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Fisheries Division Biennial Report 1981–1982

MICHIGAN DEPARTMENT
OF
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FISHERIES DIVISION BIENNIAL REPORT 1981 - 1982

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PREFACE

Herein is Fisheries Division's tenth report to our stockholders: the licensed anglers and commercial fishermen of Michigan. As in the case of previous reports, we have attempted to identify and address problems in managing recreational and commercial fisheries, as well as to report progress and achievements in meeting the goals of the division. We are particularly proud of completing the remodeling of the state's fish hatchery facilities, of the extension of the division's resources to serve urban anglers; of research and management efforts to enhance fisheries for walleye and other warmwater species; and the balancing of inland and Great Lakes fisheries program development and implementation.

Late in the biennium the division implemented plans to realign some programs and staff. This included assignment of more personnel in field positions to work on inland fisheries management and Great Lakes monitoring; and closer involvement of research personnel with field managers in research and fisheries management evaluation activities. We believe these changes will enable Fisheries Division to carry out its mission to protect and enhance the public trust in populations and habitat of fishes and other forms of aquatic life, and promote optimum use of these resources for the benefit of the people of Michigan.

John A. Scott
Chief, Fisheries Division
November 1983

ACKNOWLEDGEMENTS

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INTRODUCTION

The Fisheries Division's Biennial Report is a record of the activities of the Division during the period October 1, 1980 through September 30, 1982. However activities are dynamic and seldom fall nicely within fiscal year limits. Summaries of last year's fishing are sometimes not completed until next year and management actions are ongoing. The result is a report that covers more than the designated calendar time for some activities and less for others. The years 1981-82 were ones of an increase in problems and complex solutions but also an increase in fishing and happy anglers. The highlights of the period follow.

HIGHLIGHTS

In the Great Lakes during 1980 and 1981, sportfishing continued to increase. In 1981, 9 million angler days of fishing were recorded, a 9.8% increase over 1980.

In commercial fishing, catch of whitefish was at the highest levels since the early 1900's and lake trout harvest was also at the highest since rehabilitation of the stock began in the 1950's. However, the harvest of lake trout was mainly of stocked fish and was large enough in many areas to severely retard the effort to rebuild self-sustaining stocks.

Controversy over the Indian treaty fishing rights continued while negotiations were ongoing with the tribal leaders to obtain a compromise solution.

In the inland waters during 1980 and 1981, anglers fished approximately 13.2 and 14.4 million angler days, respectively. Total catch amounted to 52 million fish in 1980 and 60 million in 1981. Despite the outstanding Great Lakes recreational fishery that had developed over the past decade Michigan's inland fishery continued to hold prime interest with anglers. A 1980 study showed of the 1.1 million licensed anglers who fished in Michigan, 76% fished in inland waters compared to 54% who fished Great Lakes waters.

The urban fishing program continued with the development of fishing facilities and access. Fishing bulkheads and piers were developed at Ecorse, Trenton, and Detroit. Parking facilities for fishermen were constructed at Erie Township and also at dams on major anadromous streams such as Grand and Kalamazoo rivers. An artificial reef was constructed in Lake Michigan at Muskegon. Although constructed in Lake Michigan this project was developed as an urban fishing program for Muskegon.

The Fishing Information Hotline and the Master Angler Award programs completed their 10th year in 1981. Each has grown more popular with anglers through time.

Salmon and steelhead fishing was extended 55 miles inland from Lyons to Lansing on the Grand River during the fall of 1981. This was the result of fish passages being completed at Lyons, Weber, Portland, Grand Ledge, and North Lansing dams. An additional 150,000 angler days of fishing per year is anticipated.

Fish populations were improved for angling by removing problem fishes with nets in 56 lakes and with chemicals in 34 lakes. Species management inland included stocking Atlantic salmon, brook trout, brown trout, rainbow trout, lake trout, splake, coho, muskellunge, northern pike, and walleye.

Recent walleye research has determined the optimum size to stock fingerlings, the potential of walleye predation to improve panfish populations, and the utility of artificial spawning reefs. The optimum size for planting tiger muskies was also determined.

Fishing regulations on largemouth bass, bluegills, and sturgeon were evaluated and the effects of competition between sport and commercial fishing in rehabilitation of lake trout was considered.

Studies of sediment in trout streams demonstrated that trout stocks can be improved 20 to 100% with a 70% reduction in sand bedload sediment. And a catch-basin technique was developed and tested to remove most of the sediment.

Lake trout eggs and fry were found in Grand Traverse Bay, Lake Michigan. Suitable lake trout spawning substrate was determined to be rounded or angular rock 2 to 20 inches in diameter with crevices 12 inches or deeper.

Alkalinity and pH of Upper Peninsula rivers were monitored prior to and during snowmelt in the spring of 1982. Storage of acid in the snowpack during the winter resulted in a significant acid release during snowmelt. However, the low pH levels were of short duration and consequently were probably not lethal to fish.

In 1975, it was recommended Thompson, Harrietta, and Wolf Lake hatcheries be completely redesigned and rebuilt. Thompson was completed in 1978, Harrietta in 1979, and Wolf Lake in the summer of 1982. Wolf Lake hatchery because of ideal water temperatures is expected to be an excellent producer of steelhead, chinook, Atlantic salmon, and brown trout.

GREAT LAKES

Recreational Fishing

Sportfishing during 1980 and 1981 in the Michigan waters of the Great Lakes and the anadromous streams continued to increase. In 1981, fishing was estimated at 9 million angler-days, an increase of 9.8% over 1980 (Table 1). The principal cold water species sought were chinook, coho, brown trout, rainbow trout, steelhead, smelt, and lake trout. The principal warm and coolwater species sought were perch, catfish, carp, walleye, smallmouth bass, pike, musky, panfish, and largemouth bass. Other species creating considerable fishing interest were buffalo, white bass, herring, whitefish, menominee, and crappie. The excellent recreational fishing in Michigan is further reflected in the statistic indicating that over 50% of the boat usage in Michigan is attributable to fishing. (Michigan has the largest number, over 600,000, of registered boats in the United States.)

Commercial Fishing

During the last decade, a serious conflict has developed over Indian rights to various Great Lakes fish stocks in the treaty-ceded water masses of Michigan. This dispute has been in the courts since the early 1970's and has generated many confusing opinions on fishing rights and management of the fish stocks. Recently, however, the federal courts ruled that certain tribal parties have rights to fish in the Great Lakes waters ceded in 1836, unobstructed by the State of Michigan. This decision has created much concern over the potential for usage and development in much of this vast area of Michigan's Great Lakes. Negotiations to settle the dispute in a manner that would permit all parties to achieve their major long-term management priorities are underway.

Table 1. Angler days (x 1,000,000) of effort fishing Michigan's Great Lakes waters and anadromous tributary streams, 1980-1981.

Lake and anadromous streams	1980 Days	1980 Percent	1981 Days	1981 Percent
Michigan	3.0	37	4.0	45
Huron	1.9	23	2.1	23
Superior	0.4	4	0.4	4
St. Clair	2.2	27	2.0	22
Erie	0.7	9	0.5	6
Total	8.2	100	9.0	100

During 1980-1982, the treaty fisheries expanded production 113% while the state licensed production expanded 26% (Tables 2, 3, 4). The treaty fisheries in 1982 accounted for 25% of the total harvest in poundage and 37% of the value to the fishermen (Tables 4 and 5).

Production of whitefish, the species of primary commercial importance, was at the highest levels seen since the early 1900's. Harvest probably cannot be sustained at this level unless biological conditions are more favorable now in the Great Lakes than in the past.

Lake trout harvest was also at a high due mainly to harvest of stocked fish. This harvest was large enough to severely retard the efforts in many areas of the lakes to rebuild self-sustaining stocks. Harvest of this species will have to be reduced in these areas if the goal of developing self-sustaining stocks is to be achieved with the present stocking levels.

Commercial production of the other high-value commercial species has reached limits where there is little room for expansion and in some cases harvest rates may have to be reduced to achieve a stable rate of production. Consequently, there is little potential for increasing the value of the commercial fishery by expecting to increase harvest. (The exceptions are contingent on the recovery of the chub populations and finding new markets for low-value species.) There appears, however, to be considerable potential for increasing the value of the commercial fishery by further processing and marketing more of fish within the state.

In addition to the traditional commercial fishery, the state sold, through bid, the surplus salmon (coho and chinook) harvested at weir locations on the Little Manistee and Platte rivers. The sale was of fish used for a source of eggs in the state's hatchery system, and fish surplus to the needs of the recreational fishery (Table 6). The contract provided labor for running the harvesting

Table 2. Commercial fish harvest (thousands of pounds) from Michigan waters of the Great Lakes by non-Indian and Indian fishermen in 1980.

Species	Lake Superior		Lake Michigan		Lake Huron		Lake Erie	Total
	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	
Whitefish	519.8	272.3	2,656.1	892.3	750.2	51.9	---	5,142.6
Chubs	528.4	5.1	134.4	104.9	---	---	---	772.8
Lake trout	46.2	32.6	1.4	284.1	---	3.1	---	367.4
Siscowet	74.7	---	---	---	---	---	---	74.7
Alewife	tr	---	604.8	---	---	---	---	604.8
Burbot	37.6	---	28.1	---	0.3	---	---	66.0
Lake herring	76.0	---	---	---	---	---	---	76.0
Suckers	8.7	0.4	1,174.0	3.1	134.5	0.7	---	1,321.4
Carp	---	---	---	---	562.7	---	545.0	1,107.7
Menominee	2.3	tr	5.6	144.1	33.0	17.2	---	202.2
Yellow perch	---	1.3	---	52.2	195.1	---	---	248.6
Smelt	1.9	---	525.1	---	22.0	---	20.6	569.6
Catfish	---	---	---	---	493.9	---	---	493.9
Walleye	---	---	---	1.7	---	1.1	---	2.8
Bullhead	---	---	---	---	1.8	---	---	1.8
White bass	---	---	---	---	tr	---	2.8	2.8
Buffalo	---	---	---	---	5.5	---	36.3	41.8
Bowfin	---	---	---	---	0.5	---	---	0.5
Sheepshead	---	---	---	---	14.0	---	---	14.0
Garfish	---	---	---	---	0.4	---	---	0.4
Quillback	---	---	---	---	59.4	---	---	59.4
Crappie	---	---	---	---	7.2	---	---	7.2
Total	1,295.6	311.7	5,129.5	1,482.4	2,280.5	74.0	604.7	11,178.4

tr = less than 50 pounds caught.

Table 3. Commercial fish harvest (thousands of pounds) from Michigan waters of the Great Lakes by non-Indian and Indian fishermen in 1981.

