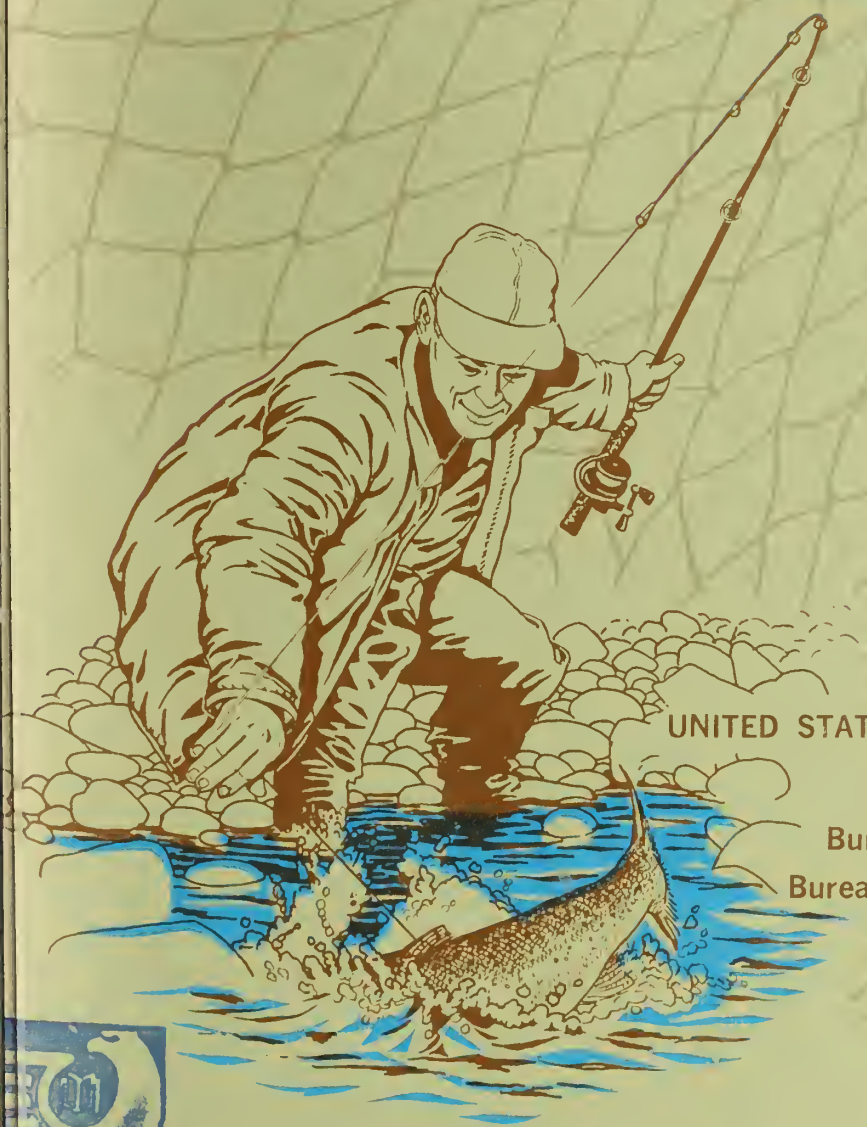
ANADROMOUS FISH RESOURCES

THEIR

CONSERVATION DEVELOPMENT ENHANCEMENT



UNITED STATES DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

Bureau of Commercial Fisheries

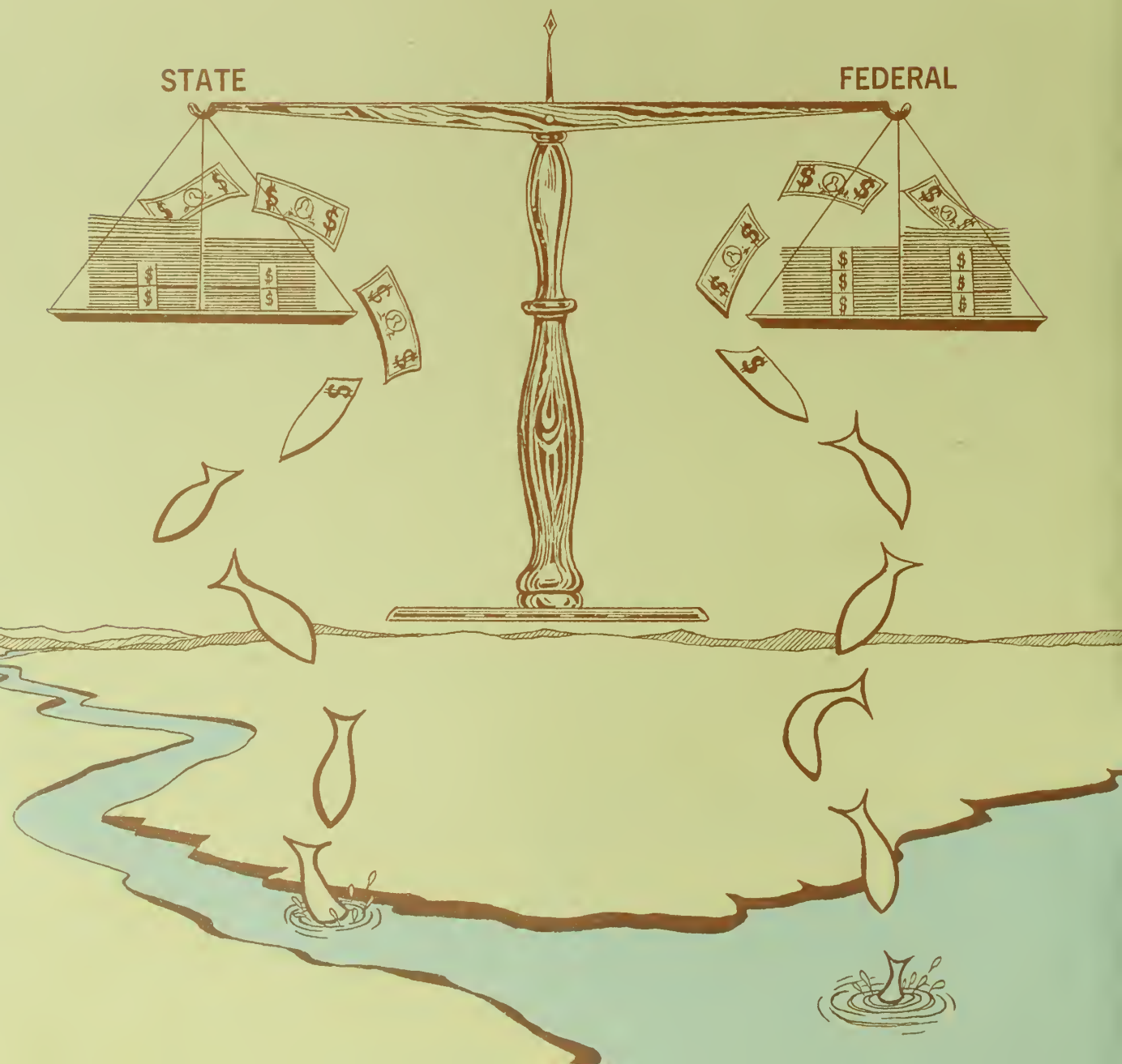
Bureau of Sport Fisheries and Wildlife

PARTNERSHIP

FOR

ANADROMOUS FISHERIES

EQUAL INVESTMENT



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CONSERVATION DEVELOPMENT ENHANCEMENT

UNITED STATES DEPARTMENT OF THE INTERIOR

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Washington, D.C.
March 1970

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FOREWORD

Anadromous fish—those which spawn in fresh water streams and migrate to the oceans or the Great Lakes—were in serious trouble a few years ago. Now there are hopeful signs.

Man with his technology, and his pollution, had drastically reduced the great runs of shad, river herring, Atlantic salmon, and other fish that once were the pride of many river systems.

The harvest had seemed unlimited. Now, to our sorrow, we know better.

For many years we fouled our rivers with city sewage and farm pesticides and industrial wastes.

We built dams that kept fish from getting back up-river to their native spawning grounds.

We stripped the land, letting silt cover the clean gravel bottoms of streams.

All this we did in the name of progress. Hardest hit of all were the estuaries—the bays and river mouths where fresh and salt waters mix—and the lakes.

And nature has been presenting her bill for payment.

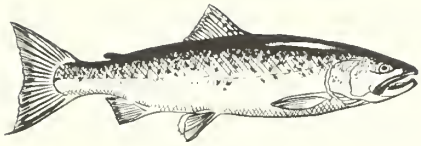
Aware of the need to restore a great natural resource, Congress in 1965 passed the Anadromous Fish Conservation Act. This law provides for Federal cooperation with States and others to conserve, enhance, and develop our anadromous fish.

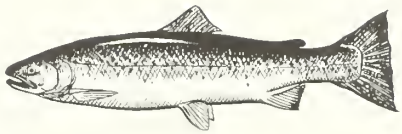
The program has sparked an enthusiastic response. A strong Federal-State partnership has developed and is flourishing.

This report summarizes the program's accomplishments and needs. It is encouraging. We must keep up the effort.

If we continue to work together, learning from and helping one another, we can do much to improve the environment—not only for anadromous fish, but for the American people.

SECRETARY OF THE INTERIOR





CONTENTS

THE PROGRAM

A Federal-State Partnership:

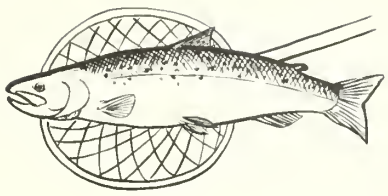
The enactment on October 30, 1965, of Public Law 89–304 teamed the Federal Government with the States and other non-Federal interests to build back and extend, where possible, the anadromous fishery resources of the Nation and the fish in the Great Lakes that ascend streams to spawn. At the Federal level, the program is administered jointly by the Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries.

The Act authorizes Federal appropriations up to $25 million through June 30, 1970. Federal dollars up to 50 percent may be used to finance project costs.

This combined Federal-State program got underway in October 1966 and during the next 4-year period met with enthusiastic response as evidenced by the participation of 29 of the 31 eligible States, plus 7 other non-Federal interests. In fiscal years 1967 through 1970 more than $15 million has been invested to help finance more than 200 projects. The States match the Federal dollars for project work; therefore, the total investment is more than $30 million.

The work carried out for the anadromous fishery resource supplements and in some instances expands the work being done individually by State and Federal agencies. It is a much needed addition to their efforts and has enabled significant accomplishments through well-coordinated and closely allied programs. Further, this program does not replace or alter the internationally known successful Columbia River salmon program being carried out by the U.S. Fish and Wildlife Service in cooperation with States within the Basin.

A brief description of each anadromous resource, including status of the fishery, and a cross section of accomplishments and needs are given in this report. Details of individual projects are available in a supplemental report from the U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife or the Bureau of Commercial Fisheries, Washington, D.C. 20240.



DISTRIBUTION OF FUNDS—STATES:

Distribution of Federal funds to States and other non-Federal interests is made on the basis of the size of their anadromous fishery resources and recognized problems faced by the concerned species, cost of continuing approved work, anticipated benefits, and potential for new work.

