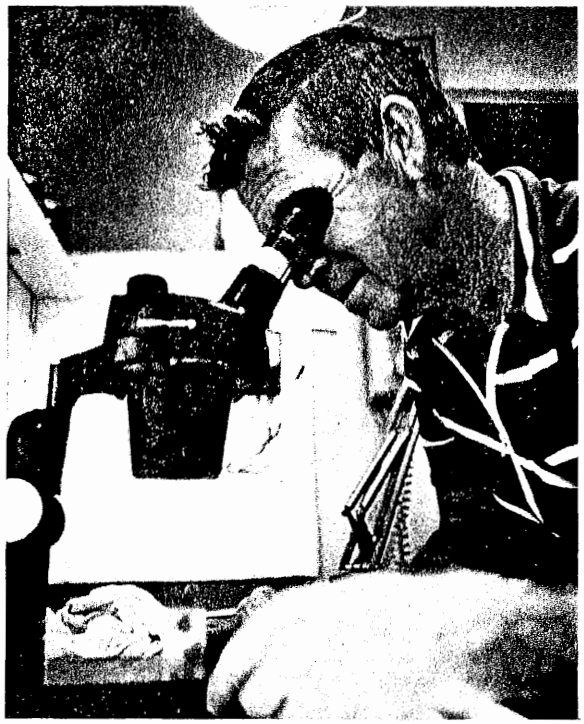
In one three-year study (83-304), researchers will develop then evaluate rapid diagnostic tests for Bacterial Kidney Disease (BKD), Furunculosis, Enteric Redmouth Disease (ERM), Infectious Hemotopoietic Necrosis (IHN), and Infectious Pancreatic Necrosis (IPN). These tests will be designed for use at hatcheries throughout the Columbia River Basin.

In the second study (82-21), biologists at the U.S. Fish and Wildlife Service's (USFWS) National Fishery Research Center (NFRC) have developed hatchery practices to control IHN virus in sockeye, chinook salmon, and steelhead trout. This new technique is called brood stock culling. It combines a method for handling spawning fish with advances in testing for viruses. Additionally USFWS has explored antiviral drugs.

Two years of brood stock culling at Cowlitz Steelhead Hatchery reduced mortality from 60 percent to zero. In 1984 researchers plan to repeat brood stock culling at this hatchery, as well as at Leavenworth National and Skamania Fish Hatcheries. They will continue to investigate how this virus is transmitted, sharing discoveries with OSU's IHN studies (82-20 and 83-312). This 3-year project began in 1982 and will end in 1985. During 1984, they will begin laboratory testing of antiviral drugs meant to block water-borne transmission of IHN.

Epidemiology and Control of Infectious Diseases of Salmonids in the Columbia River Basin (83-312)

In this 5-year project, begun in 1983, OSU biologists will examine several viral, protozoan, and bacterial fish pathogens. They aim to devise better means for pathogen control.



Scientists examine fish at several critical life stages.
COE

University researchers will establish several control measures, including methods to both prevent the introduction and spreading of disease, and produce more disease resistant fish stocks. They will also develop guidelines to aid hatchery managers in limiting the severity of the outbreaks when they occur. As part of the project, researchers will conduct field studies to determine the virulence of disease agents, followed by lab tests to discover more about host-parasite relationships, and experiments to improve fish disease diagnostic methods.

A biologist clips a salmon's adipose fin, one way to separate hatchery from naturally-produced fish.
Wes Taft

So far researchers have determined that the geographic range of the parasite *Ceratomyxa shasta* has expanded in the Columbia Basin. They began to study the effect of *C. shasta* on migrating smolts. This disease is particularly important because it occurs naturally in the river only when temperatures exceed 50°. It infects all salmon. Between 10-15 percent of all smolts may die from *C. shasta* each year. OSU will further study the susceptibility of certain types of trout and salmon to this disease.

In 1983 about 700 juvenile salmonids were captured off the coast of Oregon and Washington and examined for kidney disease caused by *Renibacterium salmoninarum.* Active infections were found, an indication that infection not only occurs in hatcheries, but causes additional mortality at sea. Biologists also began working on the production of a vaccine for kidney disease.

Biologists began to study methods of controlling IHN virus in hatchery water supplies. Dworshak and Round Butte hatcheries have suffered severe losses to IHN. Biologists have installed ultraviolet light units to irradiate water at hatchery intakes. Tests will show the effectiveness of ultraviolet light in eradicating waterborne virus.