Species	Lake Superior		Lake Michigan		Lake Huron		Lake Erie	Total
	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	
Whitefish	411.9	446.7	3,458.6	1,553.0	885.3	50.3	---	6,805.8
Chubs	269.8	---	23.4	504.0	---	0.1	---	797.3
Lake trout	39.3	82.2	---	483.9	---	4.1	---	609.5
Siscowet	34.9	1.6	---	---	---	---	---	36.5
Alewife	tr	---	1,082.2	---	0.2	---	---	1,082.4
Burbot	29.1	---	18.6	tr	1.1	---	---	48.8
Lake herring	35.8	7.3	---	0.7	---	---	---	43.8
Suckers	8.6	47.0	828.6	11.0	181.1	---	---	1,076.3
Carp	tr	0.2	0.1	---	692.6	---	664.7	1,357.6
Menominee	0.3	3.1	0.8	183.8	33.6	9.9	---	231.5
Yellow perch	---	3.2	---	55.5	185.2	2.9	---	246.8
Smelt	0.3	---	1,189.6	3.4	20.4	---	---	1,213.7
Catfish	---	---	0.7	0.1	511.1	---	49.1	561.0
Walleye	---	---	---	4.9	---	0.5	---	5.4
Bullhead	---	---	---	---	2.6	---	10.2	12.8
White bass	---	---	---	---	0.5	---	14.3	14.8
Buffalo	---	---	---	---	0.3	---	29.8	30.1
Bowfin	---	---	---	---	0.4	---	---	0.4
Sheepshead	---	---	---	---	15.1	---	---	15.1
Garfish	---	---	---	---	0.3	---	---	0.3
Quillback	---	---	---	---	49.1	---	---	49.1
Crappie	---	---	---	---	21.6	---	---	21.6
Total	830.0	591.3	6,602.6	2,800.3	2,600.5	67.8	768.1	14,260.6

tr = less than 50 pounds caught.

Table 4. Commercial fish harvest (thousands of pounds) from Michigan waters of the Great Lakes by non-Indian and Indian fishermen in 1982.

Species	Lake Superior		Lake Michigan		Lake Huron		Lake Erie	Total
	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	
Whitefish	423.7	335.8	3,155.7	1,1613.3	1,148.5	483.7	---	7,160.7
Chubs	76.7	---	119.5	614.8	---	---	---	811.0
Lake trout	32.8	67.7	---	283.8	---	239.6	---	623.9
Siscowet	23.4	0.4	---	---	---	---	---	23.8
Alewife	---	---	1,692.8	---	1.5	---	---	1,694.3
Burbot	8.6	tr	20.3	11.5	1.1	---	---	41.5
Lake herring	16.9	3.0	---	0.1	---	2.8	---	22.8
Suckers	7.2	20.6	770.6	38.6	146.0	5.1	0.2	988.3
Carp	0.1	tr	1.5	tr	726.5	0.6	678.1	1,406.8
Menominee	0.3	1.1	0.1	168.7	20.5	18.1	---	208.8
Yellow perch	---	0.3	---	38.2	155.2	3.1	---	196.8
Smelt	0.6	tr	1,529.6	0.8	27.0	---	---	1,558.0
Catfish	---	---	1.0	1.9	671.0	4.6	20.4	698.9
Walleye	---	---	---	2.1	---	13.9	---	16.0
Bullhead	---	---	---	---	7.6	---	0.1	7.7
White bass	---	---	---	---	1.7	---	1.7	3.4
Buffalo	---	---	---	---	1.5	---	22.5	24.0
Bowfin	---	---	---	---	0.5	---	---	0.5
Sheepshead	---	---	---	---	35.2	---	0.6	35.8
Garfish	---	---	---	---	0.3	---	---	0.3
Quillback	---	---	---	---	80.4	---	1.4	81.8
Crappie	---	---	---	---	11.2	---	---	11.2
Gizzard Shad	---	---	---	---	---	---	76.0	76.0
Coho salmon	---	0.6	---	0.8	---	---	---	1.4
Total	590.3	429.5	7,291.1	2,774.6	3,035.7	771.5	801.0	15,693.7

tr = less than 50 pounds caught.

Table 5. Value in thousands of dollars of commercial fish production from Michigan waters of the Great Lakes for non-Indian and Indian fishermen in 1982.

Species	Lake Superior		Lake Michigan		Lake Huron		Lake Erie	Total
	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	Indian	Non-Indian	
Whitefish	314.9	130.4	2,029.4	1,194.3	725.9	178.5	---	4,573.4
Chubs	46.9	---	123.4	406.3	---	---	---	576.6
Lake trout	36.8	38.7	---	243.0	---	94.8	---	413.3
Siscowet	8.1	---	---	---	---	---	---	8.1
Alewife	---	---	28.2	---	---	0.1	---	28.3
Burbot	0.1	---	1.7	---	---	---	---	1.8
Lake herring	12.0	1.1	---	---	---	1.3	---	14.4
Suckers	0.2	---	22.0	0.1	14.8	---	---	37.1
Carp	---	---	0.1	---	81.3	---	66.3	147.7
Menominee	---	---	---	51.4	16.8	6.0	---	74.2
Yellow perch	---	---	---	55.2	157.5	4.0	---	216.7
Smelt	---	---	44.5	---	12.4	---	---	56.9
Catfish	---	---	0.3	0.6	285.6	1.4	10.7	298.6
Walleye	---	---	---	1.8	---	11.0	---	12.8
Bullhead	---	---	---	---	1.3	---	---	1.3
White bass	---	---	---	---	1.5	---	0.9	2.4
Buffalo	---	---	---	---	0.2	---	8.2	8.4
Bowfin	---	---	---	---	---	---	---	
Sheepshead	---	---	---	---	4.1	---	0.1	4.2
Garfish	---	---	---	---	---	---	---	
Quillback	---	---	---	---	13.0	---	0.1	13.1
Crappie	---	---	---	---	12.8	---	---	12.8
Gizzard shad	---	---	---	---	---	---	2.3	2.3
Coho salmon	---	---	---	---	---	---	---	
Total	419.0	170.2	2,249.6	1,952.7	1,327.2	297.1	88.6	6,504.4

Table 6. Salmon harvest (thousands of pounds) from state-operated harvest weirs and hatchery 1980-82.

Year	Little Manistee Weir		Lower Platte Weir		Platte Hatchery		Totals		Grand total
	Chinook	Coho	Chinook	Coho	Chinook	Coho	Chinook	Coho	
1980	234.4	353.0	23.3	360.9	---	473.7	257.7	1,187.6	1,445.3
1981	188.9	93.7	34.6	875.9	---	216.8	223.5	1,186.4	1,409.9
1982	165.4	110.7	22.2	556.2	4.3	116.8	191.9	783.7	975.6

facilities and revenues ($107,000 in 1981 and $112,000 in 1982) went to the Fish and Game Protection Fund.

Concessions for the exclusive rights to buy salmon eggs from sport fishermen were also leased on five state-owned access sites. These contracts returned to the Fish and Game Protection Fund $10,200 in 1981 and $11,800 in 1982. Besides these five concessions, the state issued permits for the development of 132 egg buying stations on private sites in 1981 and 140 sites in 1982. Purchases of eggs at all sites combined equaled roughly 430,000 pounds of eggs in 1981 and 395,000 in 1982.