DISTRIBUTION OF FEDERAL PROGRAM FUNDS
(Fiscal Years 1967–70, inclusive)

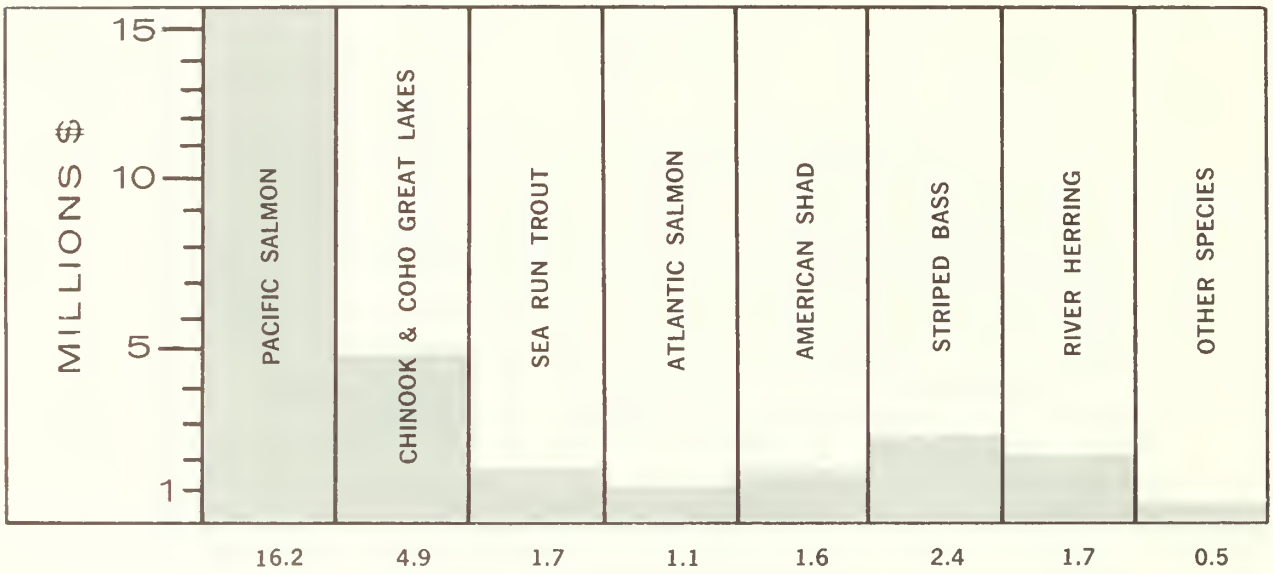
State	*Total Allocation*	*State*	*Total Allocation*
Alabama	$ 72,500	Mississippi	$ 123,000
Alaska	1,859,550	New Hampshire	118,800
California	2,155,200	New Jersey	84,950
Connecticut	128,650	New York	216,900
Delaware	210,000	North Carolina	179,025
Florida	$ 77,500	Ohio	$ 103,000
Georgia	115,100	Oregon	2,150,986
Illinois	21,000	Pennsylvania	147,000
Indiana	10,000	Rhode Island	141,000
Louisiana	103,000	South Carolina	89,200
Maine	$ 725,000	Vermont	12,300
Maryland	292,714	Virginia	505,500
Massachusetts	129,200	Washington	2,198,600
Michigan	2,255,000	Wisconsin	361,200
Minnesota	107,400	Special Allocation[1]	379,725
		Total	$15,073,000

[1] Other non-Federal interest.

All or part of an allocation not used by a State is withdrawn and distributed to other States to finance desirable work.

DISTRIBUTION OF FUNDS—SPECIES:

Salmon runs to the Pacific Northwest and Alaska, and introduced coho and chinook salmon stocks of the Great Lakes, are a tremendous asset to the Nation and the local economy. Therefore, the greater portion of the program funds have been used for enhancement of these resources. Other anadromous resources of the Great Lakes, the Atlantic Coast, and the Gulf of Mexico have received attention.



DISTRIBUTION OF FUNDS—ACTIVITY:

The critical problem areas and urgent needs of the resource were considered in developing the program. This resulted in a forceful well-balanced program.

PACIFIC SALMON

The Pacific salmon after spending from 6 months to 2 years in coastal streams and lakes depending upon the species, travel thousands of miles during their 2 to 6 years in the high seas. Thus, the stocks of fish are subjected to intensive international, national, and local fisheries. Five species make up the stocks.

Pink Salmon—Most abundant species on the West Coast, although comparatively rare south of Puget Sound. It is used primarily for commercial purposes and accounts for about 52 percent of the catch.

Sockeye Salmon—Second most abundant species on the West Coast, but are not abundant south of the Columbia River. It also is primarily taken by commercial fisheries and accounts for about 25 percent of the catch.

Chum Salmon—Third most abundant from Oregon northward. Primarily a commercial species, it accounts for about 13 percent of the catch. For unknown reasons, it has declined sharply in recent years.

Coho Salmon—Fourth in abundance of the Pacific salmon and is utilized for commercial and sport purposes. It is dispersed over the entire range but is most abundant from Alaska to northern California. This species is the most important contributor to the sport fishery. It has been successfully introduced into the Great Lakes.

Chinook Salmon—Although it ranges from Alaska to California's central valley, it is least abundant. This species is the largest of the salmons, attaining a weight of over 60 pounds. Also, introduced into the Great Lakes.

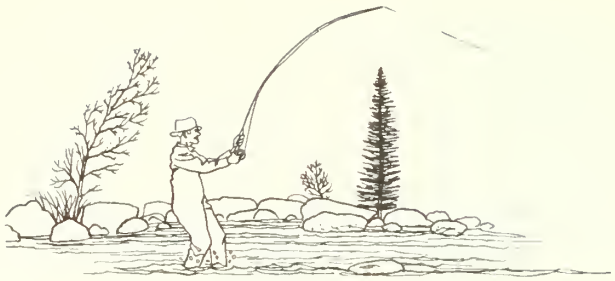
Collectively, the annual sport catch is about 1.8 million salmon in 3 million man-days fishing. The average annual commercial landings for the 5-year period (1963–67) was about 316 million pounds valued at $58 million.

RESOURCE ACCOMPLISHMENTS:

Accomplishments have been made in areas of research on improvement of the environment and of hatchery facilities and techniques.

Improvement of Environment

About 30 of the 181 earthquake-damaged pink and chum salmon streams in Prince William Sound, Alaska, have been restored. Production increases are evidenced in the improved streams and are directly attributable to the rehabilitation work. When the runs are fully restored, it will mean an annual economic gain of about $3 million to the area.

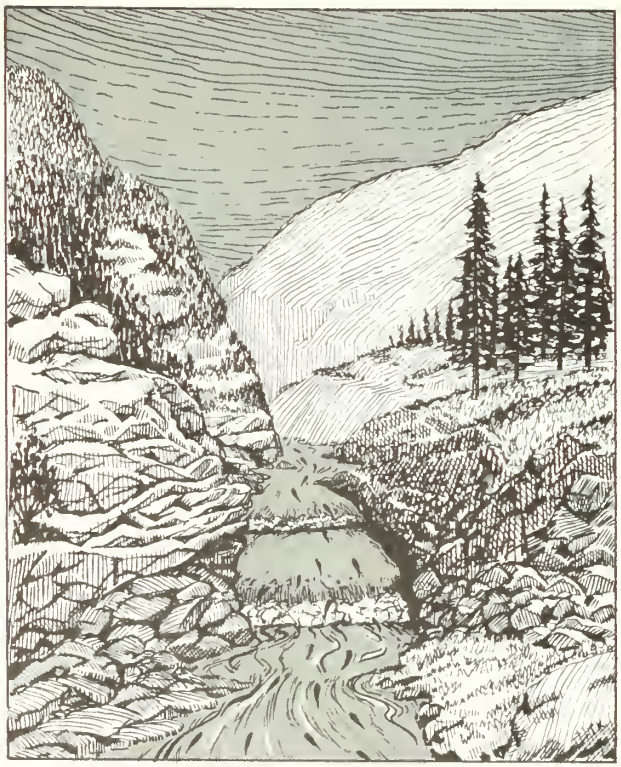


Under an aggressive stream clearance program, stream gradients at cascades and falls have been reduced, logjams and other temporary obstructions to fish movement removed, and stream beds altered in several Pacific Coast streams. Improvement of the streams has provided access for salmon to more than 200 miles of spawning and nursery areas.

Fish screens and bypasses have been installed at three diversion channels and one other is under construction in the Sacramento River, California, to protect downstream migrant fish. State fisheries scientists estimate that the four screens will save more than 12 million young salmon annually, and as returning adults, will provide about 100,000 angler-days fishing and support a commercial catch of more than 2.5 million pounds of salmon.

Additionally, artificial spawning channels for salmon are being developed to provide more spawning and nursery grounds. This work not only will increase production, but will result in better survival and growth of the fish.

Research



The purpose of State-Federal research effort on the Pacific salmon resource is to gain factual information on the stocks of fish within the streams and estuaries. This effort will supplement the oceanic work by the Bureau of Commercial Fisheries and others.

Improvements are being made in techniques for short-term forecasts of the timing and sizing of runs in Alaska as they near the inshore fisheries. The forecasts are not only valuable for management purposes but they also provide the fisheries with lead time for adjusting plant operations and disposition of the fishing fleet. This could mean savings of millions of dollars to industry through better use of manpower and equipment.

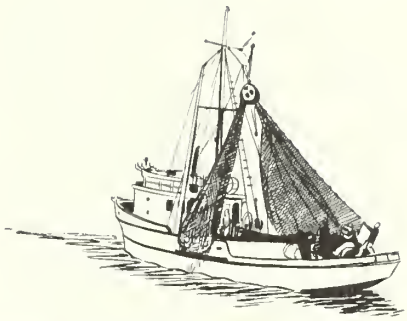
Significant advances have been made also for yearly forecasts of the size of salmon runs available to the fisheries. These forecasts are based on abundance of eggs and preemergent fry in the streams and of juveniles in estuaries. This provides information needed by the State for effective management of the resource.

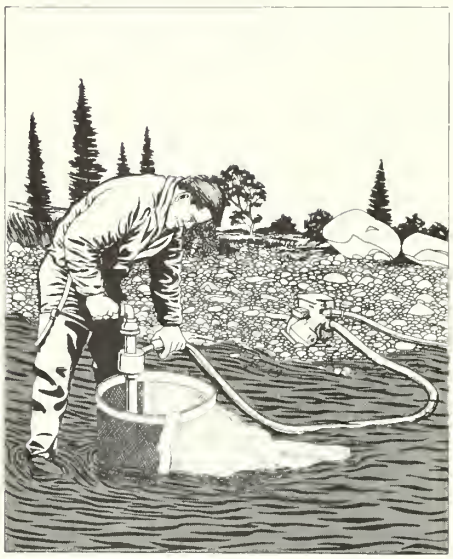
Progress is being made on the development and improvement of hatchery techniques for

detection and control of fish diseases, and on improvement of diets of hatchery-produced fish. This work could significantly affect the efficiency of hatcheries.

Water requirements for spawning king salmon and the migratory behavior in relation to flow reversals in areas of water use developments have been determined. Also a better understanding has been gained of the effects of logging operations and of measures of mitigating damages on salmon streams.

Additionally, to attain maximum use of the salmon resource, studies of gear modification are being made to reduce mortality of undersize and incidentally caught fish.





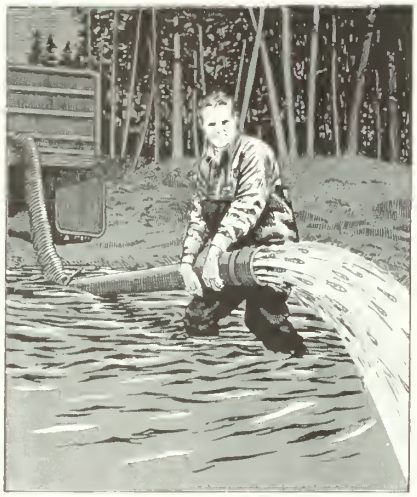
Hatchery Facilities

Hatchery production of Pacific salmon has become increasingly and significantly more successful in recent years. This success combined with increased fishing pressure and heavier demands on the resource, means that hatchery-produced fish are the most practical and economic means to increase the supply of fish. Accordingly, the Pacific Coast States have greatly expanded their hatchery facilities under the program.

