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REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

The U.S. Great Lakes Commercial Fishing Industry--Past, Present, And Potential

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Overfishing, predators (sea lamprey), contaminants and increasingly restrictive State regulations have reduced the U.S. Great Lakes commercial fishing industry to a mere shadow of its former prominence. At this time there is little chance that the number of commercial fishermen or the commercial harvest from the Great Lakes will increase.

Fish farming (aquaculture) is not considered a viable alternative to traditional fishing in Great Lakes waters. Knowledge from continued research on harvesting and using less desirable or low-value species may encourage commercial fishermen to expand their harvests.

The future of Great Lakes commercial fishing depends on the extent to which the Great Lakes States want to develop and maintain a viable commercial fishery. Federal assistance geared to meet the requirements of State commercial fishery programs will help to improve the fishery.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-177024

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses our study of the U.S. Great Lakes commercial fishing industry--past, present, and potential. We made our study at the joint request of the House Committee on Merchant Marine and Fisheries and its Subcommittee on Fisheries and Wildlife Conservation and the Environment.

This is the second report on our study. Our first report entitled, "The U.S. Fishing Industry--Present Condition and Future of Marine Fisheries," was issued to the Congress on December 23, 1976 (CED-76-130).

At the direction of the Chairman, House Subcommittee on Fisheries and Wildlife Conservation and the Environment, we did not obtain formal comments from agencies having fishery-related programs. However, we did discuss the report with the National Marine Fisheries Service and the Fish and Wildlife Service and they agreed with our conclusions.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53) and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget, and to the heads of the departments and agencies responsible for administering fishery-related programs

Comptroller General
of the United States

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COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

THE U.S. GREAT LAKES COMMERCIAL FISHING INDUSTRY--PAST, PRESENT, AND POTENTIAL

D I G E S T

The fishing industry in the Great Lakes has declined by 83 percent since 1930, due to causes such as overfishing, fish predators, and contamination of fish. Commercial fishing probably will not increase in the Great Lakes, but any improvement will depend upon State actions.

FUTURE NOT BRIGHT

There is little chance that the number of Great Lakes commercial fishermen or the commercial harvest will increase. Commercial fishing is harmed by contamination of fish, and commercial fishermen depend heavily on the State's willingness to allocate fish to them. The State and Federal governments have stocked the Great Lakes with hatchery-raised fish. (See app. VI.) These fish have not reproduced as much as expected and the States have allowed only limited harvest of them.

Determining the availability of fish for harvest (stock assessments) has been inadequate. Better information on availability of fish may provide the States with a basis to determine whether more fish, and, in some cases, more species could be allocated to commercial fishermen. But, this does not guarantee commercial fishermen an increased allocation of highly valued species.

Knowledge gained from continued Federal research on harvesting and using "less desirable" species may encourage commercial fishermen to expand their harvests with minimal effect on recreational fishing.

Tear Sheet. Upon removal, the report cover date should be noted hereon.

Raising fish under controlled conditions in enclosed areas (aquaculture) in the Great Lakes is not a feasible alternative to traditional fishing methods.

Officials of the National Marine Fisheries Service and the Fish and Wildlife Service said that the future of commercial fishermen may lie in a combination of harvesting high-value species--assuming stock assessments will convince States to allocate quotas of high-value species--and in harvesting and marketing currently underutilized species. However, the expansion of the industry into underutilized species may take many years and will require development of new products and markets and the adoption of new harvesting methods. (See app. VIII.)

Commercial fishermen are not enthusiastic about harvesting underutilized species because of their low value. They want to continue harvesting the species for which higher prices per pound are received. Some fishermen would consider harvesting underutilized species if the market prices were favorable. (See p. 59.)

According to State and Federal officials, the number of commercial fishermen probably will not increase, due to recreational fishing and fish contamination. The Director, Northeast Regional Office, National Marine Fisheries Service, believed that the number of fishermen will decline or stabilize but that employment in processing and marketing may increase with the development of products from underutilized species and the rising trend toward custom retail markets.

In essence, the future of the Great Lakes commercial fishery depends on the extent to which States want to develop and maintain a viable commercial fishery. Federal assistance geared to meet the requirements of State commercial fishery programs will help to improve the fishery.

THE FISHERY--A PERSPECTIVE

At the turn of the century, the U.S. Great Lakes commercial fishing industry was flourishing--harvests were plentiful and almost every town along the lakes was a fishing port. Over the years, the number of commercial fishermen has dwindled (see p. 8), and the harvest, which once included a large percentage of high-value species, now consists largely of medium- and low-value species.

Changes in the industry have resulted from

--overfishing certain high-dollar-value species;

--invasion of the sea lamprey, a marine parasite that destroyed some highly desirable species of fish;

--more recreational fishing, with people competing for many of the same fish desired and preferred by commercial fishermen;

--State regulations that limit the number of commercial fishermen, that restrict commercial catch of species desired by recreational fishermen, and the use of certain commercial fishing gear and techniques; and

--contaminants which made some fish unsafe for human consumption.

At the end of the 19th century, about 110 million pounds of fish were caught annually by U.S. Great Lakes commercial fishermen compared with 61 million pounds in 1975. In 1930, there were 5,284 full-time and 1,617 part-time Great Lakes commercial fishermen compared with 137 and 1,043, respectively, in 1975. During 1975 the Great Lakes attracted about 2.8 million recreational fishermen.

Tear Sheet

THE CANADIAN FISHERY

The Canadian Great Lakes commercial fishing industry did not develop as rapidly as the U.S. industry nor has it been faced with strong competition from recreational fishing. Although Canada owns only 36 percent of the lakes, its commercial harvest exceeded the value of the U.S. harvest in 1972, 1973, and 1975.

U.S. FEDERAL INVOLVEMENT

Because States have exclusive authority to manage the Great Lakes fishing industry in their respective waters, the Federal role is limited and it alone cannot direct the course or future of commercial fishing.

The States do research, determine availability of fish for harvest, stock the lakes with hatchery-raised fish and issue regulations to control the harvest of fish.

The Government

--supports stock assessments and hatcheries,

--does or funds research,

--participates in the program to alleviate the sea lamprey problem,

--furnishes some direct assistance to Indian and commercial fishermen, and

--helps resolve problems arising from adverse environmental changes in the Great Lakes. (See ch. 4.)

The sea lamprey control program is the most significant Federal effort to conserve and restore fish stocks. Through 1975 about $22 million was spent on the program which has reduced the lamprey population by 85 to 90 percent. (See p. 26.) Through 1974 the Fish and Wildlife Service planted 49 million lake trout in the Great Lakes. (See p. 28.)

Federal efforts on underutilized species have focused on product and market development and the development of selective fishing gear. (See p. 40.)

At the direction of the Chairman, House Subcommittee on Fisheries and Wildlife Conservation and the Environment, GAO did not obtain formal comments from agencies having fishery-related programs. However, GAO did discuss the report with the National Marine Fisheries Service and the Fish and Wildlife Service and they agreed with GAO's conclusions.

Tear Sheet

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APPENDIX

VIII Letter dated July 12, 1977, from the Regional Director, Glouchester, Massachusetts National Marine Fisheries Service, National Oceani and Atmospheric Administration, U.S. Department of Commerce 95

ABBREVIATIONS

BIA	Bureau of Indian Affairs
EDA	Economic Development Administration
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FmHA	Farmers Home Administration
FWS	United States Fish and Wildlife Service
GLFC	Great Lakes Fishery Commission
IJC	International Joint Commission (United States and Canada)
NMFS	National Marine Fisheries Service
SBA	Small Business Administration
UGLRC	Upper Great Lakes Regional Commission

CHAPTER 1

INTRODUCTION

On November 19, 1975, the Chairmen and ranking minority members of the House Committee on Merchant Marine and Fisheries and its Subcommittee on Fisheries and Wildlife Conservation and the Environment asked us to make a study to delineate policy issues, options, and costs of revitalizing the U.S. commercial fishing industry. (See app. I.)

The study was to be made in two phases. The Committee requested that, after we completed our study of marine fishing, we perform a study of the Great Lakes commercial fishing industry. Our report "The U.S. Fishing Industry--Present Condition and Future of Marine Fisheries" (CED-76-130, Dec. 23, 1976), dealt with the marine fishing industry. This report discusses the Great Lakes commercial fishing industry.

During the study, we had several meetings with members of the Committee and its staff to discuss the scope of the work. At the Subcommittee hearings held on February 18, 1977, we presented a briefing on the progress of the Great Lakes study. In a March 16, 1977, letter (see app. II), to the ranking minority member of the Committee, we agreed to include in our report information on the

--history of the Great Lakes fishery,

--present management of the fishery,

--Federal involvement in the fishery,

--possibility for a Great Lakes aquaculture program, and

--Canadian Great Lakes fishing industry.

SCOPE OF REVIEW

In performing the study, we met with and obtained information from officials of:

U.S. departments and agencies:

Department of Commerce:
National Marine Fisheries Service
Office of Sea Grant
Economic Development Administration

Department of the Interior:
Fish and Wildlife Service
Bureau of Indian Affairs

Environmental Protection Agency

Department of Health, Education, and Welfare:
Food and Drug Administration

Department of Agriculture:
Farmers Home Administration

Small Business Administration

Canadian Government organizations:
Fisheries and Environment Canada, Fisheries and Marine Service
Ontario Ministry of Natural Resources, Division of Fish and Wildlife

U.S.-Canada organizations:
Great Lakes Fishery Commission
International Joint Commission

U.S. Commissions:
Upper Great Lakes Regional Commission
Great Lakes Basin Commission

We also met with State government representatives responsible for fishery matters in each of the eight Great Lakes States, recreational fishing organizations, a commercial fishermen's association, and individual commercial fishermen.

We reviewed various laws and extensive literature on the fishery, including the Eastland Fisheries Survey of the Great Lakes and the Great Lakes Basin Framework Study which identified fishing problems and needs in the Great Lakes.

At the direction of the Chairman, House Subcommittee on Fisheries and Wildlife Conservation and the Environment, we did not obtain formal comments from the agencies having fishery-related programs. However, we did discuss these matters with the National Marine Fisheries Service and the

Fish and Wildlife Service. (See letter dated July 12, 1977 (app. VIII) from the Director, Northeast Region, National Marine Fisheries Service presenting his observations on Great Lakes fishing.)

CHAPTER 2

THE GREAT LAKES FISHERY--PERSPECTIVE

The Great Lakes--Superior, Michigan, Huron, Erie, and Ontario (over 94,000 square miles)--are the largest freshwater resource in the world. About 36 percent of the lakes are within the boundary of the Province of Ontario, Canada. The remaining 64 percent are within the State boundaries of Michigan, Wisconsin, New York, Ohio, Minnesota, Illinois, Pennsylvania, and Indiana. Michigan controls about 64 percent of the U.S. portion of the lakes. The following map shows the portions controlled by each State and the Province of Ontario. (See app. III for relative size of the Great Lakes waters in each State and the Province.)

FISHERY MANAGEMENT--A STATE FUNCTION

The individual Great Lakes States have exclusive authority to manage their portion of the Great Lakes fishery. The States' fishery management authority stems from the U.S. Constitution and was affirmed by the Submerged Lands Act of 1953 (43 U.S.C. 1301). Each State establishes and enforces its own fishing regulations, including the allocation of fish resources. (See ch. 3.)

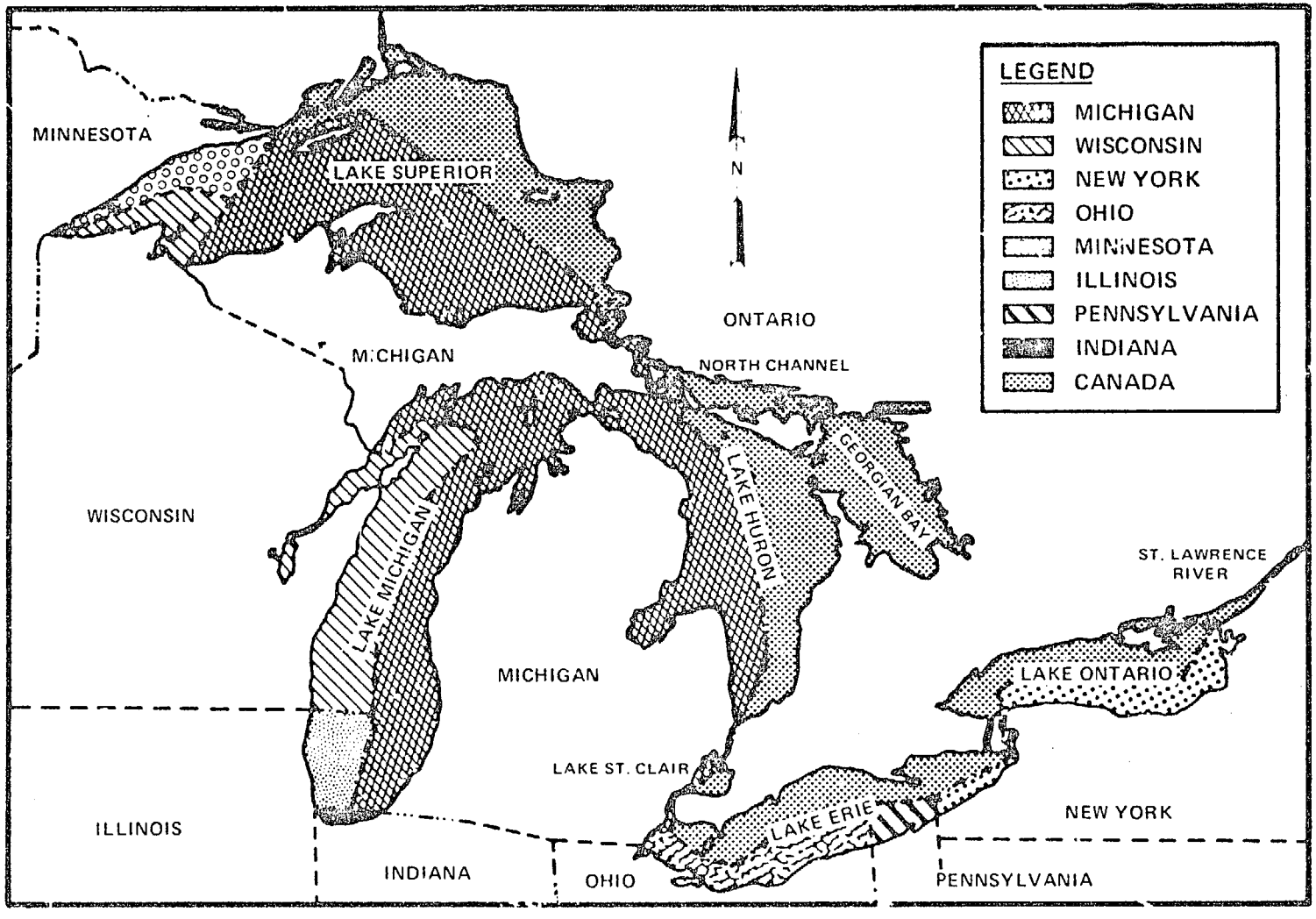
Although the Federal Government has no responsibility for fishery management in the Great Lakes, several Federal agencies provide support for research, stock assessment, lamprey control, and fish hatcheries. Federal agencies also provide financial assistance to States, universities, and, in some cases, commercial fishermen. In addition, the Federal Government provides funds to the Great Lakes Fishery Commission (GLFC), a joint U.S.-Canadian commission responsible for sea lamprey control. The GLFC also promotes coordination of U.S. and Canadian fishery research activities.

The principal fishery-oriented Federal agencies--providing services for the Great Lakes--are the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). U.S. involvement in the fisheries is discussed in chapter 4.

PROFILE OF THE GREAT LAKES COMMERCIAL FISHERY

In 1975 U.S. commercial fishermen harvested about 61 million pounds of Great Lakes fish with a value of about $9 million. This was less than 1 percent of the U.S. commercial fish harvest total value of about $971 million. The 1975 harvest statistics for the Great Lakes commercial landings as reported by NMFS follows:

GREAT LAKES FISHERY



Species	Pounds	Value
Alewife	35,215,800	$ 407,644
Carp	6,732,400	381,065
Whitefish	4,517,000	3,300,957
Yellow perch	3,035,600	1,611,472
Smelt	2,573,300	138,726
Chubs	2,444,100	1,628,641
White bass	1,699,500	490,872
Catfish	559,900	259,162
Lake herring	513,400	145,939
Lake trout	456,400	267,300
Other	2,909,400	a/ 418,514
Total	60,656,800	$9,050,292

a/No individual species valued at over $100,000.

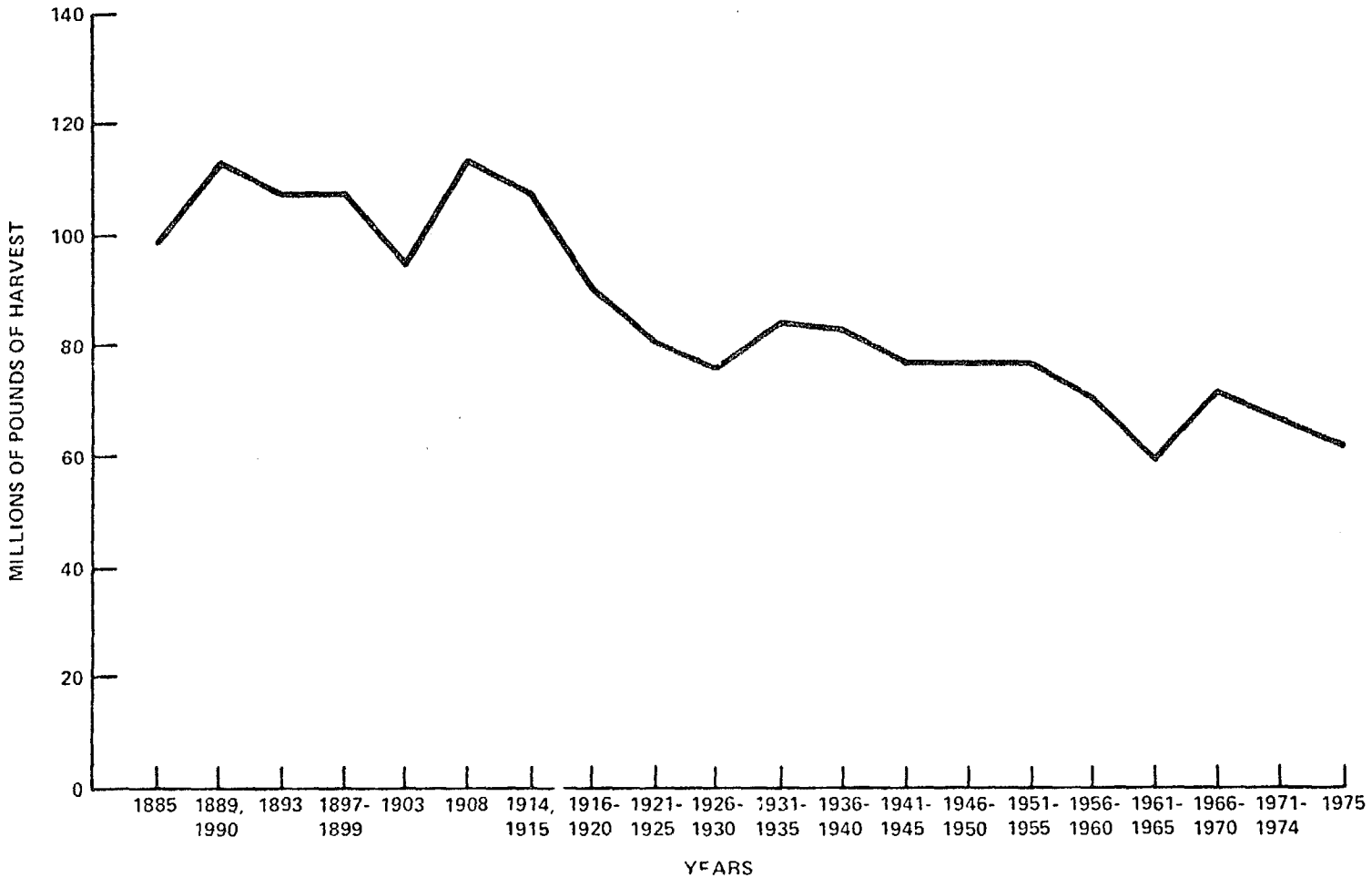
According to NMFS, 137 full-time and 1,043 part-time U.S. commercial fishermen were fishing the Great Lakes during 1975; 768 vessels and boats were used in the fishery. Processing and wholesaling establishments handling only Great Lakes fish employed 362 persons.