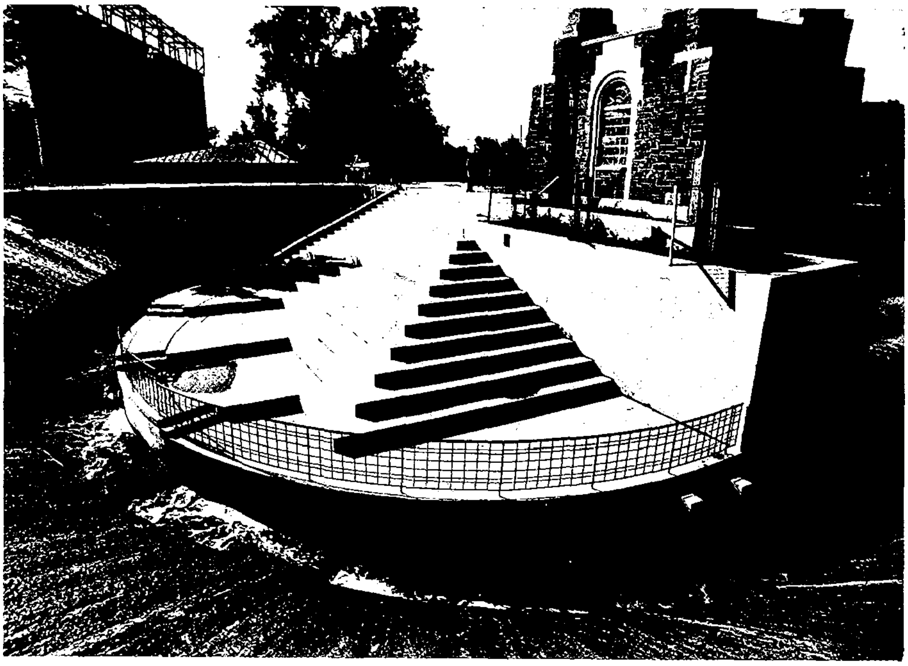
Stock Assessment

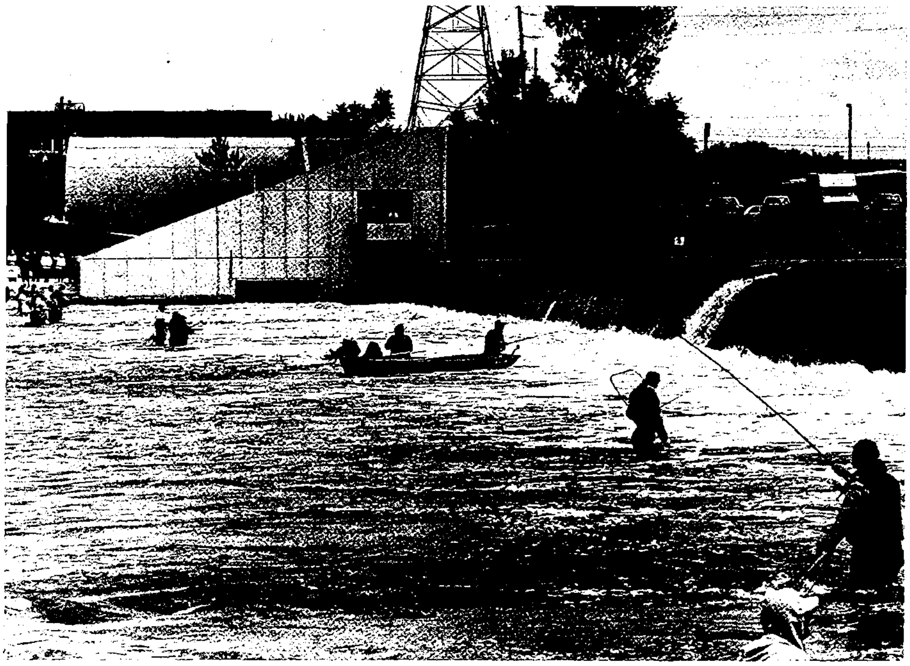
Assessments of Great Lakes fish stocks conducted during 1980-1982 indicated the following trends: chub populations in Lake Superior continued to remain stable while receiving only light fishing pressure due to poor market conditions. Chub populations in Lakes Michigan and Huron continued to show signs of recovering under light fishing pressure (treaty and assessment fisheries). Whitefish populations, lakewide, were at levels comparable to the early 1900's in many areas and were composed primarily of young fish due to the heavy harvesting pressure. Any failure of a year class could cause a dramatic decline in the population. The major forage species (smelt, alewife, and sculpins) appeared healthy but kept showing unexplainable shifts in biomass size between the species. Populations of perch in Saginaw Bay appeared healthy but elsewhere the populations remained depressed for a variety of reasons, not all of which are well understood. Walleye populations in Lakes Erie and St. Clair remained high due to good continued natural reproduction of the stocks. In Saginaw Bay, Little Bay de Noc, and southern Lake Michigan, walleye stocks expanded due to a stocking program. Populations of coho, steelhead, and chinook remained at high levels due to a stocking program but lake trout rehabilitation efforts were depressed due to increased harvest of stocked fish. An increase in naturally produced lake trout in Lake Superior and the finding of naturally produced trout in Grand Traverse Bay, Lake Michigan, and Lake Huron, at Alpena, were indicators that the present stocking program can develop self-sustaining stocks of this species if the mortality due to fishing is kept low enough to allow the stocked fish to mature and spawn.

Levels of the contaminants PCB and DDT and its derivatives continued their downward trend. However, interest increased in determining the presence and levels of dieldrin, toxaphene, chloradane, and dioxins. While these contaminants have been known in portions of the Great Lakes' drainage for a number of years, interest in their presence has not received much attention until recently because instrumentation could not accurately measure their presence at the low levels found. All of these chemicals, with the exception of toxaphene, have been banned for general usage. Consequently, the presence of these chemical contaminants in Great Lakes fish should decline with the passage of time.

Species Management

In 1981, the Michigan Department of Natural Resources Commission, upon recommendation of the Fisheries Division, reduced the number of snagging areas from nine to six. (Foote Dam site on the Au Sable River, Scottville on the Pere Marquette River, Sable River below Hamlin Lake, Tippy Dam site on the Big Manistee River, Croton Dam site on the Muskegon River and upstream of Muskegon Lake on the Muskegon River.) The areas closed were the Sixth Street Dam site on the Grand River, the Berrien Springs dam on the St. Joseph River, and the Allegan Dam site on the Kalamazoo River. In 1982, the Scottville site on the Pere Marquette was scheduled for closure but remained open under court order. A phasing out of all salmon snagging is the Commission's goal.





Fish ladders on the Grand River at Lansing (Brenke, above) and Grand Rapids (Sixth Street Dam, below). (Photographs from Lansing State Journal.)

INLAND

Michigan's mail sportfishing census showed in 1980 and 1981 that licensed fishermen fished approximately 13.2 and 14.4 million angler days, respectively, on inland lakes and streams. Total catch in inland waters amounted to 52 million fish in 1980, and 60 million in 1981. Inland fishing effort accounted for 62% of the statewide effort during the biennium.

Essential to the maintenance of good inland fishing opportunities are the protection and enhancement of habitat, protection or manipulation of fish populations, and providing diverse opportunities to meet angler demands. In order to make decisions on fisheries matters, the Fisheries Division must have knowledge of the opportunities and problems associated with public waters and be able to evaluate the management practices it initiates. Some of this knowledge is gathered from lake and stream surveys and during the biennium 371 lakes and 140 streams were surveyed. Information was collected to identify fishery problems and opportunities, to evaluate management practices, and to gather baseline data on biological, chemical, and physical features of the aquatic environment. This information will form the basis for management decisions to be made in the following program areas: recreational fishing, fish population manipulation, habitat development, and species management.

Recreational Fishing

Fisheries Division has the responsibility for managing the state's inland fisheries. The recreational activities that result from this management have substantial social and economic impacts on the state and local communities.

Despite the outstanding Great Lakes recreational fishery that has developed over the past decade, Michigan's inland fishery continues to command prime interest from anglers. A 1980 study showed that of the 1.1 million licensed anglers who fished in Michigan, 76% fished in inland waters compared to 54% who fished Great Lakes waters.

Of the inland waters, lakes commanded a major portion of the angling attention during the 1980-81 reporting period and produced an estimated 10.5 million angler days annually. During this period, inland streams contributed an estimated 3.9 million angler days for a total of 14.4 million angler days, up from 11.1 million (or 29%), just a decade ago. Of the estimated total, Region I contributed 1.6 million (11%), Region II - 6.2 million (43%), and Region III - 6.6 million (46%) angler days.

The state's urban program included the development of fishing facilities and access. Fishing bulkheads and piers were developed at Ecorse, Trenton, and Detroit. Parking facilities for fishermen were constructed at North Maumee Bay, Lake Erie and also at dams on major anadromous streams such as the Grand River and Kalamazoo.

A program to give fishermen access to various rivers and lakes in the southern part of the state was started with the Kammer Land Trust as the funding source. Priorities were established and approval given for obtaining a select number of sites on the Rogue and Grand rivers in Kent and Ionia counties and on Muskrat Lake in Clinton County.

An artificial reef was constructed in Lake Michigan at Muskegon. Although constructed in Lake Michigan, this program was developed as an urban fishing program for Muskegon. During the reporting period, evaluation studies by Michigan State University graduates continued. These studies included estimating fish species present on the reef, analysis of colonization of the reef by aquatic organisms, and measuring the physical stability of the reef.

The Fishing Information Hotline continued into its 10th year in 1981. This program has been very popular with the public and has provided fishing information from district offices to over 20,000 calls from anglers during the reporting period.

One of the most successful recreational programs of the Fisheries Division, also in its 10th year of existence in 1981, was the Master Angler Program. In 1980, 505 anglers and in 1981, 520 anglers entered qualified fish in the State's Master Angler Award Program. State records were broken for Atlantic salmon, pink salmon, northern muskellunge, white bass, redhorse sucker, and burbot in 1980 and for Atlantic salmon, pink salmon, bowfin, lake herring, and longnose gar in 1981. About 10% of the entrants were women and 10% were non-Michigan residents. The program has been most successful in emphasizing the excellent fishing in Michigan. Successful entrants receive a patch recognizing their skill in catching a trophy-size fish. The program has continued to grow in popularity as more and more anglers become aware of the recognition gained for trophy fish. Minimum entry weights and state records in pounds and ounces are listed below:

Species	Minimum entry weight	State record weight
Lake sturgeon	70.0	193-0
Atlantic salmon	12-0	32-10
Chinook salmon	30-0	46-1
Coho salmon	14-0	30-9
Pink salmon	2-4	6-2
Kokanee salmon	1-0	1-15.50
Rainbow trout (Steelhead)	14-0	26-8
Brown trout	14-0 (Great Lakes) 5-0 (Inland)	31-8
Brook trout	2-0	6-2
Lake trout	16-0	53-0
Splake	14-0 (Great Lakes) 5-0 (Inland)	16-4
Burbot	5-0	18-4
Great Lakes muskellunge	20-0	62-8
Northern muskellunge	20-0	45-0
Tiger muskellunge	20-0	53-1
Northern pike	20-0	39-0
Walleye	8-0	17-3
Sauger	5-0	6-9
Perch	1-12	3-12
Largemouth bass	6-0	11-15

Smallmouth bass	5-0	9-4
Green sunfish	0-12	...
Bluegill	1-0	2-12
Pumpkinseed	0-12	1-0
Redear sunfish	1-4	1-9
White crappie	1-12	2-10
Black crappie	1-12	4-2
Warmouth bass	1-0	...
Rock bass	1-8	3-10
White bass	2-0	3-1
Channel catfish	6-0	47-8
Flathead catfish	10-0	38-2
Brown bullhead	2-0	2-14
Black bullhead	1-8	2-0
Yellow bullhead	1-8	3-7.25
Bowfin (Dogfish)	7-0	14-0
Redhorse sucker	4-0	9-0
White sucker	2-8	7-3
Longnose sucker	2-0	6-9
Hog sucker	1-8	1-13
Carp	20-0	61-8
Freshwater drum	7-0	26-0
Gar	5-0	15-0
Lake whitefish	6-0	12-14
Lake herring (Cisco)	2-8	4-15.50
Menominee whitefish	1-0	3-12
Mooneye	0-12	1-0.40

The second and third years of art competition for the Department's Trout Stamp were held in 1980 and 1981 for the 1981 and 1982 trout stamps. The 1981 winning entry, a brown trout, was submitted by Lawrence Cory, Jr. of Troy, Michigan and the 1982 winner, a rainbow trout, was submitted by James Hublick of Milford, Michigan. The Trout Stamp Program, like the Master Angler Program, is becoming more popular each year.

Habitat Development

Streams

Fish passage.--Salmon and steelhead fishing was extended 55 miles, from Lyons to Lansing, on the Grand River during the fall of 1981. This was a result of fish passages being completed at Lyons, Weber, Portland, Grand Ledge, and North Lansing dams. In addition, support facilities such as parking areas and restrooms were completed at Weber, Portland, and Grand Ledge dams. With completion of this phase of the Grand River fisheries plan, an additional 150,000 angler days of steelhead and salmon fishing per year should be produced.

A joint interstate fish management program to extend salmon and steelhead fishing an additional 30 miles on the St. Joseph River was initiated with the state of Indiana. A preliminary management plan was prepared, including an Environmental Impact Statement, and approved for implementation. The plan calls for construction of fish passage facilities at Buchanan and Niles dams in Michigan and dams in South Bend and Mishawaka in Indiana. Preliminary engineering plans are in progress on these facilities. It is estimated that, when completed, this project will increase the annual fishing opportunities by 124,000 angler days over the existing 115,000 angler days provided by the fishery in the lower river.