One modern hatchery has been completed, and two others are under construction on Pacific Northwest streams. When fully operating, the three new hatcheries will have a potential production of about 8 million young salmon for release in coastal streams. From these releases, about 135,000 adult fish will return and be available to the sport and commercial fisheries annually. Also, funds have been provided for construction of a hatchery to improve production of salmon in Alaska. Fry and fingerling salmon from this station are urgently needed for research and experimental purposes.

Additional rearing ponds have been constructed, and other facilities such as water systems and egg-taking stations have been improved at 22 State-owned salmon hatcheries.

The program has provided financial assistance to permit full operation of State-owned hatcheries. In so operating, the States make available to the fisheries the young salmon that otherwise would have been lost because of untimely releases.



RESOURCE NEEDS

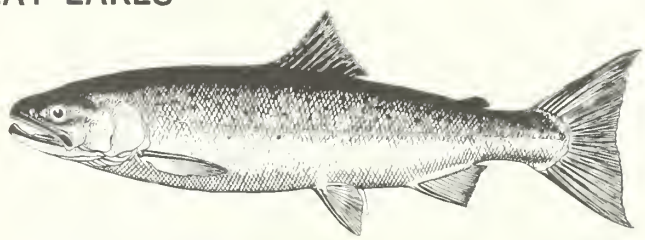
As the human population increases, demands on the resource will increase, therefore, the natural habitat and resource must be enhanced to the maximum extent and supplemented by artificial means as required.

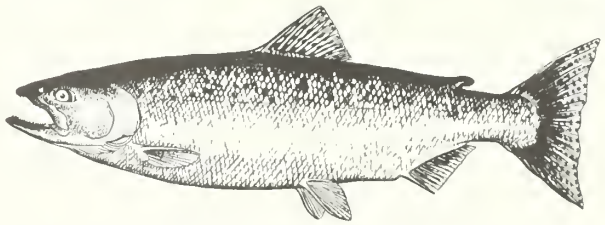
Accordingly, the rehabilitation program for earthquake-damaged streams in Alaska must be accelerated to remedy this critical situation. Fish passage at natural and manmade barriers, such as, dams, falls, water-velocity blocks, and logjams must also be provided so that available spawning and nursery areas can be utilized. Fish protective devices are needed at water diversion canals to prevent the loss of downstream migrant fish. Also, means of handling the destructive effects of pollution and other alterations of the river need to be investigated and developed.

We must expand and improve current information and present-day methods and procedures used to manage the salmon resource. Knowledge is lacking on estuarine environment and the factors that kill the fish in the rivers and estuaries. We must investigate and develop procedures for restoration of habitat and for minimizing loss of fish from water use developments, such as intensive logging, diversions for irrigation, and hydroelectric and nuclear generating stations. We need research on use of experimental spawning channels and on improvement of natural spawning beds. Certainly, we need also to know more about the deterioration of salmon stocks due to pollution by pesticides, and industrial and domestic waste. We also need to know about the abatement required. Finally, it will be necessary to provide field facilities in several areas to carry out the aforementioned research responsibilities.

The science of fish culture has progressed to such a degree that large quantities of some salmon species can be produced by hatcheries at costs less than one-half the value of the fish. In view of the predicted increasing demands on the salmon resource, we will not only need additional hatchery facilities but also new ways to rear fish, for example in impoundments. Artificial propagation is needed to provide fish for suitable habitat created through stream restoration and other environmental improvements. Further, improvement in hatchery facilities and techniques is needed not only to increase production but to release healthier fish.

COHO AND CHINOOK SALMON—GREAT LAKES

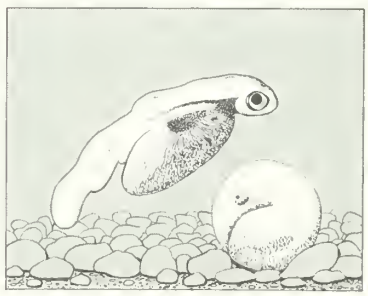




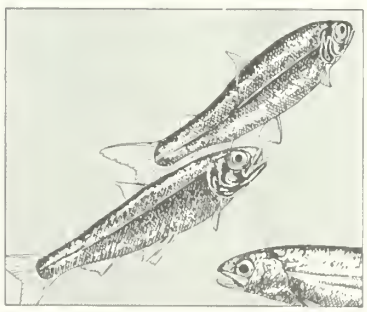
Attention of both the general public and Government has been sharply focused on the Great Lakes. There has been ample reason. The ravaging sea lamprey dates from the mid-1930's, when it invaded the upper lakes. More recently, massive die-offs of the superabundant alewife and national alarm over environmental pollution have been major concerns. One bright note has been the spectacular sport fishery for coho salmon that got underway on a small scale in Michigan in 1966.

Drastic, and in some instances catastrophic, changes in the Great Lakes fish populations have occurred dating from about 1940. Historically, the lakes held abundant populations of predatory species. Lake trout and burbot predominated in the deeper waters. Walleyes, northern pike, muskellunge and bass thrived in the shallower waters. Whitefish, lake herring and lake trout comprised 76 percent of the commercial catch by weight in Lake Michigan. By 1966, these same species accounted for only 3 percent, while the previously non-existent alewife made up 77 percent of the catch. The blue pike in Lake Erie disappeared almost entirely. Of the seven species of chubs that inhabited Lake Michigan, two of the largest are extinct.

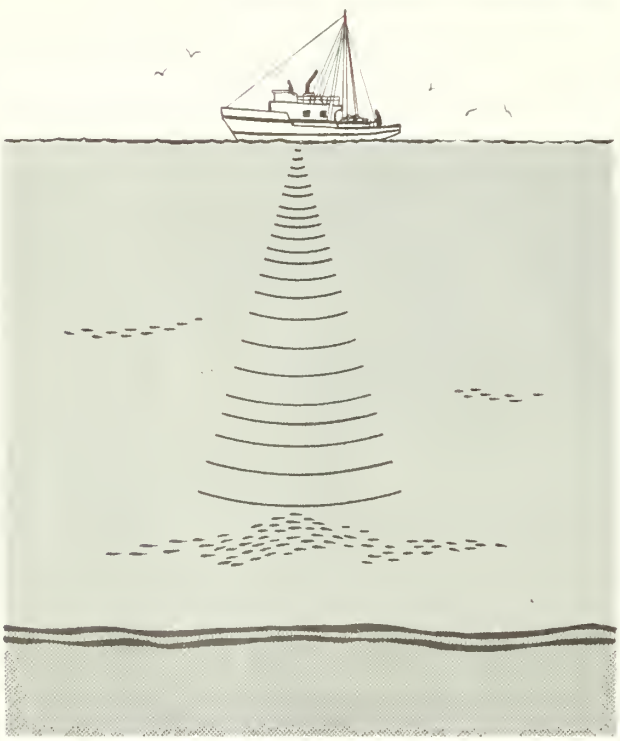
The natural population constituted a well-balanced predator-prey complex. Interactions between environmental changes, exploitation, sea lamprey depredation, and alewife population explosion doubtless are responsible in varying degrees for the extreme changes in the fish population structure of the Great Lakes.



The Great Lakes form the largest body of freshwater in the world with a tremendous potential for both sport and commercial fishing. The goal of the State/Federal Anadromous fisheries Program is to achieve management of those waters for optimum development of that potential.



The story of salmon in the waters of the Great Lakes began with Michigan's plant of coho smolts in the spring of 1966. The unprecedented success of that introduction has sparked a recreational and economic boom. In the Great Lakes, coho and chinook have found an inland sea completely to their liking. They seem never to have missed salt in the water and have thrived on the abundance of forage. Each of



the lakes has now received two or more plants of coho smolts, and four have received one or more stocks of chinook.

Both species of salmon have been raised successfully for many years in West Coast hatcheries. Hatchery expertise and initial stocks of eggs were drawn from Oregon, and from Washington and Alaska. The time table for hatchery production is approximately as follows: spawn is collected in late October and November. Hatching occurs in 50 to 60 days. Sac fry are on hand by January 1. Feeding begins in about three weeks. Chinook attain a size of about 100 per pound when planted in April, after 90-120 days of growth. Coho, however, must spend approximately 16 months in the hatchery, and are planted the following spring as smolts of about 16 per pound. Upriver spawning runs of coho are predominately three year fish, and chinook are four year fish. Some coho may not return until they are four years old. Late maturing chinook may be five, six, seven or even eight years old. A small part of each run is usually composed of early maturing fish, primarily males, referred to as "jacks".

SPORT CATCH STATISTICS (SALMON)

STATE	YEAR	CATCH	MAN-DAYS
MICHIGAN	1967	55,000	232,000
	1968	93,000	500,000
	1969	200,000	1,000,000
OHIO	1968	300	500
	1969	3,400	10,000
PENNSYL-	1968	2,000	5,000
VANIA	1969	5,500	22,500

ACCOMPLISHMENTS

Cooperative projects for developing the salmon resource are in effect with six of the Great Lakes States. The first stage of a large hatchery complex has been completed. Construction of small rearing facilities, production of salmon for experimental work, assessment of stocking potential, creel census, or economic evaluation projects are underway in five States.

One of the most important criteria favoring the selection of salmonid species to use in managing the Great Lakes is their adaptability to culture in hatcheries. Production techniques, hatchery facility requirements, diets, disease prevention, costs of production, and predictability of output of fish of a given size have been

reliably established. Projects for construction of the necessary facilities have received high priority in the program.

Only limited natural production of smolts in streams is expected. Occurrence of significant numbers of coho and chinook depends primarily upon hatchery facilities and operational know how. Populations, therefore, are subject to control. Both species make upstream spawning runs; at that time they are easily captured for removal and spawn taking.