HISTORICAL DATA ON THE GREAT LAKES FISHERY

Historically, the Great Lakes fishery has been a major and valuable renewable resource. Near the end of the 19th century, the commercial fishery was flourishing; harvests were plentiful and almost every shore town was a fishing port. Since then, the abundance of traditional food species in the Great Lakes has been adversely affected by invading species, unfavorable water quality, and commercial overfishing of certain species. Commercial harvest of fish for food has been reduced by contaminants, increased competition from expanding recreational fishing, and a substantial decline in the number of fishermen.

As shown on the following page, U.S. commercial fishermen harvested about 110 million pounds of fish annually at the end of the 19th century compared with 61 million pounds in 1975.

AVERAGE ANNUAL HARVEST THE U.S. GREAT LAKES COMMERCIAL FISHERY



Employment in the Great Lakes commercial fishing industry also has declined.

Number of Commercial Fishermen

Year	Full-time	Part-time	Total
1930	5,284	1,617	6,901
1940	3,647	1,372	5,019
1950	3,193	1,568	4,761
1960	1,914	1,911	3,825
1965	540	1,805	2,345
1970	177	1,293	1,470
1975	137	1,043	1,180

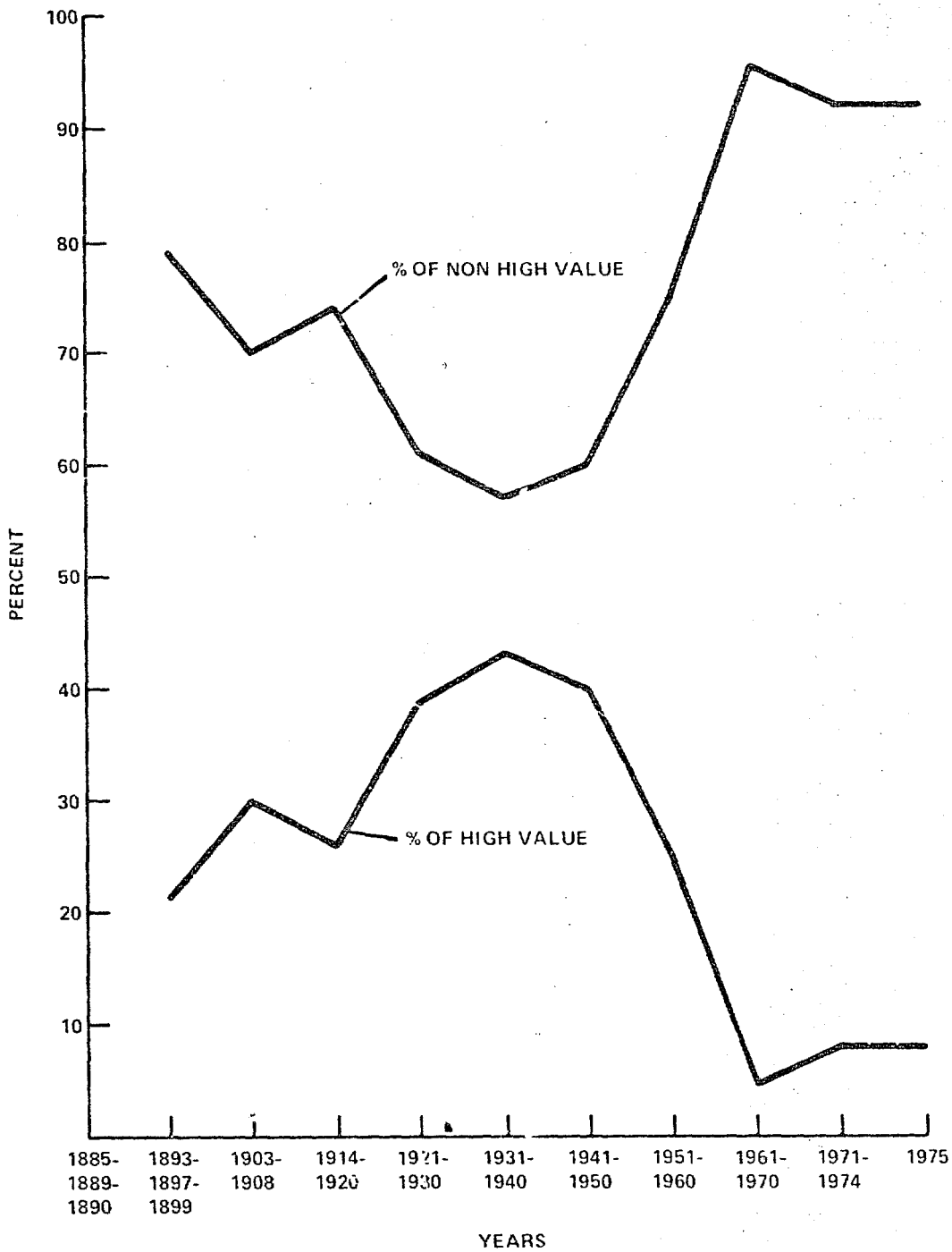
The number of commercial fishermen decreased as the abundance of high-value species declined. In the later years, 1960 to 1975, increasingly restrictive State actions and concern about contaminants further contributed to the decline in commercial fishermen.

REASONS FOR DECLINE OF THE COMMERCIAL FISHERY

Problems of the fisheries date back to the last half of the 19th century when fish stocks were considered limitless and were fished excessively by a virtually uncontrolled fishery. However, overfishing was not the only contributor to the lakes' decline as a fish producer. In the last 100 years, spawning areas have been destroyed by dam construction, stream pollution, and swamp drainage. Further, marine invaders--the alewife and lamprey--have contributed to the decline of native fish species. (See app. IV.)

As a result, the composition of fish stock in the lakes now is much different than it was in the late 19th and early 20th centuries when the Great Lakes commercial fishery was flourishing. The species of commercial fish caught in 1975 differed substantially from those caught from the late 19th century to the 1930s when slightly over 40 percent of total landings consisted of high-value coldwater species, such as blue pike, lake trout, lake whitefish, and walleye. Since the 1930s, landings of these species have dropped to about 8 percent of the total commercial catch. (See chart on the following page.)

PERCENT CONTRIBUTION OF HIGH UNIT VALUE SPECIES (LAKE TROUT, WHITEFISH, BLUE PIKE, AND WALLEYE)



COMPETING USERS

Three groups--commercial, recreational, and Indian fishermen--compete for fish in the lakes.

Until the late 1960s, Great Lakes fish were harvested predominantly by commercial fishermen. However, recreational fishing increased after the States began planting coho and chinook salmon in the lakes in the late 1960s. In the 1970s Great Lakes recreational fishing became a multimillion-dollar business and recreational demand is expected to continue to increase. All eight Great Lakes States favor recreational fishing over commercial fishing and have established regulations restricting or prohibiting the commercial catch of certain high-value species desired by recreational fishermen.

During 1975 about 2.8 million recreational anglers fishing on the Great Lakes far outnumbered the 137 full-time and 1,043 part-time commercial fishermen. The Indian fishermen, using commercial methods, are generally fishing without any restriction as to species in Lake Superior, Michigan, and Huron. The States' authority to regulate the Indian fishermen is currently being challenged in court.

CONTAMINATION PROBLEMS

Since the mid-1960s, increasing attention has been focused on contaminants in the Great Lakes. Dichloro-diphenyl-trichloro-ethane (DDT), dieldrin, mercury, mirex, and polychlorinated biphenyls (PCBs) are the major contaminants identified in Great Lakes fish.

Contaminants damaged the commercial fishery in three ways:

--Fish containing levels of contaminants in excess of those established by the Food and Drug Administration could not be shipped interstate.

--Fishing operations in certain areas of the lakes have been shut down because of dangerously high contaminant levels. For example, the U.S. Lake Ontario commercial fishery for most species was closed in September 1976 because of mirex contamination.

--Adverse media publicity has tarnished the image of the Great Lakes as a producer of wholesome fish products.

The Food and Drug Administration is considering lowering the allowable levels of certain contaminants in fish products. If this occurs, commercial fishing for certain species may be discontinued in some areas.

CHAPTER 3

MANAGING THE GREAT LAKES FISH STOCKS

States have always had the authority to manage their waters. For many years, little conflict existed between commercial and recreational fishing and the Great Lakes fisheries were not being managed intensively. Management efforts increased gradually but it was not until after the invasion of the sea lamprey and successful establishment of the sea lamprey control program in the mid 20th century, that the States emphasized the management of the Great Lakes fisheries.

As the sea lamprey control program became effective, the States and the Fish and Wildlife Service began to restore fish by stocking hatchery-reared, high-value species, particularly lake trout and other salmonids. As these species became more plentiful, recreational fishermen began demanding more of the Great Lakes fishery resource. The increased demands of recreational fishermen have influenced the States in formulating fishery management policies.

STATES' MANAGEMENT POLICIES

Each State's management policy is to protect, develop, and utilize the waters and fish populations of the Great Lakes for the maximum public benefit. In pursuing this policy, each State attempts to enhance both the recreational and commercial fisheries with emphasis on the recreational fishery.

State officials advised us that the recreational fishing industry is much more valuable to the State than the commercial fishing industry. Based on State licensing fee rates for 1975, we estimate that the 2.8 million anglers who fished the Great Lakes paid about $11.3 million to the States in license fees. During this same period, the 177 full-time and 1,043 part-time U.S. Great Lakes commercial fishermen paid about $44,000 in license fees. In addition to the license fees, recreational fishermen contributed significantly more than commercial fishermen to the State economies in the purchase of boats, equipment, bait, food, and lodging. Consequently, the States generally resolve conflicts between recreational and commercial fishing in favor of the recreational interests.

STATES' MANAGEMENT TECHNIQUES

Management of the fishery resources should be based on a sound understanding of fish stocks--species composition, abundance, interdependence of a specie on one or more other species, and the harvest on an optimum sustainable yield basis. The need for this information, usually referred to as resource assessment, is essential for effective State's fisheries management. While State fishery managers believe that present assessment is sufficient for their current management needs, they recognize that there are problems with current resource assessment and that better assessment might be needed in the future.

Resource assessment techniques

The States generally use catch data as the basis for assessing the resources and the effects of fishing on the stocks. They supplement this data with resource inventories

Catch data is collected from both commercial and recreational fishermen. Data furnished by commercial fishermen include the number of fish caught, distribution, condition of fish stocks, and the effects and efforts of fishing various water depths. Validity of the data is basically substantiated through the shipboard and dockside monitoring activities conducted by the State fishery agencies. Data on recreational catch is obtained through mail surveys and observations.

Resource inventories by the States and FWS supplement the catch data and aid fishery managers in making decisions affecting the fishery. Inventories of selected species in selected areas of the lakes have provided data on the number, condition, and location of fish stocks.

Resource assessment inadequate

Resource assessment data is inadequate because

--resource inventories are not made on all species in all lakes, and are not always timely;

--catch statistics from recreational fishermen are not obtained annually by all States, and the data obtained is not validated; and

--catch statistics from Indian fishermen are not available to the States.

According to the Eastland Fisheries Survey of the Great Lakes, 1/ adequate and timely assessment of the status of fish stocks on a year-to-year basis is essential for effective management and meaningful evaluation of the various stress effects on these stocks--overfishing, predation, pollution, and environmental changes.

At the request of the Great Lakes Fishery Commission, the FWS evaluated its own and the States' resource assessments. The FWS December 14, 1976, evaluation on the following page showed that the resource assessment studies were incomplete and inadequate. FWS found that assessments did not cover all species in all lakes and, even where adequate data on a species was available, the data had not been thoroughly compiled for application to fishery management problems.

Data on recreational fishing is developed by direct contact with and questionnaires mailed to recreational fishermen by States' fishery management agencies. Some States have not consistently obtained recreational fishing data annually. Because of the high cost of monitoring efforts, State agencies have generally accepted the reported data without validation. Even with this weakness, State fishery officials believe that data obtained through this method is beneficial to their needs and assists in the management of the Great Lakes fishery.

Indian fishermen, using commercial fishing methods, fish the upper Great Lakes waters of Michigan, Wisconsin, and Minnesota. The States' authority to regulate these fishermen is currently in litigation. Because the States' authority is under question, the States have been unable to obtain accurate statistics on the amount of fish harvested by Indian fishermen.

A 1975 Michigan Department of Natural Resources, Fisheries Division report indicated that Indian fishing has hindered effective stock management and could cause depletion, leading to stock extinction in some areas. The report indicated that Michigan does not have accurate Indian catch statistics, but that estimates of Indian harvest in the Whitefish Bay area of Lake Superior exceeded by about 100,000 pounds the annual catch of whitefish by commercial fishermen. The report stated that it was doubtful that this area would be able to sustain the high rate of fishery exploitation.

1/Special Report No. 1 of the Atlantic States Marine Fisheries Commission--Eastland Fisheries Survey of the Great Lakes (October 1976).

Lake	Species	Range	Data sources: Fish catch: Commercial	Fish catch: Sport	Resource: Surveys	Resource: Composite
Michigan						
	Lake trout	Lakewide	A	I	A	I
	Other salmonids	Lakewide		I	M	I
	Bloater chubs	Lakewide	A		A	I
	Lake whitefish	Lake-north	A		A	A
	Alewives/smelt	Lakewide	M		M	I
	Yellow perch	Lake-Green Bay	A	I	M	I
	Suckers	Lake-Green Bay			I	I
Superior						
	Lake trout	Lakewide	A	I	A	I
	Other salmonids	Lakewide		I	M	I
	Chubs	Lakewide	A		A	I
	Lake whitefish	Lake-south	A		A	I
	Lake herring	Lakewide	A		A	M
	Smelt	Lakewide				
	Suckers	Lake-near shore			I	I
Huron						
	Lake trout	Lake-north		I	A	I
	Other salmonids	Lakewide		M	A	I
	Lake whitefish	Lake-north	A		A	M
	Alewives/smelt	Lakewide			A	I
	Sculpins	Lakewide			A	I
	Yellow perch	Saginaw Bay	A	M	A	A
	Carp/suckers	Saginaw Bay			I	I
Erie						
	Walleye	Lake-west/east	A	M	A	M
	Yellow perch	Lake-west/east	A	M	A	M
	White bass	Lakewide	A	M	A	I
	Freshwater drum/carp	Lake-west	A	M	I	I
	Lake whitefish	Lake-east			I	I
	Smelt	Lakewide			I	I
	Salmonids	Lakewide		I	I	I
Ontario						
	Lake trout	Lakewide		I	M	I
	Other salmonids	Lakewide		I	M	I
	Alewives/smelt	Lakewide			I	I
	Perch-white/yellow	Lake-shore/bays	A	I	M	I
	American eel	Outlet basin	A		I	I
	Bass/sunfish/bullheads	Outlet basin	A	I	A	I
	Sculpins	Lakewide			I	I

Note: Data sources judged adequate (A), inadequate (I), or marginal (M) in terms of determining status of resource and detecting trends. Composite judged in terms of the development of estimates of standing stocks, annual production, and total allowable harvest.

Efforts to restore fish stocks

To rehabilitate Great Lakes fish stocks depleted by exploitation, marine invaders, and environmental changes, FWS and State agencies have stocked the lakes with various species. Federal stocking efforts, dealing mostly with lake trout, are discussed in chapter 4. Massive State stocking efforts, which began in the 1960s, have been directed primarily toward developing and expanding sports fishing.

In 1976 about 24 million hatchery-reared fish were released in the U.S. Great Lakes and tributary waters. The table on the following page shows the principal species planted were lake trout, coho salmon, and chinook salmon.

While stocking increased the fish available for harvest, the States, with few exceptions, have allocated this additional resource to the recreational fishermen. For instance, the lake trout and other salmonids shown in the table are reserved principally for recreational fishermen.

Several State fishery management officials told us that commercial harvest of stocked species might be possible in the future. They indicated that recreational fishing demands would have to be met first and sufficient natural reproduction would have to occur before this could be realized. Natural reproduction of lake trout has been insufficient and is under study by FWS.

Regulations used to allocate the fish stocks

Each Great Lakes State has established regulations to control fish harvest. However, regulations which apply to recreational and commercial fishermen are different. Regulations for recreational fishermen neither restrict the number of fishermen nor the species that can be caught. Recreational fishing regulations generally are designed to protect the fish stocks while maintaining recreational fishing interests.

Commercial fishing regulations generally restrict the commercial harvest to protect fish stocks and assure an ample supply of species of interest to recreational fishermen. Commercial fishing has been restricted as follows:

--Four States limit the number of commercial fishermen licensed to fish and the remaining four States are considering limiting the number of commercial licenses.

1976 Fish Plantings

State	Total	Lake trout (note a)	Coho salmon	Chinook salmon	Steel-head	Rainbow trout	Brown trout	Brook trout	Other species
	(thousands)								
Illinois	529.0	160.0	80.3	142.0	-	46.0	94.3	6.4	-
Indiana	1,050.5	164.0	432.5	38.0	217.0	-	199.0	-	-
Michigan	11,539.0	3,066.7	3,430.8	3,278.8	418.4	586.0	727.5	-	30.8
Minnesota	62[illegible].0	344.8	-	260.0	-	9.4	8.3	1.5	-
New York	2,430.5	522.9	653.6	658.4	28.8	184.4	382.4	-	-
Ohio	1,080.6	-	527.8	246.4	55.5	140.9	-	-	110.0
Pennsylvania	1,088.8	15.5	247.6	769.0	21.0	24.1	2.4	4.5	4.7
Wisconsin	5,561.0	1,861.4	647.5	1,275.6	-	1,363.5	334.8	36.6	41.6
Total	23,903.4	6,135.3	6,020.1	6,668.2	740.7	2,354.3	1,748.7	49.0	187.1

a/Stocking of lake trout is from Federal hatcheries except for the following State plantings: Michigan, 112.0; Minnesota, 50.1; New York, 57.2; Pennsylvania, 15.5; and Wisconsin, 532.4. See appendix VI for 1958-75 plantings of lake trout, coho salmon, and chinook salmon.

--The States either restrict commercial fishing for certain high-value species considered desirable recreational fish or limit the harvest to a quota or incidental catch. The States also curtail commercial fishing for seriously depleted species. For example, lake trout (historically an important commercial species) and other salmonids, being stocked by several States, are generally reserved for recreational fishermen; and the chub fishery in Lake Michigan (an important commercial species) has been closed because of depletion except for specifically authorized catches to determine the condition of the stock.

--All States restrict the mesh size of gill nets and Michigan has banned the use of gill nets (traditional method of harvesting) in some of its waters. Four States prohibit or limit trawling for fish.

--Seven States have established minimum fish size limits and designated areas where commercial fishing is not allowed.

--Six States have established closed seasons.

--Five States have designated depths where commercial fishing is prohibited.