Sea lamprey barriers.--Barrier dams are an essential part of an integrated program for controlling sea lamprey populations in the Great Lakes. Such barriers reduce dependence on the use of chemicals, and improve efficiency of control on many streams. A 3-year accelerated planning program was initiated in November 1980, to provide preliminary engineering on feasible barrier sites to support a long-range construction program of barrier dams and provide the basis for determining the significance of physical barriers in reducing the dependence on chemical control of sea lamprey.

Engineer surveys were completed on 24 of the 28 streams investigated for suitable barrier sites during the 2 years covered by this report. These surveys and hydrological analyses provided the necessary data to complete 13 feasibility reports, including preliminary plans and cost estimates. Six barrier proposals were submitted to the

Great Lakes Fishery Commission and approved for funding and construction.

Chemical reclamation.--In an effort to enhance the fishery in some of the second quality trout streams, chemical treatments to eliminate competing species is necessary. A total of 42 miles on four southern Michigan streams (Dowagiac Creek, Cass County; Sebewa Creek, Clinton and Ionia counties; South Branch White Creek, Tuscola County; and Paint Creek, Washtenaw County) were treated with rotenone and restocked to improve trout fishing.

Habitat improvement.--The habitat improvement program continued on a limited basis. Enhancement of trout habitat was accomplished on approximately 34 miles of 18 streams during the biennium. The bulk of the work consisted of adding structures such as half logs, stump, and tree covers to the North Branch Au Sable, East Branch Fox, Brule, and Paint rivers. Bank stabilization (rock rip-rap and log jams) work was an important phase of the habitat improvement program and included maintenance of structures on 5 miles of the Baldwin River and 10 miles of the Betsie River. In addition, an excavated trap was installed on the East Branch Au Sable, Clam River, Canada Creek (two traps), Newton Creek, and Mud Creek to remove excessive sediments from the streams. Gravel was placed in the East Branch and Middle Branch of the Escanaba River to provide improved spawning habitat for brook trout.

Lakes

Fish population manipulation.--Occasionally drastic measures must be taken to improve fishing in a lake or stream. In these instances events have occurred which have resulted either in an overabundance of undesirable species (i.e., suckers, carp, or bullheads) or an overabundance of small-sized fish (i.e., perch, bluegills, or rock bass). These undesirable species or stunted fish compete for food, which prevents desirable fish from surviving or growing to an attractive size. The only solution in this case is to reduce the numbers of fish present, so that those left will grow larger. The fishery manager uses three techniques to improve the population: manual thinning with nets of problem species; chemical thinning with approved selective piscicides; and total removal of all species with approved piscicides and restocking.

Manual thinning is accomplished by intensively netting and removing large numbers of problem fishes in a short period of time. This technique has proven successful in reducing numbers of stunted perch, bullheads, panfish, and even northern pike. It has been most successful in the less fertile waters of the Upper Peninsula, and during this biennium, 51 lakes were thinned in this manner. In the Lower Peninsula, only five lakes were manually thinned.

Where manual thinning is not practical, the selective piscicide, antimycin, is used to reduce numbers of problem fish. This anti-fungal agent is a by-product of the manufacture of penicillin and is one of two compounds approved by state and federal agencies for this use. During the biennium, seven lakes were treated to reduce the numbers of competing species.

If a lake is completely dominated by undesirable fish, sometimes the only solution to providing a fishery is total reclamation. In these cases, rotenone (the second piscicide approved for use) is applied to kill all species present. The lake is subsequently restocked so a balanced fish population results. During the biennium, 27 lakes were reclaimed in this fashion.

Some lakes that are reclaimed have outlets to stream systems which contain the same competing species targeted for removal from the lake. To prevent reintroduction of these undesirable species, small, low-head dams are build to block the upstream migration of these species. During this biennium, one barrier was built on Little Squaw Lake, Marquette County.

Species Management

Atlantic salmon

Michigan has been experimenting with various strains of Atlantic salmon in recent years and did produce and stock significant numbers of the Quebec and Sebago strains in the Great Lakes. However, no significant stockings were made in inland waters. During the biennium, only Higgins Lake was stocked (1,629 Quebec strain of Atlantic salmon).

Brook trout

Michigan has modified its brook trout program by shifting from domestic, hatchery broodstock as an egg source to the faster-growing, larger brook trout from the James Bay drainage of northern Canada. Two strains, from this region, Assinica and Temiscamie, commonly reach 4 pounds and live as long as 7 years. Michigan research has shown that they also grow faster and larger than progeny from hatchery broodstock brook trout. The hybrid between the Canadian strain and the hatchery brook trout also showed similar superior growth and performance.

Brook trout reared in Michigan's hatcheries are utilized to supplement stream populations which have become depressed, or are stocked in selected inland lakes. During the biennium, nearly 640,000 fingerling brook trout were stocked in inland waters, of which 61% went into streams.

Another of the objectives of the inland brook trout program is to provide anglers the opportunity to catch trophy-sized fish from lakes. Thirteen lakes in the Upper Peninsula and northern Lower Peninsula were managed this way, utilizing special regulations (artificial lures only, single pointed hooks, 15-inch minimum size, and reduced bag limits) to improve the chances of catching larger-sized fish.

Brown trout

Of the 1.3 million yearling-sized brown trout stocked during the biennium, nearly 85% were stocked in inland waters. Most of these (776,000) were stocked in inland streams. The balance (324,000) were stocked in two-story lakes (containing coldwater and warmwater species) to provide fishing opportunities over and above those provided by native, warmwater species.

Coho

During the biennium, the annual stocking of fingerling coho in Hemlock Lake, Cass County, was continued. This is one of the few landlocked lakes in Michigan which has provided a consistent fishery for coho. For that reason, it has been stocked annually since 1971 with 5,000 to 10,000 fall fingerlings.

Lake trout and splake

Of the 2.5 million yearling lake trout and splake reared in Michigan hatcheries during the biennium, 50% were stocked in inland waters, principally the deep, larger, oligotrophic lakes.

Rainbow trout

Inland waters received 97% (979,000) of the yearling rainbow trout reared during the biennium. Of this total, over 80% (814,000) were stocked in inland lakes, while the remaining 165,000 were stocked in inland streams.

Muskellunge

The goal of Michigan's inland muskellunge program is to maintain naturally reproducing muskellunge populations where they now exist, and meet the demand for additional fishing opportunities with hybrid (tiger) muskellunge. During the biennium, over 260,000 fry and 21,000 fingerling-sized purebred northern muskellunge were stocked, primarily in inland lakes where the native muskies are used for broodstock.

Hybrid (tiger) muskellunge are produced by crossing northern muskellunge (obtained from broodstock lakes) with northern pike. These hybrids are stocked in suitable, strategically located lakes statewide. Over 140 lakes were managed for tiger muskellunge and during the biennium, 330,000 hybrids were stocked in these inland waters.

Northern pike

One of the greatest threats to populations of northern pike is the loss of spawning habitat caused by dredging and filling of marshes. Prior to the enactment of strong environmental laws to control this loss, Fisheries Division approached the problem by purchasing marsh areas adjoining lakes and creating low head dams to maintain water levels during critical spawning periods. During the biennium, 20 of these marshes were operated, some of which were cooperative efforts involving local lake associations or sportsmen's clubs. Over 210,000 fingerling-sized northern pike were produced in this manner.

Walleye

Additional fishing opportunities for this species are in great demand and significant strides have been made in meeting this desire through expanded rearing capabilities. During the biennium, Michigan became self-sufficient in supplying all of the eggs necessary to produce the fry and fingerling needed to stock statewide. Previously, millions of eggs were obtained from New York.

Of the 68.3 million fry hatched, 94% (64.4 million) were stocked directly into inland waters or designated inland rearing ponds. A record 4.2 million spring and fall fingerlings were produced, from all rearing ponds, of which 81% (3.4 million) were stocked in inland lakes and streams. Many of the rearing pond operations were cooperative ventures with lake associations or sportsmen's groups. During the biennium, two additional rearing ponds were constructed (Thompson Pond, Schoolcraft County, and Caulderwood Pond, Ontonogon County), construction was begun on another (Tacoosh, Delta County), and two abandoned sewage lagoons (Auburn, Bay County) were converted to rearing ponds.

Other species

Bass, bluegills, crappies, perch, and other warmwater species are managed indirectly by using techniques such as population manipulation. These species are rarely stocked because their generalized spawning requirements and large reproductive capacity guarantee that natural reproduction is sufficient to maintain desirable numbers. More often than not the problem in managing these species is the presence of too many fish (or perch, bullheads, or suckers) which inhibit desirable growth of their own kind or other species (e.g., bass). Stocking additional fish will not solve these problems. However, in certain waters, where drastic reductions in populations of bass, bluegill, crappie, or channel catfish occurred (either through a management action or as a result of natural mortality) adult fish of these species were transferred to provide spawning populations.

Environmental Protection

During the biennium, "low-head" hydroelectric power generation was given substantial support and subsidy through changes in federal laws and their various rules and regulations. As a consequence of these actions, many projects previously deemed uneconomic, where facilities had been retired over a span of years, were eagerly sought by private developers. Coordination with the Federal Energy Regulatory Commission (FERC) and the U.S. Fish and Wildlife Service was greatly expanded. Within the Department of Natural Resources, consultation and coordination among Environmental Enforcement, Water Management, Land Resource Programs, Surface Water Quality divisions were intensified as well. Since these dams are on public streams, their operation can, and in many cases has had substantial adverse impacts on aquatic resources downstream from them. Fisheries Division's efforts concentrated on assuring flow releases provided adequate water at all times to protect fish and their food supplies.

Fish losses at water intakes were highlighted as a result of studies conducted under requirements of amendments to the 1972 "Clean Water Act." The studies were performed by the water users and demonstrated that billions of fish of all sizes are lost annually at these intakes. At one facility alone, 625 million larval and yearling fish and 17.4 million juveniles and adults were killed in a single year. A screening system to reduce these losses at that operation is being tested.

Environmental review and coordination activities with the Michigan Department of Transportation have generated a new spirit of cooperation resulting in fishermen access and parking at a number of locations. Particularly impressive are the facilities on several of the stream crossings of US-2 along the Upper Peninsula's Lake Michigan shoreline. Fishermen walkways under bridges and green belt zones to protect stream margins from destruction are additional features which have been implemented through cooperative planning.

Review and comment provided to Land Resource Programs Division through the Inland Lakes and Streams Act and other statutes have resulted in significant modification to many permits in order that resources protection be provided.

Fisheries Division has assisted in developing the state's position regarding a continuing problem with low flows at the Sault St. Marie rapids between the United States and Canada. Studies conducted in 1973 demonstrated the need for substantially more water to be released than called for by International Joint Commission rules, if aquatic resources were to be protected. In reviewing the 1909 treaty which established the Commission, it is clear that previous uses and riparian rights are protected under its terms. It is postulate, therefore, that fish and fisheries has a priority over other uses, excepting perhaps those of navigation. The matter is under consideration by the International Joint Commission.

