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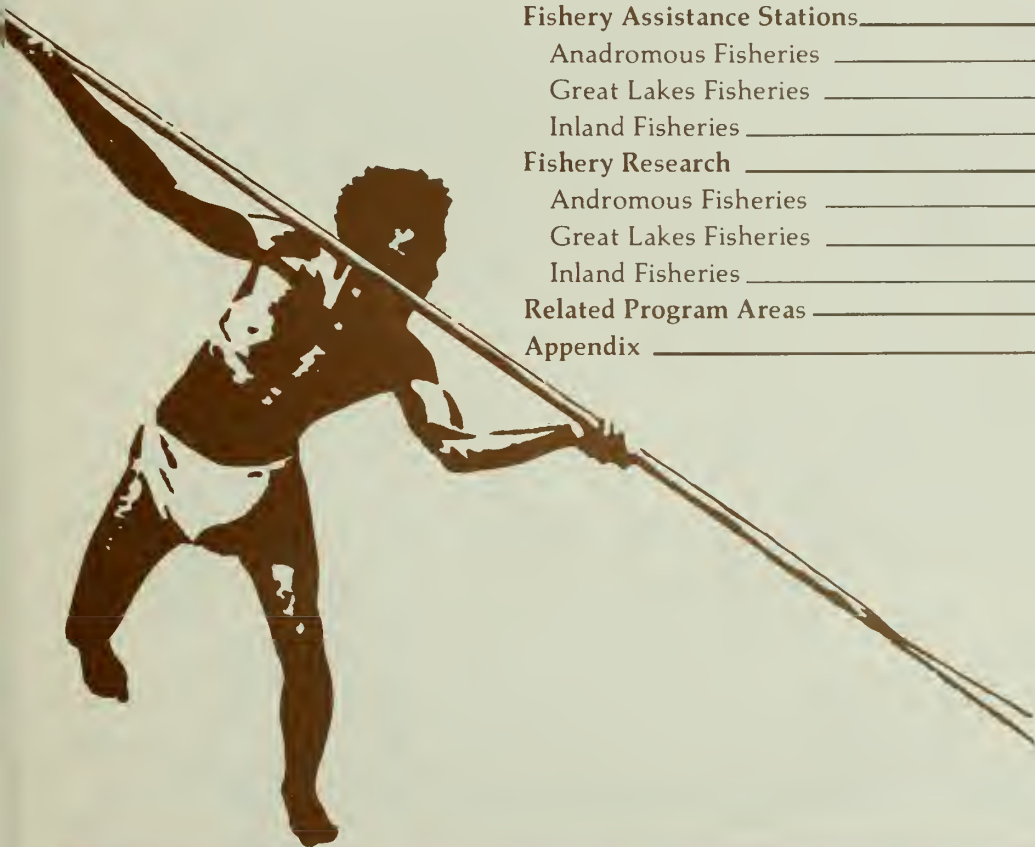
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INTRODUCTION

F is for fishing in this 19th century spelling book illustration.



The Fish and Wildlife Service of the U.S. Department of the Interior is the Nation's principal fishery conservation agency. The Service is charged by law with the responsibility for assisting in the protection and preservation of fish and wildlife on Federal, interstate, Indian and other public lands. Fostering the prudent care and use of America's fish and wildlife resources is the Service's basic function. Enlightened management and conservation of these vital resources are crucial for the benefit and enjoyment of not only Americans today but of generations to come. The Fishery Resources Program, a part of the Fish and Wildlife Service, working in collaboration with other Federal agencies and State fish and game authorities, has as its prime goal the maintenance, the improvement and, where necessary, the restoration of the Nation's recreational, commercial and fishery resources for the common good.

* * *

To achieve this purpose the Fishery Resources Program carries out projects for:

- 1) establishing, maintaining, enhancing and restoring fishery resources;
- 2) assisting the States, other Federal agencies, military organizations and Indian tribes in the development and management of fishery resources;
- 3) controlling diseases and parasites that invade and endanger fishery resources;

- 4) assuring attention to preserving fishery resources in all Federal water projects;

- 5) keeping the general public informed and responding to its needs; and

- 6) engendering a high level of expertise and competence among the personnel of the Service.

Activities of the Fishery Resources Program

The Fishery Resources Program comprises a combination of seven different activities: production of fish at hatcheries, fishery assistance to other agencies, fishery training, fishery research, grants-in-aid, law enforcement and construction of facilities. Briefly, these activities are as follows:

Fish Hatcheries

In 1872, Mr. Livingston Stone established "the hatchery-works of the first salmon-breeding station of the United States" on the McCloud River in California. This was not only the "first salmon-breeding" unit in the United States, but also the first hatchery to be established with Federal funds and, therefore, the beginning of the National Fish Hatchery System.

The National Fish Hatchery System currently (FY 1979) consists of 88 hatcheries (with an additional 2 hatcheries under construction); 3 special use facilities (fish screen, fish passage and a system of spawning channels); 12 hatchery biologist laboratories; 5 fish cultural development centers;

and the National Aquarium in Washington, D.C. The hatcheries produce and distribute various species of fish in the number, size, strain and quality required by enabling Federal legislation, cooperative agreements and other mandates. A table appended to this report sets forth the quantity of eggs and fish by weight and number, distributed by national fish hatcheries in FY 1979.

The primary function of hatchery biologists is to assist hatchery managers at Federal, State, foreign and commercial fish hatcheries in solving fish health problems through inspection, diagnosis and treatment of diseases. The diagnostic and inspection activities of the biologists support the fish health efforts of the Great Lakes Fishery Commission, the Colorado River Wildlife Council and areas of shared Federal/State responsibilities. Biologists also advise State, foreign and university fishery officials on matters of fish health and fish culture.

Fish cultural development centers conduct applied research and development in support of the hatcheries. Problems as well as new initiatives in fish culture and distribution are resolved and developed to the point that the resulting information can be utilized by fish culturists.

The National (Trout) Broodstock Program was established in 1970 to provide the National Fish Hatchery System with an orderly distribution of quality trout (brook, brown and rainbow) eggs. This program together with the Service Fish



Happy Angler! One of the goals of the Fishery Resources Program.

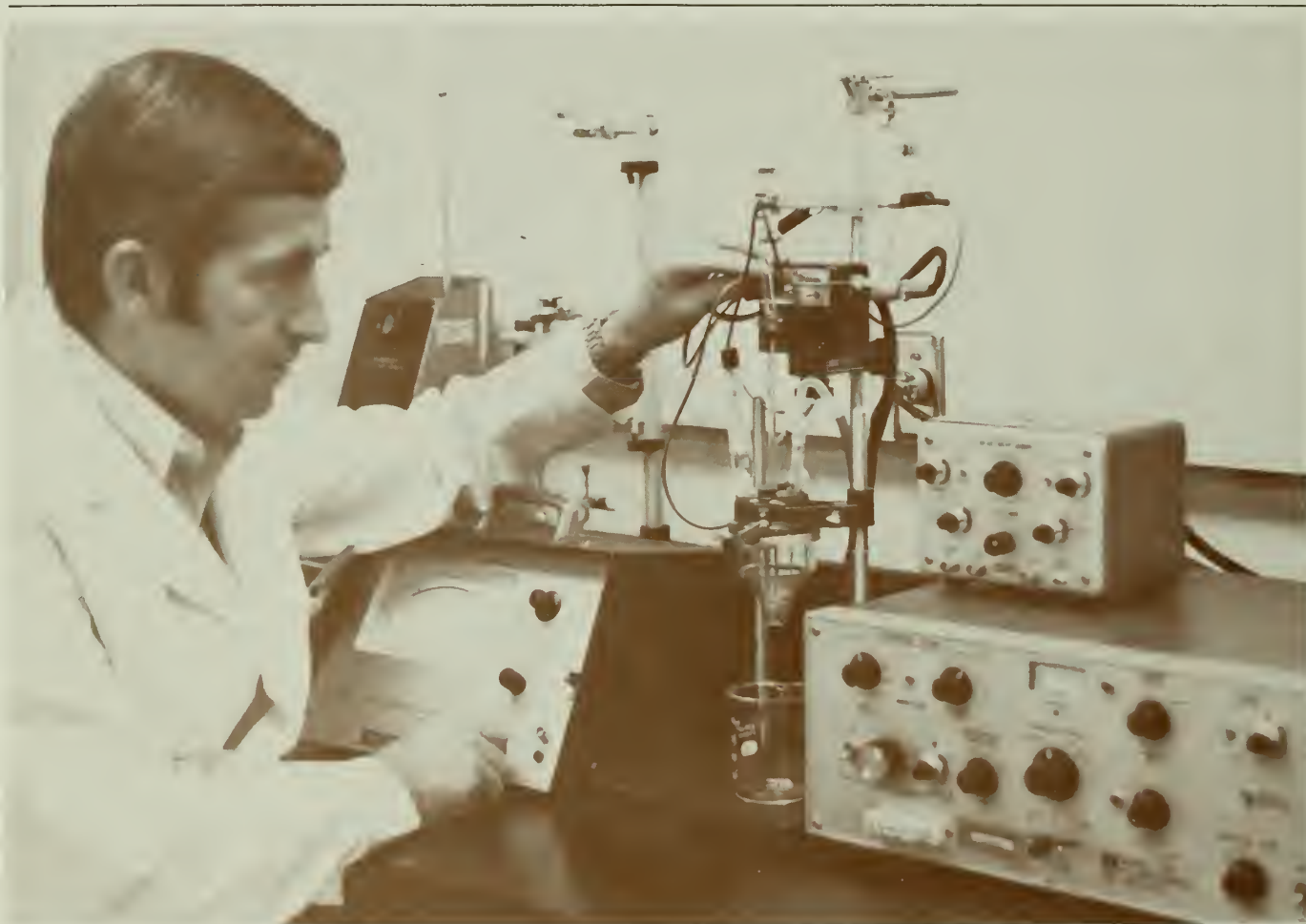
Health Policy serves to control the spread of serious fish disease agents and minimize the impact of diseases on fish populations. Twenty-five national fish hatcheries in the broodstock program distributed a total of 50,576,502 eggs weighing 21,515 pounds.

Fishery Assistance

There are 35 field stations in the country which provide assistance in the management, conservation and perpetuation of fishery resources in waters under Federal or Indian jurisdiction, or in some cases waters jointly managed by States and the Federal Government. A summary of fishery assistance provided during FY 1979 appears in the appendix of this report.

Fishery Research

The technical data needed by the Fishery Resources Program are furnished by studies and investigations conducted for the Service by the Division of Fishery Ecology Research. In addition, the research division responds to requests from other Federal agencies, Indian tribes, State fish and game authorities and private or international groups. The National Fisheries Center has been established at Leetown, West Virginia, for the purpose of coordinating research relating to fish culture and management training. The role of this Center is to administer and inter-connect research activities involving fish husbandry, fishery training programs and various development functions. Twelve research



The Fishery Resources Program is dependent on sound research.

laboratories and numerous adjunct facilities function under the supervision of the Center. Several other centers and laboratories conduct non-cultural research in such areas as fishery ecology, population dynamics and effects of pesticides on fish. Likewise, 26 Cooperative Fishery Units conduct research at universities.

Grants

Financed by statute with matching Federal and State funds, the Service administers the Anadromous Fish Conservation Act in conjunction with the National Marine Fisheries Service for the purpose of reconstituting anadromous fish stocks, restoring their habitats to proper condition, increasing

present fish populations and establishing new anadromous fisheries. Appended to the report is a table showing distribution of funds under this Act and a description of projects supporting anadromous fish development.

Law Enforcement

Enforcement of Federal laws

pertaining to fish is directed at international, interstate and Indian-related activities. The Service also enforces State laws pertaining to fish when these laws are detailed in cooperative agreements or directed by court mandate. Enforcement activities are conducted by the Division of Law Enforcement.

Construction and Engineering
Project proposals and cost estimates for constructing, maintaining and repairing fishery facilities are developed by the Office of Engineering in collaboration with the Division of National Fish Hatcheries, the Division of Fishery Ecology Research and the regional offices.



Limnologist preparing to operate Miller sampler in study of reservoir zooplankton production.

Fishery Resources Program Areas

Activities in three related program areas—anadromous fisheries, Great Lakes fisheries and inland fisheries—constitute the Fishery Resources Program.

Anadromous Fisheries

Anadromous fish are those whose adults swim upstream from the sea to spawn in fresh water. Many of the species that are most important to commerce—salmon for example—face formidable barriers to their upward migration. Dams and impoundments have been constructed; streams have been polluted; and low water levels impede their passage. As a result, anadromous fish can no longer return to many areas where their ancestors historically spawned. The Service is intensively engaged in integrated fishery resources production, assistance and research to mitigate these man-made obstacles. It is clearly incumbent upon those concerned with ensuring adequate numbers of these important species to take measures for restoring and protecting such fish during their migration, spawning and early life stages.