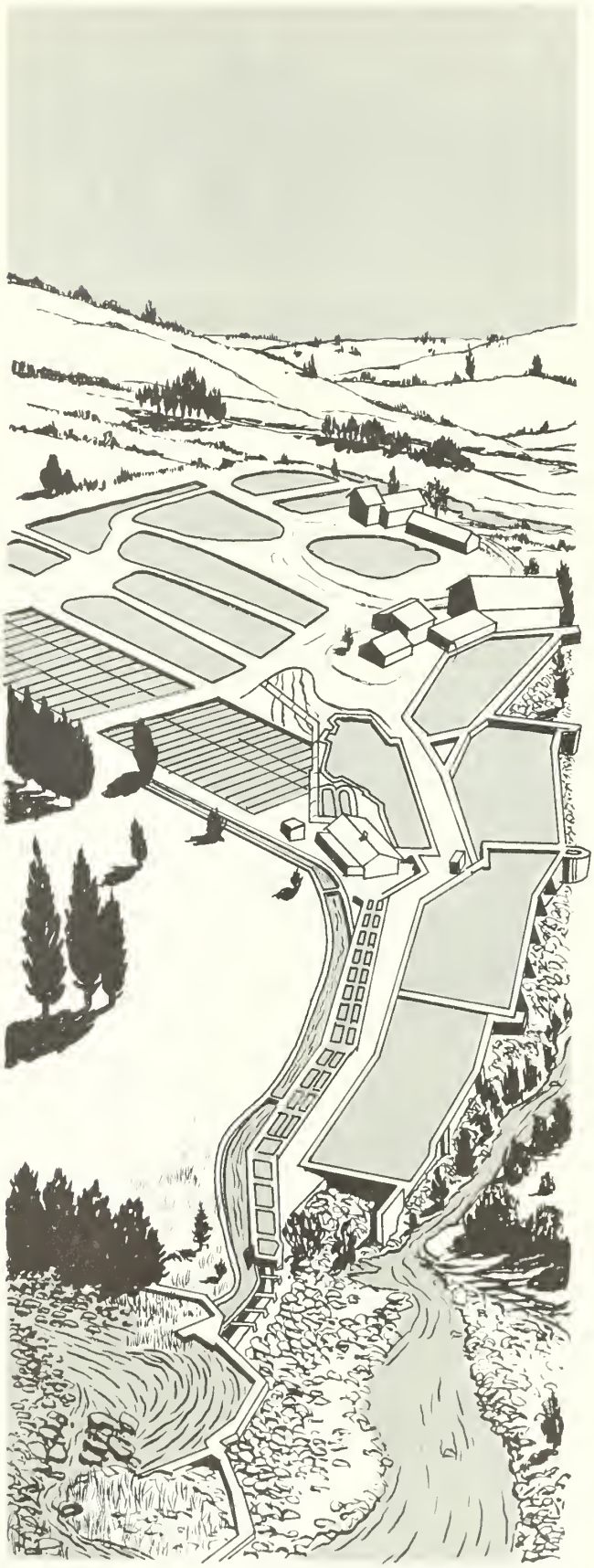
Since salmon have a well developed homing behavior at maturity, the location of spawn taking facilities can be effectively planned. Facilities required are the following: barrier weirs to intercept the adults; channels to direct them; and holding and maturation ponds. Handling, sorting and selection of suitable breeders is readily accomplished.

Production facilities require hatchery building with egg incubation trays, tanks for production of fry and fingerlings; outdoor rearing ponds with ample flows of water; accessory buildings, equipment and utilities for accomplishing the full annual cycle of operations.

RESOURCE NEEDS

Some of the obstacles in the path of anadromous fish resource development in the Great Lakes are in various stages of removal. Needs remaining include the following: additional hatchery and rearing facilities for production of smolts; weirs for intercepting adult salmon; downstream migrant traps for monitoring resident fish populations and stream production of salmonids; removal of barriers or construction of fish guidance and passage facilities; monitoring movement of salmon in the open water of the Lakes for information on population numbers, growth and interrelationships with compatible and competing species, and for information to increase the time span of availability of salmon to sport fishermen. Investigation of candidate species, such as Atlantic salmon, for possible introduction is planned for future attention.

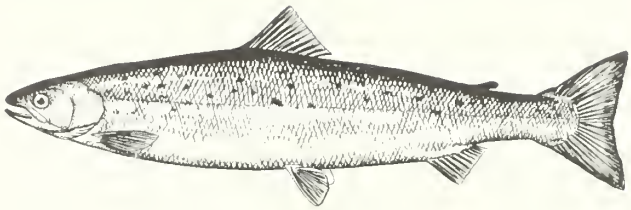
Work funded under legislation other than P. L. 89–304 is vitally important and will continue to have a profound beneficial impact on the Great Lakes environment. These are the well-known sea lamprey control program of the United States and Canada, and programs for reduction of pollution and attainment of water quality in conformance with standards.



PLANTS OF ANADROMOUS FISH IN THE GREAT LAKES

STATE LAKE/ SPECIES	1966	1967	1968	1969	TENTATIVE 1970
MICHIGAN					
Lake Michigan:					
Coho	658,800	1,732,295	1,168,372	2,631,372	3,175,000
Chinook		834,850	686,692	650,000	1,500,000
Steelhead			145,000	190,000	
Lake Superior:					
Coho	192,400	467,000	381,990	526,000	450,000
Chinook		33,460	50,000	50,000	150,000
Steelhead			80,000	55,000	100,000
Lake Huron:					
Coho			401,887	667,000	500,000
Chinook			250,000	250,000	600,000
Steelhead			45,000		300,000
State Total:	851,200	3,067,605	3,208,941	5,019,000	6,775,000
NEW YORK					
Lake Erie:					
Coho			5,100	10,000	100,000
Lake Ontario:					
Coho			25,000	109,000	200,000
Chinook				60,000	
State Total:			30,100	179,000	300,000
OHIO					
Lake Erie:					
Coho			30,000	90,709	200,000
PENNSYLVANIA					
Lake Erie:					
Coho			80,000	120,000	170,000
Grand Total:	851,200	3,067,605	3,349,041	5,408,709	7,445,000

ATLANTIC SALMON



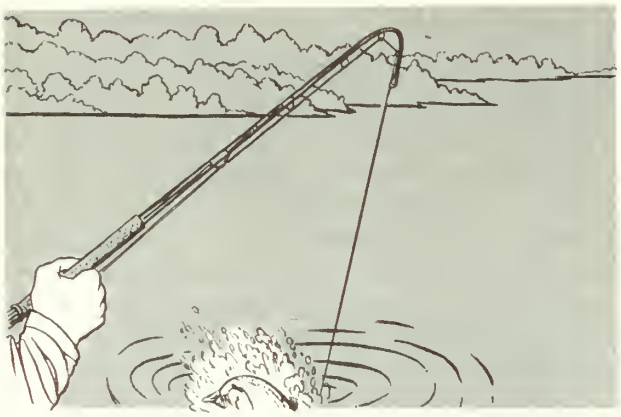
Until late in the 19th century, all suitable streams from northeastern Labrador to the Housatonic River, emptying into Long Island Sound, and perhaps the Hudson River, supported runs of Atlantic salmon. By 1870, only eight United States rivers, all of these in Maine, supported regular runs.

Atlantic salmon spawn in the rivers and streams of their birth in the fall of the year; the eggs hatch the following spring. The young typically spend two or three years in freshwater. When they are 5 to 6 inches in length, they migrate out of the streams to the Atlantic Ocean where they spend from one to three years or more growing at an astounding rate. They weigh from 3 to 30 pounds when returning as adults, depending on the time spent at sea, for the most part. They can spawn more than once, in contrast to the five species of eastern Pacific salmon; but, less than 10 percent of those returning in a spawning run have spawned before. They have been stocked in Pacific Coast streams with little or no success.

Present United States Atlantic salmon runs are estimated at less than 2,500 fish that support an annual sport catch of less than 500. Thus, the once abundant Atlantic salmon have been decimated to a point where now only remnant runs exist. Obstructions to salmon passage, pollution, overfishing, erosion which muddied over spawning beds, and incompatible water uses took a heavy toll.

Atlantic salmon migrate long distances at sea searching for food. They feed on small crustaceans and forage fish and grow at an astounding rate. After spending two to three years in the ocean, they return as adults of 9 pounds apiece or more—a growth of about 7,000 percent in body weight during their ocean residency. Their foraging migrations appear to be in a northeasterly direction with prime feeding grounds off Newfoundland and Greenland.

Atlantic salmon are a world-renowned trophy fish. Fish in the 15 to 20 pound class are quite common, while whoppers run up to 40 pounds or more. They are vigorous, flashy, leaping fighters that take advantage of the river's current, snags and boulders to thwart the angler's attempts to land his prize.



ACCOMPLISHMENTS

The Penobscot River in Maine was selected to serve as a model for Atlantic salmon restoration. Additionally, this river has tremendous potential for development of shad, alewife and other anadromous fish. Fishway construction or rehabilitation is planned at six main stem and at least eight tributary dams. Construction is essentially complete at four of the main stem dams and underway at a fifth. Fishways for three of the tributary dams are in the design stage.

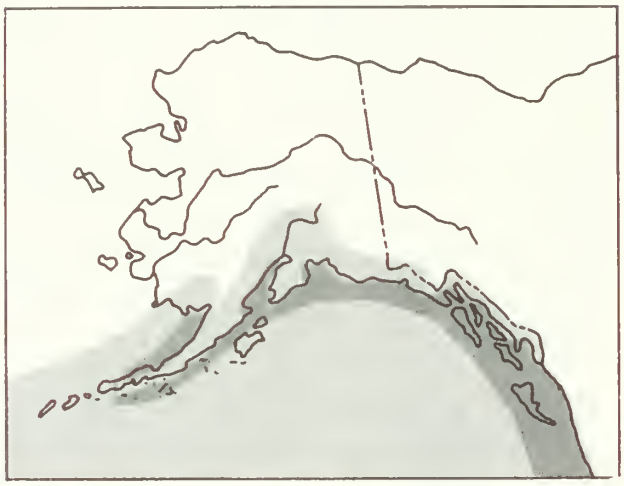
Fish production is determined, in a large measure, by the amount of food available and by the amount of living space. In the Narraguagus River, a water control structure was built to store water during periods of heavy run-off and to meter it out during periods of low-flow. The Narraguagus is plagued with low water flows during the warm summer and early fall months. Water stored behind the control structure will be used to maintain more desirable stream flows during low-flow periods, thereby increasing the stream area and maintaining food production at a higher level than was formerly the case. An evaluation will be made on proper manipulation of the control reservoir to achieve the desired biological results.

Several New England States are cooperatively and independently conducting inventory and research programs aimed at restoration and enhancement of Atlantic salmon. Coastal stream surveys are being made to provide maps of barriers to fish passage, water uses, and pollution sources. Several fish ladders have been constructed and others are in the design stage as a follow-up of survey efforts in a number of watersheds.

Research is underway to ascertain, among other things, the physical, limnological and fish population status of various rivers. Water quality data, food production, impediments to fish passage, resident fish species composition, spawning and nursery area potentials, and other vital information is being collected. This factual information will provide a basis for making program determinations for future work for the extension and enhancement of Atlantic salmon populations.

RESOURCE NEEDS

Continued efforts at stream improvements, including additional fishways and guidance devices, are sorely needed before the full potential can be realized for Atlantic salmon in their historic areas. The construction of new and the modernization and expansion of existing fish hatchery and rearing facilities are necessary to supplement natural reproduction. Pollution abatement is essential for Atlantic salmon restoration. Further research and inventory is necessary to fill knowledge voids and to direct action programs for realization of maximum benefits to the resource.



SEA-RUN TROUT

Steelhead Trout, the seaward migrating rainbow, are found in streams from about San Francisco Bay northward to Bristol Bay, Alaska. They are also found in streams tributary to the Great Lakes, having been introduced to these waters. Sea-run cutthroat trout range from Northern California to Prince William Sound, Alaska.

The above trout both spawn in winter and early spring. The eggs hatch later the same spring, and the young typically spend from one to three years rearing in freshwater before migrating to sea. They spend from one to three years in the ocean, feeding voraciously on crustaceans and forage fish, traveling as much as 2,000 miles or more from their home stream before returning to spawn in streams of their birth. Only a very small percentage survive to spawn a second time. Adult steelhead typically range from 3 to 16 pounds, while sea-run cutthroats from 1 to 4 pounds. Larger specimens of both species are occasionally taken.

Anglers prize steelhead as "big game", trophy fish. They are strong, aggressive, flashy, jumping fighters. Swift waters, large boulders, snags and other challenges test the angler's ability to land his quarry. The beautiful sea-run cutthroat trout is an excellent sport fish, wary and elusive.

Anglers of Pacific Coast States harvest about 600,000 steelhead annually. The State of Washington leads in the steelhead catch, followed by Oregon, California and Alaska. The Columbia River and its tributaries produce about 150,000 of the total catch. Precise data are not available on the take of steelhead in the Great Lakes or of sea-run cutthroat trout on the Pacific Coast.