In 1984 researchers will compare the degree of success of IHN control both by hatchery water treatment and by use of virus-free females as egg sources. They will continue their assessment of the impacts of *C. shasta* and *R. salmoninarum* on fish survival in both fresh and marine environments.

Rearing and Imprinting of Fall Chinook to Sites on John Day Reservoir (83-313)

Is it possible or economical to rear fall chinook in pens and enclosures in natural backwaters rather than in hatcheries? USFWS seeks to answer this question. Results of this study will be applied to fish rearing in acceptable backwater areas anywhere along the Columbia River.

Fishery biologists have surveyed and evaluated several backwater areas from John Day Dam to Priest Rapids Dam looking for potential rearing sites. They have selected two areas as primary study sites: Rock Creek and Social Security Pond. Rearing of fall chinook in pens and enclosures will begin in 1984.

Development of Diets for Enhanced Survival of Salmon (83-363)

What a young salmon eats during its first months as a fry is crucial to its survival during the long journey to the sea. The Oregon State University Seafoods Laboratory intends to develop a better diet, hence improving survival of hatchery fish released into the Columbia River system.

The OSU Seafoods Lab works cooperatively with the ODFW in this 7-year project. They plan to determine the relationship between a high-quality animal protein diet and salmon survival.

The Seafoods Lab uses special procedures to avoid heat damage. The lab will produce fish meal dried under both low-temperature and reduced pressure conditions. The new food will also have a lower ash content than most hatchery meal. Through cooperation with a commercial firm, OSU Seafoods Lab will manufacture a supply of vaccuum-dried fish meal and spray dried liquified fish.

ODFW will evaluate the effect of the new meal on the survival and return of coho and chinook salmon. They will insert coded-wire tags into fish and study 3 replicate year releases of coho and chinook salmon.

This project began in 1983. OSU Seafoods Lab has developed an experimental fish meal, and established food production facilities. In the same year they began laboratory feeding trials to test the relative nutritional characteristics of vacuum-dried meals. Coho were coded wire tagged for the first release year.

In 1984, biologists will design and conduct the same laboratory feeding trials for chinook fingerlings. Biologists will also complete laboratory and hatchery evaluations of a new starter ration for young fry.

Evaluation of Low-Cost Salmon Production Facilities (83-364)

Before the Clatsop Economic Development Committee's (CEDC) Young's Bay salmon enhancement project began, fishermen caught fewer than 100 fall chinook salmon in Young's Bay. Since 1977 the catch has increased to more than 1500 a year, averaging 5500 for the last 3 years. Project leaders attribute this increase, in part, to the Young's Bay project efforts.

BPA's study focuses on the low-cost salmon production facility at Young's Bay. In particular biologists will critique operations at the three hatchery ponds to determine their effectiveness in salmon production. They will use a coded wire tagging program to evaluate the effectiveness of the project.

CEDC researchers seek to produce large numbers of salmon while maintaining genetic variability. They will determine the best density level for juvenile fish reared in a hatchery and will compare the quality of fish produced in a natural pond environment against those reared in concrete hatchery troughs and ponds.

Biologists will also assess the feasibility of constructing other low-cost salmon production facilities in the Columbia Basin, exploring the potential of community involvement in such projects.

During 1983, approximately 2.5 million fall chinook and 250,000 coho were reared and released, of this 106,000 fall chinook and 25,000 coho were coded-wire tagged. CEDC built fall chinook and coho recapture facilities and completed fall chinook stream surveys.

Low Technology Fisheries Facilities for the Enhancement of Anadromous Salmonid Stocks on the Nez Perce Reservation (83-350)

The Nez Perce tribe seeks to reestablish its anadromous fishery through construction of ponds for spawning and rearing spring Chinook and steelhead. Tribal biologists will evaluate potential artificial propagation sites on reservation lands then design, construct and operate a low capital, low technology facility. Study plans will be coordinated with the Lower Snake River Compensation Plan, Idaho Department of Fish and Game, and the Columbia River Inter-Tribal Fish Commission.

Low Cost Salmon and Steelhead Production Systems for the Columbia Basin (83-353)

A private contractor, Fish Management Consultants, will develop a compendium of existing low cost capital facilities available in the Columbia Basin. Systems will be identified and listed with input from tribes and fish and wildlife agencies. Site reviews will be conducted. Facility descriptions will include illustrations and photographs, estimated costs, and available vendors, and will divulge all available economic and biological evaluations of these systems. The compendium will aid fishery managers in choosing appropriate production systems.