In the New England region, the Atlantic Salmon Restoration Program is implementing this type of integrated approach. River pollution and impassable dams have almost entirely eliminated the historic Atlantic salmon migration up New England rivers. No wild salmon have been observed in most

rivers for more than a century. Fishery resources personnel, cooperating with State fish and game agencies and the National Marine Fisheries Service, are involved in the initial stages of an effort to restore this splendid fish to New England rivers.

Basic ecological data are being assembled concerning every stage of the Atlantic salmon life cycle from egg through smolt to food habits and survival in the wild. The timing and quantity of smolt outmigration and the subsequent return of adult fish are being monitored.

Great Lakes Fisheries

Some of the country's finest commercial and recreational fishing was once provided by the Great Lakes fishery. Pollution, overfishing, eutrophication and the predatory action of the invading sea lamprey, however, have almost destroyed lake trout and other resident fish populations. To cope with these debilitating conditions, a Canadian-American joint effort under the Great Lakes Fishery Commission is working to improve both sport and commercial fisheries. In 1955, the Commission contracted with the Fish and Wildlife Service to conduct a program of sea lamprey control. The program includes monitoring lamprey larval and adult populations, the use of larvicides and other chemicals and the production of artificially sterilized adult lamprey to be introduced into the lakes in competition for mates with fertile lamprey. At the same



Largemouth bass wearing spaghetti tag in Bull Shoals Lake. The mark-recapture technique is commonly employed by biologists to make estimates of fish populations.

time, fish hatcheries in the region are striving to restore lake trout, sauger and other fish populations. The Service provides fishery assistance to Indian tribes, the States and the Commission to help them develop management strategies favoring natural reproduction of important species that eventually will result in self-sustaining populations.

Inland Fisheries

The inland fishery assistance

program covers a vast and diverse area of rivers, streams, ponds and reservoirs on Federal and Indian lands. Involved are national parks and forests, wildlife refuges, military installations, Veterans Administration hospitals and Indian reservations, as well as cooperative projects on many State waters. Assistance to these various areas takes the form of developing management plans, stocking with fish reared in national fish hatcheries, collecting wild

broodstock and eggs, controlling stream pollution and restoring fish populations, including endangered species. Indians receive training in all phases of fishery management. Warmwater, coolwater and coldwater fish of numerous species, including bass, catfish, salmon and trout are produced for distribution to cooperating agencies. Research programs for inland fisheries stress new and improved methods of fish nutrition, disease diagnosis and treatment and investigations aimed at determining optimal strains or species for differing environments.

Regional and Area Office Organization

The Fishery Resources Program is administered by six regional offices and the Alaska Area Office through area and field offices within each region. The appendix to this report carries a map showing the geographic boundaries of the regions, locations of regional and area offices, national fish hatcheries and fishery assistance field stations.

Regional activities performed during FY 1979 under the Fishery Resources Program are described in this report in sections dealing with Fish Hatcheries, Fishery Assistance and Fishery Research. The activities carried on by anadromous fisheries, Great Lakes Fisheries and inland fisheries are related under each category. The activities and field facilities of the Fishery Resources Program are so numerous and varied that it is not possible to include a description of all of them in this summary report.

FISH · HATCHERIES ANADROMOUS · FISHERIES

A representation of angling in the Middle East circa 2000 B.C.



Fishery assistance programs and fishery research activities to a great extent rely on fish produced by the National Fish Hatcheries. The primary purpose of producing anadromous fish in hatcheries is to furnish young fish as supplements to natural reproduction so as to enhance the quality, quantity and availability of fishery resources in coastal areas for both recreational and commercial uses. This effort stresses restoration and improvement of salmon runs on the Atlantic and Pacific coasts as well as other anadromous species in the Great Lakes and the Southeast.

Quinalt National Hatchery Emphasizes Stocking Indian Tribal Waters

The Quinalt National Fish Hatchery distributes anadromous fish to waters under Indian jurisdiction along 100 miles of Washington coastline. In FY 1979, the hatchery released some 4.7 million coho smolts into Cook Creek, main tributary to the lower Quinalt River, and 415,000 coho smolts into the Salmon River. The hatchery also produced 1.2 million coho eggs and 750,000 coho fingerling for the Quinalt tribe hatching and lake-penned rearing program. Other tribal waters stocked were the Hoh River (104,000 coho smolts) and the Sooes River on the Makah Reservation (1 million chum smolts).

Nutrition Studies at Abernathy Center

A starting diet trial was conducted at the Abernathy Salmon Cultural

Development Center, Washington, with fall chinook fry at 12°C and 5°C to determine if increased protein and fat would improve the performance of Abernathy Starter Mash. The highest protein concentration tested (50%) produced the most growth, while increasing total dietary fat to 20%

improved growth only at the high protein level and at the warmest temperature (12°C).

The Abernathy Center formulated an Oregon Pellet diet containing less protein and more fat for use in tests at the Dworshak National Fish Hatchery, Idaho, to see if a lowered dietary protein



Eternal vigilance in detecting fish diseases is necessary if diseases are to be controlled.

would reduce blood ammonia and associated gill damage in steelhead trout. Three dry diets containing different amounts of protein were also made for use in related experiments at the National Fisheries Research Center in Seattle, Washington.

Washington Hatcheries Assist Indian Tribal Fisheries

During peak salmon and steelhead spawning runs, the Quinault National Fish Hatchery personnel often aid in capture and transportation of returning adults. The hatchery also acts as a holding facility for broodstock and incubation facility for eggs. Hatchery personnel offered advice on development of rearing facilities and spawning methods during FY 1979. This year the Quinault hatchery held steelhead fingerlings for the Quinault Tribe from June through September. The tribe provided the fish food and other assistance.

Chinook Production for Columbia Tributary Exceeds Expectations

The Little White Salmon Hatchery, Washington, artificially propagates fall and spring chinook for release into the Little White Salmon River, a tributary of the Columbia River. During FY 1979, fish production of both spring and fall chinook was greater in numbers than had been programmed, although low spring flow and low cold river supply held down the rate of growth. Returning spring chinook for brood year 1979 produced eggs in excess of the station's needs. Excess eggs

were shipped to Leavenworth National Fish Hatchery. Returning fall chinook and coho for the previous year produced insufficient numbers of eggs and additional eggs had to be obtained from Oregon and Washington State hatcheries. Eggs and various sized fish were shipped to other Federal and State hatcheries, research installations and fish cultural development centers.

Winthrop Hatchery Supplies Fish to Colville Indian Reservation

The Winthrop station in northern Washington produced 1.8 million chinook salmon and trout in FY 1979. Some 744,600 spring chinook were released into the Methow River, while 523,000 rainbow, 492,000 brook and 40,000 cutthroat trout were distributed to the Colville Indian Reservation. Owing to a shortage of summer eggs, no summer chinook were produced. The station extended substantial cooperation to the Colville Indian Tribe both in fish distribution on the reservation and assistance during spawning operations.

Quilcene Shifting to Salmon from Trout

The Quilcene hatchery began phasing out its trout program in order to emphasize salmon production. The station increased distribution of trout to Indian and Federal lands by 50% (143,000 fish 8-10") to clear the way for construction, and no new eggs for replenishing trout stock were accepted. Eggs for a pilot spring chinook rearing program were

brought in from the Washington Department of Fisheries; the rearing succeeded, with minimal mortality. Adult fall chinook returns produced 775,000 eggs and the Skokomish hatchery provided 575,000 more. A total of 1.2 million fingerlings from these eggs were released in the Quilcene River in June, 1979.

Carson National Fish Hatchery Produces Record 10 Million Chinook

In spite of heavier than normal mortalities among returning 1977 adult spring chinook salmon, the Carson National Fish Hatchery in the Columbia Basin managed to attain a record of 10 million fish on station before the May, 1979, release—a million increase over FY 1978. This was accomplished by adding 2.5 million fall chinook and achieving excellent survival of fish on hand. A total of 1.65 million 1977 year-class smolts were released shortly before and after May 1 directly into the Wind River. Another 300,000 were planted in the Columbia River as part of a homing study.

Eagle Creek Involved in Drought Relief and Water Control

The Eagle Creek National Fish Hatchery in Oregon began construction of a large bio-filter shell with assistance from Young Adult Conservation Corps (YACC) enrollees. The chiller for the project was delivered in March, 1979. Engineering plans for construction of a drought relief water re-use system were discussed during

August by the hatchery staff and Federal water officials. As large numbers of adult chinook began returning in May, the hatchery staff, and State and Federal authorities decided to transfer all but 500 fish from Eagle Creek to the Oregon State holding ponds at Minto. Water temperature at Minto never exceeds 50° and chances for survival of adult fish were higher. There was only 20% mortality as a result of the transfer. The Forest Service, in collaboration with the Eagle Creek hatchery, is working toward protection of the watershed above the hatchery. An aerial survey showed private cutting in the early 50's on public land had exposed a 2-mile stretch of creek, resulting in a 10° temperature rise in the stream between the hatchery and the forest boundary. Environmental Protection Agency requirements for the Forest Service as well as the Oregon Timber Management Practices Act should insure no further degradation of the hatchery's water supply.

Spring Chinook Fingerlings Reared at Dworshak

Dworshak National Fish Hatchery in Idaho was constructed and is funded by the Corps of Engineers (CE) to produce steelhead trout to mitigate for the loss of spawning area resulting from the construction of Dworshak Dam on the North Fork Clearwater River, and to produce rainbow and cutthroat trout and kokanee salmon for stocking in the Dworshak impoundment.

Spring chinook fingerling were

again reared to assist the Kooskia hatchery program during times of low water and high temperatures. These fish reared well at Dworshak with few problems noted. A total of 376 adults was collected at the Kooskia facility and transported to Dworshak for spawning and later incubation of the eggs. A total of 528,000 green eggs was collected in September. The production from these eggs will be held at Dworshak until next spring when fish will be transported to the Kooskia National Fish Hatchery and released one year later.

Effects of Temperature and Diet on Seawater Conversion

A cooperative study with Dworshak National Fish Hatchery, University of Rhode Island and the Abernathy Diet Development Center was completed. The effects

of water temperature and dietary protein level on seawater conversion were measured. Changes in blood ammonia and electrolytes were monitored. Histological samples were taken to evaluate the above effects on chloride cell development.

California Station Aids Bioassays of Factory Wastes

The Coleman National Fish Hatchery in northern California provided salmon eggs and fingerlings to the Simpson-Lee Corporation and Diamond Paper Mills for their bioassay studies of the effects of effluents from their plants on fish life in the Sacramento River.

Tehama-Colusa fish Facility Stocks Salmon Spawning Channels

The Tehama-Colusa Fish Facility is located adjacent to the Sacramento River near Red Bluff, California. It comprises a large salmon spawning channel complex associated with the U.S. Bureau of Reclamation's Tehama-Colusa Canal; plus fish passage, counting, trapping and sorting facilities at the Red Bluff Diversion Dam (RBDD).

A total of 4,137 king salmon spawners were stocked in the single purpose channels in FY 1979. These included 2,085 (976 females) trapped at RBDD and 2,052 (930 females) which volunteered from Coyote Creek.

The spawning channels were activated on October 2. Selection and stocking of spawners from Coyote Creek and RBDD began the next day. The total number of



Fishery Resources biologists assist Indian tribes of the Northwest with fish health examinations at their aquaculture facilities.



Eighty eight National Fish Hatcheries produce fish to enhance declining populations and recreational fishing.

unspawned females recovered from the spawning channels was 262 or 13.7% of which two were salvaged and artificially spawned. This prespawning mortality was due in part to the green condition of some females stocked from RBDD.

Waste Discharges Monitored

The Tehama-Colusa Fish Facilities and the Bureau of Reclamation are monitoring waste discharges for the California Regional Water Quality Board. Daily and cumulative fish counts conducted at the Red Bluff Diversion Dam are distributed to various Federal and State agencies, and telephoned to four newspapers, three radio stations and one television station each day.

Hatchery Production Redirected from Trout to Salmon

Coleman National Fish Hatchery at Anderson, California, discontinued its trout production program in FY 1979 and shifted to rearing winter

and spring chinook salmon. Some 121,125 chinook eggs were taken from adults collected at the Keswick trap; no spring chinook eggs were taken.

Cooperative programs with the California Fish and Game Department continued during the year. Fall chinook salmon eggs and fingerlings were received from California Fish and Game under the salmon/steelhead accelerated production program cooperative agreement. Steelhead fingerlings produced at Coleman were transferred to the State for stocking in the Yuba River under this program.

American Shad Culture

Since 1977, the Lamar Fish Cultural Development Center in Pennsylvania has been conducting an intensive culture program for the restoration of American shad (*Alosa sapidissima*), once one of the most abundant and valuable anadromous fish in Atlantic coastal

ivers. The restoration efforts have required suitable diets and feeding techniques. The FY 1979 objective was to produce a sufficient number of healthy 5-10 cm fingerlings for transport and handling studies, as shad are extremely sensitive to any kind of handling. A number of supplements (live and frozen *Daphnia*, beef liver, ascorbic acid and neo-terramycin) were used with the basic brine shrimp—W-7 regime.