COMMERCIAL FISHERMENS' CONCERNS ABOUT RESTRICTIVE STATE REGULATIONS

Some commercial fishermen believe that the States' fishery management agencies are overregulating the industry, and are not fairly allocating fish stocks. Commercial fishing interests hope that as the States acquire better data on the condition of fish stocks, they will relax commercial fishing regulations and allocate more fish to the commercial sector.

However, there is no assurance that the States, even with more comprehensive data, would regulate or allocate their resources differently. For example, Michigan and Ohio had comprehensive data on walleye in western Lake Erie that showed the recreational catch would probably be considerably less than the allowable harvest. However, the two States did not allocate any walleye to commercial fishermen because they did not want to risk damage to the recreational fishery.

STATES' RIGHTS TO REGULATE RECREATIONAL AND COMMERCIAL FISHING AFFIRMED

The States' authority to regulate recreational and commercial fishing has been affirmed by Federal Court action. On October 16, 1975, civil action was brought in the U.S. Federal District Court, Eastern District of Wisconsin, alleging, among other things, that the Wisconsin Department of Natural Resources exercised a policy of discrimination in favor of sport fishing and against the harvest of fish for food purposes. Further, the plaintiffs alleged that the lake trout--a hatchery-reared fish--are raised and stocked with Federal tax revenue for the benefit of commercial fishermen, but because of Wisconsin's discrimination policy, the plaintiffs and many other taxpaying citizens are precluded from enjoying the lake trout. They contended that unless persons are recreational fishermen, they cannot obtain lake trout from Wisconsin's Lake Michigan waters.

The suit asked that the court enjoin the State officials from preventing commercial harvest of lake trout or enjoin the Federal officials from raising and planting lake trout and cease lamprey control efforts.

In dismissing the case in June 1976, the judge decided that the States have the authority to regulate the fishery. In arriving at a decision, the judge stated:

> "The plaintiffs argue that the program for the propagation of lake trout was designed for the benefit of commercial fishermen and, therefore, the latter are entitled to enforce such right by legal action. I believe it to be clear that regulation of fisheries is within the police power of the individual States, and the State of Wisconsin has the exclusive power and authority to regulate fishing within its territorial waters * * *"

STATES' PLANS FOR THE FISHERY--A LIMITED ROLE FOR COMMERCIAL FISHING

The States' fishery management agencies consider the future of the Great Lakes commercial fishery to be one of enhancing or complementing the recreational fishery, and have adopted a management policy which favors recreational fishing.

Several State and Federal officials told us that a future increase in the number of commercial fishermen was not probable because of

--the growth of the recreational fishery,

--fish contamination, and

--States' implementation of limited-entry regulations to control the number of commercial fishermen.

The Great Lakes Basin Framework Study report, published by the Great Lakes Basin Commission in 1976, indicated that future demands for recreational fishing will increase and predicted that the eight Great Lakes States will only be able to supply 82 percent of this demand by 1980. The State and the Federal Government stocking efforts have benefited recreational fishing.

Many contaminants in the Great Lakes waters affect the wholesomeness of fish for food. Although steps are being taken to eliminate or reduce the contaminants, no one knows how long this will take. The Food and Drug Administration is considering lowering the allowable contaminant level for polychlorinated biphenyls (PCBs) in fish from 5 parts per million to 2 parts per million. If the level is lowered, commercial fishing may be further curtailed in many areas of the lakes.

The States recognize that the Great Lakes can support a limited commercial fishery. Federal and State officials told us that the economic future for the Great Lakes commercial fishery could be improved by increasing the harvest of currently underutilized nonrecreational species, such as the sucker, carp, sheepshead, dogfish, and burbot. Before this can be realized, acceptable products will have to be developed from these species to make their harvest profitable and appropriate gear will have to be used to harvest them. Research is being conducted on both product development and gear technology. (See ch. 4.)

Some commercial fishermen told us they have not harvested underutilized species because the market price is too low. Others said they want to continue harvesting the more valuable species--whitefish, chubs, yellow perch--because they receive a high price for these species without having to handle large quantities. Those who would harvest the underutilized species said they would do so if the market price was favorable.

CHAPTER 4

FEDERAL INVOLVEMENT IN THE FISHERIES

Each of the eight Great Lakes States has legal authority to regulate fishing within its territorial waters. However, the Federal Government, directly and indirectly, assists the States through several programs intended to help them manage and develop fish resources for both commercial and recreational uses. Also, the Federal Government furnishes direct assistance to Indian and commercial fishermen and helps resolve problems arising from adverse environmental changes in the Great Lakes.

PRINCIPAL AGENCIES

The following three agencies administer Federal programs that directly concern Great Lakes fisheries:

The Great Lakes Fishery Commission, a U.S-Canada joint commission established under the 1955 Convention on Great Lakes Fisheries, is responsible for developing and implementing a program to alleviate these a lamprey problem, formulating and coordinating research, and recommending measures to maximize sustained p[illegible]ivity of fish stocks.

The United States Fish and Wildlife Service, Department of the Interior responsibilities include hatchery raising of fish to increase stocks, biological research of Great Lakes fisheries (including assessments of fish stocks), habitat protection, fishery law enforcement, and technical assistance to Indian fishermen.

The National Marine Fisheries Service, Department of Commerce responsibilities include sponsoring economic research, product and market development, vessel and gear research and development, dissemination of production statistics, and providing financial assistance to the commercial fishing industry.

FWS and NMFS administer the following laws which provide for Federal grants or other financial aid to States, fishermen and others specifically for fishery activities.

--FWS and NMFS jointly administer the Anadromous Fish Conservation Act of 1965. The act provides grants to States and other non-Federal interests for up to

66-2/3 percent of the cost of projects to conserve and enhance stocks of Great Lakes fish that ascend streams to spawn. FWS administers grants related to sport fishing, and NMFS administers grants related to commercial fishing.

--FWS administers the Federal Aid in Fish Restoration Act of 1950 (Dingell-Johnson Act). The act apportions to States the manufacturers' excise tax collected on fishing rods, reels, flies, etc., for sport fish restoration and management projects. It provides Federal funds for up to 75 percent of the cost of such projects.

--NMFS administers the Commercial Fisheries Research and Development Act of 1964. The act authorizes grants to States for projects designed for the research and development of the commercial fisheries and provides for Federal funding up to 75 percent of the cost of projects. The costs of projects to alleviate resource disasters (commercial fishery failures arising from natural or undetermined causes) and to establish new commercial fisheries are funded 100 percent by the Government.

--NMFS administers four financial programs authorized by the Fish and Wildlife Act of 1956, the Merchant Marine Act, 1936, as amended, and the Fishermen's Protective Act of 1967 to assist the commercial fishing industry. The programs include loans, loan guarantees, and tax deferral measures for the acquisition of improvement of vessels and gear.

OTHER FEDERAL AGENCIES

Several other agencies whose missions--unlike those of GLFC, FWS, and NMFS--are not primarily fishery-oriented are also concerned with Great Lakes fisheries.

The Office of Sea Grant, Department of Commerce, provides Federal grants, mainly to universities, up to 66-2/3 percent of the cost of research and development projects and advisory services concerned with commercial and recreational fisheries in the Great Lakes. The grants are provided under the National Sea Grant Program, created in 1966 to stimulate development, conservation, and use of the marine environment, including, but not limited to, fishery aspects.

The Bureau of Indian Affairs (BIA), Department of the Interior, provides assistance to Indian fishermen.

The Coast Guard, Department of Transportation, enforces Federal law prohibiting fishing by foreign vessels in U.S. waters.

As part of their overall mission, four other agencies have provided or can provide financial aid in the form of grants, loans, and loan guarantees to State and/or private projects and operations in both the commercial and recreational sectors of the fisheries. These agencies are:

--the Upper Great Lakes Regional Commission (UGLRC),

--the Economic Development Administration (EDA),

--the Farmers Home Administration (FmHA),

--the Small Business Administration (SBA).

The following table recaps the agencies and principal functional areas that comprise direct Federal participation in the Great Lakes fisheries.

Agency	Sea lamprey control	Fish stocking	Research and development	Habitat protection	Enforcement	Aid to Indians	Financial assistance
Agencies primarily fishery-oriented:							
GLFC	X		X				
FWS		X	X	X	X	X	X
NMFS			X				X
Agencies not primarily fishery-oriented:							
Sea Grant							X
BIA						X	
Coast Guard					X		
UGLRC							X
EDA							X
SBA							X
FmHA							X

Estimated fiscal year 1975 Federal expenditures by the above agencies concerning their principal Great Lakes fishery activities are shown on the following page.

Programs primarily oriented toward human health and the environment and carried out by several other Federal agencies have an indirect effect on Great Lakes fishing.

In the health area, the Food and Drug Administration (FDA), Department of Health, Education, and Welfare, as part of its responsibility for protecting consumers against unsafe and impure foods, addresses the wholesomeness of Great Lakes fish shipped in interstate commerce.

In the environmental area, Federal efforts are channeled through a variety of agencies. The U.S.-Canada International Joint Commission (IJC), under the Great Lakes Water Quality Agreement of 1972 between the two countries, is responsible for assessing water pollution control programs and assisting in their coordination. Its efforts are supported by U.S. Federal agencies. Although the States have primary responsibility for control of water pollution, the Environmental Protection Agency (EPA), plans, researches, and sets standards for control. Additionally, EPA's construction grants program provides funds to States for constructing municipal wastewater treatment facilities. Other agencies also have programs that affect or address the Great Lakes water environment:

--The Corps of Engineers, Department of the Army, carries out dredging and other water-related functions.

--The Energy Research and Development Administration performs its own or funds outside research into the environmental impact of powerplants on the lakes.

--The Great Lakes Environmental Research Laboratory, Department of Commerce, conducts research to improve environmental information and develop improved service tools to support the needs of governmental and private organizations.

--The Office of Coastal Zone Management, Department of Commerce, under provisions of the Coastal Zone Management Act of 1972, makes annual grants to Great Lakes States to assist them in developing management programs for their coastal issues of concern, including, if applicable, recreational and commercial fishing.

		Estimated FY 1975 Federal expenditures
Sea lamprey control (note a)		
GLFC		$2,100,000
Fish stocking		
FWS		800,000
Research and development (note b)		
GLFC	$ 12,000	
FWS	1,471,000	
NMFS (liaison)	102,000	1,585,000
Habitat protection		
FWS		416,000
Enforcement		
FWS	3,500	
Coast Guard	(c)	
Technical aid to Indians		
BIA	2,500	
FWS	25,000	27,500
Financial assistance:		
Anadromous Fish Conservation Act grants:		
FWS	1,291,000	
NMFS	25,000	
	1,316,000	
Federal Aid in Fish Restoration Act grants:		
FWS	248,000	
Commercial Fisheries Research and Development Act grants:		
NMFS	218,000	
Sea Grant:	351,000	
Other grants:		
EDA	393,000	
UGLRC	194,000	
	587,000	2,720,000
Loans and loan guarantees:		
NMFS	d/150,000	
FmHA	-	
SBA	-	

a/Includes research.

b/Excludes research related to sea lamprey control.

c/Not available.

d/Amount not included in expenditures column because it is a loan guarantee--only a potential expenditure.

--The Great Lakes Basin Commission, a Federal-State group established under the Water Resources Planning Act of 1965, coordinates planning for conservation and development of water and water-related resources in the Great Lakes basin and fosters studies related to such planning.

The 1975 expenditures for Federal efforts in the health and environmental areas which could be considered Great Lakes fishery-oriented were not available.

ENHANCEMENT OF FISH RESOURCES

Since establishment of GLFC in 1955, the central focus of Federal efforts in the Great Lakes fisheries has been the enhancement of fish resources--restoration of depleted stocks and conservation of valuable species. The Great Lakes sea lamprey control program is the most important Federal effort. The program has, to a large extent, overcome the sea lampreys' catastrophic destruction of the most valued fish species and has set the scene for large-scale stock restoration actions.

Sea lamprey control

The GLFC program (see app. VII) to reduce the sea lamprey population is carried out by FWS and a Canadian agency (Fisheries and Environment Canada) under contractual agreements with GLFC. The effort has been extensive. It included surveys of streams, construction of barriers to lampreys, and development and application of chemical controls (lampricides). U.S. Federal expenditures for the lamprey control program through fiscal year 1975 amounted to about $22 million.

The program has achieved a substantial reduction of the lamprey menace. Primarily through the use of chemical controls, it has reduced the lamprey population by an estimated 85 to 90 percent. As a consequence, there has been a marked improvement in the survivability of valued species that had been major prey of the lamprey.

Despite the success to date, GLFC believes that two areas of sea lamprey control warrant further efforts:

--Research to obtain approval of the lampricides from the environmental standpoint.

--Research to develop more effective and economical control methods.

Restoration of fish stocks

The success of GLFC's sea lamprey control program has been followed by a major effort to restore and enhance fish stocks in the Great Lakes. Several Federal agencies, the Great Lakes States, and the Canadian Province of Ontario participate in the restoration program.

GLFC plays an important role in the effort to restore the Great Lakes fisheries by coordinating the planning and implementation of Federal, State, and Canadian fish-rearing programs. GLFC's participation stems from its view that sea lamprey control is only the first step in redeveloping the fisheries; it sees that coordinated planting of lake trout and other desirable species to hasten rehabilitation is the second step.

GLFC coordinates restocking activities of various fishery agencies by means of recommendations and by providing a forum for agencies to reach agreement on

--species to be planted,

--number to be planted, and

--locations of plantings.

Hatchery activities

The FWS fish hatchery program has provided major support to GLFC's Great Lakes stock restoration goals. The FWS objective in producing fish for stocking the lakes is to assist in developing and maintaining a stable and favorable balance of fish. Its fish hatchery program emphasizes the restoration of lake trout--traditionally a commercial species--the fish GLFC considers the keystone of the restoration program. The hatcheries have also produced various other species, mostly recreational fish.

The lake trout plantings were initiated in 1958 on an experimental basis. To date, most plantings have been made in Lakes Michigan and Superior. Although the lake trout have survived and developed, the program's major goal remains unmet because the fish have failed to reproduce naturally except in limited areas.

The failure so far to develop a self-sustaining stock and the emergence of a large recreational fishery have resulted in State restrictions on commercial harvest of lake trout. As explained on page 19, a Federal Court in 1976 dismissed a civil suit against the State of Wisconsin's restrictions on commercial harvest of the species and, in doing so, reaffirmed the right of States to regulate fishing within their waters.

Through 1974 FWS produced 49 million, or 78 percent, of the lake trout planted. FWS is planning new facilities to increase its lake trout production.

Financial assistance to States

During fiscal years 1967-76, FWS under the Anadromous Fish Conservation Act and EDA and UGLRC under their economic development programs provided about $10.5 million to assist State projects in restoring and conserving Great Lakes fish resources. Funds provided for such projects included approximately:

--$9.1 million for fish propagation, mainly involving projects for the construction, operation, and improvement of hatcheries. The funds were provided by FWS, EDA, and UGLRC. An estimated 20 million sports fish were purchased or reared by the States through the use of these funds.

--$382,000 by FWS for studies on the development of Great Lakes recreational fisheries. This included a New York project to plan and evaluate Lake Ontario's salmonid recreational fishery and a Michigan project that studied the economic and biological impact of recreational fishery that developed after salmon were introduced to the Great Lakes.

--$48,000 by FWS for fish planting research projects in Minnesota and Ohio.

--$921,000 by FWS and UGLRC for projects to improve the habitat of fish that ascend streams to spawn--principally salmon and brook, brown, and steelhead trout. The actions primarily involved clearing streams and constructing fish ladders.

The Federal assistance has primarily benefited recreational fishing because the State projects, for the most part, have

addressed species for which commercial fishing is prohibited or restricted.

FWS has also provided funds to States under the Dingell-Johnson Act, which is specifically intended to assist in restoration of recreational fish. FWS officials told us that a summary of the cumulative amount applied to Great Lakes fisheries was not available, but that the amount was relatively small. The FWS officials also told us the States generally apply most of the funds to projects pertaining to inland rather than Great Lakes waters.

MANAGEMENT OF RESOURCES

While the States have sole authority to regulate fishing in U.S. Great Lakes waters, the Federal Government supplements and assists States by performing direct research and furnishing financial aid to State research programs. The GLFC seeks to promote coordination among the various Great Lakes States and Ontario. Additionally, FWS and the Coast Guard conduct limited activities in the area of fishery law enforcement.

Research

Research provides the information needed for effective fishery management through developing data on the present and anticipated future condition of the stocks and the factors which affect them.

Research as a practical management tool in the Great Lakes began to be emphasized during the late 1950s because of

--the reestablishment of valuable stocks, brought about by the success of sea lamprey control and stock restoration efforts;

--more intensive State management of fisheries; and

--the development of the recreational fishery and the resultant conflicts between commercial and recreational interests regarding the allocation of harvests.

Direct Federal research related to managing fish stocks is coordinated through GLFC and is performed by FWS. Both

agencies have advisory roles--neither has the authority to compel the State fishery management agencies to accept and act on information developed through their efforts. FWS and NMFS provide financial assistance to State research programs and the Office of Sea Grant provides funds to college and university research projects.

GLFC and FWS recognize that more intensive research effort may be appropriate. Beginning in late 1976, both agencies took steps to clarify their future course of action.

GLFC actions

In carrying out its mandate to formulate and coordinate research, GLFC uses the research performed by Federal, State, and Canadian agencies. It does not have its own research facilities and does not directly fund research, other than for sea lamprey control, in any appreciable amount. It is assisted by a Scientific Advisory Committee composed of scientists from U.S. and Canadian Government agencies and universities.

In its early years, GLFC focused its attention on sea lamprey control. In 1959 and 1960 it issued general guidelines for U.S. and Canadian research, and in 1964 issued a prospectus of the investigations needed for development of coordinated fishery management. Both stressed the need for better information on the condition of fish stocks.

In 1965, following the success of sea lamprey control measures and the extension of stock restoration efforts, GLFC established a committee for each lake. The "lake committees" consist of senior staff members from the State and Ontario fishery agencies bordering the individual lakes. GLFC uses these committees as a mechanism to formulate and coordinate research.

For example, the lake committees have coordinated Federal, State, and/or Canadian research on the condition of fish stocks, such as yellow perch and walleyes in Lake Erie and chubs in Lake Michigan. During our review, the Lake Michigan committee was developing a method of accumulating better statistics to determine the effect of recreational fishing on the stocks.

GLFC has not developed overall research priorities. Its officials acknowledged that research efforts can be

improved, specifically in the area of stock assessment. In late 1976, the U.S. GLFC commissioners requested FWS to review stock assessments needs. FWS initiated a detailed survey of needs of both U.S. and Canadian fishery agencies and planned to advise GLFC of the results in 1977.

FWS actions

FWS research of Great Lakes fisheries is centered in the Great Lakes Fishery Laboratory, Ann Arbor, Michigan. While the laboratory, as part of its overall effort, addresses environmental factors affecting fish (discussed on p. 44), its primary research objective is to assist States in establishing a scientific basis for managing fish stocks. It has focused the greater part of its effort on stock assessments of important fish populations.

The laboratory conducts assessment activities in close collaboration with GLFC and the States. This role is dictated, in large part, by the absence of Federal authority to manage Great Lakes fish stocks. To help insure that the States use its findings, the laboratory makes stock assessments primarily to satisfy the States' wants. Because of the limitations on Federal management authority, the laboratory takes a neutral position on allocating estimated allowable harvests to commercial and recreational fishing.