Estimation of Artificial Production Potential in the Columbia River Basin (83-424)

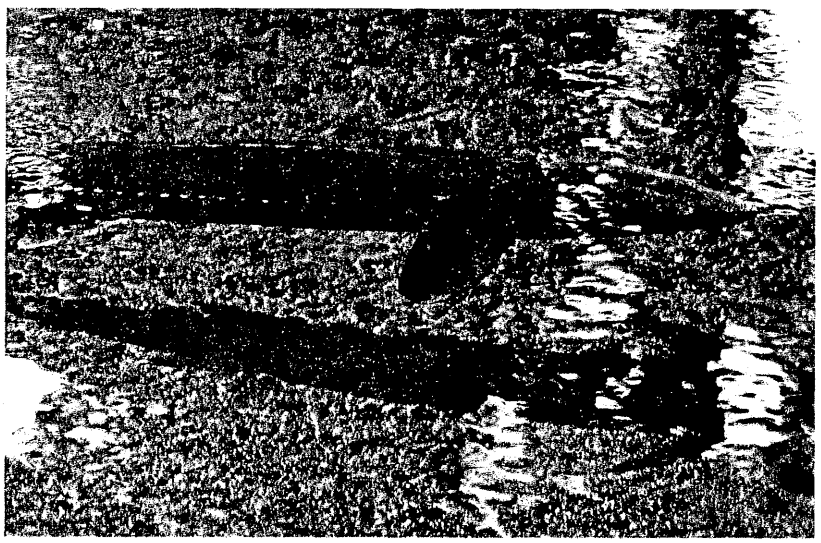
Investigators from Kramer, Chin & Mayo, Inc., collected, compiled, and analyzed data on present and potential anadromous fish hatcheries in the Columbia River Basin. Their aim was to provide the information necessary to choose the best options for restoring and enhancing levels of anadromous steelhead and salmon through artificial propagation. The data they collected will provide a base for future planning studies. This 1-year project began in 1983.

Stock Identification of Columbia River Chinook Salmon and Steelhead Trout (83-451)

OSU project leaders seek to identify unique stocks of Columbia River chinook salmon and steelhead trout in Oregon and Washington.

Researchers will characterize each wild and hatchery stock using gene frequency based on electrophoresis, life history characters such as disease resistance, and morphology such as taxonomic measurements. Biologists will compare these characteristics to denote relationships and correlate characteristics with home stream environmental conditions. Research results will be used as a basis for selection of donor stocks for hatchery programs and wild population rehabilitation.

The research team will collect field samples and complete electrophoretic and taxonomic analysis of fish stocks in 1984.



The White Sturgeon (Acipenser transmontanus)
COE

Resident Fish

Resident fish are the freshwater fish that develop, mature and reproduce within the rivers, streams, and lakes of the Columbia River Basin. Unlike anadromous fish, they do not travel to the ocean. At least 20 species of game fish reside in the basin, including kokanee, Dolly Varden (bull trout), and westslop cutthroat trout. One species, white sturgeon, biologically an anadromous fish, is now confined to certain stretches of the Snake and Columbia Rivers. Dams block their migration. Resident fish are particularly important in areas such as Montana, where anadromous fish runs no longer exist.

A proud fisherman displays his catch-a 10 foot, 500lb sturgeon, circa 1900.

Ivan Donoldson

Hydroelectric dams and their operations have greatly affected resident fish spawning, incubation, emergence, and rearing activities both in reservoirs and throughout the river system. The discharge of reservoir water also disturbs production of the aquatic organisms which serve as a major food source for game fish.

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Columbia River White Sturgeon Study (83-316)

Study of the white sturgeon's *(Acipenser transmontanus)* early life history, feeding behavior of sturgeon fry and population genetics would help in understanding the alterations in their habitat to which they are most susceptible. University of Washington researchers will examine the genetic character of sturgeon populations through electrophoretic tissue analysis as well as making comprehensive studies of young sturgeon behavior. The results will guide further development in sturgeon enhancement methods.