Atlantic Salmon Restored to White River

An estimated 58% of the Atlantic salmon stocked in the West River Branch of the White River (Vermont) in June, 1979, were still present in August. This figure does not take into account the underyearlings that moved into the main White River. For the first time since the Atlantic Salmon Restoration began eight years ago, a significant quantity of 2-year-old Atlantic salmon appeared among the fish populations of the West Branch.

At the National Fish Hatchery in Nashua, New Hampshire, plans were made to provide 100,000 2-year-old smolts for stocking the lower Merrimack River, Massachusetts and New Hampshire. A smolt imprint and release site and a broodstock holding area for returning adult fish are being developed on the river. As part of the renovation of the Essex Dam in Lawrence, Massachusetts, trapping facilities to provide broodstock are being constructed for operation by 1981.

FISH • HATCHERIES

GREAT • LAKES • FISHERIES

A 2nd Millennium fish story from an Egyptian tomb.



Fishery resources personnel in the Great Lakes during FY 1979 in coordination with the Great Lakes Fisheries Commission (GLFC), the lake States and concerned Federal agencies, undertook to restore and maintain commercial and sports fisheries in the region. Five hatcheries operated principally to stock Federally-owned and State-managed waters, the Great Lakes, Indian lands and State-owned and managed waters with both coolwater and warmwater species. Three other hatcheries were committed solely to the production of lake trout. In addition, a total of 7 million anadromous salmonids were stocked in the Great Lakes or tributary rivers. No serious

outbreaks of disease were recorded at any of the hatcheries. To facilitate evaluation of stocking programs, numerous fish were fin clipped or tagged with coded wire.

Lake Trout Hatcheries Production Exceeds 4.5 Million Fish

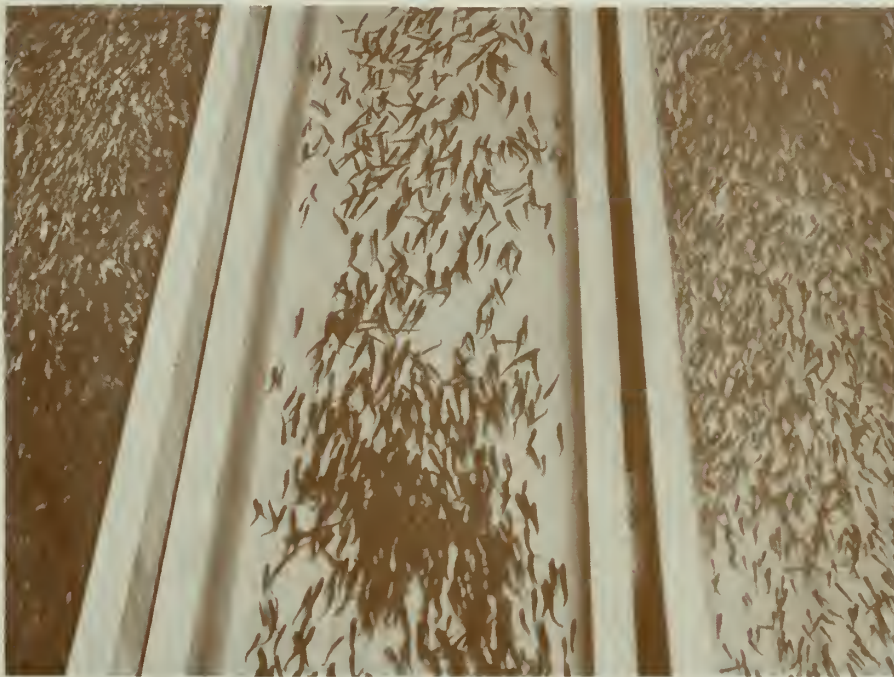
In FY 1979, Jordan River National Fish Hatchery, Pendills Creek National Fish Hatchery and its subsidiary Hiawatha Forest, produced 4.6 million fish for stocking the upper Great Lakes. The Jordan River hatchery (Michigan) stocked Whitefish Bay in Lake Superior with 124,000 lake trout within the boundaries of the Indian treaty claim areas. This was done under the auspices of Interior

Department Indian trust responsibilities after the State of Michigan ceased assigning trout to the area. The Coast Guard vessel "Arundel" assisted in this planting operation. At Jordan River hatchery, the 5-year-old broodstock were spawned for the first time. In an experiment to imprint lake trout artificially, 70,000 eyed eggs were exposed with phenethyl alcohol during the first month of chemical feeding.

For the fourth year, the Jordan River hatchery operated a 10-member, non-resident Youth Conservation Corps camp during June and July. The program involving field trips emphasizing environmental education, was regarded as highly beneficial.

The Pendills Creek-Hiawatha Forest complex began a fall stocking program for Keweenaw Bay with 100,000 fish in October. For 1980, this figure is to be increased to 250,000 by hatching fish in water warmer than normal. The station anticipates increased production without added facilities but with higher costs for feed, labor, fish marking and distribution.

Production of lake trout for Lakes Erie and Ontario continued for a second successful season. In FY 1979, approximately 200,000 were planted into Lake Erie and 500,000 into Lake Ontario. This entailed 39 distribution trips amounting to 12,600 miles. For fall planting in Lake Ontario, 200,000 trout were marked with coded wire tags and adipose clips in the first endeavor of this type on the U.S. side of the Great Lakes.



Trout in rearing troughs about two months after hatching.

FISH · HATCHERIES INLAND · FISHERIES

Sixth century B.C. view of fishing by Chachrylion of Greece.



The inland fish hatcheries program is principally directed toward producing warmwater, coldwater and coolwater species to stock Federal, State and Indian waters for recreational purposes. Thousands of sportfishermen throughout the country are given the opportunity each year to fish for such species as largemouth bass, striped bass, bluegill, channel catfish, muskellunge and tiger muskellunge, northern pike, sauger, redear sunfish, rainbow, brook and brown trout and walleye. The hatcheries and fish development centers cooperate closely with fishery assistance and research personnel providing fish for both these programs. Likewise, many of the hatcheries are popular centers for education, interpretation and information about fish and wildlife for the visiting public.

Joint Venture at Leavenworth Complex

The Leavenworth National Fish Hatchery, Washington, cooperated in a joint venture with Washington State and Federal agencies. A total of 2.6 million kokanee were reared by the station and eggs and distribution was provided by the Washington Department of Fisheries. Financing was supplied by the Bureau of Reclamation.

Fish Screens in Yakima Valley Canals

To prevent serious fish losses in the 500,000 irrigated acres of Washington's Yakima Valley, the Fish and Wildlife Service operates

fish screens on the main diversion canals during the general irrigation season. The screens consist of rotating paddle-operated drums.

Steelhead Trout Production Proceeds at Hagerman Hatchery

The steelhead trout pilot project begun last year at Hagerman National Fish Hatchery (Idaho) went forward in 1979 to produce 92,000 pounds of smolts. Aim of the project is to determine the feasibility of large-scale steelhead production and establish criteria for designing expanded Corps of Engineers facilities at Hagerman. The goal would be a facility capable of producing 400,000 pounds of salmonids a year. The hatchery is also producing steelhead for release in 1980 as part of the Lower Snake River Compensation Plan.

Bozeman Center Evaluates Trout Strains

The Bozeman (Montana) Fish Culture Development Center emphasized a water conditioning system during FY 1979 to evaluate the effects of water temperatures on the growth of brook and rainbow trout. In collaboration with the Fish Genetics Laboratory at Beulah, Wyoming, the Center evaluated four strains of rainbow trout both in the hatchery and in a pond at Three Forks, Montana. A creel census indicated that catch data were much the same over the past two years. The evaluation was based on growth, conversion and survival, while the pond evaluation was based on catchability, growth and condition factor (K). Results

showed domestic Winthrop and Spring Standard Growth strains to have greater increase in length and better feed conversion and were harvested more rapidly than the wild McConaughy and Fish Lake strains. During hatchery rearing, however, the Spring Standard Growth and McConaughy strains suffered higher mortality than the Winthrop or Fish Lake strains.

Disease Halts Rainbow Trout Stocking in Wyoming Lakes

Red-mouth disease (*Pseudomonas hydrophila*) was discovered in three rainbow trout at the Saratoga National Fish Hatchery in Wyoming. This led to cancellation of trout stocking programs in eleven back country lakes, a serious setback in the fishery program. It is likely that new sources for Yellowstone cutthroat, golden and rainbow trout will have to be re-established at Saratoga or another hatchery. This could set back a major portion of the fishery program on the Wind River for three to five years.

Lack of All-Weather Access Delays Maximum Trout Output in Utah

Jones Hole National Fish Hatchery in northeast Utah (adjacent to the Dinosaur Monument) began trout production in 1970 with a projected annual capacity of 5 million fish for a total weight of 300,000 pounds. Jones Hole spring, with a water flow of 34-cubic feet per minute and year-round temperature of 53°, is well-suited for trout raising. The production goal has never been attained, however, for lack of an

access road that is open all year. In the coming year, completion of an all-weather road will open opportunities for greatly enlarged trout production. Last summer Jones Hole supplied cutthroat trout by helicopter to mountain lakes near Leadville, Colorado.

Nation's Second Oldest Hatchery Still Supplying Rainbow Trout

The Leadville Hatchery in Colorado, second oldest National Fish Hatchery in the United States (established in April, 1889), distributed 570,000 rainbow trout weighing 82,000 pounds during FY 1979 to Army and Air Force installations in Colorado and reservoirs in Colorado and the Fryingpan-Arkansas Project.

Southwest Hatcheries Conduct Varied Programs

A 3-mile water supply line was completed at Mescalero National Fish Hatchery in New Mexico, employing Young Adult Conservation Corps labor with resultant savings adequate to purchase pipe for two other major projects.

In Arizona, the Willow Beach National Fish Hatchery produced 500,000 fingerling rainbow trout to be used for biological control of buffalo gnats on the lower Colorado River. The Service stocked the Colorado River Indian Reservation at Parker, Arizona, with 24,300 rainbow trout and 28,500 channel catfish. The tribes, the Service and the California Fish and Game Department have jointly begun a special study of the Parker



White crappie male guarding nest of eggs. This is one of the many species of fish cultured at National Fish Hatcheries.

Division of the Colorado River. The Willow Beach National Fish Hatchery has been planting rainbow trout in reservation waters at the rate of 1,500 catchables per month. In the first stocking of catfish since 1976, the station obtained 3,200 2-pound catfish from the California Department of Fish and Game for the Fort Yuma Reservation in Arizona.

Fish Culture Training at Spearfish Center

The Spearfish Fisheries Center in western South Dakota continued its program of training in fish culture during FY 1979. As in previous years, students from the United States, Canada and other foreign countries attended 2-week courses in December 1978, and March, 1979. The short fish culture courses are designed to demonstrate modern techniques and equipment. In order to foster a fruitful interchange of ideas, the center maintained a balance among students from State universities, Federal agencies, private colleges and foreign backgrounds. Demand for entry into these courses again exceeded the number of available slots.

Fisheries Center Introduces New Starter Diet

In FY 1979, the Diet Center at Spearfish Fisheries Center concentrated on improving starter diets, using westslope cutthroat, Yellowstone cutthroat, golden, brown and lake trout swim-up fry. The starter diet SD8 was introduced for the October feed,

replacing SD7. Better growth, lower feed conversion and lower mortality rates are expected, at about the same cost.

Nebraska Hatchery Supplies National Trout Pool

During FY 1979, the trout broodfish hatchery at Crawford in northwestern Nebraska supplied 4.4 million disease-free A-1 trout eggs to Federal and State hatcheries (as well as to Mexico City). The 2.6 million eyed brown trout eggs and 1.8 million eyed brook trout eggs were taken from 2-year-old broodfish. This quantity was still short of the 5 million annual egg production which is Crawford's goal, but hatchery officials expect to surpass that goal in 1980 because the broodfish will be 3-year-olds and a spawning shelter will provide protection from freezing weather during brown trout egg taking. Crawford National Fish Hatchery also stocked Nebraska public fishing waters with 421,000 brown and brook trout to repay the Nebraska Game and Parks agency for its annual contribution of northern pike and walleye eggs to the Gavins Point National Fish Hatchery at Yankton, South Dakota.

Missouri Hatchery Experiments with New Fish Diet

For the past several years, the Neosha National Fish Hatchery in southwestern Missouri has produced about 130,000 10-inch rainbow trout. Some 125,000 of these fish are stocked in Lake Taneycomo, a narrow 22-mile lake

situated below the Table Rock Dam on the White River. Last year 134,500 trout weighing a total of 45,500 pounds were transported from the hatchery to the lake by the Missouri Conservation Department. No major disease outbreaks occurred, though Gyrodactylus and bacterial gill disease persist. The hatchery undertook a diet experiment in May-July by feeding diet #355, supplied by the Spearfish Fisheries Center, and compared results with the regular production diet. Fish fed the #355 diet had a faster growth rate and a lower feed conversion rate.