State officials advised us the laboratory's stock assessment work has been of direct help. The laboratory director believes the cooperative Federal-State activities represent significant advances in the quality of research effort. Only one of the laboratory's major stock assessments--Lake Erie walleye--has involved the complex analysis necessary to enable a projection of optimum sustainable yield. According to FWS officials, the importance of sophisticated assessments evolved only in recent years, because of considerable growth of recreational fishing and the States' intensified fishery management efforts.

According to an FWS official, an evaluation in late 1976 of interagency stock assessment efforts showed that information on all but a few stocks was inadequate for development of accurate estimates of standing stocks, annual production, and total allowable harvests. However, the laboratory director told us of obstacles to providing more sophisticated assessments. These include a general lack of adequate statistics on the recreational fishery harvest and a lack of qualified personnel to perform the complex work of developing projections of optimum sustainable yield.

Financial assistance to States

The Federal Government has assisted research of Great Lakes fish stocks by providing matching funds for stock assessment projects conducted by State fishery agencies and State universities. In fiscal year 1975, FWS and NMFS provided about $327,000 to six State fishery agencies and the Office of Sea Grant provided about $72,000 to two State universities.

Management coordination

In addition to coordinating research, GLFC also encourages and promotes management coordination between the eight Great Lakes States and the Province of Ontario. The lake committees provide a forum for interagency discussion of management problems and formulation of appropriate action. The development of integrated and mutually acceptable programs is a difficult process because it involves eight States and the Province of Ontario, whose sociological and economic interests are not always the same. GLFC depends on the committees to establish mutually acceptable programs because of the differing objectives of the various agencies.

Recommendations to State and Province management agencies are usually made by the lake committees rather than by GLFC commissioners. Generally, the lake committees request the commissioners to make recommendations in cases in which they believe greater emphasis is needed.

While the effort to achieve coordinated management is a challenging one, State and Canadian fishery officials, in general, believe GLFC has been instrumental in promoting it. GLFC officials believe significant progress has been made in recent years and foresee continued progress in the future.

Following are examples of major accomplishments cited by a GLFC official.

--In July 1974, a subcommittee of the Lake Michigan Committee recommended that Illinois, Indiana, Michigan, and Wisconsin suspend chub fishing in Lake Michigan in 1975, and continue the suspension until a harvestable surplus occurred.

--In April 1975, GLFC urged Michigan, Ohio, and Ontario to adopt a Lake Erie Committee recommendation that the minimum size limit on western

Lake Erie yellow perch for commercial fisheries (8 inches) be revised to 8.5 or 8.75 inches.

--In December 1976, the Lake Erie Committee recommended that Michigan, Ohio, and Ontario adopt committee-developed total catch quotas for western Lake Erie walleye.

In general, the jurisdictions to which the above recommendations were addressed responded favorably, although economic and administrative factors have delayed implementation of the recommendations concerning the yellow perch.

GLFC's recommendations do not address the allocation of fish stocks to commercial and recreational fishermen. For example, the GLFC-recommended quotas for western Lake Erie walleye pertained to the total catch, not to its allocation among commercial and sport fisheries. GLFC acknowledges that allocation of harvests among users is the responsibility of the State and Province fishery management agencies.

However, in urging agencies to adopt the Lake Erie Committee's recommendation for an increase in the minimum size limit on yellow perch, GLFC noted that the increase was for commercial fisheries only. It suggested that as recreational catch data, incomplete at the time the recommendation was developed, became available, the agencies should consider this data and the impact of the recreational fishery in any implementation of the recommendation.

In 1974 GLFC issued a document, A Management Policy for Great Lakes Fisheries, which listed the principal general management needs in summary form, without designating priorities. However, GLFC efforts to promote coordinated management have largely addressed individual specific problems. GLFC officials believe that coordinated actions need to be developed to address the overall problems of each lake and the lakes in combination.

Fishery law enforcement

Enforcement of Federal fishery laws is performed by FWS and the Coast Guard.

The Black Bass Act (16 U.S.C. 851-856) authorized FWS to arrest persons who transport, in interstate or foreign commerce, black bass "and other fish" caught or processed contrary to the law of that State or country.

In the Great Lakes area, FWS enforcement activities have been concerned primarily with illegal catch of lake trout in Lake Michigan. Most efforts have been expended in inspecting shipments of fish to the Detroit, Chicago, and New York markets. Enforcement costs for fiscal year 1975 were $3,500 and are expected to increase to $15,000 to $20,000 in fiscal year 1977.

FWS works closely with the States, and usually refers illegal catches to State agents for prosecution, because State laws provide greater penalties than the Black Bass Act.

The Coast Guard, as a part of its random patrols of the lakes, enforces Federal laws prohibiting commercial fishing by foreign vessels in U.S. territorial waters. A Coast Guard officer told us that four or five vessels were seized in the Great Lakes waters during 1976 at relatively minor cost to the Coast Guard. Although it does not enforce State fishery laws, the Coast Guard occasionally provides transportation to State officials enforcing State laws.

ASSISTANCE TO INDIAN FISHERIES

The Federal Government has provided technical, economic, and legal assistance to Indian fishermen on the Great Lakes.

FWS, as agent of the Secretary of the Interior, provides technical assistance to Great Lakes Indian tribes for off-reservation fisheries. In fiscal year 1975, it spent about $25,000 in furnishing advice to three Indian bands (part of an Indian tribe) that fish Lake Superior waters. The advice addressed such matters as training, developing data on fish abundance, and developing catch quotas.

Indian bands fishing Lake Superior have received economic assistance from the Economic Development Administration and the Upper Great Lakes Regional Commission under their economic development programs, and from the Bureau of Indian Affairs.

--In fiscal year 1975 EDA provided $393,000 to the Bay Mills, Michigan, Indian band to construct a fish processing plant and, in fiscal year 1976, $11,266 to the Bad River, Wisconsin, Indian band for a feasibility study of a fish hatchery.

--In fiscal year 1975, UGLRC made a $25,000 grant to the Red Cliff, Wisconsin, Indian band to finance a feasibility study of a fish processing plant.

--In fiscal year 1975 BIA spent an estimated $2,500 of its general assistance funds to aid Indian fishing.

Under Federal treaties and statutes the Department of Justice represents Indians in litigation involving fishing rights, with the assistance of Department of the Interior attorneys. Information was not available on the cost of these efforts.

FEDERAL EFFORTS TO DEVELOP AND ENHANCE THE COMMERCIAL FISHING INDUSTRY

Federal efforts have been principally concerned with restoring fish stocks and assisting the commercial fishing industry through research and economic aid.

Prior to 1970, responsibilities for assisting the Great Lakes commercial fishing industry were vested in the Bureau of Commercial Fisheries, FWS, Department of the Interior. Under Presidential Reorganization Plan No. 4 of 1970, the responsibilities were transferred--with the exception of fishery biological research, which remained in FWS--to NMFS, Department of Commerce. During the reorganization, many of the Bureau of Commercial Fisheries activities that had been performed on the Great Lakes lost their identity in the components of NMFS through transfer or reprogramming to other NMFS regions. Also in this period, some uncertainties existed about NMFS obligations in the Great Lakes.

In December 1973, NMFS established a Great Lakes Liaison Office in Ann Arbor, Michigan, responsible to the NMFS Northeast Region headquartered in Gloucester, Massachusetts. The Ann Arbor Liaison Office is staffed by three people; fiscal year 1975 cost was about $102,000. The Liaison Office prepares various statistical reports and identifies needs of Great Lakes commercial fishermen. It seeks to satisfy the needs falling within NMFS' jurisdiction by arranging for assistance from other NMFS facilities and by assisting in the development of programs and projects of various universities, commissions, and private enterprise.

The Liaison Officer advised us that, since the efforts of NMFS facilities in other localities have limited applicability to the Great Lakes, NMFS has addressed the needs of Great Lakes commercial fishing primarily through the Sea Grant program and UGLRC. He also advised us that NMFS grants and financial assistance programs in the Great Lakes are administered by NMFS' Northeast Regional Office.

Financial assistance

In fiscal year 1975, NMFS awarded grants totaling about $218,000 to six Great Lakes States primarily for stock assessments under the Commercial Fisheries Research and Development Act. Under the Anadromous Fish Conservation Act, NMFS awarded grants of about $25,000 to Wisconsin to be used in a stock assessment program and to identify causes of off-flavor in Great Lakes fish.

The four NMFS financial programs to assist commercial fishermen are:

--The Fisheries Loan Fund makes loans available to finance vessels and gear.

--The Fishermen's Guaranty Fund Program provides reimbursement for certain losses due to vessel seizure by a foreign country.

--The Capital Construction Fund allows fishermen to accumulate tax deferred funds for construction, reconstruction, and/or acquisition of vessels.

--The Fishing Vessel Obligation Guarantee Program authorizes guarantee of obligations which aid in financing up to 75 percent of the cost of construction, reconstruction, or reconditioning of vessels.

A nationwide moratorium on use of the Fisheries Loan Fund has been in effect since 1973, and NMFS officials told us no applications from Great Lakes commercial fishermen have been received under the Fishermen's Guaranty Fund Program because, to their knowledge, Canada has not seized a U.S. vessel. However, the fishermen have participated in two funds administered by NMFS--the Capital Construction Fund and the Fishing Vessel Obligation Guarantee Program.

From fiscal year 1971 through May 5, 1977, commercial fishermen executed 10 Capital Construction Fund agreements

with NMFS involving an estimated $1.4 million. Under these agreements, three vessels have been constructed, two are under construction, and four have been reconstructed. An additional six new vessels are planned, four more are to be reconstructed, and seven used vessels are to be purchased. NMFS told us that only one Great Lakes commercial fisherman has applied for a loan--a $150,000 guaranty made in April 1975--under the Fishing Vessel Obligation Guarantee Program.

The Office of Sea Grant has provided grants to universities for advisory services to Great Lakes commercial fishermen. Information was not available to show the amounts granted over the years for these activities. In fiscal year 1975, the Office provided about $117,000 to Wisconsin, Michigan, New York, and Cornell Universities for advisory services for Great Lakes commercial fishermen. In the same year, the Office provided an estimated $65,000 to Wisconsin and Cornell Universities for advisory services for Great Lakes recreational fisheries.

The Economic Development Administration provides financial aid to States and local areas to encourage long-range industrial and commercial growth. It carries out four major programs that could have applicability to the fishing industry if assistance is unavailable from other sources. The programs' basic purposes are to:

--Assist private industry to expand or locate new facilities in areas generally burdened with high unemployment or low family income.

--Provide special economic development and adjustment assistance to help State and local areas meet needs arising from actual or threatened severe unemployment resulting from changes in economic conditions.

--Help provide public works and development activities needed to attract new industry and encourage business expansion.

--Provide information and expertise in evaluating or shaping specific projects and programs for economic development.

While EDA has provided funds for assistance to Indian fishermen (see p. 34) and State propagation of recreational fish (see p. 28) in the Great Lakes, it has not provided funds to assist commercial fishing activities. EDA,

however, did not know if commercial fishing interests had applied for such assistance.

The Small Business Administration can make loans to eligible recipients in the fishing industry. Both regular business and disaster recovery loans are available. We contacted 10 SBA offices in eight Great Lakes States and were advised that one loan for $10,000 had been approved for a commercial fisherman in 1972. Most offices indicated they had not received applications from commercial fishermen, fish processors, or marketers.

Fishing industry firms are also eligible for financial assistance provided by the Farmers Home Administration, Department of Agriculture, which provides loans to entrepreneurs interested in developing businesses and industries in rural America. However, an FmHA official told us that no applications had been received from Great Lakes commercial fishing interests. He said that one casual inquiry had been made but an application was not received.

We discussed Federal financial assistance with 15 current and 2 former Great Lakes commercial fishermen. Only six knew that Federal financial assistance was available. Most of them regarded local lending institutions or large commercial fishing operations as potential sources of financial assistance but believed that local lending institutions would generally be reluctant to make loans to Great Lakes commercial fishermen. Fishermen cited the fishing industry's instability as the reason for lender reluctance. Most fishermen interviewed said they had never applied for financial assistance.

The NMFS Great Lakes Liaison Officer stated that financial assistance may not be a critical need for all fishermen. However, he believed that some fishermen and processors may need financial assistance to purchase improved handling and processing equipment, such as deboning machines and quick chilling units. He indicated that financial assistance for such equipment could benefit processors and small harvesters who would agree to diversify their operations by handling underutilized species.

Development of underutilized species

The depressed stocks of traditional commercial species and State restrictions favoring recreational fishermen serve as restraints on the growth of the Great Lakes commercial

fishery. The potential for enhancing the industry appears to be in developing a more diversified fishery--increased harvest of presently underutilized species, such as carp, sucker, sheepshead, and smelt. The commercial fishermen interviewed expressed interest in expanding their harvest of underutilized species if a better market could be obtained for them. State and Federal officials believe underutilized species offer potential for increased commercial harvest. Further, this would make use of a resource that would otherwise be wasted. The success of the fishery, however, will require developing (1) information on abundance (stock assessment), (2) selective fishing techniques, and (3) marketable products.

The NMFS Great Lakes Liaison Officer believed that three species--sucker, sheepshead, and smelt--offer the greatest potential for promoting early and broad benefits to the commercial fishery. Two of the species, sucker and smelt, are abundant in all the lakes, and sheepshead is exceedingly abundant in Lake Erie. His estimate of their potential harvest, based on information received from producers, State officials, and university investigators, is shown below:

	Pounds	
	1975 harvest	Potential harvest
	(millions)	
Sucker	0.6	3 to 10
Sheepshead	0.9	3 to 8
Smelt	2.6	6 to 10

The NMFS Liaison Officer indicated that (1) some gear research, including development of new harvesting methods for smelt, will have to be done to determine the best methods for catching these species; (2) new products, to gain consumer acceptance, and good storage techniques will have to be developed for sheepshead; and (3) use of high-volume processing equipment and/or freezing facilities will have to be increased for smelt.

In October 1976 the NMFS Liaison Officer proposed a program for Great Lakes fishery development aimed at solving the problems of product development, processing, and marketing of sucker, sheepshead, and smelt. The proposal was submitted for consideration and possible inclusion in the

fiscal year 1979 budget. The program would rely on research performed by NMFS facilities and research supported by the Office of Sea Grant. Where ongoing research is not sufficient, NMFS funds would be used to contract for additional effort.

Federal efforts on underutilized species have largely been carried out through UGLRC and the Office of Sea Grant, focusing on product and market and selective fishing gear development.

To assist commercial fishing in Michigan, Minnesota, and Wisconsin, at the request of the States' governors and the advice of Federal, State, and commercial interests, UGLRC concentrated on developing a fishery for suckers in 1974. In fiscal years 1975 and 1976, UGLRC provided grants of about $484,000 to universities for three projects to develop and market new food products using suckers. UGLRC was assisted by an advisory committee that included the NMFS Liaison Officer and State officials.

According to UGLRC and NMFS officials, the projects met their objectives--yielding acceptable new products, developing quality control, and developing a market for the products. The NMFS Liaison Officer believes the projects, coupled with consumer education, will provide a basis for future use of suckers by private enterprise.

The NMFS Liaison Officer told us that these efforts have been complemented by other Federal efforts dealing with underutilized species. For example: (1) under the Sea Grant Program, some university stock assessment projects have addressed such species, and university marine advisory service personnel have assisted in test marketing new products, (2) stock assessments of some underutilized species have been performed by FWS, and (3) in fiscal year 1975, Ohio received a $70,000 NMFS grant for a project to develop greater commercial use of sheepshead.

In fiscal year 1976, as a further means of helping develop greater use of underutilized species, UGLRC provided a $30,000 grant and the Office of Sea Grant provided $27,200 to a University of Michigan project aimed at evaluating the feasibility of purse seine nets--a form of selective harvesting gear--for Great Lakes fisheries. Commercial fishermen contributed about $50,000 of time and effort to the project, and NMFS and the State of Michigan provided technical assistance.

The FWS Liaison Officer told us that initial trials under the project indicated that the purse seine gear has great promise for harvesting Great Lakes species.

ENVIRONMENTAL PROBLEMS

The Great Lakes fisheries have been adversely affected by a variety of environmental factors, including water pollution and destruction of spawning areas. The U.S.-Canada Great Lakes Water Quality Agreement of 1972 was an important step in the effort to alleviate environmental problems. The agreement established water quality objectives, committed each country to developing and implementing measures to achieve them, and assigned the U.S.-Canada International Joint Commission responsibility for assessing progress and assisting in the coordination of joint activities contemplated by the agreement.

In 1977, the fifth year of the agreement's existence, IJC advised the two Governments that much had been achieved and that some near-shore waters had shown noticeable improvement in quality. As evidence of progress, IJC cited:

--major programs underway for municipal sewage treatment and phosphorus removal facilities;

--progress in industrial pollution control;

--enactment of legislation for controlling contaminants; and

--much improved surveillance activities.

However, IJC reported that the "high hopes of 1972 for quick results" in restoring water quality had not been realized and much remained to be done. IJC pointed out that certain problems--such as reducing pollution from atmospheric fall-out and various land-use activities--are long term in nature.

Our report "Cleaning Up The Great Lakes: United States And Canada Are Making Progress In Controlling Pollution From Cities And Towns," (RED-75-338, March 21, 1975) described how the two countries were progressing in controlling pollution in the Great Lakes area.

Contaminants

In IJC's view, contaminants and other toxic substances--factors that have had a particularly adverse effect on the fisheries (see p. 41)--may be the most serious problem facing the effort to ensure future beneficial uses of the Great Lakes.

Attention was drawn to persistent contaminants found in Great Lakes fish in the 1960s. The most common types identified have been DDT, dieldrin, mercury, and PCBs. In 1976 an additional contaminant--mirex--was identified in Lake Ontario fish. Actions taken include (1) curtailing industrial discharges of mercury, (2) banning the use of DDT and dieldrin, and (3) enacting legislation prohibiting use of PCBs except under controlled conditions by some States.

Despite such actions--and resultant reductions of certain contaminants in some areas--available data indicates that the contamination problem is a stubborn one and that control will be difficult to achieve.

Certain contaminants are persistent and their sources can be wide-ranging. For example, PCBs enter the water from such diverse sources as runoffs from landfills and pollutants from the atmosphere. Little can be done to remove them. Moreover, the contaminant level in fish is much higher than the level in the waters they inhabit. This phenomenon occurs because fish concentrate and, in effect, magnify the contaminants they absorb. Some fish contain contaminants in excess of FDA guidelines, even though the level of many contaminants in the waters they inhabit is low--so low that it is undetectable by standard analytical procedures.

New legislation for controlling toxic contaminants was recently enacted by the United States and Canada. In Canada, the Environmental Contaminants Act, passed in late 1975, provided for establishing an Environmental Contaminants Board of Review to inquire about and regulate any substance suspected to be dangerous to human health or the environment. One of the first substances to be regulated is PCBs. In the United States, the Toxic Substances Control Act, signed into law on October 11, 1976, authorizes EPA to obtain production and test data from industry on selected chemical substances and mixtures, and to regulate them when needed. The act prohibits all production of PCBs and their distribution in commerce after July 1979.

In February 1977 IJC urged the two Governments to implement the legislation as quickly and comprehensively as possible. However, according to IJC, it is not known whether the legislation is adequate to protect the environment from all known and future adverse effects of contaminants.

IJC has recommended that the Governments give the highest priority to jointly undertaking a special program to assess the problem of persistent contaminants in the Great Lakes with a view to developing and implementing programs for their control. In particular, IJC called for research and development of early warning mechanisms to identify new chemical substances that present risks if discharged into Great Lakes waters.