Effects of Operation of Kerr and Hungry Horse Dam on Reproductive Success of Kokanee in the Flathead System (815-5)

This Montana Department of Fish, Wildlife, and Parks (MDFWP) study will determine what flows from Hungry Horse and Kerr Dams are necessary to optimize spawning, incubation, and rearing conditions for kokanee in the Upper Flathead River and the south bay of Flathead Lake in western Montana. MDFWP's recommendations will take into consideration power production needs. Researchers will monitor the timing and distribution of upper Flathead River kokanee runs and determine how controlled flows from Hungry Horse dam affect kokanee reproduction and survival. Similarly, researchers will examine the affect of Kerr Dam discharges on kokanee spawning and incubation in Flathead Lake.

This project began in 1981 and will end in 1988.

Lower Flathead Fisheries Study (83-1)

Fisheries biologists working for the Salish-Kootenai Tribes will assess the effect of hydroelectric development on tribal fisheries in the Lower Flathead River below Kerr Dam.

Tribal researchers will study the existing aquatic habitat in the Lower Flathead River and its tributaries. They will assess its relation-

ship to the present population size, distribution, and maintenance for all trout species (including whitefish), northern pike, and largemouth bass.

They will study how hydroelectric development and operation affects the aquatic habitat of the river, and the life cycles of the trout, pike, and largemouth bass living in the river. The possibility of increasing quality aquatic habitat, which would result in increased game fish production, will be considered.

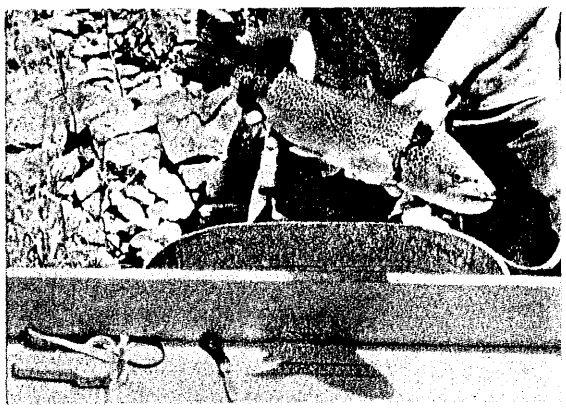
Researchers will develop several options to offset the effect of the dams. They will also study the potential effect of future hydroelectric development on certain species of fish in the south fork of the Flathead River.

This study began in 1983. Tribal biologists have established permanent sampling stations and made some preliminary observations. In 1984 researchers will construct weirs to trap adults on the Jocko River and Mission Creek, and begin intensive stock assessments on the main river and tributaries.

Managing Water Releases For Painted Rock Reservoir (83-463)

The Montana Department of Fish, Wildlife, and Parks began evaluating the management of water releases at Painted Rocks Reservoir in Western Montana. Fishery biologists schedule reservoir water releases to aid the localized movements of fish spawning on the Bitterroot River, tributary to the Clark's Fork of the Columbia.

The Montana agency will monitor many aspects of reservoir operations, including the water temperature, stream discharge, and water quality of the Bitterroot River. They will



Tribal worker weighs and measures brown trout.

Photo Ron Smith

Restoration efforts will benefit fisheries throughout the Pacific Northwest.

Jay Dugoni

study the habitat available to trout and kokanee, measuring the physical characteristics of redd sites. Biologists will monitor brown and rainbow trout spawning activities to develop trout population estimates and needs. Department biologists will author a final water management plan in 1985.

Quantification of Hungry Horse Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-465)

Quantification of Libby Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-467)

These Montana Department of Fish and Wildlife studies focus on kokanee and other game fish in Libby and Hungry Horse Reservoir. Investigators will study the effects of "drawdowns"—water releases for power generation, flood control, or other water management activity—on fish in the reservoirs.

Biologists will evaluate changes primarily for their effect on food organism production,

Tribal biologists study the resident fish of the South Fork of the Flathead River.

Ron Smith

growth, and abundance; and secondly, with regard to distribution of game fish, and location of spawning habitat. Researchers will assess the effects of reservoir drawdown on food organism production by dividing the reservoir into zones. They will quantify the distribution of fish and their use of these zones, as well as timing the alterations of each zone's physical parameters in relation to important life stages of the fish. Biologists will develop a model based on this data. The study began in April 1983, and will end in 1987.

Department biologists will examine a range of fluctuations from minimum pool to peak capacity and subsequently predict the effects of hydro operations on resident fisheries. They will also use this data to recommend the seasonal drawdown levels that best suit the needs of the fish.