Environmental liaison activities with Water Quality personnel and the Water Resources Commission were of an ongoing nature but a significant amount of time was involved in proposals for changing Michigan's water quality standards. The proposals have ranged from a complete revamping to altering only one or two rules. The changes offered are controversial and as yet have not been approved for submittal to the Legislative Rules Committee.

The sharp increase in small dam rehabilitation focused attention on the "Fish Passage" statute Act 123, P.A. 1929. Based on advice of the Attorney General, the Division renewed its efforts to provide rules for administration of the Act. The process is lengthy but all intra-departmental issues have been resolved and public hearings are scheduled.

Continuing pressure has been applied to the Division by lake property owners and associations to allow the introduction of grass carp, or white amur, for aquatic vegetation control. One great concern, and one expressed by biologists from other Great Lakes states as well, is the potential for natural reproduction in Great Lakes waters, as has occurred in the lower Mississippi River. Production of sterile grass carp or sterile hybrid fish may, in the future, provide the basis for quantitative evaluation of these biological "control" measures to reduce nuisance aquatic plant growth.

Applications to "drawdown" lake levels for the purpose of aquatic vegetation control rose alarmingly during the biennium. Concern has been expressed that non-target species of both plants and animals may be damaged if such requests are approved. In one instance, the Division, with the assistance of the Attorney General, urged and obtained significant modification to a proposal before the circuit court. The court is maintaining jurisdiction over a second year of operation. Subsequently, coordination with Land Resource Programs Division has produced a procedure for evaluation which will provide the mechanism for proper evaluation of the efficacy of this approach to control aquatic plant growth.

Fishing for yellow perch in Lake Michigan.

Fishing walk along Detroit River at Ecorse.

RESEARCH

In 1981-82 fisheries research was conducted in four categories of management interest--warmwater fish, coldwater fish, Great Lakes fish, and environmental problems. The highlights of research accomplished in each category follows.

Warmwater Fish

Recent walleye research has been directed at determining the optimum size to stock fingerlings, the potential for walleye predation to improve panfish populations, and the utility of artificial spawning reefs. Results from a study at ponds containing bluegills but no large predatory fish indicated that relatively inexpensive 2-inch walleye fingerlings can survive and grow as well (or better) than more costly 4- or 6-inch fingerlings. In a large lake (Manistee) with a natural fish community, these larger fingerlings experienced a 74% mortality the first year after stocking, and an additional 56% died each year thereafter. It was estimated that about 3.5% of the stocked fingerlings eventually would be harvested by anglers. Elsewhere, in a small, intensively managed lake (Jewett), stunting of perch was prevented and fishing was improved by stocking the large fingerlings.

An artificial walleye spawning reef in Six Mile Lake is currently being evaluated by estimating the number of eggs deposited and the subsequent number of age-I walleye produced. Adult walleyes deposited eggs on the reef each spring, 1981-82, but they also spawned on a natural sand-detritus area. Production of age-I recruits was 117 prior to installation of the reef (1979 year class) and 694 and 361 afterwards (1980 and 1981 year classes, respectively). The 1979 year class originated either from spawning on the sand-detritus area or, possibly, from an unauthorized fry plant. Irregardless, walleye recruitment has increased at least 3-6 times since installation of the reef.

Similarly, research on tiger muskies has been directed at determining the optimum size for planting fingerlings reared on pelleted foods. It was learned that large (7-inch) fingerlings survive better than small (3-5-inch) fingerlings in natural lakes containing bass and other predators. Losses among small muskies were so severe that good fisheries could not be maintained. Conversely, in waters without bass the less expensive small fingerlings survived better because they could be planted when temperatures and natural food supplies were more favorable.

Concerns about bass fishing prompted a study of three typical southern Michigan lakes to determine modern-day exploitation rates, the effects of changing the minimum size limit from 10-12 inches (in 1976), and angler opinions about fishing. The bass populations were found to be in good shape overall, and exploitation rates were not excessive (18-48% per year). One bass population had increased by 22% due to the higher size limit but, as had been predicted by previous mathematical modeling, harvest of bass by numbers and weight decreased (Table 7). Nevertheless, most anglers were satisfied with the higher size limit, sensing that they were catching more bass of all sizes. Catch rates were 6-15 bass per acre, of which 1-4 were actually harvested. About 50% of the anglers said they were fishing for bass and other game fish, and 27% said they usually released the legal-sized bass they caught.

The status and management of lake sturgeon in Michigan were reviewed. Significant populations of this threatened species now occur in only 10 locations. For the Black Lake population, mortality is about 10% per year, of which about 2.5% is due to spearing and angling. It was recommended that exploitation be maintained at less than 4.8% per year and that the 50-inch minimum size limit be retained to protect sturgeon until they have a chance to reproduce.

Table 7. Effects on bass harvest of increasing the size limit from 10 to 12 inches.

Harvested bass	Predicted change	Observed change	
		Pontiac Lake	Whitmore Lake
Numbers	-33%	-26%	-29%
Pounds	-5%	-13%	-13%

The structure of typical fish communities, and the factors which influence the quality of angling, were defined by a study which analyzed data from 229 lower Michigan lakes. Warmwater fishes predominated in 90% of these lakes, coolwater species in 10%. Bluegills alone made up more than half of the fish biomass in 41% of these lakes. In general, better angling was experienced in deeper, clearer, moderately vegetated lakes which had a layer of cool and oxygenated water in summer. Factors favorable to good fishing were relatively high proportions (greater than 20%) of largemouth bass and other piscivors, relatively low proportions of bluegill (less than 78%), carp or white sucker (less than 50%), good growth of bluegills (state average or better), and the presence of large bluegills (larger than 8 inches).

The feasibility of improving bluegill populations and fisheries by means of special bluegill fishing regulations was evaluated with a mathematical model of bluegill population dynamics. Simulations predicted that even a severe restriction, such as protecting all bluegills over 7.0 inches from harvest (7-inch maximum size limit), would not effectively control bluegill recruitment or significantly increase the abundance of large bluegills. Under the best conditions likely to be found, the numbers of large (7.0 inches and larger) bluegills in the population would increase 23%, but harvest (of 5- to 7-inch fish) would drop 13%, and total catch (all sizes) would remain the same.

Coldwater Fish

Two studies measuring the effect of bedload sediment, caused by soil erosion, in trout streams showed it is very detrimental to trout. These studies demonstrated that trout stocks can be improved 20 to 100% with a 70% reduction in sand bedload sediment. Catch-basin techniques have been developed and tested that can remove most of the bedload. This new stream improvement technique is inexpensive.

The impact of delaying the opening date of the trout fishing season on trout lakes until July 1 was tested. Preliminary findings indicated trout yield (weight cropped) would increase by 10% or more. With this delay in the opening of the season anglers would creel fish of a much larger size but would sacrifice numbers caught. This regulation could be combined with a May-June season of catch-and-release preceding a harvest season beginning in July without sacrificing yield.

Research continued to demonstrate the desirable characteristics of Assinica strain brook trout. This strain grows faster and larger than domestic strains. The hybrid cross of Assinica male X domestic female produced a fish that grew and survived as well as the Assinica parent strain. Thus, the hybrid strain will probably become the hatchery production brook trout because the domestic provides a reliable egg source and is relatively ease to rear.

Preliminary findings of the slot-size limit regulation (in which only trout 8-12 inches long and those larger than 16 inches may be kept) on the Main Au Sable River indicated good angler acceptance of the new rules. Catches of trout 12 to 16 inches long increased slightly. The availability of large fish appeared to be unchanged. The harvest of 8-12 inch trout was up considerably because formerly they were not legal targets. Angler use increased on all special regulation waters of the Au Sable River.

A study of the trout population of Newton Creek, a central lower peninsula trout stream, indicated a lower average trout population than the more northerly trout streams. This was primarily the result of poor reproductive success. However, trout growth and survival was similar to that found in northern streams. Also, hatchery planted trout were found to augment the population without adverse effects on the mature stock.

Great Lakes Fish

A 14-year study of rainbow trout-coho salmon population dynamics in Lake Superior tributaries was concluded in 1982. The study provided baseline data on juvenile salmonid abundance in streams and explored interspecific relationships between salmonids. No competition between rainbow and coho juveniles was found. It also documented the establishment of naturally reproducing coho populations, and determined that scale characteristics could be used to distinguish hatchery from wild coho. The rainbow trout biology from the study contributed to an international assessment of rainbow trout stocks in the Great Lakes.

A 9-year study of juvenile lake trout morphological characteristics was concluded in 1981. The objective of the study was to identify characteristics which would assist in differentiating between juveniles of lean, humper, and siscowet races of lake trout which are found in Lake Superior. Siblings of the three races were reared at Marquette and Thompson hatcheries and sampled at intervals as they grew. They were examined for differences in growth, coefficient of condition, specific gravity, dry weight, and numerous morphological and meristic characteristics. Differences were found in most parameters but none were definitive. Those that may be useful to distinguish among races included measurements of head features, girth, furcation, anal fin size, and dorsal and anal ray counts.

Objectives of a study concluded in 1982 were to (1) develop methods to sample lake trout eggs and fry and then (2) assess early survival of young lake trout in Lake Superior and Lake Michigan. The United States Fish and Wildlife Service, Biological Station, Ashland, Wisconsin, assisted with portions of this study. Various designed suction pumps, trawls, and traps were found to be effective gear for capturing lake trout eggs and young-of-the-year.

Lake trout eggs and fry were found in Grand Traverse Bay, Lake Michigan. Lake trout young studied in Presque Isle Harbor, Lake Superior were found to reside in the harbor for up to 3 months after hatching where they fed mainly on insect pupa and larvae and grew to over 50 mm in total length. Suitable lake trout spawning substrate was determined to be rounded or angular rock 2-20 inches in diameter with crevices 12 inches or deeper.

Four ongoing Great Lakes fish studies were dynamics of pink salmon in the Great Lakes; reproduction of lake trout; survival of planted lake trout eggs; and age, growth, and mortality of chubs (Coregonus spp.) in Lake Superior.