As a step in this direction, in March 1977 an IJC work group proposed that a fish contaminant survey program be undertaken by several Great Lakes Jurisdictions. Because the presence of contaminants is more readily detectable by analysis of fish and other aquatic life than by analysis of the waters themselves, the proposed program provides for a coordinated survey of contaminant levels in selected species of fish to identify areas where contamination is excessive. Identification of such areas, in turn, would assist in identifying sources, and thereby aid in remedial efforts. According to an IJC official, near-shore surveillance may be implemented during 1977.

Fishery agencies' involvement in environmental matters

Although IJC and EPA have the primary responsibilities for Great Lakes environmental matters, the Great Lakes Fishery Commission and FWS are also involved.

GLFC has taken several steps to make fishery concerns about the environment better known to IJC. In January 1976 GLFC furnished IJC with a summary of findings and opinions on environmental issues developed by its lake committees and the Scientific Advisory Committee. A GLFC official advised us that the two commissions have arranged to meet jointly to discuss fishery environmental problems, at either's request. Additionally, IJC has sent a representative to GLFC meetings, and GLFC personnel are included on certain IJC boards.

FWS conducts various ecological assessment activities aimed at protecting fish habitats in the Great Lakes. During fiscal year 1975, it spent about $416,000 for this program. The efforts primarily involved reviewing proposed Federal or federally assisted water-related projects, including the Corps of Engineers dredging actions, to assess their potential effect on fish habitat. FWS involvement is required by the Fish and Wildlife Coordination Act and the National Environmental Policy Act of 1969. An FWS official told us that favorable consideration has been given to its views and recommendations.

In addition, the FWS Great Lakes Fishery Laboratory conducts research on the effects of contaminants on fish and the response of fish to environmental stress. Among other things, its efforts address the effects of water-use practices on fish and their habitat. In fiscal year 1975, about $524,000 of the laboratory's expenditures pertained to FWS environmental research.

Other agencies' involvement

FDA plays an important role in environmental factors affecting the Great Lakes fisheries. For the purpose of protecting public health, it conducts research and issues regulations governing the permissible levels of pesticides and industrial contaminants in fish. FDA samples interstate shipments of fish and can seize the shipments if contamination exceeds tolerable levels.

EPA has the primary Federal responsibility in environmental improvement efforts. Its mandate is to mount an integrated, coordinated attack on environmental pollution in cooperation with State and local governments. Besides setting standards for control of pollutants, it conducts or supports water quality research, including studies relating pollution to fish and the aquatic environment. In fiscal 1975 EPA expenditures for Great Lakes water-related research, development, and management amounted to about $33.2 million. In addition, under its Construction Grants Program, EPA allotted an estimated $712.5 million in fiscal year 1975 to States for construction of municipal wastewater treatment facilities in the Great Lakes basin.

In 1970 the Corps of Engineers established a Great Lakes Confined Disposal Program, which calls for placing behind retaining dikes any material dredged from the Great Lakes area that EPA determines to be polluted. The program

to date has experienced substantial delays and cost increases. These matters are discussed in our report "Dredging America's Waterways And Harbors--More Information Needed On Environmental And Economic Issues," (CED-77-44, June 28, 1977).

The Energy Research and Development Administration, as part of its research into the environmental impact of powerplants on the Great Lakes, has addressed the effects of certain elements on freshwater food chains and has supported FWS research about the effects of waste heat discharges from powerplants on fish.

The Department of Commerce's Great Lakes Environmental Research Laboratory has addressed matters of importance to fisheries, principally through research into factors affecting the aquatic food chain.

The Office of Sea Grant has provided funds to assist university research projects addressing Great Lakes water environment and pollution. In fiscal year 1975 funds made available to university Sea Grant programs for this purpose was about $432,000.

The Office of Coastal Zone Management, Department of Commerce, is assisting all Great Lakes States in developing management programs to protect and enhance their coastal resources. In fiscal year 1975 Federal expenditures applicable to the Great Lakes States was about $1.7 million.

CHAPTER 5

FEASIBILITY OF A GREAT LAKES AQUACULTURE PROGRAM

The Congress has shown considerable interest in developing aquaculture in the United States to supplement the harvest of naturally produced aquatic species. During our review, aquaculture development legislation had been introduced in the Congress.

AQUACULTURE NOT APPLICABLE TO THE GREAT LAKES

The Great Lakes fishery-oriented organizations do not consider aquaculture as a viable alternative to traditional harvesting operations, and believe that aquaculture techniques are not feasible for the Great Lakes waters.

Aquaculture is the propagation and rearing of aquatic species in controlled or selected environments. To be successful and compete with naturally produced products, aquaculture must be easily accomplished or must grow a very high-market value product. It requires a strong market to provide adequate returns which encourage the development of production systems. Generally, aquaculture requires that an enclosed area--a pond, fish tank, or pen or cage within a larger water area--be used to control fish movement and facilitate feeding to increase growth rate and harvest.

Aquaculture experts from Government and universities and fishery managers from the Great Lakes States believe use of pens or cages in the Great Lakes open waters is not feasible because the rough waters would destroy the enclosures. There are some protected areas where the rough water would not be as great a problem (e.g., Saginaw Bay in the Michigan waters of Lake Huron). Protected areas tend to be in high demand for industrial navigation and recreational boating and fishing. State officials said that because these high priority uses already exist, they believe it is not feasible to set aside areas for aquaculture purposes.

Further, Federal and State officials believe that aquaculture on the Great Lakes is not practical because of other problems such as

--contaminated water,

--a short fish growing season, and

--water temperature variances.

The commercial fishermen we contacted had not seriously considered aquaculture as an alternative to open water fishing. They also generally agreed that aquaculture involving pens and cages was not practical in the Great Lakes.

AQUACULTURE IN INDOOR FACILITIES, INLAND LAKES, AND PONDS

The University of Wisconsin, under a Sea Grant College Program, has successfully grown two Great Lakes species (perch and walleye) under controlled conditions in an indoor facility. This project is marginally profitable. Both State and Federal fishery officials believe that this type of inland aquaculture may hold some promise, and that if aquaculture is successful in the Midwest it will be of this type.

A Michigan State official indicated that aquaculture on inland lakes would have to be done in private ponds or lakes and would probably not be a viable enterprise because growing seasons are too short. A National Marine Fisheries Service official told us that outdoor aquaculture in the Great Lakes region is less feasible than in other areas of the country because of extreme water temperature variances.

Even if indoor or inland aquaculture is successful, the Great Lakes commercial fishermen may not benefit. In fact, it may compete with commercially harvested Great Lakes fish in the marketplace.

CHAPTER 6

CANADA'S GREAT LAKES COMMERCIAL FISHERY

Although only 36 percent of the Great Lakes waters is in Canada, the 1975 value of the Canadian commercial fishery harvest exceeded that of the U.S. commercial fishing industry.

Canadian Great Lakes fish stocks have suffered the same depletion and instabilities as the U.S. Great Lakes fish stocks except for isolated areas like Georgian Bay in Lake Huron. (See app. IV.) However, the Canadian commercial fishing industry was less affected by competition from recreational fishing and restrictions on gear than its U.S. counterpart. Canada's Great Lakes recreational fishery is much smaller than that of the United States, principally because fewer people live near the Canadian side of the lakes and the Canadian recreational fishermen prefer fishing in Canadian inland waters. Because recreational fishing is small, it has had limited effect on Canada's commercial fishing industry.

HISTORICAL DEVELOPMENT

Population growth along the Canadian shore of the lakes has been slower than on the U.S. side, and Canada's commercial fishery did not develop as quickly as that of the United States. In the early 20th century when the U.S. fishery was flourishing, Canada's Great Lakes fish market was limited to consumers living near the ports where fish were landed. As methods of processing, storing, and transporting fish were improved, Canadian fishermen were able to increase their harvest and market their fish in the United States. As a result, Canada's Great Lakes commercial fish harvest increased from about 19 million pounds in 1903 to about 40 million pounds in 1975. Over 75 percent of the Canadian harvest is exported to the United States, principally to the Detroit, Chicago, and New York markets.

Fish stocks declined on both sides of the lakes, but the number of Canadian commercial fishermen decreased at a lower rate than the U.S. commercial fishermen. From 1940 to 1975, the number of Canadian commercial fishermen decreased by about 47 percent compared with a decrease of about 77 percent for U.S. commercial fishermen.

The value of the Canadian commercial harvest began to approximate that of the United States in 1969 and, as shown below, exceeded the U.S. harvest in 1972, 1973, and 1975.

Year	Canadian		U.S.	
	Pounds	Value (note a)	Pounds	Value (note a)
	(millions)			
1966	47.8	$4.4	67.7	$5.7
1967	44.8	4.6	82.0	6.0
1968	47.2	4.5	67.3	5.8
1969	55.6	5.8	67.0	6.0
1970	40.2	5.4	70.4	6.3
1971	38.1	6.0	62.8	6.5
1972	38.3	7.2	58.4	7.1
1973	47.9	9.2	66.7	8.6
1974	47.9	8.3	77.0	10.5
1975	40.4	9.6	60.7	9.1

a/Not adjusted for differences in U.S. and Canadian dollars.

As shown on the following page, the 1975 Canadian and U.S. commercial catch consisted of several of the same species; however, over 50 percent of the U.S. catch consisted of low-value alewives.

Species	Canadian		U.S.	
	Pounds	Value (note a)	Pounds	Value (note a)
	(thousands)			
Smelt	17,333	$1,202	2,573	$ 139
Yellow perch	9,419	4,387	3,036	1,611
White bass	2,580	709	1,699	491
Lake herring	2,232	435	513	146
Chubs	1,249	771	2,444	1,629
Whitefish	1,203	811	4,517	3,301
Alewives	2	(b)	35,216	408
Other	6,411	1,294	10,659	1,325
Total	40,429	$9,609	60,657	$9,050

a/Not adjusted for differences in U.S. and Canadian dollars.

b/Value included in other category because source data did not include a dollar value breakdown for all species.

Lake Michigan is exclusively in U.S. waters. Of the remaining four lakes, the United States controls 53 percent and Canada 47 percent. In 1975, Canada harvested 73 percent of the volume and 68 percent of the value of the fish harvested commercially by both countries in the four commonly shared lakes. Following is a comparison of the 1975 Canadian and U.S. catches by lakes:

Lake	Canadian		U.S.	
	Pounds	Value (note a)	Pounds	Value (note a)
	(thousands)			
Erie	30,549	$6,009	8,484	$1,964
Superior	3,769	1,012	4,735	1,792
Huron	3,334	1,806	1,658	630
Ontario	2,777	782	233	99
	40,429	$9,609	15,310	4,485
Michigan	-	-	45,347	4,565
Total	40,429	$9,609	60,657	$9,050

a/Not adjusted for differences in U.S. and Canadian dollars.

In 1975 the Canadian commercial fishery employed 1,563 fishermen operating 794 vessels and boats. During this same year there were 1,180 U.S. commercial fishermen operating 768 vessels and boats. About 50 percent of the Canadian vessels and boats were over 20 feet in length with about 25 percent of them over 40 feet--comparable size data was not compiled for U.S. commercial vessels and boats.

We believe the relative success of Canada's commercial fishing industry compared with that of the U.S. industry can be attributed, in part, to the fewer and less restrictive regulations imposed by Canadian authorities.

FISHERY MANAGEMENT

Management of the Canadian Great Lakes fishery is the responsibility of the Province of Ontario which regulates both commercial and recreational fishermen.

Ontario performs stock assessment on its portion of four Great Lakes, and uses this information, along with catch statistics, to manage the fishery. Limited entry and quota management are used to control commercial harvest. Ontario tries to minimize gear restrictions which would adversely affect the efficiency of commercial harvesting.

Ontario's policy is to manage the Great Lakes fishery to obtain maximum public benefit. Because its Great Lakes recreational fishery is small, compared to its U.S. counterpart, Ontario has been able to allocate more of its fishery resource to the commercial sector. When a real conflict exists between commercial and recreational interests, Ontario has favored the recreational interest.

Ontario has been reluctant to restrict efficient commercial harvesting techniques, and has not always strictly enforced its regulations applicable to its commercial fishermen. For example, in the past, Ontario's size limit for perch in Lake Erie was not enforced, and special permission was given to catch small perch. As a result, about 70 to 90 percent of Ontario's perch catch in western Lake Erie was under both the Ontario and U.S. 8-inch size limit. Ontario also permits certain harvest techniques which are generally not allowed on the U.S. side. A Canadian trawl fishery is permitted in Lake Erie for smelt, and gill nets are still widely used. These two harvest techniques are largely restricted on the U.S. portion of the lakes.

Ontario has also allowed limited commercial harvest of certain high-value species, such as the walleye in western Lake Erie. U.S. commercial fishermen are prohibited from harvesting this species in the U.S. western part of Lake Erie.

Ontario's fishery management policy differs from the U.S. policy on stock rehabilitation. Ontario does have some stocking programs but believes that stocking the lakes will not be worthwhile (cost beneficial) in the long run unless natural reproduction is achieved. As a result, Ontario is pursuing programs to enhance natural reproduction, and stocking the lakes only in areas where recreational fishing demand is high.

ASSISTANCE TO THE INDUSTRY

Ontario and Canadian Federal fishery officials pointed out that commercial fishermen, processors, retailers, and ancillary enterprises are distributed throughout Ontario and are important to the economy of many communities. In addition, the fishing industry is export-oriented, contributing favorably to Canada's balance of payments.

The Ontario and Canadian Federal governments provide assistance to commercial fishermen through the following programs.

--The Vessel Assistance Program subsidizes the construction and/or modernization of fishing vessels. During 1976-77 1/, 14 Great Lakes vessels were constructed or refurbished with Canadian Federal assistance of $87,000. This program has, in part, been responsible for the modernization of Canada's Great Lakes fishing fleet, particularly on Lake Erie.

--The Fish Chilling Assistance Program subsidizes 50 percent of cost of chilling equipment for processing plants and fishing vessels. Although no grants were made to the Great Lakes commercial fishing industry in 1976-77 1/, $90,000 has been budgeted for 1977-78 1/.

--The Fisheries Improvement Loan Act provides loans to commercial fisnermen for vessel and equipment purchases. In 1975-76 1/, three loans totaling $6,342 were made to Ontario commercial fishermen.

--The Fisheries Loan Act, terminated in 1973, provided loans of $68,000 to commercial fishermen forced out of business when the fishery was closed in 1970 due to contamination. These loans were forgiven in 1976.

--The Fishing Vessel Insurance Plan provides coverage for fishing vessels at below-market interest rates. In 1976-77 1/, 110 Great Lakes vessels, with an insured value of about $3 million, were covered under this plan. The plan is designed to be self-supporting and is not considered a subsidy.

--The Federal Provincial Industrial Development Program funds research and development work on commercial fishery problems, such as gear technology, processing innovations, and exploratory fishing. In 1976-77 1/, $110,000 was spent on such research.

--The Fisheries Prices Support Board is designed to protect fishermen against sharp price declines. During 1972-73 1/, $755,405 was paid out to support the price for perch. Most, if not all, of this amount was recovered in subsequent resale of fish. Because the price of Great Lakes fish has remained high, this program is rarely used.

1/Fiscal years ending March 31.

Canada also has fish quality, vessel safety, and harbor development programs which indirectly aid its commercial fishing industry.

FUTURE PROSPECTS FOR THE CANADIAN COMMERCIAL FISHERY

Ontario fishery management officials expect that the world food shortage will increase and that the price of fish will increase. This will encourage the commercial harvest of underutilized species, such as sheepshead and alewife. They told us that the future of the Canadian commercial fishery may be adversely affected by

--changes in water quality and contaminant levels and

--growth of the recreational fishery.

Both Canadian Federal and Provincial fishery officials believe that efforts are needed to correct water quality and contaminant problems, and they support the actions of the Great Lakes Fishery Commission and the International Joint Commission in this area.

Ontario fishery officials believe that any adverse effect on the commercial fishery caused by increased recreational fishing can be minimized by continued use of sound fishery management practices, equitable allocations, and development of more selective commercial fishing techniques.

CHAPTER 7

CONCLUSIONS AND OBSERVATIONS ON THE U.S. COMMERCIAL FISHING INDUSTRY

Various complex issues severely limit the potential for expanding the U.S. Great Lakes commercial fishery.

At the turn of the century, the U.S. Great Lakes commercial fishing industry was flourishing--harvests were plentiful and almost every town along the lakes was a fishing port. Over the years, however, the number of commercial fishermen has been reduced substantially and the harvest, which once included a substantial percentage of high-value species, now consists largely of medium- and low-value species. The following factors are the primary causes for the changing face of the Great Lakes commercial fishing industry.

--Most species which were important to the fishing industry have been depleted or are near depletion because of overfishing or the invasion of the sea lamprey. As the abundance of high-value human food species was reduced and the industry turned more to the low-value species--over half of the pounds caught in 1975 consisted of alewives.

--Some traditional commercial species are under heavy demand by recreational fishermen. With the relative success of the sea lamprey control program and the stocking programs for lake trout and other salmonids, a large recreational fishery has developed in the Great Lakes. The recreational fisherman fish for some species highly valued by commercial fishermen--yellow perch, walleye, and lake trout.

--The States generally favor the recreational interests in their management of the fisheries. The Great Lakes States' fishery management policies are to protect, develop, and use the fish resource of the lakes for maximum public benefit. The States emphasize recreational interests because of the highly favorable economic value of the recreational fishery. They consider the future of commercial fishing

to be one of enhancing or complementing the recreational fishery.

--The States, to protect the resource and assure adequate stocks for recreational fishermen, have limited the number of commercial fishermen through licensing, generally prohibited commercial catch of species desired by recreational fishermen, and restricted the use of various types of commercial fishing gear and techniques traditionally used to harvest fish.

--Commercial fishing has been adversely affected by contamination of certain species in parts of the lakes. Since the mid-1960s, increased attention has been focused on contaminants, such as DDT, dieldrin, mercury, mirex, and PCBs in Great Lakes fish. The Food and Drug Administration has issued regulations that limit the amounts of contaminants allowable in fish sold interstate. Although not all Great Lakes fish exceed the FDA tolerances, the publicity about contaminants has harmed the image of the Great Lakes as a producer of wholesome fish products. The problem of contaminants is complex and available data indicates that its control will be difficult to achieve. This area is receiving continuing attention by the International Joint Commission concerned with water quality, the Great Lakes Fishery Commission, and Federal and State government organizations.

--The absence of reliable data on the volume of fish that can be harvested hampers efforts of commercial fishermen to obtain larger volumes of desirable species. Federal and State fishery officials and commercial fishing interests recognize that stock assessments have been inadequate. The commercial fishing interests hope that better stock assessments will influence the States to allocate stocks exceeding recreational needs to commercial fishermen.

FEDERAL ROLE IS LIMITED

The eight Great Lakes States have exclusive authority to manage U.S. Great Lakes fishing. Consequently, the

Federal role is limited to providing supportive services--research, stock assessment, sea lamprey control, hatcheries --and financial assistance.

Federal efforts have been directed toward both recreational and commercial fishing. These efforts have contributed significantly to the conservation and restoration of fish stocks, alleviation of the sea lamprey problem, and the pursuit of new uses for underutilized species.

Because stock assessments have not been adequate, increased Federal assistance to improve stock assessments may provide the States with data needed to determine optimum sustainable yield. This would provide the States with a basis to determine whether more fish and, in some cases, more species could be allocated to commercial fisheries. The knowledge gained from continued Federal research on harvesting and using underutilized species may encourage commercial fishermen to expand their harvests with minimal effect on the recreational fishery. Vigorous identification and control of the sources of contaminants by Federal agencies, in coordination with the States, will help to overcome the problems of contaminants in Great Lakes fish.

Because the States control the fisheries in their respective waters, Federal efforts alone cannot assure the course or future of commercial fishing in the Great Lakes.