Genoa Hatchery Marks Heavy Production of Bass, Pike and Walleye

Genoa National Fish Hatchery in Wisconsin was involved mainly with the production of largemouth bass (1,500,000 fingerlings), northern pike (9,000,000 fry), walleyes (9,700,000 fry), sauger (1,460,000 eyed eggs shipped) and rainbow trout (220,000 fish). Also, carp, bluegill, yellow perch and black bullhead were produced primarily for research purposes.

Lake Mills Emphasizes Trout and Walleye Production.

Lake Mills National Fish Hatchery in Wisconsin raised both trout and warmwater fish for Federally-managed areas, including Indian reservations, National Wildlife Refuges, military bases, Veterans Administration hospitals, Corps of Engineers reservoirs and the Great Lakes.

Lake Mills increased production of trout 85% over the number produced in FY 1978. Brook, lake and rainbow trout were reared to various sizes from eyed eggs supplied by the national broodstock system. The station's coolwater program devoted 80% of its pond space to walleye production from fry supplied by the Genoa and New London hatcheries. Yellow perch produced as part of the coolwater program were delivered to the National Fishery Research Laboratory, La Crosse, Wisconsin. Muskellunge production was unsuccessful. Young Adult Conservation Corps personnel helped the station during the early part of the year in maintenance, rehabilitation and pond operations.

Bass Production Maintained in Louisiana Despite Water Supply Problems

In Louisiana, the Natchitoches Hatchery continued to meet its production standard of 1.5 million striped and hybrid bass, in spite of problems of water supply from Cane River Lake, an isolated oxbow of the Red River. The high fertility of this lake makes it nearly impossible to control a rich bloom and alleviate the low oxygen level resulting from dying phytoplankton.

Ohio Station Supplies Corps of Engineers Reservoirs

Senecaville National Fish Hatchery in Ohio produced smallmouth bass, striped bass, walleye, sauger, channel catfish and flathead catfish. Management programs on Corps of

Engineers' reservoirs in Ohio utilize much of this station's production. Shad, entering station ponds through the water supply, competed with striped bass but, nevertheless, 208,000 advanced striped bass fingerlings weighing 929 pounds were produced for Federally-constructed reservoirs in the State.

Development Center Uses Intensive Culture Techniques

The Lamar Fish Cultural Development Center in Pennsylvania, using intensive culture techniques, successfully reared walleye to three weeks of age, with almost 50% survival. Previous efforts had been only half as productive. Even greater success was achieved in converting walleye fry to artificial food. Whereas in 1978 the highest rate of survival for intensively reared fish was only 12%, the 1979 rate was 62%. These results demonstrate that techniques similar to those employed with trout and salmon will work with walleye.

Kentucky Station Continues to Stock Streams and Ponds

The Frankfort (Kentucky) National Fish Hatchery stocked largemouth bass, bluegill, other sunfish and channel catfish in Federal waters and military installations, Veterans Administration hospitals, National Parks and National Wildlife Refuges. Eggs and fish were supplied researchers at the Universities of Kentucky, Louisville and Wisconsin, as well as at the National Fishery Research

Laboratory at La Crosse, Wisconsin, and Florida Atlantic University.

Streams affected by coal-mining operations in Kentucky were stocked with redbreasted sunfish. Farm ponds in both Kentucky and Tennessee received redear and bluegill sunfish, largemouth bass and channel catfish. Public fishing lakes in Kentucky and Tennessee were stocked with 8-inch channel catfish.

Mid-South Hatcheries Distribute Millions of Fish

Five warmwater fish hatcheries in North and South Carolina and Kentucky distributed 10.9 million fish to nearly 8,000 farm ponds at an average cost of 25¼ cents per fish. The fish supplied from these hatcheries included bluegill (5.9 million), channel catfish (1.5 million), largemouth bass (1.25 million) and redear sunfish (1.5 million). Coldwater hatcheries (Pisgah Forest, Dale Hollow, Erwin, Walhalla and Wolf Creek) distributed 4.6 million rainbow, brook, brown, steelhead and Ohrid trout. In addition, 17.6 million eyed trout eggs were shipped from these hatcheries.

North Carolina Hatchery Conducts Striped Bass Pilot Program

Edenton National Fish Hatchery in North Carolina has a pilot program designed to rear and maintain striped bass broodstock. In FY 1979, 30 females of the second generation of hatchery-reared broodstock spawned 7 million eggs of 4 strains (Weldon, Moncks Corner,



The Fish and Wildlife Service's farm pond stocking program results in many hours of pleasure for young anglers.

Maryland and Hudson River) of which 850,000 survived to be stocked in ponds.

Federal and State Agencies Collaborate in Improving Fishery

In the area served by the Asheville (North Carolina) Area Office which encompasses North and South Carolina, Kentucky and Tennessee, there is a major interaction of fishery programs among coldwater, farm pond and striped bass fisheries. Federal coldwater hatcheries supply trout to the four

states, which also receive various species from warmwater hatcheries, including all of the fish for Kentucky's State farm pond program. Federal and State agencies cooperate in improving the striped bass fishery.

Hatchery Supplies Fish for Farm Ponds

During FY 1979, Millen National Fish Hatchery in Georgia increased fish production to a total of 3.6 million, two-thirds of which were distributed to farm ponds.

Extensive irrigation practices in southeast Georgia make use of ponds which are stocked with fish for recreational purposes. Production of striped bass increased nearly one thousand percent over the previous year (387,000 in 1979 as against 40,000 in 1978). This increase was brought about by holding fry in troughs for 8 to 10 days while feeding them brine shrimp. Channel catfish eggs were produced in spawning pens and open ponds and hatched in troughs treated daily to eliminate fungus.

FISHERY·ASSISTANCE ANADROMOUS·FISHERIES

Australian Aborigine displays an old fishing technique—the direct approach.



Information about the spawning and habitat requirements of anadromous fishery resources is regularly collected by field biologists for the purpose of protecting existing fish populations and/or restoring them to their historic grounds. Surveys of anadromous fish stocks enables fishery management to develop appropriate conservation and development plans.

Assistance projects involving fishery resources may include amassing data on spawning and nursery areas, evaluation of spawning results, distribution and abundance assessments, migratory patterns and habits and statistical surveys and inventories. Such data are the basis for fishery management plans for Indian reservations, National Parks, National Wildlife Refuges, military installations, National Forests, river basins and other areas. Activities include collection of wild broodstock and eggs for hatchery and research purposes, stocking hatchery-produced species in Federal lakes, ponds, streams and rivers and educating Indians in fish culture and the techniques of management.

Alaska Stations Stress Long-Range Planning

The largest and most valuable commercial salmon fisheries in the world are in the State of Alaska. Subsistence fishing for salmon is the primary source of food for many Alaskans, while sport fishing for salmon, trout and other game fish is an economic as well as a



Fishery Biologist counts lateral line scales on a striped bass in order to determine if it belongs to the native Gulf Coast strain or an introduced strain.

recreational asset for the State. The Fish and Wildlife Service has proprietary jurisdiction over these fish resources, while the State exercises responsibilities for management. Technical assistance by the Fishery Resources Program is important for managers of Fish and Wildlife Refuges and for the Alaska Department of Fish and Game. In FY 1979, effort was placed on program planning for management of Alaska's fishery resources for the coming 10 to 15 years.

Kenai National Moose Range

At some period during their lives, some 40% of the salmon in Cook Inlet in Alaska inhabit the waters of the Kenai National Moose Range (a territory extending over 1.73 million acres). This fish population has great potential for recreational and commercial fishing and needs to be managed under a carefully designed strategic plan. Such a plan is being developed by the staff at Kenai Field Station in cooperation with the Alaska Department of Fish and Game, the Forest Service, the

Cook Inlet Aquaculture Association and Fish and Wildlife Service research personnel. The target date for completion of this plan is September, 1981.

Arctic National Wildlife Range

The staff of the Fairbanks Field Station is working on a fishery management plan for the vast Arctic National Wildlife Range (8.9 million acres). This range lies north of the Arctic Circle and many of its rivers and lakes are covered with ice for as much as nine months of the year. Information about the abundance and distribution of species such as Arctic char and lake trout which are anadromous and migrate to the Beaufort Sea, as well as on fish life histories, hydrological

regimes and utilization by sport and subsistence fishermen is urgently needed. The Fairbanks project started with studies on Lake Peters and Lake Schrader, and by September, 1981, the Arctic National Wildlife Range Fishery Plan is scheduled for completion.

Salmon and Shad Restoration Progress Along Atlantic Coast

The program to restore Atlantic salmon to New England rivers and to re-establish American shad in their historic spawning grounds along Atlantic Coast rivers continued in FY 1979. This effort was supported by joint Federal-State funds to restore anadromous fish to the Connecticut and Delaware Rivers, and multi-agency

management cooperative efforts in Maine and on the Merrimack and Susquehanna Rivers.

Special River Study Undertaken in Florida

A special study is underway on the 107-mile long Apalachicola River in Florida. This study is concerned with anadromous species utilizing this river with particular emphasis on striped bass and a hybrid bass (striped bass x white bass). Last year Panama City biologists were involved in collecting valuable data for these species through a systematic monthly sampling schedule. Project biologists were also involved in a joint Federal-State creel census program on this important river.



Tagging American shad to determine escapement rates. Photo by South Carolina Wildlife and Marine Resources Department.

FISHERY·ASSISTANCE

GREAT · LAKES · FISHERIES

Three examples of various spear points fish have had to contend with through the ages.





Life cycle of the sea lamprey.

The fisheries assistance programs in the Great Lakes region emphasize producing lake trout as part of the international cooperative effort to restore the trout population in lake waters, furnishing technical and diagnostic assistance for fish disease control to field stations, managing sea lamprey control in behalf of the Great Lakes Fishery Commission, administering the Anadromous Fish Grant-in-Aid Program for the six states bordering the Great

Lakes and providing technical assistance to Indian tribes on adjacent reservations. Progress in these several endeavors requires close collaboration by fishery assistance staffs with personnel who work in fish hatcheries and fishery research.

Guidance Given to Indian Reservations

Three fishery assistance field stations in the Great Lakes area (Bemidji, Minnesota; Ashland,

Wisconsin; and Princeton, Indiana) operate principally to provide guidance to Indian reservations for developing and managing sport fishing resources. The goal is to train tribal members in resource management so they will be able to function on their own. In addition, the stations provide fishery management assistance to military and Veterans Administration installations, National Wildlife Refuges and, in cooperation with the Forest Service and State fish and game agencies, two National Forests in Indiana and Illinois.

Great Lakes Salmonid Stocking Seen of Economic Value

Approximately 7 million anadromous salmonids were stocked in the Great Lakes and their tributaries during FY 1979. The anadromous fish program generated some 7.5 million angler days, providing a catch of some 4.7 million salmonids. Based on an estimated expenditure of over \$17.00 per day each angler, the economic value of this recreational fishing was calculated at \$130 million.

Sea Lamprey Control

As the United States agent for the Great Lakes Fishery Commission, the Service is continuing its program for control of sea lamprey. In FY 1979, surveys were conducted on 314 streams flowing into the Great Lakes and 38 streams were treated with larvicide. Portable assessment traps for adult lamprey have been efficient monitors. For the first time,

larvae were detected in the St. Louis River of Lake Superior. This will create a major problem for the future and treating the system will cost an estimated \$80,000.

An ironic result of continuing pollution abatement in the Great Lakes has been improvement of stream habitat for sea lamprey. Nevertheless, the lamprey control program is succeeding; lamprey are no longer the major factor limiting fishery productivity. In FY 1979, only 2,400 sea lampreys in spawning phase were captured at the eight index barriers on Lake Superior as compared with 4,800 caught the previous year. This is one of the smallest catches since the start of the control program.

Sea Lamprey Symposium

The Great Lakes Fishery Commission held a Sea Lamprey Symposium during July-August, 1979, in Marquette, Michigan, at which 88 scientists from the United States and 9 other countries discussed the biology and control of sea lamprey and the interaction between fish and sea lamprey. *The Canadian Journal of Fisheries and Aquatic Sciences* and the Commission's own *Technical Report* are both publishing the symposium's proceedings.

Stream Barrier Modification

Improves Steelhead Trout Runs
Studies made on the Lester River, Minnesota, definitely established the value of modification of stream barriers for fish passage in the northern shore streams of Lake Superior. Since the first stream

barrier was modified, three year classes of steelhead have been observed in the creel census. Natural production and steelhead runs were increased in the Lester River by making a portion of the stream above the barrier accessible as a steelhead spawning and nursery area.

Chinook Salmon in Lake Superior
Assistance given by the Bemidji (Minnesota) station to the Grand Portage Indian Reservation involved continuing the introduction of chinook salmon into Lake Superior tributaries. An evaluation is underway to determine if fishing benefits warrant further stocking.



The business end (rasping-sucking mouth) of the sea lamprey.

FISHERY·ASSISTANCE

INLAND · FISHERIES

Early Chinese depiction of the patient fisherman.