The attempt to document the dynamics of pink salmon in Lake Superior and one of its tributaries in 1981 was set back by failure of the 1981 spawning run to materialize. Only 14 pink salmon were captured in Lake Superior despite extensive netting efforts from 4 August to 10 September. These fish were close to spawning and had ceased feeding so no food habit information was obtained. Only 165 pink salmon were captured in the Laughing Whitefish River where a cooperative population dynamics study with Michigan State University was underway. These 165 salmon were marked and passed upstream but none reached the spawning grounds and there is some evidence that they left the Laughing Whitefish and entered another stream. The poor 1981 spawning run may have been due to failure of the 1979 year class or that maturity was delayed until 1982. But, a large run of 3-year old salmon did not occur in 1982. In Lake Superior runs were even less than in the previous even year. However, in Lake Michigan and Lake Huron runs were equal to or greater than previous years. A sample of 60 salmon was obtained from Lake Huron near Detour, in 1982. Again the fish were close to spawning, were not feeding, and no useful food habit information was obtained. The Michigan State

University personnel monitored pink salmon smolt emigration from spawning streams during the spring of 1982. Smolt emigrations occurred during the first week of May.

Field work was completed on a study of the dynamics of lake trout reproduction on a man-made spawning reef. Number of adults, eggs deposition, and fry production were measured. Physical and biological characteristics of the spawning reef were also described. These parameters were estimated on a 2,800 m^2 man-made reef in Presque Isle Harbor, Lake Superior during 1977-1980. Two attempts at gathering similar data on a natural reef met with failure. Manpower and gear were inadequate to cope with hazardous working conditions on a reef in the open waters of Lake Superior. In Presque Isle Harbor, annual estimates of eggs deposited and swim-up fry produced during 1977-1980 with 95% confidence limits were as follows:

	Eggs deposited		Fish produced		Egg-to-fry survival (percent)
Year	Per m^2	Total	Per m^2	Total	
1977-78	518±348	1,467,753	46±21	130,341	9
1978-79	122±52	345,687	20±10	56,670	16
1979-80	230±106	651,705	27±13	76,504	12

A study started in 1979 of planting eyed eggs as a means of restoring lake trout stocks in the Great Lakes achieved some success on small reefs on the south shore of Drummond Island, Lake Huron. Fry were captured on these reefs in emergent fry traps. Previous plants of eyed eggs, mostly on offshore reefs, produced no results probably due to no survival or the inability to adequately sample reefs in the open lake. At Drummond Island, eggs were planted at a density of slightly more than 200/m^2. Although fry production on the planted reefs has not been quantified, survival of eggs to fry in incubation cages on these reefs has been in excess of 90%. All reefs planted will be checked for adult lake trout during the spawning season 6-8 years from year of planting. Any unclipped lake trout captured will be considered to be from the planted eyed eggs.

Field work was completed in 1981 on an assessment of growth and mortality for chub stocks on fishing grounds in Lake Superior north, east, and west of the Keweenaw Peninsula. Length, weight, sex, maturity, and scale samples have been collected from net-run samples of commercial catches since 1975 and from graded-mesh nets fished with commercial nets in 1981. Length-weight and length-frequencies have been calculated and these parameters along with growth and age composition will be used in an attempt to identify individual chub stocks. Age and growth has been determined from the scale samples. These data will be summarized, mortality rates determined, and a report documenting results of the study prepared in 1983.

The goal of reestablishing adequate lake trout reproduction in the Great Lakes has not been achieved after 20 years of sea lamprey control and stocking fingerling lake trout. Survival of eggs and fry is known to be a problem, but it is also likely that sport and commercial fishing are significantly depressing the broodstock. Recent mathematical simulations indicate that broodstocks are too low, and that about 8 years would be required for the stocks to build up to an adequate level if all fishing were banned. It was concluded that fishing should be curtailed by means of higher size limits or reduced quotas.

Environmental Problems

A fishing pier was constructed in 1976 in Chesterfield Township, on Lake St Clair, to allow fishermen access to the lake. Yearly and seasonal fluctuations in abundance of various species of fish inhabiting the pier area, and the success of fishermen fishing from the pier have been measured. An opinion survey was also conducted to determine fisherman satisfaction with the pier. Abundance of fish was estimated each year by setting two trap nets near the pier for 7 days each month from April through October. Fishing pressure and success were measured by creel census. In May 1978, tire "reefs" were placed near the outer end of the pier to attract fish. The tires were evaluated as fish attractors for 2 years and then soybean meal was placed in the tires as an added attractor. The most abundant species of fish around the pier were yellow perch, channel catfish, white bass, rock bass, pumpkinseed sunfish, and black crappie. Throughout the study, trap net catches indicated a good population of fish around the pier, however, fishing success has always been poor. Neither the tires nor the soybean meal increased the catch. Despite the poor fishing success, fishermen indicate satisfaction with the pier as a place to fish. Satisfaction seemed to be related to the aesthetic values of the pier more than the quality of the fishing.

Invertebrate fauna in the Betsie, Baldwin, Green, and Sturgeon rivers were sampled to measure the effects of repeated lampricide treatments with TFM (trifluormethyl-4-nitrophenol). Mark-and-recapture population estimates of brown trout were made also in treated and untreated sections of the Sturgeon River. No adverse effects on the trout population in the Sturgeon River were evident. There were more brown trout and rainbow trout, of most all sizes, in the treatment area than in the control area. However, immature aquatic insects were considerably reduced in abundance in the treated area of the Baldwin River. All species known to be sensitive to TFM were adversely affected. Four species of burrowing mayflies present in the control area were all either reduced in abundance or absent in the treated area. Results in the Green River were variable with 13 species being more abundant in the treated area, and 7 species more abundant in the control area. The Betsie River and the Sturgeon River were sampled only for burrowing mayflies. Numbers were considerably reduced in the treated area of the Sturgeon, however, sampling variability masked any differences in the Betsie River.

In Lake St. Clair, fish distribution, in relation to seasons and types of habitat, was studied in a Harsen's Island marsh-bay complex. A total of 7,367 fish, representing 39 species, were collected. Four species assemblages were identified, based on the seasonal catch of 18 most common species. The resident assemblage was made up of 14 species and accounted for 90% of the total catch of fish. Spring, summer, and fall assemblages each comprised less than 3% of the total catch. The resident species included rock bass, pumpkinseed, largemouth bass, smallmouth bass, brown bullhead, yellow perch, mimic shiner, sand shiner, golden shiner, bluntnose minnow, johnny darter, Iowa darter, banded killifish, and brook silverside. The marsh was generally used as a nursery area, while the bay was used for both spawning and nursery purposes.

Alkalinity and pH of Upper Peninsula rivers were monitored prior to and during snowmelt in the spring of 1982. Precipitation throughout Michigan is known to be acid. Storage of acid in the snowpack during the winter results in a significant acid release during snowmelt. Measurements were made on March 18 during the mid-winter low flow and then on April 27 during the peak of spring melt and runoff. Most of the streams were diluted by almost 50%, and experienced a drop in pH of one to two units, (from 7 plus to 5 or 6 plus). The low pH levels were of short duration and consequently were probably not lethal to fish. However, it is possible that newly hatched trout fry would suffer from pH shock due to the sudden change.

The smallmouth bass populations of several southern Michigan rivers have been surveyed, and the Huron River has been chosen for additional study. It appears that stream populations of smallmouth bass are subject to exceptionally high mortality. Reproduction seems satisfactory in several of the rivers, however, very few bass reach the legal size of 12 inches. Smallmouth bass in the Huron River reach legal size at age III, however, a mortality rate near 90% for both ages I and II results in very few fish reaching legal size.

A fishing reef, constructed in Lake Michigan, was evaluated for use by fish and fishermen. During the fall of 1980, lake trout and whitefish had located the reef but it is not known whether or not they spawned. During May through July 10, 1981, the most abundant fish species using the reef were: yellow perch, alewife, bloaters, sculpins, johnny darters, and sticklebacks. Other less common species were white suckers, rainbow smelt, brown trout, coho and chinook salmon, whitefish, and burbot. Invertebrates had begun to colonize the reef by May 1981 and increased during the summer. Wind direction was very influential in governing the abundance of the fish at the reef. Offshore winds brought cold water (30-50 F) inshore and resulted in few fish present at the reef. Onshore winds brought warmer water into the reef and as a result fishes were more abundant. Early season observations indicated the reef had settled considerably but later in the year it appeared to stabilize. Very few anglers fished Muskegon Reef in 1981. Only three parties were observed by the census clerk and they caught nothing. Inclement weather, combined with generally very cold water at the reef, appeared to be responsible. Many anglers fished from the breakwaters at both reef and control census sites and were quite successful. There were, however, many days when inclement weather prevented fishing from the breakwaters. It was ironic that the onshore winds, which appeared to increase the abundance of fish at the reef, were responsible for making it too difficult to fish the reef from a boat.

Research reports completed for 1981-82 are listed below:

Report number	Author and title
1892.	Peck, James W. 1981. Dispersal of lake trout fry from an artificial spawning reef in Lake Superior. 13 pp.
1893.	Wagner, Wilbert C., and Thomas M. Stauffer. 1981. Distribution and abundance of pink salmon in Michigan tributaries of the Great Lakes, 1967-1980. 15 pp.
1894.	Beyerle, George B. 1981. Comparative survival and growth of 8.9- and 17.8-cm (3.5- and 7.0-inch) tiger muskellunge planted in a small lake with forage fishes. 7 pp.
1895.	Clark, Richard D., Jr. 1981. Analysis of "quality fishing" regulations through mathematical simulation of a brown trout fishery. 33 pp.
1896.	Goudy, Greg W. 1981. The exploitation, harvest, and abundance of largemouth bass populations in three southeastern Michigan lakes. 85 pp.
1897.	Smith, Kelley David. 1981. A general numerical model for evaluating size limit regulations with application to Michigan bluegill (*Lepomis macrochirus* Rafinesque). 87 pp.
1899.	Alexander, Gaylord R., and Donald R. Peterson. 1981. Trout of Newton Creek, Clare County, Michigan: a transitional zone trout stream. 29 pp.
1900.	Merron, Glenn S. 1982. Growth rate of brown trout (*Salmo trutta*) in areas of the Au Sable River, Michigan, before and after domestic sewage diversion. 38 pp.
1901.	Hansen, Edward A., Gaylord R. Alexander, and William H. Dunn. 1982. Sand sediments in a Michigan trout stream. Part I. In-stream sediment basins: A technique for removing sand bedload from streams. 26 pp.
1902.	Alexander, Gaylord, R., and Edward A. Hansen. 1982. Sand sediments in a Michigan trout stream. Part II. Effects of reducing sand bedload on a trout population. 20 pp.

1903. Clark, Richard D., Jr. 1982. The impact of voluntary catch and release of legal-sized fish on recreational fisheries. 23 pp.