FUTURE NOT BRIGHT FOR COMMERCIAL FISHING INDUSTRY

There is little potential for increasing the number of commercial fishermen or substantially increasing the commercial harvest. Commercial fishermen depend heavily on the State's willingness to allocate fish resources to them and are strongly affected by contamination of certain species.

State and Federal efforts to rebuild the Great Lakes fish resource through stockings have yet to result in significant natural reproductions and the States will not allow significant commercial harvest of these high-value species. Improved stock assessment may be an answer, but this does not guarantee commercial fishermen an increased allocation of highly valued species.

As discussed in chapter 5, aquaculture in the Great Lakes does not seem a feasible alternative to traditional

fishing methods. The use of pens or cages in the open lake waters is not feasible because the rough waters would destroy the enclosures and would interfere with industrial navigation and recreational boating and fishing. Further, aquaculture would face contamination problems, a short fish growing season, and wide variances in water temperatures.

NMFS and FWS officials believe that the future of commercial fishermen may be in a combination of (1) an increase in the harvest of high-valued species--assuming improved stock assessment will convince States to allocate quotas of yellow perch, walleye, and the lake trout--and (2) harvesting and marketing currently underutilized species, such as suckers, sheepshead, and burbot. The expansion of the industry into underutilized species may take many years and will require the adoption of new harvesting methods and development of new products and markets.

The commercial fishermen are not enthusiastic about harvesting underutilized species because of their low value. They want to continue harvesting the species for which the higher prices per pound are received rather than harvesting large quantities of low-value, underutilized species. Fishermen who indicated they would consider harvesting underutilized species said they would do so if the market prices were favorable.

Both State and Federal officials told us that the number of commercial fishermen will probably not increase because of the recreational fishery and fish contamination. The Director, Northeast Regional Office, NMFS, believed that:

--The total number of fishermen will decline or stabilize with State implementation of limited entry programs designed primarily to phase out casual fishing operations.

--Changes in harvesting methods will require less staffpower in the production sector.

--Employment in the processing and marketing sector may increase with the expected development of processed products from underutilized species and the rising trend toward custom retail markets.

In essence, the future of the Great Lakes commercial fishery depends on the extent to which States want to develop and maintain a viable commercial fishery. Federal assistance geared to meet the requirements of State commercial fishery programs will help to improve the fishery.

APPENDIX I

NINETY-FOURTH CONGRES

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U.S. House of Representatives
Committee on
Merchant Marine and Fisheries
Room 1334, Longworth House Office Building
Washington, D.C. 20515

November 19, 1975

The Honorable Elmer B. Staats
Comptroller General
General Accounting Office
441 "G" Street, N.W.
Washington, D.C. 20548

Dear Mr. Staats:

For some time, we and other Members of our full Committee and especially of our Subcommittee on Fisheries and Wildlife Conservation and the Environment have been concerned with the plight of the U.S. fishing industry and believe we must seriously consider what measures might be taken to revitalize the industry.

The GAO Report entitled "The U.S. Fishing Industry Can be Strengthened by Developing Underutilized Fish Resources" (May 1975) points out that ". . . the development of the vast underutilized fish resources into commercially viable fisheries . . . ." would have numerous benefits. The supply of fish products available to the consumer would be increased, our reliance on imported fish would be decreased, exports would be increased, and new fisheries would be provided as alternatives for those fishermen involved in fisheries where excess harvesting capacity now exists.

The GAO Report entitled "Need to Establish Priorities and Criteria for Managing Assistance Programs for U.S. Fishing Vessel Operators"(February 1975) recommended redirection of certain financial assistance programs administered by the Department of Commerce toward modernizing segments of the U.S. fishing fleet to enable it to compete effectively with foreign fleets.

Spurred by a sense of urgency to control the increased foreign fishing in waters off the United States, Congress is now likely to enact some form of extended fisheries jurisdiction by late 1975 or early 1976. The advent of extended jurisdiction presents new opportunities for development of the domestic fishing industry. It calls for a reassessment of the Government's role in assisting industry to take advantage of the potential presented and assure optimum utilization of our resources in the national interest.

As enunciated in Senate Concurrent Resolution 11 (1973), ". . . it is the policy of the Congress that our fishing industry be afforded all support necessary to have it strengthened, and all steps be taken to provide adequate protection for our coastal fisheries against excessive foreign fishing."

In response to recommendations of the National Advisory Committee on Oceans and Atmosphere in both 1972 and 1973, NOAA's National Marine Fisheries Service is finalizing a National Plan for Marine Fisheries which considers problems, issues, and possibilities for action and which sets broad goals for all interested entities in designing the future of the marine fisheries of the United States. That plan considers only in general terms the role of Government in expanding and developing the utilization of available fishery resources to provide a strong competitive U.S. fishing industry.

Other involved agencies are also addressing alternatives for management and allocation of fisheries resources in the extended jurisdiction zone. For example, the Congress' Office of Technology Assessment is presently engaged (at the request of this Committee, the Senate Commerce Committee, and the Senate National Ocean Policy Study) in an ambitious examination of present and future impacts of technology in U.S. fisheries, with special consideration of implications of an extended fisheries jurisdiction.

It is apparent from all these sources that ample opportunities do exist for strengthening the American fishing industry, but they remain to be translated into specific requirements for future industry and Government action. We are, therefore, requesting that GAO undertake

a study to delineate policy issues, options, and costs of revitalizing the U.S. commercial fishing industry. However, the study should not include aquaculture as this will be the subject of separate consideration by the Committee. We intend to use your study in formulating comprehensive legislation for development and utilization of our fish and shellfish resources and in formulating a National Fisheries Policy. We want the GAO study to serve two broad functions:

1. Provide an objective analysis of a number of areas where present programs may be inadequate or non-cost-effective, or where additional programs are needed. For example, deficiencies in the following areas might constitute limiting factors or "weak links" contributing to present difficulties in the industry:

a. adequacy of the biological knowledge base and fisheries research efforts to improve it;

b. adequacy of present fisheries regulations and management -- both for assuring wise conservation and use of the resource and for assuring an industry structure which permits a fair and equitable rate of return on investment of participating fishermen;

c. education and manpower -- the adequacy of the work force to provide the necessary skills now and in the future which can support a modern, competitive fishing industry in the United States;

d. adequacy of available statistical, economic, and market analysis data and the industry and Government capabilities for providing needed information of these kinds in a timely fashion;

e. adequacy and cost-effectiveness of financial assistance programs available to various segments of the fishing industry.

2. Clarify the roles of Government and of the private sector in the structure and functioning of the various sectors of what we collectively refer to as the American fishing industry. We are interested both in the present separation of responsibilities and roles as well as in clear indications of where new or additional federal

involvement is necessary or desirable if the revitalization of the industry is to occur quickly and efficiently.

To assist you in designing your study to serve the two broad functions just enumerated, we offer these following questions as examples of our information needs and concerns. They are intended only to further convey the sense of what we need to know, and not to constitute a list of itemized contractual obligations from GAO in this study.

-- What national benefits accrue from a strong American fishing industry? What is the industry's contribution to the national and regional economies? To the national food supply?

-- Where do opportunities lie for effective restoration and growth of the American fishing industry? What resources are available geographically and within what industry sectors?

-- How will the areas [supra] for potential growth and development be affected by extended jurisdiction? What areas were not affected?

-- What obstacles inhibit industry growth and development? What are the present institutional barriers to industry growth (e.g., regulations, labor, etc.)? Technology lag?

-- Can the U.S. harvesting sector compete with foreign interests even with extended jurisdiction? What is the impact of foreign subsidized fisheries on the competitive position of the U.S. industry? What is the impact of Government subsidies of selected food commodities on the competitive position of fish products in the marketplace? What type of financial assistance, if any, should the Government provide to strengthen the competitive position of fish products?

-- What forms of assistance to the industry might be justified? What is the Government role in processing and marketing of seafood? Is the present industry structured to effectively do more on its own? For example, should it do more marketing and processing and/or research and development? If so, how might this work be financed?

-- What can Government do to stimulate greater leadership in the American fishing industry, either cooperatively or independently, that will result in a stronger and more competitive position in World fisheries? What Government programs can be considered to strengthen the U.S. fishing industry? If possible, identify the costs and benefits of such Government programs.

To the extent possible, the assessments you make and the findings you reach should be formulated in your report so that various Government and industry actions necessary to strengthen the U.S. fishing industry are considered; present Federal programs are evaluated for cost-effectiveness; necessary investment and operating costs of securing for our fishing industry a competitive position in U.S. and World markets are estimated, if possible (together with recommended sources of funding); and appropriate Federal roles in recommended programs of action are suggested. Please identify to the extent practicable whatever new or modified legislation you find is needed to accomplish the purpose of strengthening our domestic and distant water fisheries operations.

Finally, it is our desire and intent that your research and analyses not be unnecessarily duplicative of efforts past or present of the National Marine Fisheries Service, the Office of Technology Assessment or any others. The National Marine Fisheries Service has a great deal of information and personal expertise which is critical to the successful completion of this GAO study. Director Schoning has personally assured us of his readiness to provide data and data analyses in support of your work, and to cooperate with you however he can. Mention has already been made of the on-going OTA study and technology assessment. We suggest that you consult freely with both these agencies and through joint meetings, as you deem desirable and necessary, arrange for the sharing of information and assistance so as to avoid duplication and best prepare the report we

APPENDIX I

seek. Because analysts in the Congressional Research Service of the Library of Congress are routinely involved in assisting this Committee and other Congressional Committees having interests in the area of marine fishing and the fishing industry, we also suggest you may wish to maintain liaison with the Congressional Research Service, as appropriate, during the course of your study. Since we recognize this is a broad and still somewhat loosely defined set of tasks, we know periodic meetings with us and our staff will be valuable in assuring continued agreement on this assessment and the character of your final product. We want to have your study results, if possible, no later than September 1, 1976.

It is recognized that the Great Lakes offers the potential for sustaining a substantial fishery. Accordingly, though it is generally understood that the initial thrust of your efforts will be in the saltwater regions, it should also be understood that as resources become available and before dispersement of your study team, a similar assessment of opportunities for revitalization of the Great Lakes commercial fisheries will be undertaken. The Great Lakes study, we agree, may be submitted independent of and subsequent to the target date for completion of the main study but, hopefully, no later than March 1, 1977.

Sincerely,

Leonor K. Sullivan, Chairman
Committee on Merchant Marine
and Fisheries

Philip E. Ruppe
Ranking Minority Member

Robert L. Leggett, Chairman
Subcommittee on Fisheries
and Wildlife Conservation
and the Environment

Gavin B. Forsythe
Ranking Minority
Subcommittee Member

APPENDIX II

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

COMMUNITY AND ECONOMIC
DEVELOPMENT DIVISION

IN REPLY
REFER TO: CED7-244

MAR 16 1977

The Honorable Philip E. Ruppe
House of Representatives

Dear Mr. Ruppe:

Your letter dated February 25, 1977, elaborated on areas of interest to you in the GAO study of the Great Lakes fisheries, which is being made for the House Committee on Merchant Marine and Fisheries. Members of my staff met on March 10, 1977, with Chairman Robert L. Leggett, George Mannina, Legislative Assistant, John Bruce, Minority Staff, and Jeff Cook, Staff Member to discuss your interests in greater detail.

Ir light of that discussion, we plan to

--provide historical data on the Great Lakes fisheries,

--develop information on the present management of the Great Lakes fishery stocks and identify additional information that may improve the management,

--evaluate current Federal involvement in the Great Lakes fisheries and identify additional Federal efforts that might be taken to assist (1) the States in managing the fisheries and (2) the industry directly,

--assess the possibility for a Great Lakes aquaculture program, and

--develop information on the Great Lakes Canadian fishing industry.

Work will be performed in the eight Great Lakes States, at appropriate Federal agency locations, and in Canada. We expect to be able to provide a report by October 1, 1977. If you have any questions regarding this approach, please contact our Task Force leader, Mr. J. P. Glick (443-8691).

Sincerely yours,

Henry Eschwege
Director

cc: Mr. Mannina

GREAT LAKES WATER SURFACE AREA

State	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario	Total	Percent
	(square miles)						
Michigan	16,231	13,037	8,975	216	-	38,459	63.8
Wisconsin	2,675	7,387	-	-	-	10,062	16.7
New York	-	-	-	594	3,033	3,627	6.0
Ohio	-	-	-	3,457	-	3,457	5.7
Minnesota	2,212	-	-	-		2,212	3.7
Illinois	-	1,526	-	-	-	1,526	2.5
Pennsylvania	-	-	-	735	-	735	1.2
Indiana	-	228	-	-	-	228	0.4
Total U.S. surface	21,118	22,178	8,975	5,002	3,033	60,306	64.0
Total Canadian surface	11,120	-	13,900	4,940	3,920	33,880	36.0
Total Great Lakes surface	32,238	22,178	22,875	9,942	6,953	94,186	100.0

APPENDIX III

APPENDIX IV

REASONS FOR DECLINES IN FISH STOCKS

Species	Lakes	Reason(s) for decline
Atlantic salmon	Ontario	Deterioration and blockage of streams and exploitation
Sturgeon	All	Exploitation and destruction of spawning streams
Lake trout	All	Exploitation and, except for for Lake Erie, also sea lamprey
Northern pike	Erie, Ontario, and Huron	Destruction of spawning areas and exploitation
Lake herring	All	Exploitation, environmental changes, and competition with introduced species
Burbot	All	Sea lamprey and environmental change
Chubs	All	Exploitation, competition with introduced species, and sea lamprey
Sauger	Huron and Erie.	Environmental change and exploitation
Walleye	All	Enviromental changes, exploitation, and destruction of spawning streams
Blue pike	Erie and Ontario	Environmental changes and exploitation
Whitefish	All	Environmental changes, exploitation, and sea lamprey
Yellow perch	Erie, Huron, and Michigan	Competition with introduced species, exploitation, and environmental changes

EXPLOITATION

The lake sturgeon was one of the first species affected by intensive exploitation. These large fish were abundant in all lakes before 1900 and frequently damaged gear used to fish for more valuable species. Because of this, lake sturgeon were extensively fished, often to be killed and thrown back in the lake or left to rot on the beach.

Commercial exploitation helped to deplete both lake herring and whitefish stocks. Historically, the lake herring had been the most productive specie in the Great Lakes, frequently contributing up to one-half of the catch. Before the collapse of the herring fishery, recorded catches were sometimes greater than 20 million pounds annually in Lake Erie and ranged as high as 49 million pounds for all lakes. This heavy exploitation, as well as interactions with environmental changes, are the probable causes of the collapse of the herring fishery.

The whitefish, a preferred and heavily exploited species in the early days of the Great Lakes fishery, suffered stock declines as early as the 1860s. However, the first collap e was recorded in the late 1920s when the deep trap net was introduced into the Lake Huron fishery. The whitefish was extremely vulnerable to this new equipment because of certain behavioral characteristics. Subsequently, the invading sea lamprey contributed to additional depletion of the whitefish.

MARINE INVADERS

The sea lamprey invaded the three upper Great Lakes in the late 1930s. The lamprey selectively attacked the native predatory species and caused a collapse in their stocks.

The lamprey first depleted the lake trout and other deepwater predator stocks. Chubs, normally prey for predator fish, became a valued commercial fishery and a prey for the lamprey. Large chubs were depleted by the lamprey, while the slow growing chubs were exploited by a new trawl fishery and the conventional gill net fishery. This situation was conducive to the growth of a small marine fish--the alewife--which had long been established in Lake Ontario. Like the lamprey, it probably gained access to Lake Erie and the other lakes through the Welland Canal, which bypasses Niagara Falls. Because the predator stock became depleted, the alewife population increased and soon dominated the fish stocks in

lakes Huron and Michigan, adversely affecting competing species. An alewife fishery, limited to Lake Michigan, was developed in the early 1960s for this tremendously abundant but low-value specie.

ENVIRONMENTAL CHANGES

Environmental changes have also had adverse impacts on fish stocks. For example:

--Construction of dams have blocked spawning streams, preventing the spawning of Atlantic salmon in Lake Ontario.

--Destruction of spawning areas through draining of swamps (marshlands) has depleted northern pike stocks in lakes Erie, Ontario, and Huron.

Deterioration of water quality has probably had some adverse effect on fish stocks, but the extent of the effect is not known.

STATISTICS ON GREAT LAKES

COMMERCIAL HARVESTS

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a/Chubs included with lake herring through 1949.

b/Beginning with 1944, the catch by Indiana fishermen in Michigan waters is included in the Michigan catch.

c/Lake Michigan is wholly within U.S. waters.

APPENDIX V

TABLE 1--U.S. GREAT LAKES CATCH B

Year	Blue Pike	Carp	Catfish	Chubs (note a)	Lake Herring (note a)	Lake Trout	Lake Whitefish	Sauger	Sheepshead
1879	-	-	-	-	15,716	6,805	-	-	-
1885	-	-	-	-	24,662	12,587	(1)	5,466	-
1889	-	-	-	-	53,110	11,202	15,162	-	-
1890	-	-	-	-	49,959	12,889	-	4,180	-
1893	-	-	-	-	-	16,183	-	-	-
1897	4,901	(-)	-	-	49,140	12,949	6,605	4,907	-
1899	4,732	3,666	-	-	64,771	10,418	5,863	3,067	1,363
1903	4,975	4,123	-	-	39,651	16,274	5,037	2,014	731
1908	6,634	9,788	-	-	49,218	12,937	6,806	2,557	1,489
1914	11,898	-	-	-	37,655	9,913	5,274	4,561	-
1915	18,800	-	-	-	38,605	10,898	4,031	4,523	-
1916	9,431	-	-	-	30,463	9,994	4,692	6,181	-
1917	1,627	7,193	-	-	46,720	11,027	5,662	4,334	-
1918	1,272	-	-	-	63,720	10,793	5,476	2,095	-
1919	1,783	-	-	-	40,516	12,407	4,243	2,652	2,150
1920	4,000	-	-	-	30,600	10,253	3,275	2,926	1,984
1921	9,006	-	-	-	28,449	15,302	3,365	5,004	2,905
1922	10,436	5,837	-	-	28,125	11,579	3,948	3,409	1,415
1923	9,817	-	-	-	34,136	9,942	3,467	3,312	1,621
1924	9,076	-	-	-	37,055	11,230	3,480	1,829	2,340
1925	10,513	-	-	-	26,711	11,238	3,796	2,119	2,429
1926	9,262	-	-	-	23,859	11,559	5,018	1,551	1,325
1927	7,323	-	-	-	30,996	10,493	5,386	1,164	4,360
1928	4,843	-	-	-	20,427	9,425	6,371	1,554	2,933
1929	2,834	2,006	-	-	25,936	10,544	7,767	1,589	2,981
1930	11,823	3,284	-	-	29,261	9,684	10,123	1,747	2,906
1931	12,680	4,145	-	-	21,947	10,691	10,629	2,230	1,635
1932	9,948	4,267	-	-	16,098	10,735	9,594	3,225	2,161
1933	9,313	3,964	-	-	18,566	9,691	7,465	2,302	3,024
1934	8,509	3,970	-	-	31,306	9,922	6,102	837	2,255
1935	312	4,107	-	-	29,419	10,099	5,140	1,772	2,374
1936	19,937	4,958	-	-	27,190	9,446	4,053	1,780	3,520
1937	11,021	5,142	-	-	27,667	9,429	3,160	1,220	4,069
1938	8,719	4,484	-	-	27,204	9,360	3,239	846	3,417
1939	9,151	5,790	-	-	26,149	9,792	3,905	1,742	3,523
1940	5,074	5,873	-	-	25,048	9,897	4,589	614	2,994
1941	3,385	5,376	-	-	25,093	10,536	4,649	774	3,702
1942	6,262	4,998	-	-	21,114	10,174	4,132	1,351	4,631
1943	11,273	5,051	-	-	20,695	10,375	3,263	1,053	4,648
1944	14,949	4,316	-	-	20,096	10,605	3,225	621	2,534
1945	7,849	6,460	-	-	26,957	8,980	3,489	1,050	4,546
1946	3,140	4,839	1,040	-	31,730	7,457	4,859	769	4,383
1947	3,379	4,130	1,062	-	24,293	5,402	11,594	393	3,309
1948	9,122	4,171	872	-	30,931	4,155	12,217	252	3,737
1949	14,056	4,568	1,062	-	29,790	3,309	8,787	390	3,128
1950	6,237	4,209	1,174	9,414	17,646	3,242	5,141	488	2,328
1951	2,402	5,054	1,520	10,529	20,333	2,924	2,718	397	3,616
1952	7,239	5,759	1,835	11,261	23,566	2,844	3,671	205	3,577
1953	5,102	5,467	1,684	11,343	18,647	2,416	2,948	194	1,947
1954	6,361	6,543	2,144	10,999	20,974	2,257	2,283	78	1,752
1955	7,678	6,547	2,306	11,367	16,624	2,101	1,833	15	1,625
1956	6,868	6,503	2,007	11,430	16,390	1,813	1,462	13	1,957
1957	3,993	7,128	1,838	11,319	14,533	1,191	1,357	4	3,821
1958	581	8,344	1,765	12,107	12,336	1,061	618	1	2,842
1959	35	7,274	1,767	11,212	12,534	865	569	1	4,657
1960	12	7,343	1,902	16,853	11,111	384	781	3	5,157
1961	2	8,026	1,869	16,516	11,710	334	1,241	-	5,798
1962	1	7,646	1,805	14,428	10,058	258	1,002	1	3,553
1963	-	6,298	1,266	11,023	8,463	127	878	-	4,152
1964	-	5,272	1,315	7,217	6,270	102	1,387	1	4,571
1965		6,652	1,137	10,920	4,440	124	1,624	1	4,105
1966	-	7,263	910	9,992	4,576	120	1,940	4	2,173
1967	-	6,574	769	11,314	3,630	202	1,601	-	2,569
1968	-	6,100	873	11,127	3,663	274	1,704	-	3,152
1969	-	6,508	861	10,155	2,321	244	2,324	-	2,074
1970	-	6,583	756	10,977	1,364	275	2,353	-	1,059
1971	-	7,286	996	7,523	1,190	279	3,729	-	849
1972	-	5,493	940	6,655	885	295	4,412	-	924
1973	-	6,389	582	5,488	942	262	4,422	-	1,164
1974	-	7,056	544	4,987	541	365	4,369	-	714
1975	-	6,732	561	2,444	713	476	4,517	-	973

See footnotes on p. 71.