Fishery assistance activities on inland fisheries provide basic data on the present stocks and habitat requirements of sport fishing resources in order to manage those resources for the Nation's fishermen. Some of the areas of emphasis include: collecting and analyzing data through the use of surveys, inventories, creel censuses, limnological studies, water quality monitoring and tagging; preparing fishery management plans for Indian reservations, National Wildlife Refuges, National Parks, National Forests, military installations, river basins and other areas; distributing hatchery-produced fish into tribal, Federal and State waters; preparing and presenting information on fishery resources and environmental impact assessments; and training native Americans in fish culture and management techniques.

Crow Tribe's Approval of Fishing by Non-Indians Awaited

A court decision in the spring of 1979 gave control over fishing on the Big Horn River in eastern Montana to the Crow Tribe, but the question of opening the reservation to non-Indian fishermen has not yet been resolved by tribal council. Stocking by the Hardin Fishery Assistance Project has been significantly reduced, because comparatively few members of the tribe engage in fishing and natural fish reproduction in the river appears more than sufficient. If the tribal council should decide to allow non-



Ladies can catch fish also.

Indians to fish in reservation waters, there will be need for an intensive fishery management program to stock the river.

Instream Flow Needs of Wind River Reservation Waters

As a result of a suit filed by the State of Wyoming against all water users of the Big Horn River system, the United States Government, trustee for the Arapahoe and Shoshone Indian Tribes, was called upon to determine the amount of water that Indians and the government could claim as reserve rights. Technical assistance from biologists at the Lander Fishery Assistance Office was requested by the Bureau of Indian Affairs and the Justice Department. Using methods developed by the Instream Flow Group at Fort Collins, Colorado, the project biologists began making determination of inflow stream needs for all major water resources on the Wind River Reservation.

Yellowstone Park Fishery Management Actions

Investigation of the water resources of Yellowstone National Park continued in FY 1979. The National Park Service provided temporary laboratory and office space for fishery assistance personnel at Mammoth Hot Springs. When the field season began in July, the staff moved near Yellowstone Lake to buildings constructed in the 1930's by the U.S. Bureau of Fisheries and the Civilian Conservation Corps.

The staff's mission is to assist the

National Park Service to maintain or restore native fish populations and water resources in as near a natural state as possible. Regulations are developed to assure high quality angling for visitors to the Park without disturbing the natural environment. Visitors are to participate in the Park's program of conservation of the natural environment in an effort to preserve native species and provide angling for wild fish populations. Lakes and streams in the Park are fished each year by thousands of visitors. In 1979, the National Park Service issued 216,130 fishing

licenses. Forty thousand anglers came from states adjacent to the Park, and Yellowstone licenses equaled 83% of the total licenses issued in the State of Wyoming, 74% of those issued in Montana and 55% of the number issued in Idaho.

Higher Fees No Deterrent to Sport Fishing

The Gallup Fishery Assistance Office in New Mexico regards the fishery at Isleta Pueblo as its best program. It maintains the highest ratio of creel to stocked fish as well as the least costly angler day. Raising fishing fees from \$1.50 to



Examination of benthos for fish food organisms.

\$2.00 in April, 1979, did not adversely affect use of the reservation's fishing waters, in part, because sports fishermen in the Gallup area had only a short distance to travel for their recreational activities.

Southwest Fishery Assistance Stresses Indian Reservations and Sport Fishing

Fishery assistance in Texas, Oklahoma, New Mexico and Arizona focused mainly on assistance to Indian reservations. Approximately three-fourths of management assistance and half the fish production in the region went to supporting Indian fishery programs. The second emphasis was on producing fish for sport fishing programs on other Federal waters. In FY 1979, a management assistance position was created at San Marcos, Texas, with primary responsibility for military service lands in Oklahoma and Texas.

Fishery Management Programs Planned for Arizona Indian Tribes

A fishery management program was drafted for the Colorado River Indian Reservation near Parker, Arizona. In a joint effort by the Colorado River Indian tribes, the Service and the California Fish and Game Department, a special study of the Parker Division of the river was initiated. Tribes on two contiguous Indian reservations (Fort McDowell and Salt River) are interested in improving the quality of their rainbow trout fishing program on the Verde and Salt Rivers to take advantage of their



Stomach contents of fish are examined to determine which food organisms are utilized.

proximity to the Phoenix metropolitan area.

At Fort Apache Indian Reservation, a search was made in the Ord River for Arizona trout (*Salmo apache*) by intensive electrofishing. On San Carlos Indian Reservation, black crappie broodfish, transported from the Fort Apache Reservation, were introduced into Tlkalai Lake, the new 600-acre irrigation reservoir on the San Carlos River. The unique population of Gila chub (*Gila intermedia*) in the Blue River was closely monitored all year, even though it is not presently threatened or endangered.

Preventing Entry of Predators into Wapanocca Lake
Sport fishing on the 5,000-acre

National Wildlife Refuge at Wapanocca, Arkansas, has dropped off in recent years because of increasing numbers of bowfin, gar, bigmouth buffalo, carp and large gizzard shad which enter Wapanocca Lake from Big Creek, a tributary of the Mississippi River. Construction of a higher levee between the lake and the creek is underway to prevent additional invasions. Lowering the lake's level to clear the way for work on the levee endangered the food supply of seven wintering bald eagles, a pair of which had nested but not laid eggs the previous year. In consultation with staff concerned with endangered wildlife species, the fishery and refuge personnel decided to remove about 700 fish, mostly yellow bass and gizzard shad, to neighboring small, shallow ponds on the refuge's lands near an eagle perching tree. Also, 3,400 pounds of shad, bass and carp were frozen to provide carrion for the eagles.

Genoa Hatchery Makes Wide Distribution

The Genoa National Fish Hatchery in Wisconsin distributed a total of 19 species of fish to four Great Lakes states and Tennessee—mainly largemouth bass, rainbow and brown trout, northern pike, walleye and sauger. Fish were supplied to the National Fishery Research Center at La Crosse, Wisconsin; the Veterans Administration Hospital at Tomah, Wisconsin; Fort McCoy, Wisconsin; Environmental Protection Agency units in Chicago, Illinois, and



In FY 1979 the Fish and Wildlife Service assisted 130 military installations with managing their fishery resources.

Monticello, Minnesota; Tennessee Valley Authority in Morris, Tennessee; the University of Wisconsin at Madison and four Indian reservations in Wisconsin.

Menominee Indian Walleye Fishery

Efforts were undertaken to establish a walleye fishery on two lakes in the Menominee Indian Reservation, Wisconsin. Survival of fin-clipped fingerling stocked at 3-4 inches was compared with that of those stocked at $\frac{1}{2}$ to $1\frac{1}{2}$ inches. This study is expected to provide guidelines for future management plans by the Menominee Tribe, which is rapidly nearing the point of managing its own fish and wildlife resources.

Central States Fishery Station

Owing to a shortage of threadfin shad, a forage species, weights of white crappie declined during 1978. In a cooperative effort involving the Service, the Illinois Department of

Conservation, and Southern Illinois University, 3,000 threadfin shad were stocked in Crab Orchard Lake in 1979. Crappie of catchable size will be present in the lake in 1980.

Survey of Ponds Carried Out in Shawnee National Forest

A 1979 survey of 26 ponds in the Shawnee National Forest found 18 sites suitable for sport fishing. Management of these ponds is difficult, however, because of poor access, small size and shallow depths. Out of nearly 1,000 ponds in the forest, 133 were deemed appropriate for fisheries management. During the coming season, a cyclic type management system will be undertaken at these ponds.

Hoosier National Forest Waters Surveyed

Under a cooperative agreement, the Fish and Wildlife Service assisted the Forest Service by carrying out

surveys of all waters of less than five acres in the Hoosier National Forest (Indiana). Fifty sites, which the Forest Service deemed to have potential for fish management, were surveyed for physical and biological characteristics. Desirable fish populations were found in only 14 of the ponds, while 19 required stocking or renovation and 17 were considered as needing further evaluation.

Walleye Fingerling Stocking to Replace Fry Stocking in Indiana Lake

Future stocking of walleye in Old Timbers Lake on the Jefferson Proving grounds, Indiana, will be limited to 1-3 inch fingerlings, after an investigation of the 165-acre impoundment indicated a low survival rate of walleye fry. Continued evaluation of the 12-15 inch length limitation on largemouth bass showed a greatly increased harvest as well as an adequate bass population to maintain control over forage species. The study also revealed an excellent structure in the lake's sunfish population.

Put-and-Take Trout Evaluation Made at Gravel Lake

At Wright-Patterson Air Force Base, Ohio, 6-acre Gravel Lake was used to obtain information for the National Put-and-Take Trout Fishery Evaluation. The April to June creel census showed an overall return of catchable trout of 82.6%. During 1979, the catchable trout program provided 1,626 recreational angler hours per acre.

FISHERY · RESEARCH

ANADROMOUS · FISHERIES

Four examples of wooden fish hooks—all of which presumably worked.



Research on anadromous fish species is oriented toward solving the problems encountered in the spawning, production and distribution of fish stocks. Major interests of fishery research are the diagnosis and treatment of fish diseases and diet-related abnormalities, the development and testing of new fish foods, and the evaluation of fish species and strains with reference to their potential for intensive fish culture.

Fishery research personnel study the response of anadromous fish to hatchery practices and to chemicals in hatchery waters, streams and rivers and develop new diagnostic tools to identify fish diseases.

Methods of Predicting How Changes in Habitat Affect Fish Populations

In 1979, the Service, in cooperation with the Alaska Department of Fish and Game, trapped and marked

nearly 200 adult chinook salmon for release into the Kenai River, Alaska. The purpose of the study is to assist in identifying spawning and rearing areas. Forty fish were equipped with radio transmitters and were followed as far as 50 miles to their spawning areas. With the aid of telemetry, SCUBA and an underwater TV camera, 12 chinook spawning areas were defined in the Kenai River this year. Many of these sites are associated with large cobble and rubble substrates at the upstream tips of islands.

Juvenile Salmon Study in Puget Sound

The National Fishery Research Center in Seattle has worked with the Washington Cooperative Fishery Research Unit and Sea Grant in a study on the feeding behavior and diet composition of juvenile salmon in a Puget Sound

salt marsh. Juvenile chum and chinook salmon fed heavily on salt-marsh insects and amphipods during daytime high tides. Estimates of daily food intake ranged from 10% to 20% of fish body weight, indicating that body weight probably was increasing by 3% to 6% per day. Even a short period of such rapid growth could be very advantageous, since survival of fry is related to body size at the time of entrance into saltwater.

Protection of Returning Atlantic Salmon Against Furunculosis

Atlantic salmon returning to the Penobscot and Connecticut Rivers often develop furunculosis during the five months they are held before spawning at Craig Brook (Maine) or Berkshire (Massachusetts) National Fish Hatcheries. High mortality was prevented in past years by an effective antibiotic, chloramphenicol. The Food and Drug Administration suggests a "conditional use" permit since chloramphenicol has not been cleared for use on fish. Disease specialists at the National Fish Health Research Laboratory, West Virginia, have begun work on alternative controls. A candidate antibacterial, potentiated sulfonamide Ro5-0037, was tested on salmon at Craig Brook and Berkshire. Additionally, passive immunization was tested at Berkshire by injecting anti-*Aeromonas salmonicida* serum prepared from a few hyperimmune salmon.



Biologists inspect the exit of a tunneled fish ladder, on the Russian River, Alaska.

FISHERY • RESEARCH

GREAT • LAKES • FISHERIES

Earliest known illustration of a reel from a 13th century Chinese painting.



Fishery research in the Great Lakes is oriented toward improving the recreational and commercial fisheries. Fishery stocks of native and stocked species in the Great Lakes are assessed in order to provide data for management decisions. Research studies also include testing chemicals for use as lampricides in tributary streams and studying the sea lamprey life cycle to find a biological means of lamprey control. Of particular concern is the potential impact of lampricides on important commercial, sport and forage fishes.

Strengthened Bloater Stock

Recent surveys for young bloaters show that the resource continues to strengthen. Catches indicated that the 1977 year class was the strongest since 1970, and that the 1978 year class was the strongest since assessment surveys began in 1967. These year classes should begin entering the fishable stock in significant numbers in 1980 and 81.

Effects of Ship-Induced Waves in an Ice Environment

In response to requests from the Division of Ecological Services (FWS-ES) and the U.S. Army Corps of Engineers (CE), the Great Lakes Fishery Laboratory, Ann Arbor, Michigan, conducted CE-funded studies during January-April, 1979, at selected sites in the St. Marys River (the connecting waterway between Lakes Superior and Huron). These studies were performed in connection with the Corps' Winter Navigation Season



Fish stocks in the Great Lakes are determined by sampling with a trawl.



Using a grab sampler to bring up aquatic plants from Lake St. Clair.