ACCOMPLISHMENTS

Work on improvements to the Fire Lake Fish Culture Station near Anchorage, Alaska is nearing completion. This station will contain a sophisticated recirculating and reconditioning system including water sterilization and water temperature control equipment. Annual production will be increased from 665 to 8,000 pounds.

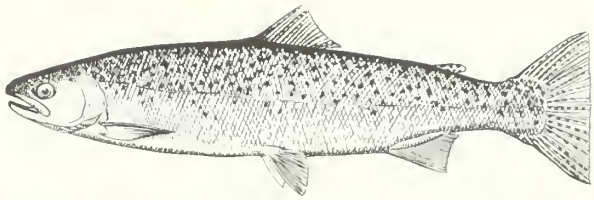
In Washington, rearing ponds are under construction at the Shelton Hatchery and Barnaby Slough; new impoundments have been completed at the Bogachiel River, Tokul Creek and

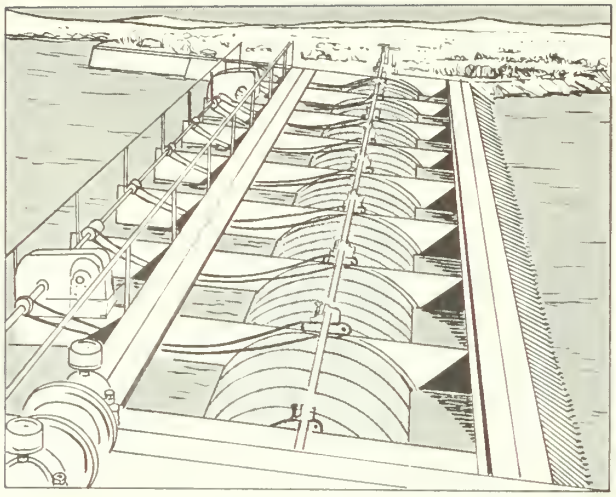
Green River. A project for repair of flood damage at the Tokul Creek Hatchery has been completed. A new fish hatchery at South Tacoma is currently in the design stage. Benefits attributable to the rearing pond impoundment projects are estimated at 1.25 million steelhead and 200,000 searun cutthroat trout smolts for stocking annually. These are expected to sustain an additional adult harvest of 50,000 steelhead and 10,000 cutthroat. The South Tacoma hatchery, when completed, will produce 2½ million steelhead fry.

Oregon is conducting research on the effects of logging on salmon and steelhead, the development of parr-smolt transformation in anadromous salmonids, a racial (genetic) study of steelhead, and culture of summer-run steelhead. Results of these projects have influenced logging practices and hatchery operations. Oregon's development projects include propagation of winter steelhead at the Alsea Hatchery, Butte Falls Hatchery expansion and steelhead propagation, completion of Corvallis Fishery Research Laboratory, construction of the Gold Ray Dam fish trap and viewing chamber, Cedar Creek Hatchery improvements, and construction of the North Umpqua River fish trap and adult holding ponds. The improved and expanded rearing facilities will increase production by 500,000 steelhead smolts annually which, on returning as adults, will provide a catch of 15,000 additional steelhead.

In California, projects include the Woodbridge fish screen near Lodi, which prevents the annual loss of an estimated 5.4 million chinook salmon fry and 118,000 yearling steelhead; and the Glenn-Colusa fish screen on the Sacramento River, which will save an estimated 10 million chinook salmon and 232,000 steelhead smolts annually, when completed.

In the Great Lakes, Minnesota is conducting stream improvement work in tributaries flowing into Lake Superior. Wisconsin is stocking steelhead in streams tributary to Lakes Superior and Michigan. Michigan is building hatchery facilities which can be used for steelhead. New York is doing research on artificial spawning channels for steelhead and is involved in a comprehensive plan for its Great Lakes fish program.





The chars (Dolly Varden, arctic, eastern brook) and brown trout have not been mentioned since no specific projects are underway for their exclusive benefit. None-the-less, stream improvement and hatchery facilities, among others, can and will benefit these species.

RESOURCE NEEDS

Stream improvements such as fishways past obstructions, guidance devices to ensure safe passage of downstream migrants, and water flow maintenance through water control structures and impoundments are needed. Construction of new and the modernization and expansion of existing fish hatchery and rearing facilities are essential to keep from lagging far behind rapidly increasing demand and to mitigate losses incurred by destruction and loss of habitat. Mineral exploration and development, logging, road building, housing construction and pollution have their adverse effects on water quality and habitat. Means to eliminate or mitigate losses from these developments are needed. The installation of screens in irrigation and other water diversions is essential to prevent fish losses. Research is needed on early disease detection and fish treatment, and for filling knowledge voids on the fish and their habitat. Pollution abatement methods must be developed.

AMERICAN SHAD

On the Atlantic Coast, the shad ranges from Canada to Florida and is most abundant from North Carolina to Connecticut. It was successfully introduced to the Pacific Coast where it now ranges from Mexico to Cooks Inlet, Alaska.

Spawning migations into the Atlantic Coast rivers begin in January in southern parts of the range and are progressively later northward until about June in Canadian streams. Young shad, 2 to 5 inches long, leave the rivers in autumn and, after spending 2 to 6 years in the ocean, return to spawn in their native stream. The species is largest of the herrings—males average 3 pounds and females 4 pounds.

Shad is an important food and game species and is caught both in the rivers and along the coast. The species was a staple item of diet for the early settlers because it was easily captured and preserved. The demand increased as towns and cities sprang up along the coast. Fishermen believed that the supply was inexhaustible. The catch often exceeded 45 million pounds until about 1900; however, after that it steadily declined.

Today, this fishery ranks 40th in relative volume or about 10 million pounds, and 28th in relative value or about $1.5 million of the total annual U.S. commercial catch by species. The annual sport catch is about one-half million fish in more than 1 million man-days fishing. The annual total value of the fishery is about $6.5 million. Annual yield restored to 1900 level—45 million pounds—would be worth five times the current value.

The adult shad migrates thousands of miles and is influenced by the environment both in rivers and coastal waters. Factors blamed for its decline in abundance are physical changes in the environment that rendered it unsuitable for fish survival and water developments that barred fish from their spawning and nursery grounds.

ACCOMPLISHMENTS

We have developed multi-State-Federal cooperative projects for some rivers to attack jointly the problems faced by shad on a river basin basis. This combined effort is showing tangible results—long-range programs for effective management of the fisheries have been developed.

Improvement of Environment

We have established that it is feasible to restore this important commercial species and prize game fish in several rivers where the efforts of man have sharply reduced fish abundance and in other instances destroyed runs completely. Manmade obstacles, such as dams, pollution, water-velocity blocks, and areas of thermal alteration of water have been partially cataloged and corrective devices considered. In other words, the ground work has been laid for an aggressive environmental program.

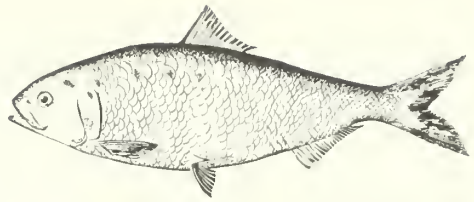
Restoration programs are in progress on several Atlantic Coast rivers, principally, in mid-Atlantic and New England streams. Rehabilitation of shad runs and expansion of spawning and nursery areas will greatly increase production of shad, as well as other anadromous species.

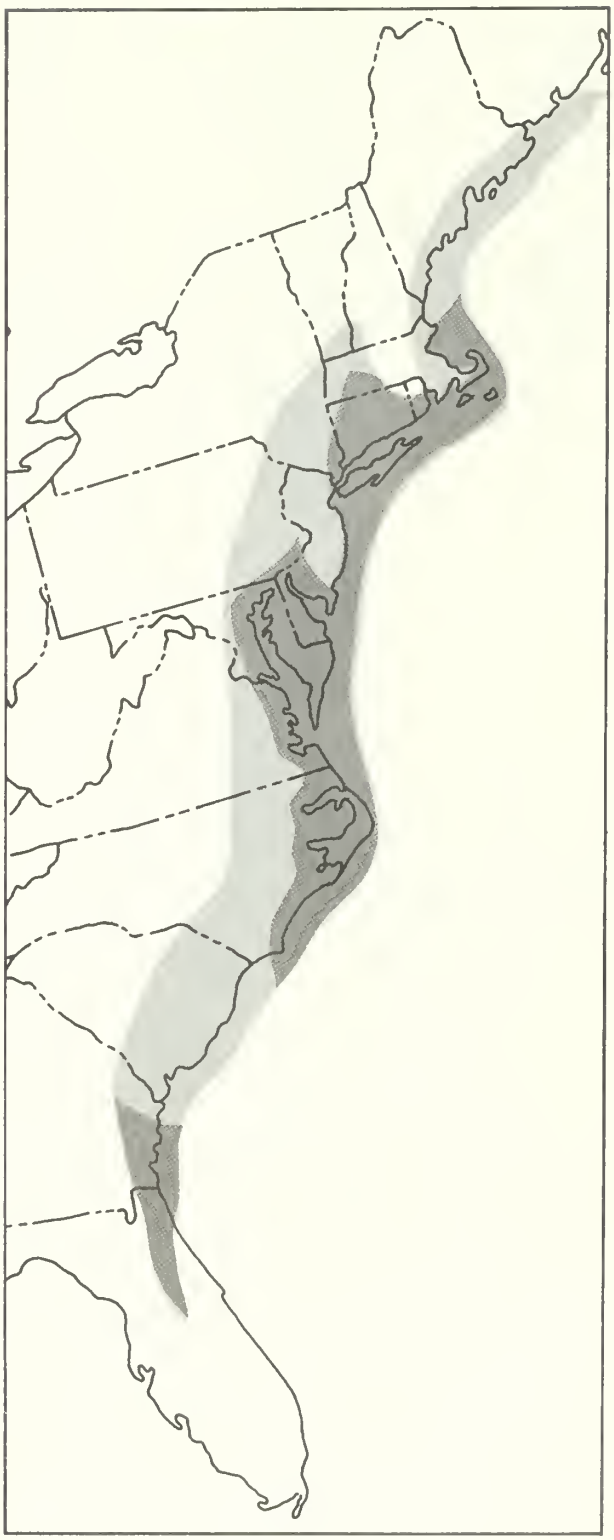
Connecticut and Delaware Rivers have the most important restoration programs. Means of overcoming the destructive effects of pollution on shad survival and migration are being investigated. Also, plans are being made for fish passage facilities at natural and manmade barriers or for removal of such obstructions. We estimate that annual runs of shad will be developed that can support commercial catches of more than one-half million fish and provide more than 100,000 angler days.