Cumulative Impact Study of Microhydro Sites, Swan River (82-19)

Fish and wildlife resources, especially those stressed by past hydroelectric development, need protection from the possible effects of future development. According to the records of the Federal Energy Regulatory Commission (FERC), most new hydroelectric projects will be built by private or non-Federal public entities. FERC has at least 400 applications for hydroelectric projects pending in Oregon, Washington, Idaho, and Montana. In addition, the FERC has at least 400 outstanding preliminary permits—indicating ongoing project feasibility studies—pending in those four states. Many of those applications propose projects in tributary drainage basins containing important anadromous fish habitat.

Several applications propose small hydroelectric facilities producing less than 5 megawatts of power. An individual project may not have much of an effect on fish and wildlife; however, the cumulative effect of many small projects throughout a river basin could be significant.

In the past, Federal review was limited to individual projects, with little or no consideration given to their combined impact. A BPA-funded contract with the Montana Department of Fish, Wildlife, and Parks and the U.S. Forest Service (Flathead National Forest) will provide the first look at cumulative effects.

This study, which began in July of 1982, will examine the combined effects of the small or "micro" hydro sites on the fish and wildlife resources of the Swan River in Montana. The researchers will determine the environmental impacts of 22 proposed small hydro projects in the Swan River drainage, projects which may have cumulative effects on the resident fish there, including adfluvial migratory species. Adfluvial species, like the bull trout or Dolly Varden, migrate from lakes to streams to spawn.

Researchers have completed a comprehensive history of development activities, such as logging and road building, at each site. They also developed a preliminary sediment model, based on various types of soil and soil structure. They computerized the model for use in future development activity assessments.

Field work on this project ended in November of 1983. Researchers will complete a final data analysis and a report by September of 1984.

Wildlife

The development of hydroelectric power in the Columbia River system has had adverse effects not only on fish but on wildlife as well. Creating and filling the reservoirs has inundated important habitats. Water level fluctuations from dam operations have in some cases led to barren and altered vegetation zones, exposed wildlife to increased predation, destroyed essential wildlife habitat, and altered species composition.

Wildlife have also suffered as a result of other activities related to hydroelectric development. The construction of roads, draining and filling of wetlands, stream channelization, shoreline riprapping, and housing development have caused changes in both the streams and the land adjacent to them. These impacts are felt both locally and systemwide.

Evaluation of the Effects on Wildlife and Wildlife Habitat Associated with Development of Hydroelectric Projects in Montana (83-464)

Status Report on Wildlife Mitigation at Columbia Basin Hydroelectric Projects (83-478)

Impact of Water Levels on Canadian Geese (83-2)

BPA is funding three projects in an effort to begin to address some of these wildlife concerns.

The Montana Department of Fish, Wildlife, and Parks is evaluating the probable effects that the development of Hungry Horse, Libby, and three Clark Fork dams have had on wildlife and wildlife habitat (83-464). Researchers have prepared habitat, land use, and ownership maps which they included in a draft report outlining wildlife loss estimates and impacts. In 1984, MDFWP will produce and implement a final mitigation plan. Measures in the plan will be coordinated with several agencies, including the U.S. Forest Service, the Northwest Power Planning Council, and BPA.

The U.S. Fish and Wildlife Service and state wildlife management agencies will document and review all information on wildlife mitigation at the Columbia River Basin hydroelectric facilities in Oregon, Washington, and Idaho (83-464). The review will identify and summarize existing agreements as they pertain to wildlife mitigation history, effects of hydroelectric development and operation on wildlife, and past, current, and proposed wildlife mitigation, enhancement, and protection activities. The review will summarize the wildlife mitigation required at Federal projects in those states. Agency representatives will complete the study in 1984.

Biologists working for the Salish-Kootenai tribes are studying Canada geese in the Flathead Valley of western Montana (83-2). Water level fluctuations influenced by hydroelectric dams may greatly affect existing riparian areas. Biologists placed solar-powered radiotracking collars on adult birds' necks just prior to or during nesting. Solar-charged transmitters have an expected life of 2 to 3 years as opposed to battery-powered transmitters which typically last seven months.

Biologists use radiotelemetry equipment, both during on-ground searches and while flying over an area, to pick up signals sent by the collars. Signals help biologists track subtle movements of the geese in and around thick streamside vegetation while the geese brood their goslings. Biologists will determine which riparian vegetation is most important for goose nesting and brood rearing. Maintaining the integrity of protective vegetation in these shoreline areas is essential to gosling survival.