1904. Wagner, Wilbert C. 1982. Lake trout spawning habitat in the Great Lakes. 14 pp.

1905. Schneider, James C. 1983. Experimental walleye-perch management in a small lake. 30 pp.

1906. Alexander, Gaylord R., and Edward A. Hansen. 1983. Effects of sand bedload sediment on brook trout population. 50 pp.

1909. Clark, Richard D., Jr., and Bin. Huang. 1983. The dynamics of competition between sport and commercial fishing: Effects on rehabilitation of lake trout in Lake Michigan. 62 pp.

1910. Beyerle, George B. 1983. Survival and growth of 5-, 10-, and 15-cm walleye fingerlings stocked in ponds with bluegills. 10 pp.

Digging research sediment trap on Poplar Creek.

Sea lamprey barrier dam on the Days River.

HATCHERIES

Broodstock Developments

In 1981, the Broodstock Committee completed its assignment and submitted their recommendations. The recommendations were two-fold: (1) Fisheries Division should begin, as soon as facilities and personnel allow, a scientifically designed genetic selection program; and (2) domestic strains should be hybridized, with "wild" stock wherever practical, to produce fish for management.

Although these recommendations were approved and supported by the Division, they can not be implemented until facilities are available where disease-free (certified) stocks can be maintained and propagated. Since such facilities will not be available in the near future, the decision was made to discontinue most of the domestic broodstock program and obtain certified eggs of brown trout and rainbow trout, from the commercial market or through other governmental agencies. A small number of brook trout broodstock will be retained, however. Obtaining disease-free eggs of rainbow and brown trout will bring the Division a step closer toward specific pathogen-free rearing at the new spring or well-water hatcheries. The hatcheries at Thompson, Harrietta, and Wolf Lake have been built on disease-free water sources, and fish pathogens which depend on fish to survive, can therefore be eliminated from these hatcheries, providing only certified stocks enter the facilities and other safeguards are taken to prevent contamination. This concept will be tested in the years to come, and, if successful, will become the normal procedure. The program consists of two major elements requiring evaluation, namely evaluation of the product for management (various strains of rainbow and brown trout) and testing the concept of specific pathogen-free rearing.

Hatchery Construction

In 1975, it was recommended Thompson, Harrietta, and Wolf Lake hatcheries be completely redesigned and rebuilt. Thompson was completed in 1978, Harrietta in 1979, and Wolf Lake in the summer of 1982.

During the last 2 years, various problems with the Thompson and Harrietta hatcheries have been resolved. The most significant improvement was the conversion of the "jet-aeration" system to the "packed column" aeration-degassing system. The packed column consists of a tube filled with plastic ballast rings which break up the water as it falls through the tube. As the water breaks up, there is maximum air contact to allow for gas exchanges to take place. The supersaturated nitrogen gas escapes into the atmosphere while oxygen is added. Water supersaturated with nitrogen can create serious problems in fish rearing. Since this gas is inert, the fish cannot readily dispel it. As the fish absorbs the gas into its bloodstream, it may form bubbles, thus blocking blood flow into tissues. This condition can result in death, but often, if there is but a slight supersaturaion, the fish will survive, but are living under stressful conditions, making them more susceptible to diseases. Thompson and Harrietta received additional alarms to safeguard individual rearing tanks and outdoor ponds.

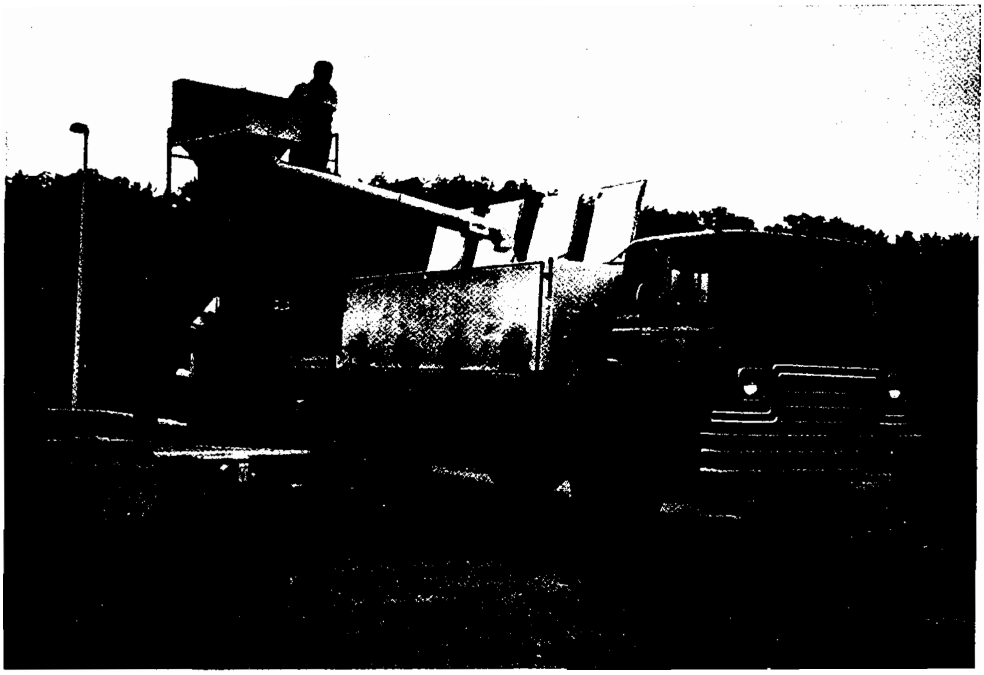
Fish were brought into the Wolf Lake Hatchery in the summer of 1982. This hatchery is expected to be an excellent production unit, especially for steelhead, chinook, Atlantic salmon, and brown trout. These species require relatively warm water to grow to the proper size by planting season. The Wolf Lake Hatchery is uniquely equipped to do this. Not only does it have warmer well water than the other units, but it is also designed with a large solar heating system which is capable of heating 1,000 gallons per minute well water from 52 C to 68 C, during the summer months. Although basically this heating capability was designed for the production of coolwater fish (muskie, pike, and walleye) there will also be opportunities to use some heated water for salmon and trout. The solar heating system consists of five 1-acre solar cells whose water, after it is heated, is delivered to a large storage basin. From there, it is pumped through a heat exchanger to transfer the heat to the well water. After this process, the water is returned to the solar cells. It is therefore a closed system. In effect, the cells resemble giant waterbeds. They are only 4 inches deep. This solar system is one of a kind, not only in design, but in application as well.

One accomplishment during these 2 years was the installation of a solid collection system at the Platte River Hatchery for the outdoor rearing ponds. It consists of a piping arrangement along the foot of the raceways through which the solids are pumped directly into a tanker distribution truck. Solids are thus directly removed from the raceways rather than being settled in the large treatment pond from which they cannot be retrieved. This approach can reduce the phosphorus output of this hatchery by an estimated 20%. Also, at Marquette, a new well field was constructed. Now enough well water is available to incubate all the lake trout eggs in this relatively warm water (48 F). This will reduce incubation time by some 55 days. By using this water also for early rearing of fry and fingerlings, growth rates will be accelerated and the final result will be production of larger yearling lake trout by stocking time in the spring (April and May).

The Oden Hatchery received a new, large production well, capable of augmenting the water for the outdoor rearing ponds by 1,600 gpm. This vastly improves rearing conditions outdoors for increased production. All of the listed improvements were aimed at increasing both the quality and quantity of fish that Michigan's hatcheries produce for a very ambitious and successful fish management program.

Hatchery Production

The fish production levels are still below normal. They reflect some of the problems encountered at the new hatcheries and also the fact that the Wolf Lake Hatchery was out of operation due to construction. Significant increases in numbers stocked are expected in 1983 and 1984. Tables 8 through 13 show numbers and weights of warmwater and coldwater fish stocked in 1980, 1981, and 1982.



Loading fish for stocking at the Wolf Lake Hatchery.

Packed columns used to aerate the water entering the raceways at the Wolf Lake Hatchery.

Table 8. Number of each size and total weight (kilograms) of trout and salmon planted in Michigan waters, 1980.

Species	Fingerlings		Yearlings	Adults	Total weight
	Spring	Fall			
Brook trout	124,725	76,606	9,833	1,650	2,561
Brown trout	62,118	254,221	552,123	25	30,355
Chinook salmon	5,030,545	---	---	---	17,784
Coho salmon					
Alaskan	---	---	225,026	---	4,641
Michigan	---	5,000	2,969,395	---	70,113
Lake trout[1]	---	---	906,800	25	12,089
Rainbow trout	38,600	51,650	656,433	6,316	55,740
Steelhead trout	---	1,012,000	756,729	---	9,664

[1] 1,867,111 lake trout eggs were planted also.

Table 9. Number of each size and total weight (kilograms) of warmwater fishes planted in Michigan waters, 1980.

Species	Fry	Fingerlings		Adults	Total weight
		Spring	Fall		
Bluegill	---	---	53,100	315	96
Channel catfish	---	---	---	44	44
Largemouth bass	---	520	21,538	33	80
Smallmouth bass	---	---	21,475	---	116
Northern muskellunge	133,553	---	13,502	---	594
Great Lake muskellunge	---	---	38	---	1
Tiger muskellunge	---	---	251,607	---	6,555
Northern pike[1]	700,850	367,739	15,006	1,608	1,240
Walleye[1]	10,577,469	557,760	642,109	84	1,382
Yellow perch	---	---	---	214	6

[1] In addition, 1,000 yearling hybrid sunfish, weighing 11 kilograms; 274 yearling northern pike, weighing 4 kilograms; and 200 yearling walleyes, weighing 4 kilograms, were stocked.

Table 10. Number of each size and total weight (kilograms) of trout and salmon planted in Michigan waters, 1981.

Species	Fingerlings		Yearlings	Adults	Total weight
	Spring	Fall			
Brook trout					
Assinica	45,487	25,800	204	51	379
Assinica X domestic	44,690	---	---	---	63
Domestic	20,674	66,525	16,000	2,050	2,132
Brown trout	4,000	---	681,064	549	21,299
Atlantic salmon					
Quebec	---	---	19,529	29	302
Chinook salmon	4,102,398	---	---	---	11,575
Coho salmon	---	5,040	2,339	---	54,377
Lake trout[1]	---	622,300	2,970,610	1,400	73,299
Rainbow trout	13,600	103,709	458,446	7,266	36,364
Spake	---	19,800	188,165	---	10,276
Steelhead trout	---	102,236	925,900	---	14,344

[1] 1,485,000 lake trout eggs were planted also.

Table 11. Number of each size and total weight (kilograms) of warmwater fishes planted in Michigan waters, 1981.