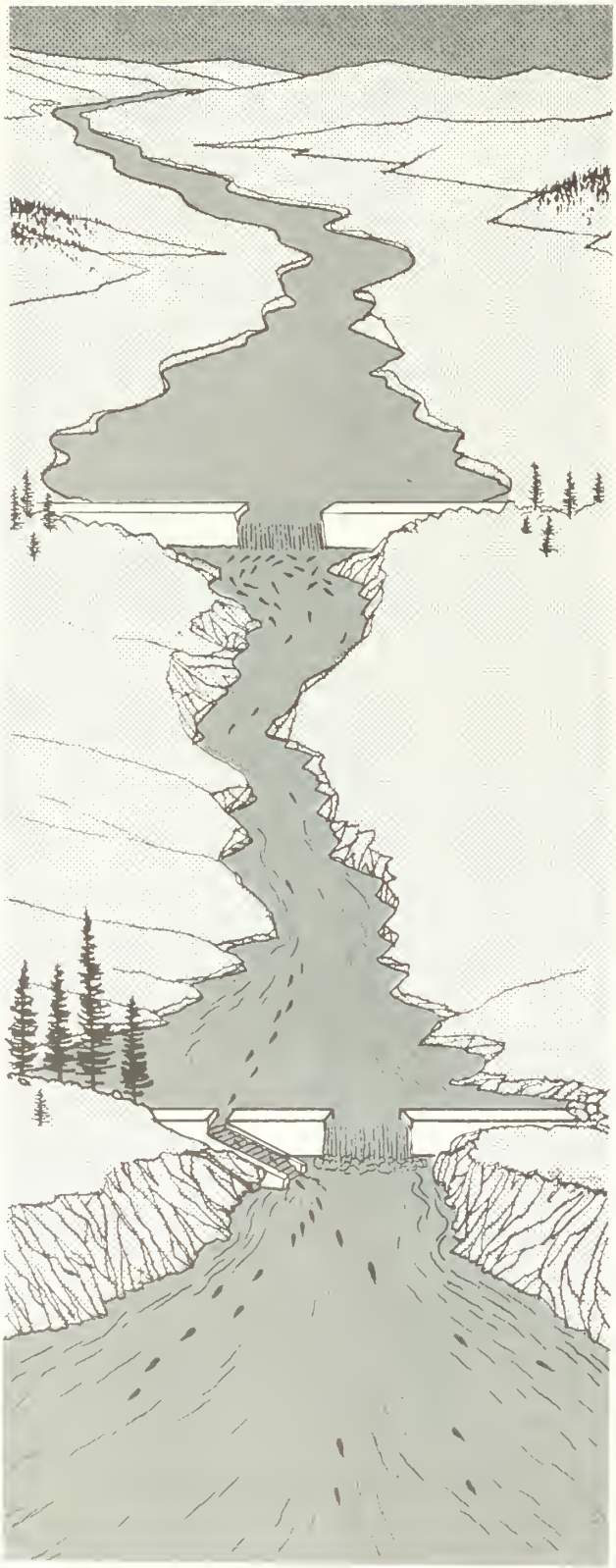
Although the projects for stream clearance and habitat improvement now underway in Chesapeake Bay tributaries are not directed specifically for shad, this work is expected to significantly enhance the resource.

RESEARCH

Research on American shad is mainly a continuation and in some instances, an expansion of work using methods and procedures developed by Bureau of Commercial Fisheries programs.







Investigations are concerned mainly with factors influencing abundance of the species. In addition, data are being collected on the fisheries and the environment to provide needed information for more effective management of the resource.

Spawning and nursery areas are being zoned as to importance so that recommendations can be made to minimize, prevent, or mitigate adverse effects of proposed water developments on the fish populations. Information is obtained also to assist in the solution of biological problems at such developments.

Through the use of electronic tracking of fish marked with sonic tags, information is gathered on how the migratory behavior of shad is affected by the heated water from nuclear generating plants. Findings from this study will have an immediate and wide application.

Also, fluorescent dyes are being used to mark young shad to obtain data on their ability to move throughout polluted areas, such as encountered in the Delaware River during the young fish's downstream migration.

Pertinent information has been collected on the life history and population dynamics of shad stocks in selected areas along the Pacific Coast. This information is being used to develop long-range programs to obtain information for management purposes.

RESOURCE NEEDS

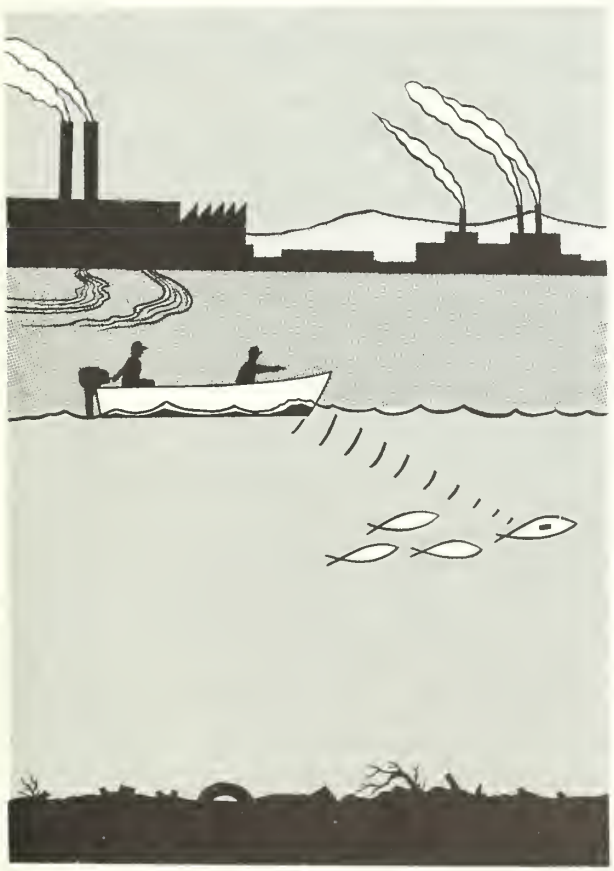
Barriers that block shad from their natural spawning and nursery grounds have been cited as the major cause for the decline in fish abundance and are currently a serious threat to the runs. Within little more than half a century about 1,500 river miles of natural shad habitat in 23 Atlantic Coast rivers have been made unavailable to spawning fish by pollution, dams, and other water use developments. To provide access to these areas, stream clearance or passage facilities at obstructions are seriously needed. Once access is provided, factual information on fish migratory behavior must be obtained. Additionally, how to safely transport downstream juveniles needs investigation and development.

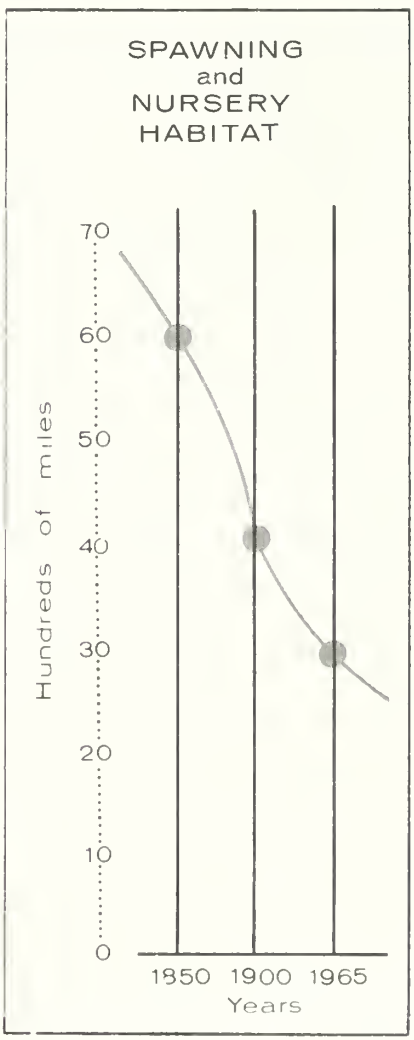
A vast amount of biological data has been collected on the shad stocks along the Atlantic Coast by State and Federal agencies, mainly the Bureau of Commercial Fisheries. These

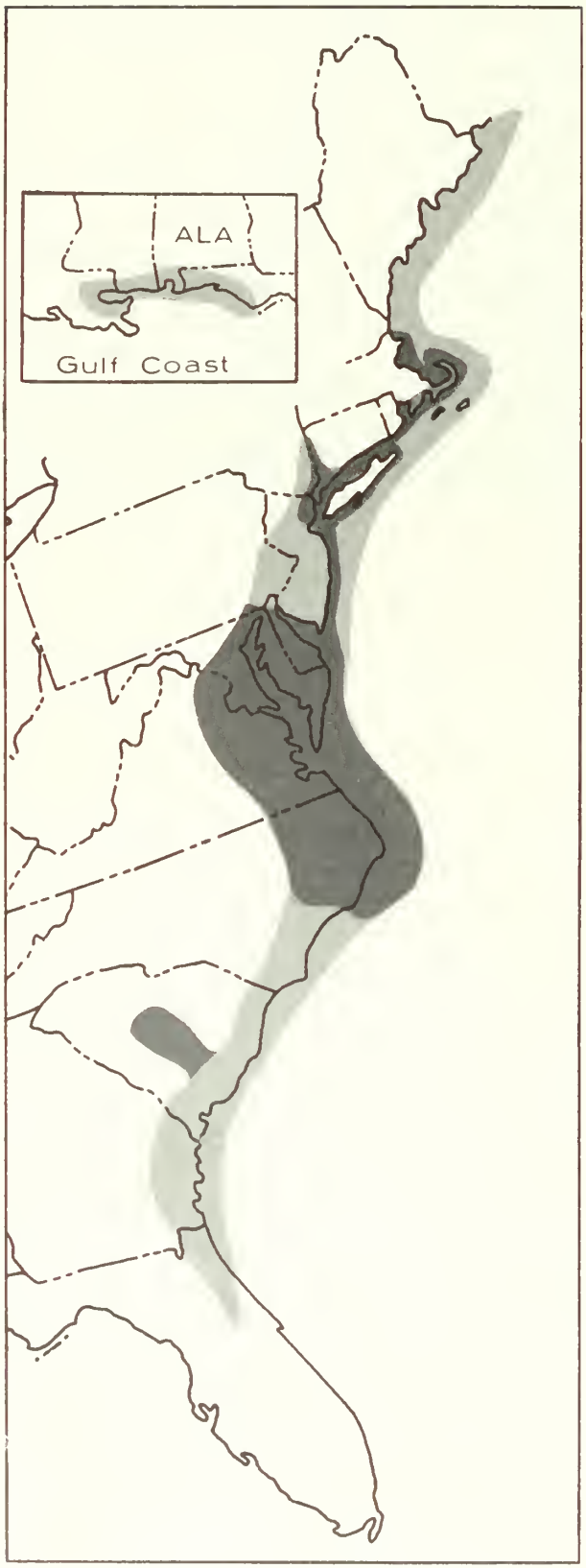
data are now obsolete, however, and need to be updated. More specifically, this updating involves obtaining information on water quality with emphasis on alterations due to pollution, siltation, and temperature, and developing the best way to improve the runs of fish that are affected adversely. Additionally, information is lacking on the oceanic life and migrations of shad.

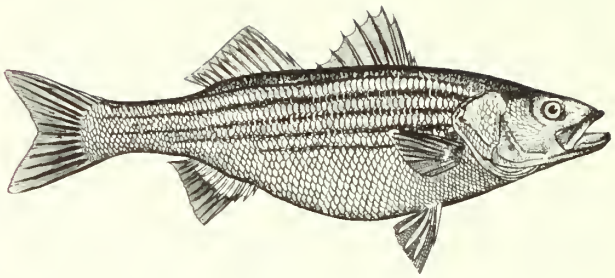
Although shad fishermen spend about 100,000 angler days on the Pacific Coast, little is known about the status or potential of the stocks there. Biological information is needed on the stocks; effects of pollution, over fishing, and water use developments need to be investigated, and protective measures developed where necessary.

Although shad hatcheries were operated for more than half a century to supplement natural reproduction, the runs could not be maintained. However, with the new advancements in hatchery techniques and new developments in feeding and rearing, we need to reinvestigate the practicability of artificial propagation of shad.