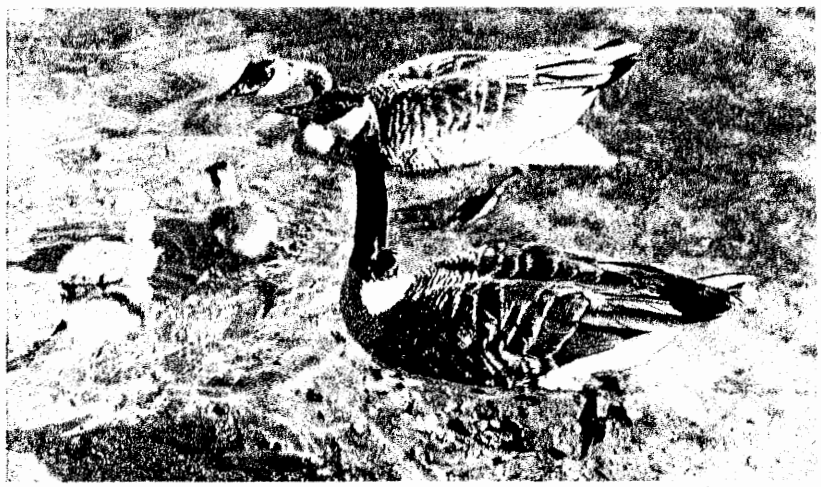
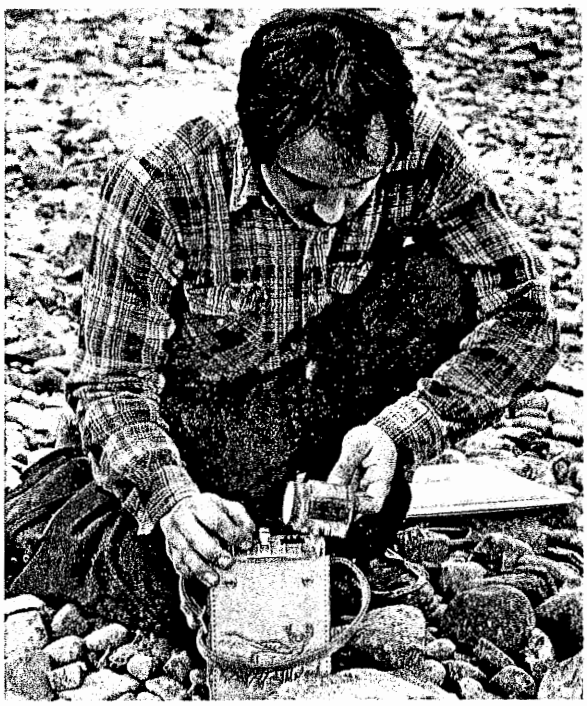


Photo USFWS



A wildlife biologist checks the frequency of the radio transmitter before putting it on a goose.