APPENDIX V

L CANADIAN CATCH, VARIOUS YEARS, 1879-1975
s of Pounds)

Suckers	White Bass	Yellow Perch	Yellow Pike (Walleye)	Coho Salmon	Miscellaneous	Total United States	Total Canada	Total United States and Canada
-	-	-	-	-	44,370	66,891	9,347	76,238
-	-	-	-	-	54,938	97,623	23,668	121,290
3,883	-	8,541	-	-	23,677	115,575	28,362	143,937
-	-	7,021	-	-	37,501	111,550	28,646	140,196
-	-	7,932	-	-	83,467	107,582	26,629	134,211
-	-	8,100	-	-	8,328	94,930	20,541	115,470
-	1,579	9,847	3,941	-	10,177	119,424	26,107	145,530
7,911	33	7,007	3,788	-	3,236	94,185	18,839	113,024
6,901	222	6,611	3,983	-	3,969	113,315	24,473	137,789
-	478	5,790	2,498	-	25,140	103,407	31,731	135,138
-	694	6,118	3,194	-	24,724	111,587	38,279	149,865
-	343	5,702	3,188	-	19,091	89,085	32,900	121,987
6,918	333	4,259	2,992	-	6,374	97,439	37,798	135,237
-	129	3,972	2,902	-	15,822	106,181	39,187	145,367
-	193	6,608	2,135	-	12,713	85,400	30,546	115,947
-	504	4,391	1,873	-	13,165	73,168	31,680	104,848
-	841	5,262	1,948	-	15,659	87,741	29,883	117,625
4,793	821	3,592	3,677	-	3,475	81,107	32,020	113,127
-	300	3,517	2,119	-	10,054	78,285	34,148	112,433
-	182	3,626	1,702	-	7,449	77,969	34,492	112,461
-	232	4,509	2,030	-	10,009	73,586	26,466	100,050
-	158	5,385	2,218	-	12,747	73,182	24,718	97,900
-	121	4,976	2,367	-	12,318	79,508	27,847	107,354
-	287	5,764	2,318	-	8,135	62,027	27,015	89,040
5,866	155	7,972	1,737	-	1,757	71,174	27,216	98,388
6,687	484	6,567	3,100	-	1,942	87,412	28,354	115,765
6,529	418	11,109	3,559	-	1,683	87,341	27,092	114,431
6,195	253	11,421	-	-	5,350	79,370	24,945	104,313
5,532	395	4,911	3,018	-	1,961	70,751	23,703	94,454
5,563	685	16,071	3,159	-	1,550	90,880	25,269	116,149
5,826	739	11,849	3,494	-	1,693	87,011	29,132	116,143
5,675	664	5,797	-	-	6,388	90,570	27,794	118,363
5,707	435	4,846	-	-	6,677	81,001	30,098	111,099
4,820	735	7,957	4,588	-	1,709	79,299	28,929	108,228
4,457	715	5,304	6,495	-	1,706	82,720	27,509	110,229
4,267	469	6,173	5,498	-	1,883	76,588	21,770	98,358
4,135	459	6,699	4,494	-	2,332	76,429	20,935	97,365
4,312	516	5,211	6,112	-	1,592	68,261	19,206	87,466
4,439	460	5,403	4,969	-	1,367	81,968	23,140	105,108
4,114	860	5,696	4,754	-	1,206	83,483	27,660	111,144
4,658	884	3,266	6,201	-	875	68,906	26,502	95,408
4,215	823	4,517	7,472	-	795	68,623	24,147	92,771
3,565	497	3,512	4,795	-	932	79,663	30,353	110,017
3,681	493	4,894	4,920	-	881	75,525	36,949	112,473
3,557	807	4,574	6,662	-	910	79,748	39,866	119,614
2,963	1,142	4,548	7,060	-	965	75,207	38,572	113,778
2,912	1,036	4,343	6,419	-	877	78,948	52,218	131,165
2,679	897	4,199	5,613	-	773	74,041	43,743	117,783
2,370	1,324	6,116	6,661	-	785	68,897	38,405	107,303
2,224	3,361	8,042	5,914	-	823	63,464	40,098	103,562
2,027	2,973	6,555	6,937	-	883	65,936	37,918	103,854
1,555	2,404	10,799	7,085	-	941	67,140	45,368	112,508
1,507	1,421	11,948	5,425	-	834	61,850	58,534	115,384
1,441	949	10,915	4,293	-	826	55,823	42,794	98,617
1,389	825	11,710	1,950	-	742	53,559	34,045	87,604
1,551	1,806	10,223	1,427	-	565	54,156	43,579	97,735
1,441	2,212	9,324	985	-	565	67,726	47,813	115,539
1,292	1,409	11,995	673	479	628	81,956	44,836	126,792
1,096	1,174	11,255	1,022	-	730	67,324	47,219	114,543
951	1,542	8,291	682	-	492	66,969	55,579	122,548
794	1,113	5,490	573	-	979	70,390	40,167	110,557
941	1,224	6,141	435	-	938	62,824	38,106	100,930
859	1,099	5,778	556	1,484	904	58,428	38,782	97,210
836	729	5,267	554	1,999	953	66,657	47,886	114,543
1,168	1,221	4,906	339	1,444	1,215	76,990	47,854	124,844
1,324	1,103	4,272	86	2,243	1,312	60,657	40,429	101,086
1,708	1,001	4,018	65	5				
733	776	3,342	98	2				
1,054	2,430	3,005	94	1				
889	2,918	3,950	120	-				
592	1,699	3,036	133	1				

APPENDIX V

TABLE 2--U.S. LAKE ONTAR

Year	Blue Pike	Carp	Catfish	Chubs (note a)	Lake Herring (note a)	Lake Trout	Lake Whitefish	Sauger	Sl
1879	-	-	-	-	621	57	1,064	-	
1885	-	-	-	-	404	21	91	-	
1889	-	-	-	-	1,050	-	23	-	
1890	-	-	-	-	599	41	149	-	
1893	-	-	-	-	165	8	45	-	
1897	49	-	-	-	46	3	142	-	
1899	187	1	-	-	47	15	162	-	
1903	61	4	-	-	121	4	25	-	
1908	100	5	-	-	35	12	56	-	
1913	39	1	-	-	85	7	16	-	
1914	39	1	-	-	174	14	21	-	
1915	39	1	-	-	232	31	27	-	
1916	50	1	-	-	164	14	38	-	
1917	22	1	-	-	351	44	116	-	
1918	50	-	-	-	206	20	101	-	
1919	108	3	-	-	141	24	76	-	
1920	35	-	-	-	144	14	44	-	
1921	62	17	-	-	1,521	25	109	-	
1922	77	32	-	-	514	34	106	-	
1923	34	262	-	-	59	35	130	-	
1924	109	22	-	-	394	45	134	-	
1925	3	1	-	-	47	10	111	-	
1926	22	15	-	-	142	61	179	-	
1927	22	15	-	-	122	45	166	-	
1928	24	15	-	-	342	44	116	-	
1929	14	14	-	-	414	61	97	-	
1930	31	26	-	-	144	24	87	-	
1931	37	35	-	-	81	24	67	-	
1932	81	44	-	-	73	24	55	-	
1933	227	6	-	-	42	20	40	-	
1934	153	17	-	-	126	24	84	-	
1935	136	24	-	-	147	7	41	-	
1936	28	17	-	-	223	-	53	-	
1937	60	88	-	-	124	13	57	-	
1938	59	138	-	-	42	17	56	-	
1939	102	411	-	-	59	24	104	-	
1940	123	464	-	-	98	24	111	-	
1941	98	84	-	-	22	9	60	-	
1942	40	52	-	-	24	4	21	-	
1943	45	68	-	-	56	4	26	-	
1944	66	16	-	-	104	4	57	-	
1945	77	185	-	-	29	1	33	-	
1946	128	26	-	-	17	1	44	-	
1947	209	16	2	-	41	1	21	-	
1948	119	21	-	-	50	-	9	-	
1949	86	21	1	-	46	-	2	-	
1950	47	3	-	11	2	-	21	-	
1951	252	10	-	39	9	-	33	-	
1952	468	14	-	9	3	-	23	-	
1953	60	13	-	17	1	-	32	-	
1954	116	11	-	1	1	-	10	-	
1955	30	12	-	1	1	-	12	-	
1956	13	9	-	-	2	-	13	-	
1957	12	17	-	-	2	-	12	-	
1958	5	32	1	-	2	1	11	-	
1959	3	14	1	1	3	-	6	-	
1960	5	11	2	-	9	4	20	-	
1961	-	49	3	-	2	-	59	-	
1962	-	39	2	-	3	1	27	-	
1963	-	36	2	-	5	-	31	-	
1964	-	59	1	-	6	-	16	-	
1965	-	22	1	-	8	-	14	-	
1966	-	18	1	-	3	-	2	-	
1967	-	22	3	-	2	-	2	-	
1968	-	44	4	-	2	-	-	-	
1969	-	70	2	-	3	-	1	-	
1970	-	22	1	-	1	-	1	-	
1971	-	55	3	-	-	-	-	-	
1972	-	28	2	-	-	-	-	-	
1973	-	14	-	-	1	-	-	-	
1974	-	14	4	-	-	-	-	-	
1975	-	-	1	-	-	-	-	-	

See footnote on p. 71.

APPENDIX V

ES AND TOTAL CANADIAN CATCH, VARIOUS YEARS, 1879-1975
(Thousands of Pounds)

Smelt	Suckers	White Bass	Yellow Perch	Yellow Pike (Walleye)	White Perch	Miscellaneous	Total United States	Total Canada	Total United States and Canada
-	-	-	-	-	-	1,395	3,640	3,238	6,878
-	-	-	-	-	-	1,882	2,398	4,204	6,602
-	74	-	85	-	-	653	2,692	4,833	7,525
-	279	-	359	-	-	2,019	3,446	4,089	7,535
-	48	-	138	-	-	533	928	3,670	4,598
-	53	-	169	5	-	414	921	2,753	3,674
-	264	-	397	10	-	1,187	2,310	2,761	5,071
-	73	-	122	8	-	655	1,073	2,682	3,754
-	128	-	35	54	-	390	817	3,199	4,016
-	9	-	4	4	-	23	208	3,153	3,361
-	16	-	6	5	-	20	296	4,024	4,320
-	23	-	7	5	-	19	384	4,787	5,170
-	17	-	4	5	-	27	344	5,253	5,597
-	13	-	5	5	-	55	628	5,600	6,228
-	20	-	3	12	-	50	464	5,103	5,567
-	40	-	3	8	-	99	544	5,504	6,048
-	17	-	4	9	-	49	330	4,988	5,318
-	20	-	10	23	-	127	1,914	4,577	6,491
-	20	-	8	36	-	138	965	4,532	5,497
-	24	-	9	52	-	136	841	4,947	5,788
-	92	-	9	38	-	151	993	4,975	5,968
-	40	-	9	29	-	104	446	4,250	4,696
-	66	-	34	22	-	194	788	4,116	4,905
-	62	-	34	19	-	228	698	3,731	4,429
-	71	-	45	20	-	175	854	3,477	4,330
-	62	-	36	11	-	226	948	3,610	4,557
-	51	-	30	16	-	228	682	4,021	4,703
-	29	-	24	9	-	177	442	2,869	3,310
-	36	-	27	12	-	165	521	2,532	2,754
-	23	1	35	7	-	134	527	2,551	3,078
-	47	-	21	25	-	200	717	2,231	2,948
-	51	-	60	18	-	246	770	2,723	3,493
-	38	-	55	9	-	174	601	3,126	3,727
-	49	-	49	4	-	176	618	3,330	3,948
-	129	5	58	2	-	187	690	3,068	3,758
-	54	1	33	6	-	154	1,456	3,495	4,951
-	35	-	36	6	-	175	1,359	3,022	4,381
-	52	-	48	3	-	175	597	3,126	3,724
-	19	-	23	2	-	93	325	2,488	2,813
-	45	-	32	3	-	118	396	2,311	2,707
-	33	-	28	4	-	94	400	2,637	3,037
-	29	-	36	3	-	130	492	2,338	2,830
1	14	-	34	4	-	125	384	2,059	2,442
-	23	-	25	4	-	122	464	2,002	2,465
-	18	-	42	2	-	126	386	2,045	2,431
4	27	-	18	2	-	143	351	2,006	2,357
-	8	1	3	-	-	93	189	2,219	2,408
7	22	-	18	1	-	116	498	2,410	2,908
3	19	-	9	-	-	116	668	2,281	2,950
7	2	3	4	-	-	54	196	2,059	2,256
5	15	35	4	1	-	111	511	1,714	2,225
5	6	31	11	2	-	124	233	1,943	2,176
3	9	21	7	1	-	103	180	2,627	2,807
-	8	4	12	-	-	146	206	1,997	2,203
1	18	6	35	2	1	170	263	2,098	2,361
-	14	4	24	1	2	143	226	2,051	2,277
-	12	8	37	1	1	137	258	1,958	2,216
-	19	8	68	1	1	136	351	2,109	2,460
-	16	9	23	14	4	95	233	1,748	1,981
-	11	4	52	2	6	84	233	2,008	2,241
1	13	4	59	3	3	96	267	2,015	2,282
-	6	1	68	5	16	78	217	2,646	2,863
-	10	1	16	4	100	85	237	1,624	1,861
-	9	-	12	1	146	87	284	1,832	2,116
-	4	-	14	1	205	164	342	2,009	2,351
-	5	-	14	1	95	138	294	2,272	2,566
-	6	1	19	-	111	171	333	2,905	3,238
3	2	-	31	-	84	124	305	2,906	3,211
5	6	-	69	1	45	126	292	2,347	2,829
5	8	2	64	1	84	144	300	2,356	2,656
7	6	-	49	1	91	159	324	2,364	2,688
19	2	-	61	1	35	112	233	2,777	3,010

APPENDIX V

TABLE 3--U.S. LAKE ERI

Year	Blue Pike	Carp	Catfish	Lake Herring (note a)	Lake Trout	Lake I
1879	-	-	-	11,774	26	3
1885	7,889	-	-	19,355	107	3
1889	-	-	-	37,201	67	3
1890	7,489	-	-	39,166	121	2
1893	-	636	-	21,062	[illegible]	1
1897	4,852	-	-	19,567	37	
1899	4,545	3,634	-	33,428	32	2
1903	4,915	3,547	-	8,794	15	
1908	8,734	8,893	-	10,599	7	1
1914	11,859	12,024	-	14,108	6	2
1915	18,761	9,615	-	15,978	16	1
1916	9,381	5,859	-	8,337	5	
1917	1,605	5,794	-	19,453	5	1
1918	1,222	4,172	-	35,291	21	1
1919	1,675	2,961	563	17,846	12	1
1920	2,965	4,102	557	12,893	2	1
1921	8,944	6,542	1,198	14,964	46	
1922	10,359	3,887	553	14,022	2	
1923	9,683	3,215	-	20,930	1	
1924	8,967	1,261	248	21,293	1	
1925	10,476	2,339	-	2,817	4	
1926	9,340	4,204	-	1,449	3	
1927	7,301	1,696	-	2,350	9	
1928	4,819	1,031	221	618	1	
1929	2,620	983	215	128	1	1
1930	11,792	1,898	178	346	5	1
1931	12,643	2,404	118	346	3	1
1932	9,867	2,913	264	160	10	1
1933	8,786	2,067	-	136	4	
1934	8,356	1,609	-	110	1	
1935	9,686	1,950	437	72	-	
1936	19,909	2,667	-	68	2	1
1937	10,961	2,153	-	64	3	
1938	8,659	2,209	-	810	-	
1939	9,049	2,445	-	717	-	2
1940	4,951	2,486	-	62	-	2
1941	3,287	2,555	-	48	-	2
1942	6,222	2,448	-	25	2	1
1943	11,228	2,232	-	26	-	
1944	14,933	1,932	-	98	-	
1945	7,772	2,153	-	2,765	-	
1946	3,012	1,881	695	6,638	-	
1947	3,120	1,765	730	1,177	-	1
1948	9,003	1,596	653	213	-	2
1949	14,000	2,234	867	88	-	3
1950	6,198	1,879	990	246	-	1
1951	2,150	2,231	1,283	150	-	
1952	6,771	3,002	1,523	56	-	1
1953	8,042	2,476	1,351	64	-	1
1954	6,245	3,756	1,879	100	-	
1955	7,643	3,308	1,947	34	-	
1956	6,655	3,425	1,660	59	-	
1957	3,991	3,766	1,554	23	-	
1958	576	4,580	1,472	14	-	
1959	32	4,015	1,429	16	-	
1960	7	4,532	1,614	12	-	
1961	2	4,699	1,626	6	-	
1962	1	4,764	1,127	5	-	
1963	-	3,336	1,090	1	-	
1964	-	2,909	1,164	1	-	
1965	-	3,191	993	1	-	
1966	-	3,702	743	-	-	
1967	-	3,042	655	-	-	
1968	-	2,663	759	-	-	
1969	-	3,020	736	-	-	
1970	-	3,401	529	-	-	
1971	-	3,376	628	-	-	
1972	-	3,251	684	-	-	
1973	-	2,393	254	-	-	
1974	-	3,110	310	-	-	
1975	-	3,221	274	-	-	

See footnote on p. 71.