STRIPED BASS

The striped bass is distributed from Canada to Florida along the Atlantic coast and from Louisiana to Florida along the Gulf of Mexico. Chesapeake Bay is the area of greatest abundance. The species was landlocked by dams in Santee-Cooper River system in South Carolina and now supports a very productive sport fishery above the barriers. In 1879, the species was succesfully introduced on the Pacific Coast and now occurs from California to Washington.

This species matures in 2 to 5 years and ascends rivers from March to July to spawn. After spawning, the mature fish move out of the river. Certain segments of the stocks, primarily from the Chesapeake and Delaware Bays, make coastal migrations. Most fish taken by the fishermen weigh 3 to 5 pounds. Fish 20 to 25 pounds are not uncommon.

The supply of this fish varies widely for reasons not completely known. Fortunately, the stocks have been high in recent years and have supported large fisheries, both sport and commercial. The annual commercial catch is more than 8 million pounds worth about $1.5 million. Sport fishermen take more than 9 million striped bass annually along the Atlantic Coast. On the Pacific Coast, the supply of striped bass has increased many fold since its introduction. Prior to 1930, the commercial fishery harvested over 17 million pounds. In 1931, California declared it a sport species, and commercial netting was prohibited. On the Pacific Coast, sport fishermen catch about 3 million fish annually.

ACCOMPLISHMENTS

At the present time, the fisheries for striped bass are generally productive and healthy. There is, however, need for improvement of the environment, management of the stocks and for extension of the resource.

Improvement of Environment

Inventories are being made of the estuarine environment in major spawning and nursery grounds of striped bass because these areas are important in the production and survival of the species. A stream clearance program is underway to remove temporary blockages and nonfunctional dams and allow access to available spawning, nursery, and feeding grounds in Chesapeake Bay and New England coastal streams. In some areas, stream courses are improved and stabilized to provide better and more spawning and nursery grounds. Investigations in the estuaries and bays are underway to study siltation. The ultimate goals are to formulate guidelines for allowable sediment loads and to develop the best means of combatting the siltation problem.

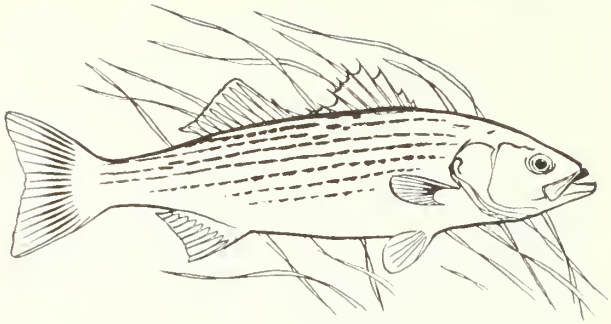
Research

Here again, much of the program research is a continuation and application of methods and procedures developed, and in some instances an expansion of earlier work by State and Federal agencies, particularly the Bureau of Commercial Fisheries.

Review and analysis of available State and Federal striped bass tagging data along the Atlantic Coast have been completed. From the information gained, projects are being developed under a multi-State-Federal approach to jointly attack biological problems faced by the species.

Significant information has been obtained, also on the status of the striped bass stocks in the streams and estuaries along the Gulf of Mexico, and on the factors limiting abundance. Progress has also been made on the practicability of augmenting natural reproduction of striped bass in these areas by the planting of hatchery-produced fingerlings.

Additionally, hatchery methods and techniques for rearing of striped bass for release in the Gulf Coastal streams have been improved.



Hatchery Facilities

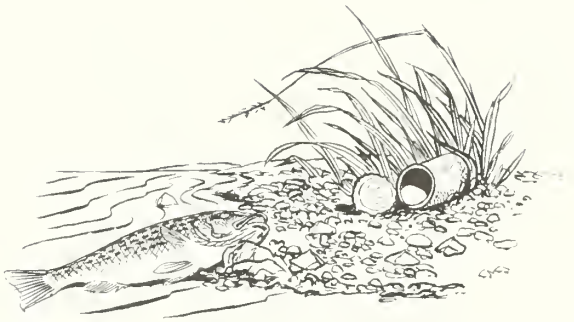
In cooperation with State and Federal striped bass hatchery personnel, advances have been made in the techniques for rearing striped bass. Additional work is underway on selective breeding and hybridization for development of strains of fish that are most easily handled and have fastest growth.

Also, funds have been provided for constructing a hatchery, for improving facilities at State-owned hatcheries, and for rearing striped bass for release in the Gulf Coastal streams. Fry and fingerling striped bass from these stations will be used for research.

These coordinated State-Federal efforts could open up a new and effective means for reintroduction of fish for recreation and for large-scale commercial rearing in ponds. In the Gulf streams it is estimated that reestablishment of the runs of striped bass through the introduction of fish will provide an estimated 150,000 angler days fishing.

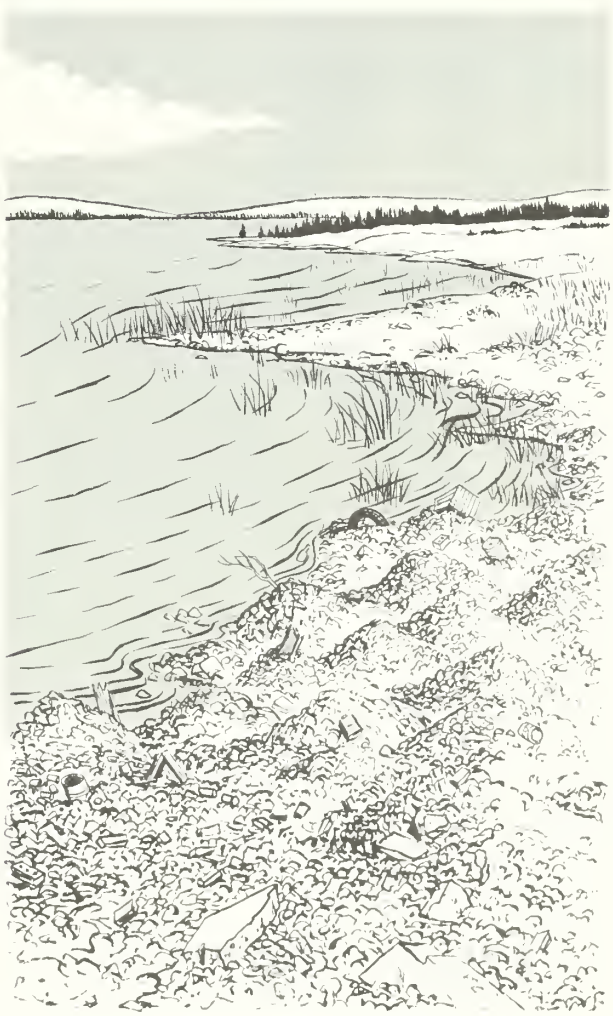
RESOURCE NEEDS

The major problems encountered by striped bass are changes in the environment resulting from water use developments and increased pollution entering the rivers and estuaries. While suitable spawning and nursery areas are being effectively reduced by siltation, dams, diversion canals, industrial wastes, and other pollutants, and through increased water temperatures, utilization and demand on the resource by sport and commercial fishermen is high and in most instances increasing. These problems are of major concern, and we need to understand how the changes in the environment affect the fishery resource. We also must find how to develop means to best cope with adverse conditions.

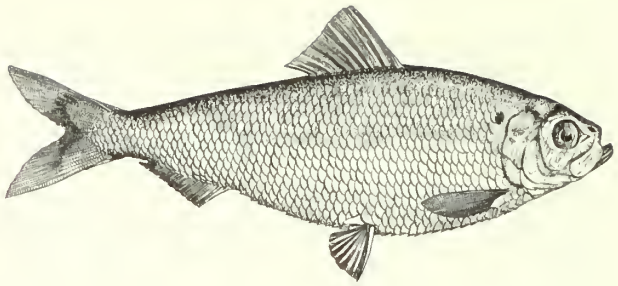


The urgent needs for the striped bass resource center around protection and improvement of the freshwater habitat; however, artificial propagation is needed to provide fish for planting in areas where the abundance of the species has declined and in some instances temporarily disappeared. We need to establish landlocked populations wherever feasible.

Progress has been made in experimental rearing and stocking of striped bass to augment natural reproduction. However, we have not reached any peak of efficiency in this field. We need to improve the hatchery methods so that large numbers of fish can be produced economically. Furthermore, we need to develop strains of fish that will survive and reproduce in freshwater ponds, reservoirs, and inland impoundments. Also needed is development of stocks of fish that are disease resistant and tolerant of high temperatures and other similar adverse factors.



Although the striped bass populations on the West Coast provide more than 2 million angler days and represent a harvest of more than 2.5 million fish annually, little is known about their potential. Many gaps appear in our knowledge of the species, particularly about its oceanic life. We need to gain a better understanding of the effects of land and water use, such as the filling and dredging that destroys nursery areas, and the ever-increasing pollution that threatens to diminish the habitat of striped bass. We need this information to develop the best means of combating these adverse conditions in the environment.



RIVER HERRINGS

Alewife, blueback herring, and hickory shad are collectively called river herrings. These fish are distributed along the Atlantic Coast from Florida to Canada, and are most abundant in the Chesapeake Bay and Albemarle Sound. The alewife is also distributed throughout the Great Lakes and is abundant in Lake Michigan.

Young river herrings live in the rivers and lakes during their first summer of life and then migrate to the sea. The river herring attain sexual maturity after spending 2 to 6 years in the ocean at which time they weigh from one-quarter to 3 pounds, depending upon the species. Although these fish spend the major portion of their lives in the ocean, little is known about their oceanic life.

Most of the commercial catch is made by pound nets; a relatively small amount is taken by haul seine in late winter and spring when adult fish are entering the bays and tributaries. The annual commercial catch is about 65 million pounds, worth about $1 million. About 75 percent of the landings are made in Virginia and North Carolina waters. Industry does not separate the species, because they are essentially identical when processed. The primary products are canned fish, canned roe, and pet food. Some are used for lobster bait.

These species also support extensive but unrecorded recreational dip-net fisheries in tributary streams along the Atlantic seaboard. Also, sportsmen take a few fish by rod and reel.

ACCOMPLISHMENTS

Along the Atlantic Coast the work is directed toward improving the habitat and obtaining information on the oceanic life of these species. Also, the program plays a part in the overall coordinated effort on investigation of the alewife in the Great Lakes.