Extension Program and were designed to permit preliminary evaluation of the effects of ship-induced, under-ice surge and drawdown waves on fishery resources. Support for these investigations was generated on January 25, 1978, when representatives of FWS-ES, the Michigan Department of Natural Resources and the U.S. Army Cold Regions Research and Engineering Laboratory witnessed the ramparting of ice blocks at the

shoreline and the hydraulic transport of sediments and aquatic biota onto shore ice, during the passage of an ore carrier off Frechette Point in the St. Marys River.

Alternative Methods of Sea Lamprey Control: Attractants and Repellants

During FY 1979, over 600 behavioral bioassays were conducted at the Hammond Bay Biological Station on Lake Huron

near Rogers City, Michigan, and at the Monell Chemical Senses Center in Philadelphia, Pennsylvania. The purpose of these bioassays was to aid in isolating and identifying sea lamprey pheromones that could be used as attractants or repellants for spawning-run adults. The results have confirmed that the substances released by sexually mature lampreys, which attract other sexually mature lampreys, are present in the lamprey's urogenital fluid. These bioassays have also confirmed that sexually mature male lampreys, captured early during the spawning run, are attracted to water in which sea lamprey ammocoetes have been held. Sexually mature males tested later in the spawning run also appear to be attracted to rinses of ammocoetes, but the intensity of the response is less than that observed earlier in the run. The results suggest that spawning-run sea lampreys may use chemical cues emanating from the resident ammocoete population in a river to aid them in finding a suitable spawning area. Such a response would explain the reduced spawning run frequently observed in rivers treated the previous year with TFM—that is, when the ammocoetes in a stream system are killed by the application of TFM, an important attractant for migrating adults may be reduced or eliminated. Although lampreys probably use a number of cues in locating a suitable stream for spawning, the odors released by ammocoetes that are resident in the stream may be an important one.

FISHERY • RESEARCH INLAND • FISHERIES

All the accoutrement of the 19th century fly fisherman.



Research on inland fish species is oriented toward solving the problems in the production, distribution, survival and harvest of fish stocks. The major research efforts of the inland fisheries program are the formulation and testing of new diets and feeds for intensive fish culture, the diagnosis and treatment of fish diseases, strain evaluations of cultured fish species, investigations into various aspects of fish husbandry and training and field studies on inland fisheries. A sizeable effort is made to understand the dynamics of large reservoirs and their fish populations, and the causes of fluctuations of these populations.

Rainbow Trout Strain Characterization

Studies continued at the Fish Genetics Laboratory, Buelah, Wyoming, to genetically characterize different rainbow trout strains under controlled conditions and to determine their suitability for various management uses. Of the 14 strains evaluated through 364 days of age, numerous strain differences have been found: feed conversion efficiency (1.38 to 2.76) frequency of crippled fry at the swim-up stage (4.3 to 14.9%), mean fish weight at 147 days of age (2.8 to 7.0g), mean fish weight at 364 days of age (85 to 202g) and frequency of vertebrae fusions at 364 days of age (6.2 to 27.2%).

Effect of Feeding Frequency

Knowledge of the effect of feeding frequency is a promising method of improving feed utilization



Sampling for fish with an electro-shocker in the tailwater below Green River Lake, Kentucky. Fish are collected with nets after they are drawn to the surface by the current.

efficiency and reducing production costs. In studies conducted during 1978 at the Fish Farming Experiment Station, Stuttgart, Arkansas, it was found that weight gain of channel catfish reared in 28°C water and fed 2 to 4 times daily exceeded the weight gain of channel catfish fed the same amount of feed once daily by 10% and 23% respectively. Studies in 1979 showed that fish reared in 22°C water and fed 4 times daily resulted in production increases of 14.8% and 8.5% over those obtained by feeding the same amount of feed once or twice daily. Fish reared in

33°C water showed production increases of 18.4% and 8.9% when fed 4 times daily in comparison to feeding the same amount of feed once or twice daily.

Detection of Immunity in Fish

New methods developed at the National Fish Health Research Laboratory in Leetown, West Virginia, demonstrated the time/cellular response relationship of lymphocytes producing specific antibodies and its subsequent appearance in circulation after fish were given bacterins against fish diseases. The results gave more

sensitive and earlier indications of the immune response of fish than previous methods.

Bacterial Pathogen Detection and Disease Diagnosis

Research continued at the National Fish Health Research Laboratory on methods to develop and validate direct Fluorescent Antibody Tests (FAT) for fish pathogens. These rapid tests give pathogen-specific information for diagnosis and high sensitivity for detecting subclinical bacterial kidney disease (BKD), enteric redmouth (ERM) and furunculosis. The FAT is completed in about seven minutes by microscopic examination after adding fluorescent dye-labeled specific antiserum to tissues

containing fish pathogenic bacteria. Bacteria showing a positive reaction fluoresce brilliantly in ultraviolet light.

National Fisheries Center Visited by President and First Lady

A highlight of the year at the National Fisheries Center in Leetown was a visit by President and Mrs. Carter. The party flew from Camp David to Leetown by helicopter for a tour and briefing of the new National Fish Health Research Laboratory and enjoyed more than three hours of trout fishing in Hopewell Run. The First Lady tried her hand at fly fishing. A retired Fish and Wildlife Service employee instructed her in the art of casting. President and Mrs.

Carter expressed their appreciation for a very pleasant and successful day at the center.

Fishing Derby Held in Honor of International Year of the Child

In recognition of the International Year of the Child, the National Fisheries Center and the Jefferson County Chapter of the Izaak Walton League of America jointly sponsored a fishing derby at the League's property near Leetown. Over 600 children, parents and guardians attended the event.

On-Line Searchable Fisheries File Accessible

The Librarian has created an on-line searchable fisheries file that may be accessed by telephone from



*The pike killifish (*Belonesox belizanus*), has established breeding populations in Dade County, Florida and preys on small native fish. Photo by Florida Game and Fresh Water Fish Commission.*

anywhere in the U.S. (and other countries as well) by calling the National Fisheries Center Library, Leetown, West Virginia. Currently, the file of 500 items is in a test stage. It is expected by the end of FY 1980 to allow public access to the file. A tape was prepared from this file which allowed computerized production of the April issue of *Fish Health News* by the Government Printing Office. Author, title, subject and genus/species indices are targeted for the July issue.

Water Re-Use in Aquaculture Studied at Tunison Laboratory

According to studies by the Tunison Laboratory of Fish Nutrition in Cortland, New York, salmonids in a nearly 100% closed experimental system grew better and had a better food conversion efficiency than fish held in flow-through, once used water. Applications of advanced waste water treatment techniques are essential to successful closed-system culture, and its efficiency is related to the ability to economically control and alter the physical and chemical characteristics of the water to suit the needs of the fish. Expanded-bed biofiltration, vertical-plate settling, ozonation and activated carbon treatment yielded wastes that were readily separated from the economically reuseable culture water. A full-scale, compact pilot system has been constructed based on this research and is being tested for its applicability to practical aquaculture.



Temperature and oxygen profiles are recorded in Keowee Reservoir, South Carolina prior to applying a fish toxicant to estimate fish present in the reservoir.

Program for Evaluating Captive Striped Bass Broodstock Begun

In response to the increasing demand for knowledge about striped bass reproduction, a program to domesticate and establish a captive broodstock was initiated at the Southeastern Fish Cultural Laboratory in Marion, Alabama. Striped bass, once found throughout the coastal drainage of the southeastern Atlantic states and the northern Gulf of Mexico, have been severely reduced in numbers as a result of over-fishing

and habitat alteration caused by pollution, dams, channelization etc. More than seventeen states and the Fish and Wildlife Service are propagating striped bass for release in reservoirs and estuaries. These programs have relied on wild broodfish to produce fingerlings for stocking.

Exotic Fish Studies in Florida

The National Fishery Research Laboratory in Gainesville, Florida, is responsible for developing a national research program on exotic fishes which are established or likely to become established in the nation's open waters. As part of this responsibility, the laboratory funded a contract to develop an *Atlas of North American Freshwater Fishes* which will illustrate and provide information on distribution, status and life history of each of the 760+ species found in the fresh, brackish and coastal waters of the United States.

A detailed field survey of Florida found 49 species of exotic fish in the State's waters with 18 species having established breeding populations. Six species (blue tilapia, spotted tilapia, tilapia Mozambique, walking catfish, oscar and black acara) have significantly expanded their populations in the past five years. Some of these populations may be adversely impacting native fish populations. A detailed nationwide survey of exotic fishes in U.S. waters determined that 84 exotic species have been taken from the open waters of the nation and 39 have established breeding populations.

RELATED PROGRAM AREAS

Neither snow, nor sleet, nor thick ice shall keep a fisherman from his appointed catch.



Fishery resources activities are interrelated with other Fish and Wildlife Service programs, and with other Federal and State programs involving fish and wildlife and their habitats. Many of the activities conducted as part of Fishery Resources also contribute to other Service programs, such as Habitat Preservation and Endangered Species. The activities undertaken in these and other cooperative programs are important steps in the fulfillment of Fish and Wildlife Service goals.

Interpretation and Recreation

Many Fishery Resource facilities are open to the public and receive large numbers of visitors during the year. At some hatcheries and

development centers there are aquaria containing specimens of fish native to the area as well as species of fish used by personnel in hatchery and stocking programs. Fishery resources personnel conduct tours of facilities and distribute pamphlets and brochures describing present operations and historical activities.

During June and July, the Jordan River hatchery in Michigan conducted a program in environmental education for Youth Conservation Corps personnel. The annual visitors' weekend at Spring Creek hatchery in Washington presented thousands of visitors the opportunity to observe the station's activities. Seven nearby schools brought students for instructional tours. In FY 1979, approximately 19,500 persons from many states

and foreign countries visited the Cohutta National Fish Hatchery in Georgia. Remarks made by the visitors about the aquarium were "beautiful", "very impressive", "enjoyable", "well-kept", "something to be proud of" and "we need more of the same". The National Fish Hatchery at Jackson, Wyoming, welcomed approximately 50,000 visitors during FY 1979. Twenty-four group tours and talks were given, and 10,000 leaflets describing the hatchery were distributed.

Habitat Preservation

During FY 1979, many projects of the Fishery Resources Program were involved in the preservation of fish and wildlife habitat, including studies to identify and evaluate environmental



Information is gathered for instream flow requirements of fish.

contaminants that affect these resources.

Studies associated with habitat preservation included the determination of inflow stream needs for water resources on the Wind River Reservation in Wyoming.

In heavily fished areas, such as Yellowstone National Park, the Fish and Wildlife Service and the National Park Service worked together in formulating regulations to maintain fish populations and to maintain water areas in as near a natural state as possible. Efforts are being made to permit heavy angling pressure while at the same time do so without disturbing the natural environment.

Cooperative studies with the Corps of Engineers in FY 1979 were in connection with the evaluation of ship-induced, under-ice surge and drawdown waves on fishery resources in the Great Lakes.

Field investigations were done at Montana's Big Horn River and in Coos Bay, Oregon, on the environmental tolerance level of gas supersaturation in marine and alpine ecosystems. Results suggested that there was a strong need to define limits of gas pressures on fishery resources, both as an emergency procedure to save fish and as an operational alternative to the reconstruction of facilities such as dams.

Endangered and Threatened Species

During FY 1979 numerous fishery resource projects were involved

with the protection and restoration of endangered and threatened fish species. For example, the Lahontan National Fish Hatchery in Nevada continued to operate the Marble Bluff Fishway on Pyramid Lake which was constructed in order to help cui-ui sucker and cutthroat trout swim up to their spawning grounds on the Truckee River. This fishway provides a means of avoiding the silt-clogged delta where the lake and river join.

In relation to the Tellico Dam Project, biologists were involved in 48 census surveys, 5 informal Section 7 consultations and transplant operations involving 1,515 snail darters. Cooperative transplant efforts by the Service and the Tennessee Valley Authority were aimed at establishing populations in the Hiawasee and Holston Rivers in Tennessee. Fishery Resources personnel located scattered individuals of the threatened spotfin chub in the Emroy River, Morgan County, Tennessee. The watershed of this relatively small river system is thought to be in jeopardy because of ongoing coal strip-ming activities on the Cumberland Plateau. Attempts were also made to more accurately define the critical habitat of the spotfin chub in the upper Little Tennessee River system.

The Fish and Wildlife Service again took part in activities of the Okaloosa Darter Recovery Team. Service involvement was requested because of a fear that a close relative, the brown darter, was encroaching on the endangered

fish's range. Ten man-days were spent by a fishery resources biologist in monitoring the darter populations on Eglin Air Force Base in northwest Florida.

The Colorado River Fishery Investigation Project with headquarters in Salt Lake City, Utah, undertook a high priority effort to collect biological information on the endangered and threatened species in the Colorado River.

Training

The Fisheries Academy at Leetown, West Virginia, which was established in FY 1978, provided professional fisheries training for Fish and Wildlife Service fishery biologists and for other Federal, State, private and foreign biologists. The academy is dedicated to the continuing education and development of fishery managers and is intended to provide practical courses aimed at better field management. Experts from government, industry and universities conduct training courses to provide the best up-to-date information available. Several courses traditionally taught by fishery research staff members are included in the academy's program. Two long courses, one on fish health, conducted at the Fish Health Research Laboratory, and one for hatchery managers were given at the Spearfish National Fish Hatchery in South Dakota.