Species	Fry	Fingerlings		Adults	Total weight
		Spring	Fall		
Crappie[1]	---	---	---	548	17
Pumpkinseed	---	---	---	103	4
Bluegill	---	---	8,250	2,665	158
Channel catfish[1]	---	---	32,809	97	199
Largemouth bass[1]	---	5,549	57,938	18	221
Smallmouth bass	---	---	13,720	---	257
White bass	---	---	---	83	28
Northern muskellunge	12,750	175	15,802	---	412
Tiger muskellunge	58,400	---	104,947	---	2,130
Northern pike	1,197,473	133,327	---	82	559
Walleye[1]	25,703,970	2,078,006	1,076,467	420	2,829
Yellow perch	---	---	---	1,700	17

[1] In addition, 104 yearling crappie, weighing 26 kilograms; 30,222 yearling channel catfish, weighing 2,368 kilograms; 59 yearling largemouth bass, weighing 7 kilograms; and 2,930 yearling walleye, weighing 57 kilograms, were stocked.

Table 12. Number of each size and total weight (kilograms) of trout and salmon planted in Michigan waters, 1982.

Species	Fingerlings		Yearlings	Adults	Total weight
	Spring	Fall			
Brook trout					
Assinica	11,020	65,614	850	---	631
Temiscamie	---	9,693	---	---	65
Assinica X domestic	20,520	32,350	---	---	328
Domestic	3,000	41,462	3,000	1,100	7,664
Brown trout					
Domestic	1,900	620,652	588,497	6,302	31,127
Brown X brook	---	---	---	145	167
Atlantic salmon					
Quebec	---	29,694	1,629	710	1,182
Sebago	---	---	45,030	---	1,404
Chinook salmon	5,018,873	---	---	---	19,472
Coho salmon	---	275,769	2,362,909	---	62,441
Lake trout	---	814,142	3,187,104	655	90,938
Rainbow trout	10,000	41,830	555,024	9,997	33,880
Splake	---	8,500	247,504	---	15,348
Steelhead trout	---	896,013	655,300	---	5,298

Table 13. Number of each size and total weight (kilograms) of warmwater fishes planted in Michigan waters, 1982.

Species	Fry	Fingerlings: Spring	Fingerlings: Fall	Adults	Total weight
Sturgeon	---	---	275	---	1
Crappie	---	---	---	3,894	138
Bluegill	---	---	6,000	9,168	1,184
Sunfish Hybrid[1]	---	---	600	600	56
Channel catfish	---	---	---	1,294	1,190
Fathead minnow	---	---	---	3,894	138
Largemouth bass[1]	---	600	12,336	202	252
Smallmouth bass	---	---	21,800	744	169
Northern muskellunge	251,710	---	5,237	---	176
Tiger muskellunge	---	63,638	199,488	---	3,007
Northern pike	1,438,200	84,298	21,600	147	878
Walleye					
Clinton	---	---	37,340	---	109
Michigan[1]	16,840,300	374,317	527,636	400	1,815
New York	11,150,000	---	---	---	50
Macatawa	9,364,000	---	---	---	40
Muskegon	5,270,000	---	75,880	---	713
Yellow perch	---	---	---	247	13

[1] In addition, 3,500 yearling hybrid sunfish, weighing 39 kilograms; 4,753 yearling largemouth bass, weighing 376 kilograms; and 9,522 yearling Michigan walleye, weighing 13 kilograms, were stocked.

ADMINISTRATION

During the 1981-82 period, the management personnel of the Fisheries Division have put primary emphasis on formulating and implementing a strategic approach to managing the Division. New program strategies and budgets were developed. Plans for staffing changes and new financial and work control systems were prepared for implementation during 1983. The net result of these changes is expected to be substantially greater concentration of effort on the highest priority work of the Division.

Programs were defined as follows and budgeted as shown in Table 14.

Division Management provides strategic direction to the other fisheries programs; acquires, allocates, and controls key program resources; coordinates Division programs with those of other agencies; holds the components of the Division accountable for their performance; and is itself accountable for the Division's overall performance.

Through the Recreational Fisheries program, the Division determines the variety of preferences of recreational fishermen; establishes fishery objectives for various waters; secures public access and adjusts fishing regulations and access controls to best satisfy fishing demand; and provides information to recreational fishermen about the fishing opportunities available to them.

The Commercial Fisheries program controls commercial fishing within harvest limits determined in the Great Lakes program while encouraging economic efficiency and vertical integration of fishing enterprises.

The Great Lakes program provides the empirical basis for management of Great Lakes fish stocks and fisheries; identifies and anticipates environmental problems and recommends appropriate responses; develops harvest rates, stocking schedules, and lamprey control levels; and

Table 14. Dollars (in hundred-thousands) by program appropriated to the Fisheries Division in fiscal years 1980-84 with personnel numbers in parentheses.

Program	Fiscal year				
	1980	1981	1982	1983	1984
Division management	580.6 (20.4)	547.5 (16.3)	634.4 (17.0)	719.2 (15.0)	816.2 (16.0)
Recreational	570.0 (21.9)	701.0 (20.3)	862.0 (21.2)	994.6 (18.0)	988.1 (16.0)
Commercial fisheries	225.0 (7.1)	271.0 (7.1)	345.7 (8.4)	97.7 (4.0)	105.0 (2.0)
Great Lakes	1,112.8 (37.9)	1,325.6 (36.6)	1,286.0 (34.7)	1,873.3 (60.0)	1,940.2 (55.0)
Inland	2,240.9 (75.3)	2,786.4 (77.3)	3,148.2 (87.8)	3,353.7 (94.5)	3,422.3 (80.0)
Fish production	2,136.2 (54.5)	2,507.4 (52.4)	3,494.0 (58.3)	3,695.3 (71.0)	3,957.4 (67.0)
Total	6,865.5 (217.1)	8,138.9 (210.0)	9,770.3 (227.4)	10,733.8 (262.5)	11,229.2 (236.0)

coordinates these plans with those of other Great Lakes jurisdictions.

The Inland program diagnoses and anticipates problems with habitat and the structure of fish communities in inland lakes and streams; plans and implements efforts to correct such problems; determines the productive capacity of inland waters as basis for limiting the fisheries; and provides for management of anadromous runs of fish from the Great Lakes.

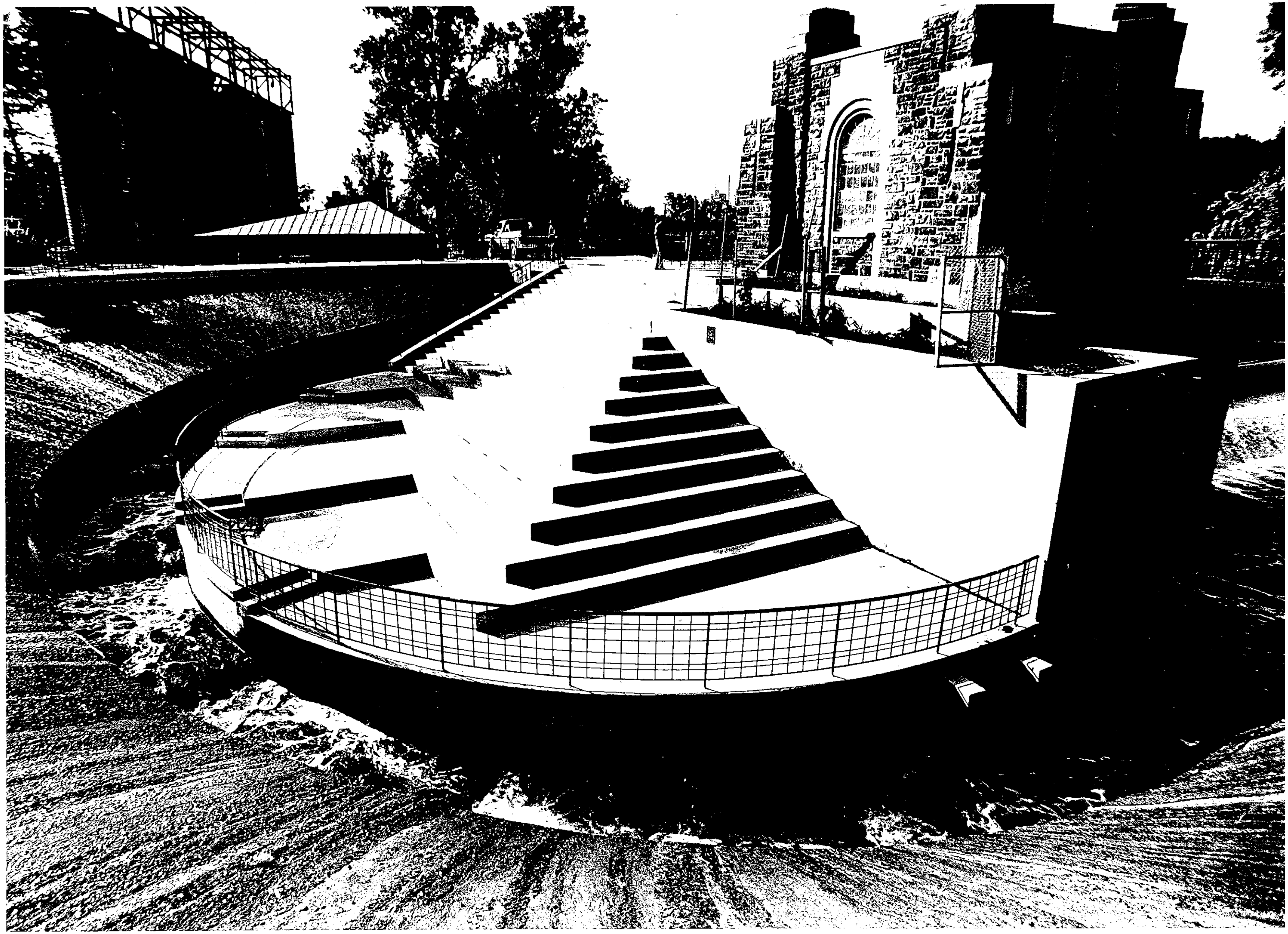
The Fish Production program hatches, rears, and transports fish required for management of both Great Lakes and inland fisheries.

Within these program budgets, priority is given to maintenance of the Division's lands, facilities, and equipment to assure safety and usefulness; to paraprofessional rather than professional staff; and to extensive use of automatic data processing and other productivity-enhancing technologies.

Current emphasis in control system design is on improved reporting of work accomplishment and costs, better measurement of program performance, and more frequent and definitive accounting to the public on the Division's performance.

After adjustment for inflation, costs of Division management have been reduced by 20% since 1980. Additional reduction of approximately 5% will be obtained by 1984.


case



BRENKE FISH LADDER, LANSING

VIA DEBBIE 6th St. Dam, Gr. Rapids