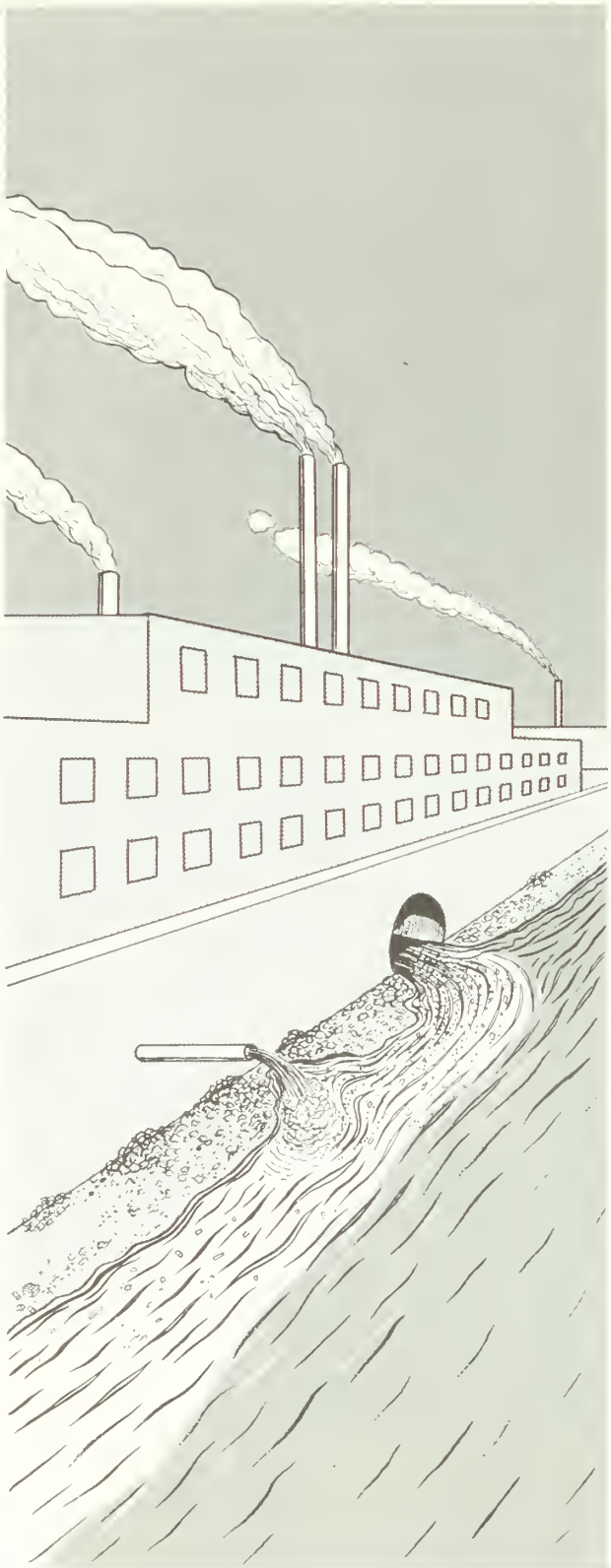
Improvement of Environment

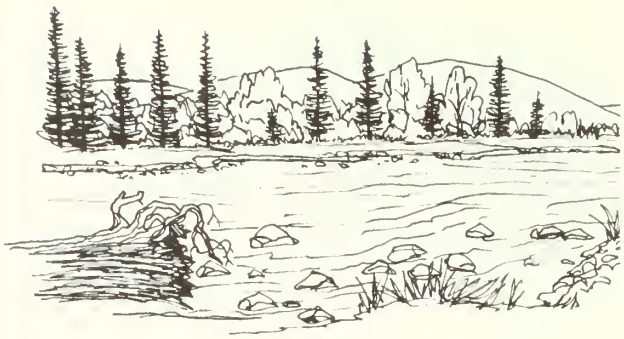
Fish passage facilities have been mapped and priorities established for most coastal streams throughout the New England area. Old nonfunctional dams are being removed, and fish passage facilities provided at operative dams. Such improvement of the environment will restore runs of fish in suitable streams and lakes, and rehabilitate available spawning and nursery areas. The expected immediate return is fivefold in increased production, and we estimate that long-range benefit will be a tenfold increase in landings.

Research

Significant information is being obtained on the oceanic life and migrations of river herrings to fill important gaps in our knowledge of these fish and to determine causes of wide fluctuations and abundance of the stocks. Also, biological data are obtained on the species throughout the areas of high production to determine how much additional fishing the stocks can stand without damage to the resource.

On the Great Lakes, research on alewife is the vital part of an overall coordinated program to determine causes of the annual heavy mortality rate of the species, particularly in Lake Michigan. We are obtaining significantly important information on previously unknown aspects of the biology of the species.





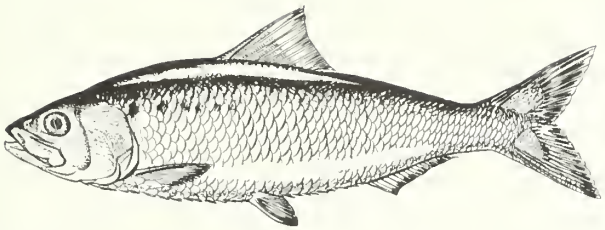
RESOURCE NEEDS

With the possible exception of stream pollution that creates conditions unsuitable or beyond the tolerance limits of the river herrings, dams blocking adult fish from their natural spawning grounds are the most serious threat to the resource. If landing of these fish must increase to satisfy consumer demands, we need to rehabilitate all suitable habitat and make it available to the fish. We also need to investigate how adaptable the species are to the environment created by water use development.

Early industrial water use developments throughout the New England States were responsible for closing most of the coastal streams to river herrings. Today most of the industry is gone, but not the dams. Consequently, to reestablish runs of fish above these barriers, an aggressive stream clearance program and laddering of obstructions are urgently needed. As a companion effort, research is needed to investigate the success of movement of the fish through impoundments, and to develop the best means for transporting downstream migrants past barriers.

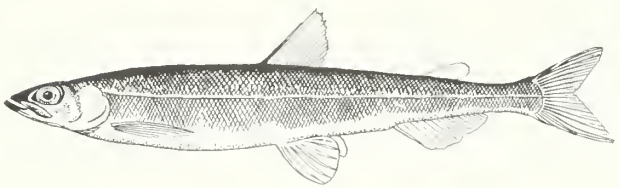
We cannot overemphasize the need for information on water quality with emphasis on pollution (mostly pesticides and industrial waste) as it affects all stages in the life of river herrings, and emphasis on how to abate such pollution.

Although river herrings are common along the entire Atlantic Coast, the biology and migratory habits are not well known. There is, therefore, need also for more information on the biology and migration of the fish and changes in the environment.



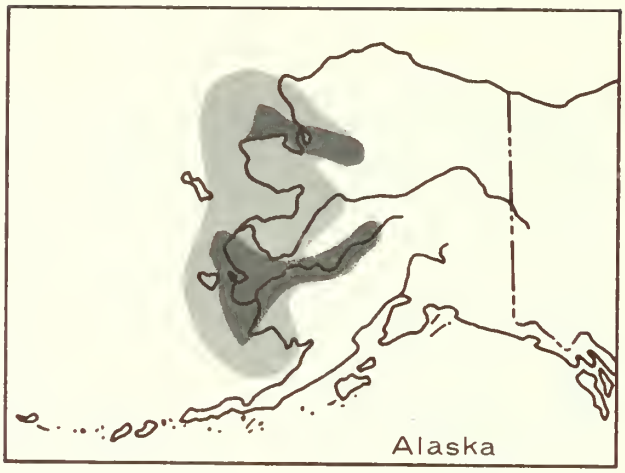
ALABAMA SHAD

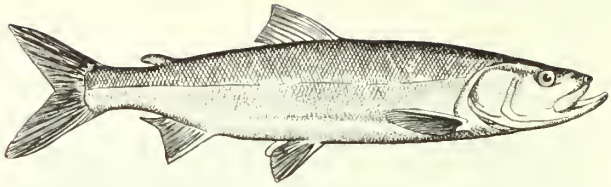
This species is reported from all major drainages of the Gulf of Mexico from eastern Florida to Louisiana, inclusively, and is undoubtedly the most abundant anadromous fish in the Gulf. It supports a small sport fishery, and several thousand pounds are taken by commercial gear incidental to the catch of menhaden and other species. The catch is mainly used for bait and reduction or pet food. It is quite possible that this is an underutilized resource. Information is being obtained on its abundance and migratory behavior to determine its potential value as a commercial and sport species.



SMELT

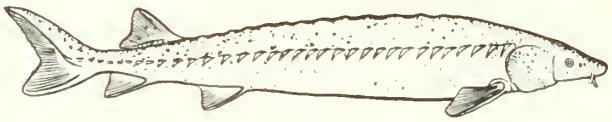
Four species (American, on the Atlantic Coast; Arctic, along the Atlantic Coast; longfin, in Puget Sound on the Pacific Coast; and the eulachon, on the Pacific Coast from northern California to northwestern Alaska) make up the anadromous smelt resource. The American smelt is the only one of major concern at present under the program. It is found on the Atlantic Coast from Delaware Bay to eastern Labrador but is more abundant north of Cape Cod. This species was successfully introduced into the Great Lakes where it is now abundant. On the Atlantic Coast, the annual average commercial catch is about 300,000 pounds, valued at $75,000. Its recreational value and catch is equal or exceeds the commercial catch. The drastic decline of the smelt may be due to pollution entering the streams, dams, and destruction of spawning habitat. The environmental improvement work under the program will make a significant contribution toward rehabilitation of the spawning areas and enhancement of the resource.

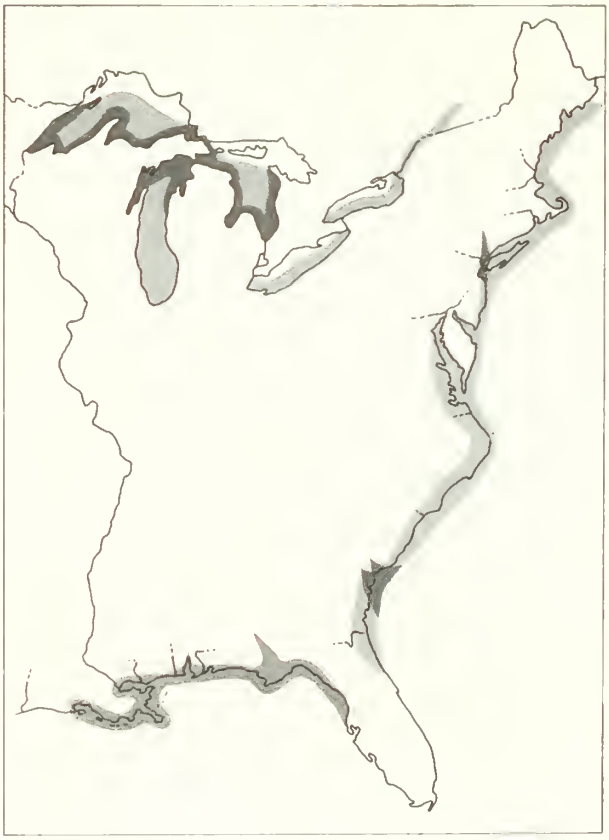




SHEEFISH

The sheefish, or inconnu, is a member of the whitefish family and is abundant in northwestern Alaska. The species spends some of its life in bays and tributaries and other coastal waters. Like salmon it spawns in the spring and summer in freshwater streams often hundreds of miles from the ocean. This fish grows to relatively large size (maximum weight 50-60 lbs.) but average weight of fish in the catch is 6 to 8 pounds. It is highly prized as a food fish. At the present time, a limited commercial fishery takes about 50 thousand pounds annually. Native Eskimo and Indian residents take sheefish for their own use also. Fishermen and representatives from industry have made inquiries about whether commercial fisheries are feasible for this species. Studies are underway to obtain information on the life history, migration, and abundance of the stocks.





STURGEON

Anadromous sturgeon are predominately three major species: Atlantic sturgeon, on the Atlantic and Gulf Coast and throughout the Great Lakes system; and the green and white sturgeons in rivers and streams of the Pacific and Alaska Coasts. Little information is available on the sturgeon or their fisheries. However, it is known that the catch has been drastically reduced. Although this species may live 100 years or more, it can be overfished and depleted easily because it takes about 15 to 20 years to reach maturity. In 1880, the commercial harvest was more than 2 million pounds on the Atlantic seaboard, but today the average annual catch is less than 50,000 pounds. We are inventorying the major fisheries of the Atlantic Coast to obtain information on possible factors that limit the abundance of the fish.

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A LOOK TO THE FUTURE

As our Nation grows and develops the demands on anadromous fish and their environment will greatly increase.

The job of conservation, development, and enhancement of this renewable resource and its environment is large and continuing.

The job can be done by a strong Federal-State partnership effort.