Students from the United States, Canada and other foreign countries took two-week courses in fish culture during FY 1979 at the



Biologists with the Tennessee Valley Authority and the Fish and Wildlife Service acclimate snail darters before release into the Holston River, Tennessee.

Spearfish Fisheries Center. Shorter fish culture courses demonstrated modern equipment and techniques.

Cooperative Projects

Many fishery resources activities are carried out in cooperation with other agencies and programs in order to ensure that assistance, production and research efforts are properly coordinated.

In exchange for lake trout eggs, the New London hatchery in Minnesota supplied the Canadian Province of Manitoba with smallmouth bass. Under a cooperative arrangement with the Minnesota Department of Natural Resources, the station carried on a program of walleye egg incubation while retaining sufficient fry for its own production needs. A tripartite cooperative program originating at the Leavenworth National Fish Hatchery in Washington involved funding by the Bureau of Reclamation of kokanee salmon production at the station; the eggs and subsequent distribution were provided by the Washington Department of Fisheries. The Lake Champlain Fish and Wildlife Management Cooperative, involving the Fish and Wildlife Service and the States of New York and Vermont, continued the evaluation of the sea lamprey population in Lake Champlain. Surveys were conducted in four areas: the timing and extent of sea lamprey spawning runs in two tributaries, transforming lamprey surveys using trap net sets, ammocete surveys using backpack shockers and sea lamprey attack

data collection involving three creel census checks.

A five-year cooperative Federal Aid agreement was initiated during FY 1979 between the South Carolina Wildlife and Marine Resources Department and the Fish and Wildlife Service's Orangeburg National Fish Hatchery to develop techniques of spawning, rearing and transporting Atlantic sturgeon. During FY 1979, six broodstock (100-300 pounds) were captured off Georgetown, South Carolina, in the Atlantic Ocean. The first "induced spawn" of this species was accomplished with the result that about 100 fish were reared to four-inch fingerlings.

Construction and Engineering

Fishery resource facilities require continual maintenance and repair to provide the quality and numbers of important sport and commercial fish species desired by the nation's fishermen. New construction is also required to keep up with the demands and to provide facilities to do the research conducted by the Service.

Over 50 construction contracts were awarded in 1979 with construction varying from minor rehabilitation projects to major new construction projects of fish hatcheries and fishery research facilities. The largest single award of about \$11.4 million was for the initial phase of construction of the Makah National Fish Hatchery on the Makah Indian Reservation in Washington. This initial phase has



The recently completed National Fishery Research Laboratory at La Crosse, Wisconsin was engineered for conducting a wide range of sophisticated studies.

been scheduled for completion in June, 1981. Annual fish production for this hatchery will be around 11 million fish weighing nearly 200,000 pounds.

Construction at the Iron River Fish Hatchery in Wisconsin is continuing with plans for building the hatchery starting in the summer of 1980.

In Fishery Research, construction continues at the La Crosse (Wisconsin) Laboratory. The main laboratory building is scheduled for completion early in 1980. The majority of the site work is

completed with the additional remaining work scheduled to be completed in the spring of 1980.

The Leetown National Fishery Center in West Virginia had its new laboratory building accepted for use in February of 1979 and construction started on a training academy in July.

Construction continues at the Wellsboro Laboratory in northeast Pennsylvania. A waste treatment system was accepted for use in July and a paving contract was awarded in September. Design is underway for the outside ponds and raceways.

A P P E N D I X

Finally, if the fish won't come to you; you come to the fish—with a bow and arrow.



Summary of Fishery Assistance on Areas Served

Fiscal Year 1979

AGENCY SERVED	NUMBER OF AREAS SERVED	ACRES OF IMPOUND- MENTS	MILES OF STREAMS	HATCHERY FISH STOCKED		MAN- DAYS OF FISHING
				LBS.	NO.	
Air Force	31	3,100	29	43,800	177,400	256,700
Army	64	21,500	318	149,300	1,080,200	915,600
Navy & Marine	35	7,100	189	12,900	160,300	228,700
National Forests	16	17,700	2,964	379,700	2,398,100	2,045,700
National Parks	11	136,100	5,681	19,000	72,400	520,800
National Wildlife Refuges	75	493,500	532	25,700	3,196,300	1,566,400
Veterans' Administration	21	200	1	6,900	31,100	24,500
Other Federal Areas	14	600	1	10,400	243,100	43,300
Indian Reservations	106	558,100	8,623	723,800	16,746,800	2,001,100
Federal-State Cooperative Areas	48	10,600	764	277,000	1,899,900	936,700
Other Public Waters	8	1,800	12	968,100	52,573,200	130,800
Private Waters	6	700	140	1,400	205,500	22,400
TOTALS	435	1,251,000	19,254	2,618,000	78,784,300	8,692,700

Fish and Fish Egg Distribution by Major Groups

Fiscal Year 1979

	Warmwater		Coolwater		Non-anadromous Salmonid		Anadromous Salmonid		Other		Total	
	number	pounds	number	pounds	number	pounds	number	pounds	number	pounds	number	pounds
eggs	67,000	7	4,130,200	115	16,073,091	2,451	30,306,211	18,942	—	—	50,576,502	21,515
fry	9,529,585	2,074	105,478,010	1,222	3,423,538	1,308	6,612,487	24,458	—	—	125,043,620	29,062
fingerlings	51,063,698	250,881	10,800,572	7,085	25,119,514	859,493	75,342,884	1,733,642	—	—	162,326,668	2,851,101
adults	308,407	66,261	9,509	875	11,482,023	3,096,356	330,343	64,174	8,000	165	12,138,282	3,227,831
total	60,968,690	319,223	120,418,291	9,297	56,098,166	3,959,608	112,591,925	1,841,216	8,000	165	350,085,072	6,129,509
	includes bass, sunfish, catfish, etc;		includes yellow perch, walleye, sauger, northern pike, muskellunge, etc;		includes rainbow, brown, brook and other trout species		includes Pacific and Atlantic Salmon		includes crawfish			

Anadromous Fish Act Funds

Alabama

Hatchery Production and Stocking

AFCS-6

FY 79 Allocation \$20,000

To produce fingerlings and determine tag loss and fouling and maximum stocking densities in cage rearing of striped bass to be stocked in Alabama estuaries.

Alaska

Southeast King Salmon Investigations

AFS-41

FY 79 Allocation \$59,000

To determine the contribution of Alaska chinook salmon stocks to southeastern Alaska fisheries and to determine the feasibility of increasing the sport catch by pond rearing and smolt stocking.

Southeast Alaska Steelhead and Sea-run Cutthroat Trout Investigations

AFS-42

FY 79 Allocation \$38,600

To determine the life history of steelhead and sea-run cutthroat trout in the Petersburg Creek system.

Mendenhall Salmon Rearing Ponds

AFS-43

FY 79 Allocation \$59,450

To convert seven lakes (30.8 acres) to salmon or steelhead smolt rearing ponds for stocking in the Mendenhall River.

Russian River Red Salmon Study

AFS-44

FY 79 Allocation \$19,950

To determine escapement, reproduction and other life history facts of red salmon on the Russian River.

California

Mad River Fish Hatchery Operations AFS-15

FY 79 Allocation \$88,000

To augment north coastal fisheries for steelhead and salmon by rearing and releasing annually 1 million yearling steelhead and silver salmon in combination and 5 million king salmon.

American Shad Study

AFS-17

FY 79 Allocation \$72,000

To determine size of runs, distribution, and utilization, particularly in the major central valley streams.

Trinity River Anadromous Fish Study AFS-20

FY 79 Allocation \$89,000

To determine salmonid harvest and escapement, juvenile life history and emigration and to evaluate the Trinity River Hatchery in order to determine the causes of the decline in anadromous fish runs.

Connecticut

Connecticut River Basin Anadromous Fishery Research and Management AFS-4

FY 79 Allocation \$20,800

To determine research and management needs in the Basin and design a program to meet them.

Quinebaug-Thames River Study AFS-5

FY 79 Allocation \$2,000

Limnological and fisheries study to determine the success of introducing American shad and

coho salmon.

Delaware

Delaware River Basin Studies AFS-2

FY 79 Allocation \$14,000

To develop the sport and commercial fisheries of the Basin with emphasis on American shad and striped bass.

Restoration of Shad Run in Brandywine Creek and Its Tributaries AFSC-4

FY 79 Allocation \$3,200

To restore runs of anadromous fishes to Brandywine Creek with the States of Delaware and Pennsylvania and thereby provide an estimated additional 30,000 man-days of recreational fishing annually.

Georgia

Enhancement of Striped Bass in Ogeechee River

AFS-11

FY 79 Allocation \$20,000

To produce striped bass fry and rear fingerlings for stocking in the Ogeechee River to enhance the striped bass fishery.

Illinois

Purchase of Chinook Salmon Smolts AFS-3

FY 79 Allocation \$39,000

To purchase 400,000 chinook salmon fingerlings from Michigan for release in Lake Michigan.

Lake Michigan Anadromous Fish Management

NEW

FY 79 Allocation \$12,500

To monitor anadromous fishes in Illinois waters of Lake Michigan by determining harvest, movement, distribution, population, structure and salmon sport fishing patterns.



The Platte River Hatchery: producing Pacific salmon for stocking the Great Lakes. Photo by Michigan Department of Natural Resources.

Indiana

Lake Michigan Anadromous Fish Stocking AFS-3

FY 79 Allocation \$38,000

To maintain the existing salmonid fishery by stocking 100,000 each of coho salmon, brown, and steelhead trout, and 200,000 chinook salmon annually.

Louisiana

Striped Bass Production

AFS-6

FY 79 Allocation \$20,000

To operate and maintain anadromous striped bass hatchery constructed under a previous project

Maine

Evaluation of Penobscot River Migrations AFS-12

FY 79 Allocation \$16,000

To evaluate the effectiveness of the Penobscot Model River restoration program.

Development of Shad and Smelt Fishery Resources

AFS-19

FY 79 Allocation \$25,000

To restore American shad in barren coastal streams and assess smelt sport fishery.

Evaluation of Salmon Spawning Sites and Winter Habitat

AFS-20

FY 79 Allocation \$3,000

To assess potential Atlantic Salmon spawning areas in Maine rivers to maximize use of these areas in



Steelhead (sea-run rainbow trout): one of several anadromous fishes being managed by coastal States. Photo by Washington Department of Game.

management of this fishery.

Atlantic Salmon Planning NEW

FY 79 Allocation \$3,000

To conduct a Statewide planning project for restoration of Atlantic salmon and to coordinate with Atlantic salmon planning by Fish and Wildlife Service.

Massachusetts

Connecticut River Basin Studies

AFS-4

FH 79 Allocation \$52,000

To determine research and

management needs in the Connecticut River Basin and to design a program to meet them.

Merrimack River Basin Restoration Program

AFS-10

FY 79 Allocation \$30,000

To investigate the Merrimack River Basin in Massachusetts and New Hampshire to determine feasibility of restoring runs of anadromous fish. To coordinate and implement an anadromous fish restoration plan.

Michigan

Fish Passage, Weirs and Barriers AFS-22

FY 79 Allocation \$338,100

To construct fishways, weirs, traps and sea lamprey barriers to increase spawning and sport fishing areas, to prevent spawning of sea lampreys and to facilitate spawning for hatchery purposes. Includes 4 separate projects.

Sturgeon River Sea Lamprey Barrier NEW

FY 79 Allocation \$12,500

To develop plans for construction of a sea lamprey barrier on the Sturgeon River.

Minnesota

Improvement of Sport Fishing for Anadromous Species

AFS-3

FY 79 Allocation \$34,000

To increase the sport fishing opportunities and the quality of angling for certain anadromous

fishes on streams tributary to Lake Superior, through habitat improvement and annual stocking of up to 300,000 steelhead trout and coho salmon smolts.

Andromous Fish Stocking
NEW

FY 79 Allocation \$51,500

To produce salmon and steelhead at the French River and Spire Valley fish hatcheries for stocking in Lake Michigan.

Mississippi

Hatchery Production
AFSC-5

FY 79 Allocation \$17,500

To establish populations of striped bass which will utilize the coastal streams, the estuaries, and open Gulf of Mexico waters by stocking striped bass strains which are known to utilize each type of water.

New Hampshire

Connecticut River Basin Anadromous Fishery Studies
AFS-4

FY 79 Allocation \$6,800

To determine research management needs in the Connecticut River Basin, and to design a program to meet those needs.

Coho Salmon Introductions
AFS-5

FY 79 Allocation \$15,700

To establish a coho salmon fishery in New Hampshire's Great Bay, Little Bay and Piscataqua River



Most runs of anadromous fishes receive heavy fishing pressure. Photo by Maryland Department of Natural Resources.

area.

Merrimack River Basin Restoration Program
AFS-10

FY 79 Allocation \$15,800

To restore American shad and Atlantic salmon in the Merrimack River. Activities include planning, research and coordination.