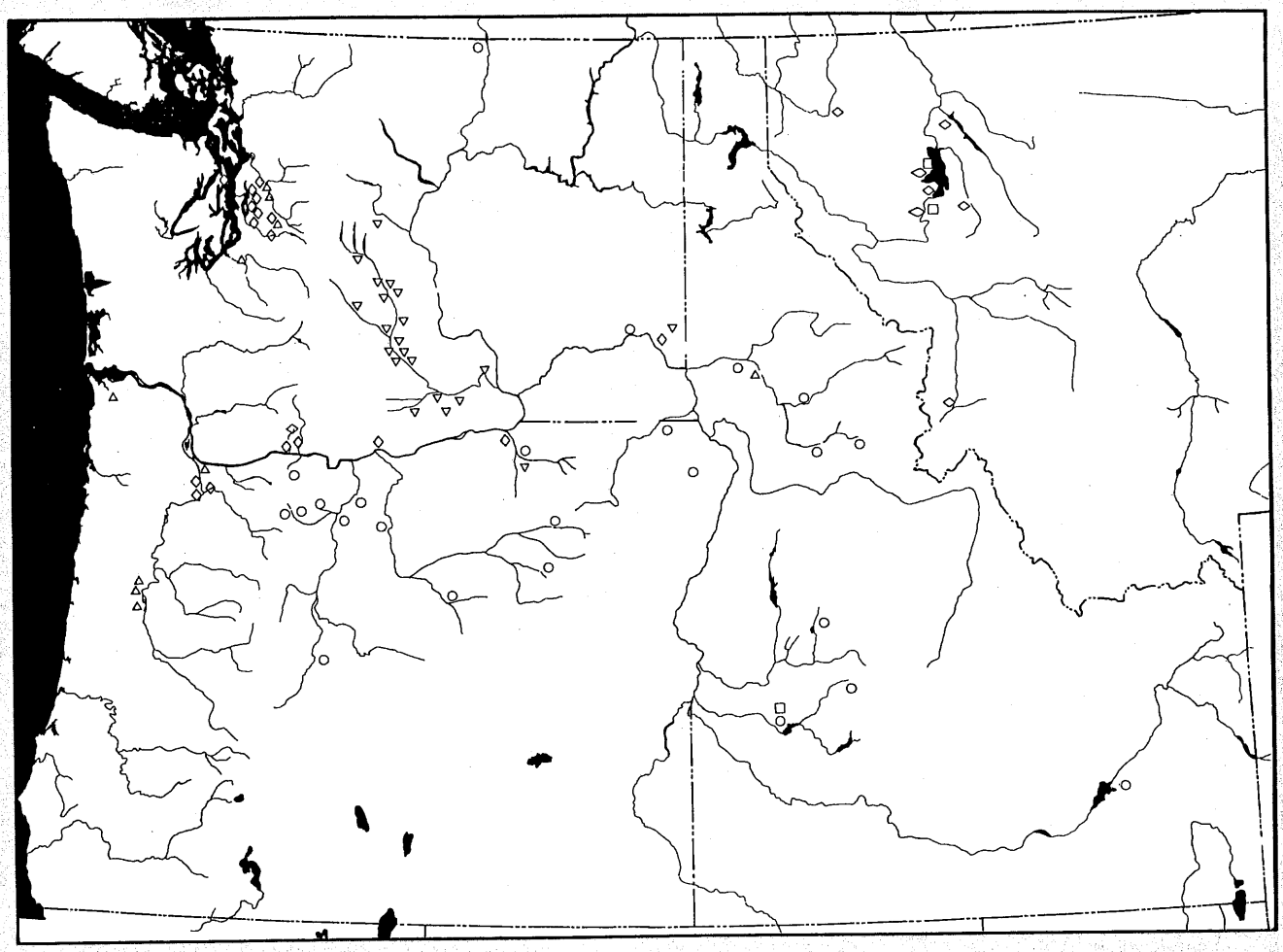
Bob Reed

The radio collar contains two solar panels that charge the transmitters. This allows biologists to track the geese for two or more years.

Bob Reed

Fish and Wildlife Projects

(FY 1983)



▽ Adult Passage and Yakima Projects

◇ Resident Projects

□ Wildlife Projects

○ Habitat Projects

△ Hatchery Projects

◊ Downstream Migration Projects

Summary

BPA's Division of Fish and Wildlife was created in 1982 to develop, coordinate and manage BPA's fish and wildlife program. Division activities protect, mitigate, and enhance fish and wildlife resources impacted by hydroelectric development and operation in the Columbia River Basin.

At present the Division spends 95% of its budget on restoration projects. In 1983, 83 projects addressed all aspects of the anadromous fish life cycle, non-migratory fish problems and the status of wildlife living near reservoirs.

Projects take place in the Pacific Northwest states of Washington, Oregon, Idaho, and western Montana. Research or enhancement efforts in one state often benefit fish and wildlife resources throughout the region.

Division staff members review and analyze proposed BPA policies and programs to ensure equitable treatment for fish and wildlife. While evaluating existing hydroelectric operations for fish and wildlife impacts, they develop methods to protect critical habitat from future hydroelectric development.

BPA's fish and wildlife expenditures are funded through revenues from power sales, as part of marketing power generated by the Federal Columbia River Power System. BPA has the authority to borrow Treasury funds to finance major capital construction — facilities with a life expectancy of more than 15 years and costing more than $1 million to build. However, Division activities are not supported by taxes or Congressional appropriations.

For further information and copies of specific project reports, contact:

BPA Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208
Phone: 503-230-4981

Bonneville-funded studies will look at hydroelectric impacts on bighorn sheep and other big game species.

USFWS

A wildlife biologist for Western Montana's Salish Kootenai tribe, releases a group of radio-collared geese after two hours of banding, weighing and collaring.

Bob Reed