New Jersey

Delaware River Basin Anadromous Fishery Studies
AFS-2

FY 79 Allocation \$12,000

To develop the sport and commercial fisheries of the basin with special emphasis on American shad and striped bass.

Shad Study, Raritan River
AFS-6

FY 79 Allocation \$7,500

To conduct surveys to determine

feasibility of development program.

New York

Delaware River Basin Andromous Fishery Studies
AFS-2

FY 79 Allocation \$18,000

To develop the sport and commercial fisheries of the basin with special emphasis on American shad and striped bass.

Anadromous Trout and Salmon Hatchery Development
AFS-8

FY 79 Allocation \$350,000

To construct a major hatchery for production of trout and salmon smolts for recreational fishing in Lake Ontario and its tributaries.

Anadromous Fish Enhancement in Lake Ontario
FA-2-R

FY 79 Allocation \$26,000

To complete development of plan for Lake Ontario to serve as a baseline for research and management activities.

Fish and Wildlife Management Coordination

FWA-2-C

FY 79 Allocation \$16,500

To participate in cost of administering the State's Federal Aid Program.

Lake Erie Investigations

NEW

FY 79 Allocation \$20,000

To develop a plan for Lake Erie anadromous fishes to serve as a baseline for research and management.

Hudson River Sturgeon Study

NEW

FY 79 Allocation \$25,000

To study the biology and management of the short-nosed sturgeon and Atlantic sturgeon of the Hudson River.

North Carolina

Anadromous Fisheries Research, Neuse River

AFCS-13

FY 79 Allocation \$12,500

To define the status, abundance and vital statistics of Neuse River anadromous fish populations.

Cooperative Management of Striped Bass

AFCS-14

FY 79 Allocation \$31,900

To obtain appropriate data on Albemarle-Roanoke River striped bass in order to initiate and maintain realistic management of

these stocks and their dependent fisheries on an optimum yield basis.

Anadromous Fisheries Research, Cape Fear, Phase II

NEW

FY 79 Allocation \$10,800

To identify anadromous fish nursery areas throughout the Cape Fear River; to establish representative sampling stations to monitor relative abundance of juveniles during future segments; and to require data on growth and movement of juvenile anadromous fishes.

Biology and Management Under Extended Jurisdiction

NEW

FY 79 Allocation \$42,300

To estimate catch and effort statistics in North Carolina and Virginia and to detect changes in the intensity and success of the river fishery.

Ohio

Anadromous Fish Resource Enhancement

AFS-4

FY 79 Allocation \$41,400

To stock into Lake Erie 400,000 coho and 300,000 chinook salmon smolts to produce 100,00 angler days of recreational fishing.

Oregon

Streamflow Requirements of Salmonids

AFS-62

FY 79 Allocation \$37,200

Preliminary investigation to determine the relation of

anadromous and resident salmonid production to streamflow.

Rock Creek Fish Hatchery Rehabilitation

NEW

FY 79 Allocation \$58,600

To replace old ponds, water lines, intake dam, construct a pollution abatement facility, and develop a supplemental water supply from the North Umpqua River.

Genetic Studies and Stock Assessment

NEW

FY 79 Allocation \$125,000

To evaluate spray immunization against vibriosis; to assess ocean distribution, catch and escapement of hatchery stocks and native stocks reared in hatcheries; and to assess transfer of fish on ocean catch and distribution.

Ocean Sport Catch Assessment

NEW

FY 79 Allocation \$32,000

To determine the economic value of ocean sport caught anadromous fish.

Fish Disease Investigations and Treatment

NEW

FY 79 Allocation \$40,000

To develop rapid and efficient methods for detection of diseases, primarily viral diseases, and to improve or develop new methods of control.

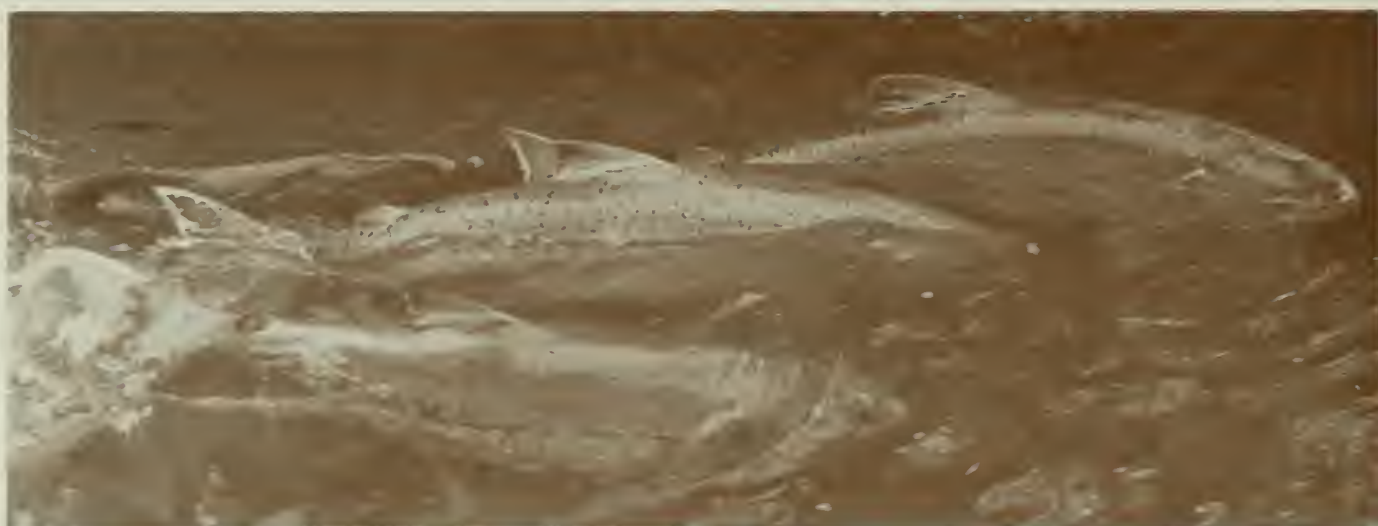
Pennsylvania

Delaware River Basin Anadromous Fishery Studies

AFS-2

FY 79 Allocation \$10,000

To develop sport and commercial



Chinook salmon spawning in an Oregon coastal river. Photo by Oregon Game Commission.

fisheries of the basin with special emphasis on American shad and striped bass.

Restoration of Shad Run in Brandywine Creek and Its Tributaries

AFSC-4

FY 79 Allocation \$500

To restore runs of anadromous fishes to Brandywine Creek within the States of Delaware and Pennsylvania and thereby provide an estimated additional 30,000 man-days of recreational fishing annually.

Establishment and Maintenance of Pennsylvania Waters of Lake Erie

AFS-5

FY 79 Allocation \$88,800

To establish chinook salmon in Lake Erie and to maintain populations of coho and chinook salmon in Lake Erie at a level which will provide a high quality sport fishery.

Girard Anadromous Fish Rearing Station
NEW

FY Allocation \$65,500

To rehabilitate the Girard Anadromous Fish Rearing Station for production of Pacific salmon.

Susquehanna River Anadromous Fish Research

NEW

FY 79 Allocation \$25,000

To determine status of hickory shad populations in the Susquehanna River.

South Carolina

Detail Studies of the Santee and Cooper Rivers

AFS-3

FY 79 Allocation \$37,500

To obtain biological, chemical and physical data on the anadromous species in the Santee and Cooper Rivers.

Enhancement of Striped Bass in Santee River

NEW

FY 79 Allocation \$52,000

To stock and evaluate hatchery reared striped bass and determine natural reproduction and survival.

Atlantic Sturgeon Research and Management

NEW

FY 79 Allocation \$25,000

To develop hatchery cultural techniques for spawning and rearing of Atlantic sturgeon.

Vermont

Connecticut River Basin Studies

AFS-4

FY 79 Allocation \$6,800

To determine research and management needs in the basin and to design a program to meet those needs.

Washington

Operation of Fish Ponds

AFS-48

FY 79 \$136,500

To operate fish ponds constructed with PL 89-304 funds to provide maximum production of steelhead and sea-run cutthroat migrants. A consolidated O and M project, replacing the former individual rearing projects.

Development of Anadromous Fish Catch Record System

AFS-50

FY 79 Allocation \$57,800

To develop a computerized system for instantaneous daily estimates of the steelhead and salmon harvest to assure proper sharing of fish with Indians and to provide adequate escapement for perpetuation of the runs.

Nisqually Fisheries Enhancement

AFCS-85

FY 79 Allocation \$42,500

To assess anadromous fish stocks on the Nisqually Reservation, to rehabilitate streams and to expand hatchery and rearing facilities. This project is related to implementation of the Judge Boldt Decision.

Development of Fish Counter

AFS-04

FY 79 Allocation \$50,000

To develop an acoustic fish counter for censusing upstream migrant salmon and steelhead. This project is related to implementation of the Judge Boldt Decision.

Fisheries Enhancement—Hoh Indian Tribe

AFCS-05

FY 79 Allocation \$20,400

To construct spawning and rearing facilities for chinook, coho, pink and chum salmon. This project is related to implementation of the Judge Boldt Decision.

Cedar River Sockeye Spawning and Rearing Channel

AFCS-104

FY 79 Allocation \$184,000

To construct a new sockeye spawning and rearing channel on the Cedar River for Lake Washington. This project is related to implementation of the Judge Boldt Decision.

Squaxin Island Pen Rearing of Coho



A very successful fishery for Pacific salmon has been developed in the Great Lakes through cooperative efforts under the Anadromous Fish Conservation Act. Photo by Michigan Department of Natural Resources.

Salmon

NEW

FY 79 Allocation \$10,000

To evaluate the contribution of pen reared coho salmon to the sport, commercial and Indian fisheries. The contribution to the spawning escapement will also be evaluated.

Northwest Indian Catch Monitoring

NEW

FY 79 Allocation \$42,000

To provide treaty Indian tribes with a computerized system to store and retrieve, on a real time basis, harvest and licence data for salmon fisheries of various rivers in the Boldt case area.

South Tacoma Hatchery Pump Intake

NEW

FY 79 Allocation \$20,000

To install a new water intake pump at the South Tacoma Fish Hatchery for the continued production of 2,500,000 steelhead fingerling smolts.

Wisconsin

Anadromous Fish Stocking and Evaluation

AFS-0

FY 79 Allocation \$305,000

To continue the sport fishery evaluation, experimental introduction and assessment of anadromous salmonid stocks in Lakes Superior and Michigan.

Sea Lamprey Barriers

AFS-

FY 79 Allocation \$50,000

To survey and select streams for construction of physical barriers against sea lampreys. One barrier per year will be constructed.

Distribution of Anadromous Fish Conservation Act Funds

State Allocations for
Fiscal Years 1967-1979

STATE	FISCAL YEARS 1967-1970	FISCAL YEARS 1971-1975	FISCAL YEARS 1976-1978	FISCAL YEAR 1979	TOTAL
Alabama	20,000	113,000	62,500	20,000	215,500
Alaska	309,400	366,750	709,295	177,000	1,562,445
California	1,045,625	959,500	830,500	249,000	3,084,625
Connecticut	72,450	169,233	173,000	22,800	437,483
Delaware	136,413	235,000	109,300	17,200	497,913
Florida	30,000	60,000	—0—	—0—	90,000
Georgia	69,388	136,550	89,000	20,000	314,938
Illinois	5,000	20,000	52,500	39,000	116,500
Indiana	15,000	135,000	119,500	38,000	307,500
Louisiana	27,800	125,000	55,000	20,000	227,800
Maine	650,675	276,950	223,750	47,000	1,198,375
Maryland	58,022	70,500	50,000	—0—	178,522
Massachusetts	93,987	242,354	142,100	82,000	560,441
Michigan	2,140,000	1,590,000	899,300	278,000	4,907,300
Minnesota	99,314	380,700	284,300	85,500	849,814
Mississippi	55,000	87,500	52,500	17,500	212,500
New Hampshire	63,638	303,352	90,800	38,300	496,090
New Jersey	43,230	99,750	57,250	19,500	219,730
New York	155,238	773,982	1,703,400	455,500	3,088,120
North Carolina	31,187	145,000	255,000	97,500	528,687
Ohio	15,000	—0—	42,500	41,400	98,900
Oregon	781,520	832,732	607,800	455,000	2,677,052
Pennsylvania	67,625	308,000	436,105	189,000	1,000,730
Rhode Island	53,500	96,595	23,500	—0—	173,595
South Carolina	69,200	285,500	248,500	114,500	717,700
Vermont	25,525	66,482	20,400	6,800	119,207
Virginia	238,437	215,000	20,000	—0—	473,437
Washington	716,300	657,020	1,540,200	542,700	3,456,220
Wisconsin	396,526	1,273,550	924,000	305,600	2,899,676
TOTAL	\$7,485,000	\$10,025,000	\$9,822,000	\$3,378,800	\$30,710,800

LEGEND

- [illegible]