AND TOTAL CANADIAN CATCH, VARIOUS YEARS, 1879-1975
(Thousands of Pounds)

Sheepshead	Smelt	Suckers	White Bass	Yellow Perch	Yellow Pike (Walleye)	Miscellaneous	Total United States	Total Canada	Total United States and Canada
-	-	-	-	-	-	13,953	79,087	1,560	80,647
-	-	-	-	1,601	2,705	10,802	51,457	7,686	59,142
-	-	1,072	-	3,830	-	18,069	63,563	9,626	73,189
-	-	-	-	2,900	2,152	6,875	65,224	8,424	73,648
-	-	1,361	-	2,595	-	15,987	43,136	9,412	52,548
-	-	-	-	3,253	1,529	1,035	35,954	8,654	44,607
1,147	-	1,628	1,579	3,340	1,845	2,514	58,912	10,063	68,975
642	-	877	33	873	947	945	23,937	5,403	29,340
1,394	-	1,810	222	1,756	2,733	2,215	42,466	10,746	53,212
2,262	-	1,350	478	2,039	1,867	1,437	54,144	17,130	71,274
2,212	-	1,124	694	1,933	1,635	1,937	59,773	16,540	76,313
2,384	-	1,321	343	1,637	2,032	2,784	41,195	12,622	53,818
3,013	-	1,058	333	1,259	1,619	2,399	42,649	18,780	61,429
2,982	-	911	129	1,068	820	1,148	51,479	19,495	70,974
2,11,	-	953	193	2,775	600	1,105	35,165	14,127	49,293
1,926	-	1,061	504	1,259	890	721	32,232	10,812	4,,044
2,842	-	1,420	841	2,192	1,038	764	46,717	16,409	63,126
1,370	-	991	821	1,926	2,265	506	40,898	17,685	58,583
1,456	-	1,038	300	1,870	1,137	946	44,377	17,772	62,149
2,289	-	684	182	1,941	1,020	227	40,273	18,976	59,249
2,365	-	905	232	2,458	1,431	913	26,644	10,997	37,640
1,214	-	1,045	158	2,622	1,273	1,237	25,057	8,750	33,807
4,318	-	1,142	121	2,748	1,364	952	23,795	10,067	33,862
2,918	-	1,319	266	4,275	1,314	478	19,762	10,294	30,056
2,970	-	1,293	155	6,043	934	480	18,646	11,259	29,905
2,886	-	2,024	464	4,341	1,859	687	29,584	12,680	42,264
1,626	-	1,416	418	9,062	2,644	821	34,800	13,807	48,606
2,145	-	1,321	253	9,741	2,024	743	33,761	12,733	46,494
3,007	-	1,525	394	3,434	1,181	1,370	25,120	10,231	35,351
2,241	-	1,024	685	14,218	1,345	945	32,096	11,500	43,598
2,351	-	1,086	739	9,045	1,764	615	30,297	14,429	44,726
3,501	-	946	664	2,051	2,637	1,389	36,749	11,953	48,702
4,059	-	1,103	435	1,750	3,060	1,476	26,925	14,664	41,590
3,392	-	756	727	5,187	3,135	969	27,619	14,501	42,120
3,494	-	1,008	712	1,608	4,767	1,025	28,663	14,263	42,927
2,960	-	714	469	3,030	3,872	1,148	22,944	9,767	32,711
3,646	-	698	459	3,821	2,910	1,420	22,063	8,950	31,013
4,548	-	698	516	1,959	2,972	1,471	24,131	10,037	34,168
4,513	-	576	460	1,253	3,222	1,610	27,115	14,483	41,598
2,452	-	456	860	2,738	3,496	1,237	28,837	15,255	44,092
4,405	-	426	883	1,352	5,319	1,613	28,631	18,949	47,580
4,265	-	432	821	2,685	6,219	914	29,121	18,925	48,046
3,230	-	568	497	1,797	3,914	848	19,818	12,334	32,152
3,676	-	469	498	2,640	4,021	694	26,502	14,926	41,428
3,085	-	634	807	2,659	5,314	692	34,249	19,093	53,342
2,299	-	650	1,141	2,554	5,465	476	23,982	16,866	40,848
3,593	-	558	1,036	2,526	5,682	429	20,921	13,144	34,065
3,555	1	627	897	1,738	5,147	471	25,351	17,417	42,768
1,924	-	352	1,317	3,418	6,162	438	27,347	23,389	50,736
1,730	-	361	3,298	4,835	5,219	453	28,340	28,912	57,252
1,614	-	256	2,931	2,408	5,795	465	26,796	30,285	57,080
1,924	-	269	2,368	7,054	6,130	543	30,744	44,682	75,426
3,795	2	328	1,424	8,593	5,335	442	29,706	37,105	66,811
2,816	1	244	942	7,061	3,961	429	22,575	30,751	53,326
4,608	15	249	815	9,346	1,615	238	22,433	31,597	54,030
5,098	28	250	1,779	6,390	1,171	315	21,258	29,219	50,477
5,764	16	330	2,192	3,694	805	424	19,563	35,698	55,261
3,524	74	261	1,390	7,548	433	530	19,660	44,464	64,124
4,126	306	224	1,153	5,822	600	372	17,238	34,233	51,471
4,549	446	240	1,535	1,520	565	422	13,354	25,381	38,735
4,086	3	197	1,110	3,157	437	346	13,524	35,096	48,620
2,156	9	187	1,222	4,063	354	259	12,698	41,426	54,124
2,560	3	177	1,099	3,365	511	200	11,615	37,770	49,385
3,145	1	141	729	3,734	514	202	11,920	39,415	51,335
2,060	2	173	1,219	3,369	283	191	11,050	48,027	59,077
1,047	2	123	1,102	3,025	74	243	9,546	31,755	41,301
840	2	129	1,000	2,644	55	166	8,842	29,076	37,918
917	2	153	771	1,919	91	131	7,920	30,182	38,102
997	-	123	2,424	1,883	69	115	8,281	39,829	48,110
693	6	114	2,913	2,376	113	190	9,826	38,607	48,433
854	13	87	1,692	1,912	127	303	8,484	30,549	39,033

APPENDIX V

TABLE 4--U.S

Year	Carp	Catfish	Chubs (note a)	Lake herring (note a)	Lake Trout	Lake Whitef
1879	-	-	-	247	2,085	2,701
1880	-	-	-	1,266	2,540	1,425
1881	-	-	-	4,109	2,181	2,392
1882	-	-	-	2,515	1,750	1,033
1883	-	-	-	3,405	2,816	1,625
1884	-	-	-	2,323	2,382	1,406
1885	-	-	-	4,299	3,105	1,578
1886	-	-	-	3,629	2,039	1,218
1887	-	-	-	5,085	1,875	946
1888	-	-	-	6,674	1,527	1,006
1889	-	-	-	5,519	1,292	866
1890	-	-	-	5,406	1,299	593
1891	6	-	-	4,996	1,460	646
1892	-	-	-	4,722	1,732	555
1893	-	-	-	7,314	1,608	758
1894	-	-	-	9,731	1,739	914
1895	37	-	106	6,997	1,724	937
1896	-	-	472	7,279	2,016	787
1897	-	-	1,[illegible]	5,243	1,987	675
1898	-	-	1,490	4,381	1,966	792
1899	-	-	1,156	5,945	1,831	1,133
1900	407	-	291	5,738	1,362	974
1901	176	-	292	4,999	1,050	782
1902	375	-	919	2,399	2,163	757
1903	14	-	75	2,397	1,365	1,393
1904	516	-	513	3,491	1,774	612
1905	-	-	24	7,674	1,798	1,919
1906	1,141	-	214	4,411	2,111	889
1907	643	-	742	5,044	2,614	1,102
1908	1,109	38	531	4,636	2,322	727
1909	1,721	[illegible]	525	3,387	1,220	647
1910	859	17	770	2,164	1,358	766
1911	1,169	31	344	4,396	1,928	1,401
1912	293	17	456	3,139	1,827	1,199
1913	492	40	375	2,879	1,395	1,352
1914	427	82	1,531	5,148	1,615	1,203
1915	414	118	1,564	4,311	1,685	1,723
1916	1,939	177	[illegible]	5,604	1,692	1,677
1917	283	163	77	2,709	1,598	1,469
1918	390	167	102	2,139	1,283	1,456
1919	666	62	513	4,757	1,729	2,579
1920	675	31	345	4,423	2,049	4,142
1921	1,011	31	643	2,511	2,165	4,603
1922	972	43	499	3,411	1,970	3,334
1923	1,023	36	447	4,336	1,576	2,869
1924	1,079	55	387	3,586	1,743	1,895
1925	772	98	353	3,482	1,400	1,442
1926	978	115	196	4,151	1,340	1,059
1927	631	135	192	5,429	1,270	558
1928	734	118	174	6,948	1,372	255
1929	644	245	148	3,803	940	188
1930	669	386	126	3,159	842	114
1931	759	397	80	2,408	728	95
1932	1,243	395	128	2,309	459	149
1933	1,151	325	221	1,273	363	195
1934	2,373	384	190	1,173	173	151
1935	1,669	254	40	1,462	16	248
1936	1,327	271	126	1,071	12	3,063
1937	1,459	193	159	1,636	4	2,978
1938	952	167	148	1,452	1	830
1939	1,152	162	83	1,748	-	114
1940	1,627	227	114	1,379	-	143
1941	1,637	303	63	1,792	-	166
1942	1,361	333	106	1,426	-	151
1943	1,432	256	248	1,226	-	91
1944	1,373	355	317	168	-	86
1945	1,219	338	301	121	-	80
1946	1,369	271	507	68	-	41
1947	2,212	266	1,343	46	-	32
1948	1,304	330	2,151	33	-	10[illegible]
1949	1,333	277	2,936	45	-	[illegible]38
1950	1,437	240	3,197	68	-	438
1951	1,637	176	2,360	24	-	[illegible]0
1952	1,647	172	1,975	17	-	11
1953	1,003	153	1,256	40	-	167
1954	1,443	146	1,347	43	-	178
1955	[illegible]32	166	807	16	-	17[illegible]
1956	[illegible]72	129	356	11	-	[illegible]0
1957	1,016	101	134	19	-	[illegible]0
1958	1,293	122	13	13	1	107
1959	1,224	226	12	-	-	[illegible]
1960	1,357	365	-	-	-	[illegible]0
1961	[illegible]00	254	4	-	-	[illegible]4
1962	[illegible]00	326	-	-	-	16
1963	[illegible]04	272	-	-	-	[illegible]
1964	[illegible]24	253	-	-	-	[illegible]0

See footnotes on p. 71.

APPENDIX V

BY SPECIES AND TOTAL CANADIAN CATCH, VARIOUS YEARS, 1879-1975
(Thousands of Pounds)

Shad	Smelt	Alewife	Suckers	White Bass	Yellow Perch	Yellow Pike (Walleye)	Miscellaneous	Total United States	Total Canada	Total United States and Canada
	-	-	-	-	-	-	2,172	7,205	4,197	11,402
	-	-	-	-	-	-	6,226	11,457	10,136	21,593
	-	-	1,007	-	2,417	-	3,324	15,429	11,720	27,149
	-	-	1,110	-	1,818	-	2,104	10,330	14,190	24,520
	-	-	1,036	-	1,295	1,859	666	12,702	12,219	24,921
	-	-	1,836	-	1,828	1,405	511	11,776	14,691	26,467
	-	-	2,345	-	1,752	1,099	637	14,816	11,312	26,128
	-	-	2,971	-	2,029	1,989	598	14,677	9,938	24,615
	-	-	3,365	-	1,771	1,038	470	14,470	9,501	23,971
	-	-	1,387	-	1,593	930	524	13,541	9,127	22,668
	-	-	1,600	-	1,599	1,388	628	12,393	6,752	19,145
	-	-	1,317	-	2,246	1,858	729	13,448	8,030	21,478
61	-	-	1,383	-	2,672	1,789	1,007	14,320	10,278	24,597
	-	-	1,710	-	3,566	983	883	14,151	7,452	21,603
	-	-	1,745	-	3,529	945	884	16,813	7,623	24,436
	-	-	2,814	-	2,652	1,359	794	20,003	8,047	28,050
47	-	-	3,525	-	2,413	2,406	774	18,566	8,341	26,907
	-	-	2,853	-	1,794	2,128	660	17,989	9,475	27,464
	-	-	3,458	-	1,864	1,668	1,037	16,895	8,227	25,122
	-	-	4,020	-	1,968	1,263	980	16,860	8,077	24,937
	-	-	3,646	-	2,125	1,221	861	17,821	7,247	25,068
8	-	-	1,871	-	1,259	870	271	13,075	7,642	20,716
	-	-	1,320	-	4,512	398	347	13,876	7,060	29,937
	-	-	1,580	-	2,323	416	296	11,258	6,816	18,074
	-	-	1,501	-	997	340	249	8,294	7,063	15,354
	-	-	2,306	-	1,371	1,067	395	10,245	8,735	18,980
	-	-	2,266	-	1,795	846	890	17,212	9,395	26,607
18	-	-	1,485	-	891	1,147	286	12,577	7,765	20,342
	-	-	1,779	-	934	1,904	215	14,977	6,855	21,831
13	-	-	2,714	-	1,337	1,388	227	15,242	6,619	21,861
42	-	-	1,900	-	1,051	944	191	11,541	6,324	17,865
47	-	-	1,803	-	945	724	164	9,607	6,437	16,044
42	-	-	1,986	-	674	1,284	106	13,279	7,192	20,471
58	-	-	1,445	-	759	809	102	10,102	6,841	16,943
46	-	-	1,073	-	544	503	143	8,877	7,325	16,202
52	-	-	1,374	-	526	456	182	12,600	7,654	20,254
91	-	-	1,827	-	458	816	123	13,128	7,539	20,667
40	-	-	2,461	-	204	901	157	15,706	8,897	24,603
13	-	-	1,873	1	281	699	181	9,993	7,844	17,836
8	-	-	1,576	-	507	717	150	8,829	7,490	16,319
3	-	-	2,237	-	719	1,109	2 1	15,317	6,892	22,209
2	-	-	2,132	-	731	825	173	16,467	7,247	23,714
2	-	-	2,403	-	690	1,535	106	15,414	7,492	22,903
3	-	-	1,890	-	427	1,636	105	13,471	7,813	21,284
4	-	-	2,123	-	523	1,603	84	14,390	7,550	21,940
11	2	-	1,766	-	983	1,574	87	13,640	8,402	22,042
8	-	-	1,814	-	1,175	1,565	106	12,734	7,815	20,548
4	-	-	1,726	-	548	1,627	140	11,844	7,595	19,438
20	-	-	1,788	-	500	1,356	152	12,033	7,303	19,336
15	-	-	1,382	1	565	1,641	121	13,333	6,444	19,777
11	-	-	1,343	-	528	1,573	87	9,012	5,662	14,674
4	20	-	1,312	-	416	1,532	97	8,727	5,423	14,150
1	1	-	1,196	-	575	2,104	124	8,466	4,779	13,244
2	-	-	1,414	-	975	1,660	169	8,610	4,418	13,028
3	-	-	1,236	-	604	1,138	130	6,433	3,492	9,925
4	3	-	1,554	1	407	678	152	7,475	3,029	10,504
1	3	-	1,646	-	341	974	168	7,147	2,536	9,683
1	2	-	1,282	-	291	485	139	8,034	2,040	10,074
4	-	-	1,305	-	694	225	183	8,836	2,798	11,634
2	12	-	1,022	-	518	200	76	5,580	3,373	8,953
5	116	-	977	-	405	212	69	5,073	4,762	9,835
1	218	-	1,197	-	363	154	46	5,521	5,742	11,264
4	227	-	1,199	-	494	153	77	6,118	7,528	13,646
7	211	-	1,144	4	458	177	115	5,498	8,730	14,227
12	161	-	1,185	28	507	164	110	5,421	6,150	11,571
5	159	-	1,024	11	585	142	156	4,561	3,804	8,365
26	296	-	611	15	415	152	111	3,635	2,764	6,398
24	91	2	482	3	353	124	65	3,341	1,844	5,185
23	101	-	451	1	377	113	67	5,094	2,685	7,780
49	70	3	464	3	356	148	27	5,041	2,600	7,641
52	78	12	454	16	509	136	152	6,338	3,913	10,251
32	32	12	551	12	598	81	220	6,918	5,207	12,125
28	29	4	707	10	372	156	125	5,880	4,175	10,055
26	13	2	509	17	567	156	50	5,206	3,587	8,793
22	32	1	438	3	536	79	67	4,095	3,967	8,062
19	28	-	389	2	966	102	31	4,673	3,567	8,240
17	30	4	313	1	1,318	52	41	3,769	2,917	6,686
9	52	-	243	-	1,134	27	15	3,211	2,666	5,877
10	28	-	162	-	885	28	44	2,678	2,430	5,108
14	64	-	136	2	690	41	90	2,897	2,329	5,226
12	-	-	140	-	536	-	88	2,411	2,125	4,536
9	1	-	134	1	597	-	118	2,815	2,757	5,572
7	-	-	91	1	327	-	114	1,984	2,397	4,381
104	20	-	145	-	309	-	105	1,942	2,540	4,482
19	4	-	112	1	229	-	127	1,718	3,371	5,089
16	-	-	111	-	269	-	145	1,858	3,334	5,192

APPENDIX V

Year	Carp	Catfish	Chubs (note a)	Lake Herring (note a)	Lake
1879	-	-	-	3,050	2,
1885	-	-	-	3,312	6,
1889	-	-	-	9,569	5,
1890	-	-	1,398	6,082	8,
1892	-	-	-	10,206	6,
1893	2	-	-	20,085	8,
1894	-	-	-	22,364	9,
1895	-	-	-	20,222	7,
1896	-	-	-	25,893	9,
1897	-	-	-	23,814	7,
1899	23	-	2,462	22,283	5,
1901	535	-	1,331	15,351	4,
1908	483	-	3,054	24,191	8,
1911	-	-	2,561	8,752	8,
1912	-	-	2,820	8,184	5,
1913	-	-	3,845	8,847	6,
1914	-	-	3,368	7,972	6,
1915	-	-	2,912	10,456	7,
1916	-	-	1,786	7,137	5,
1917	247	-	3,742	11,325	6,
1918	-	-	5,763	8,330	5,
1919	-	-	4,927	5,777	6,
1920	-	-	2,306	5,061	6,
1921	-	-	1,346	2,875	11,
1922	749	-	1,426	3,687	7,
1923	-	-	1,237	3,190	6,
1924	-	-	2,273	3,625	7,
1925	-	-	3,840	4,226	6,
1926	-	-	3,740	5,284	6,
1927	-	-	4,765	5,842	5,
1928	-	-	3,752	3,033	4,
1929	608	1	4,338	5,225	6,
1930	491	12	5,038	6,281	5,
1931	831	22	4,405	5,275	5,
1932	264	5	4,123	2,943	5,
1933	919	5	4,032	4,009	5,
1934	1,320	3	6,237	6,419	4,
1935	1,054	-	5,794	5,425	4,
1936	1,456	23	5,674	4,795	4,
1937	1,925	18	5,679	5,502	4,
1938	1,873	9	5,404	4,473	4,
1939	1,869	22	4,025	2,904	5,
1940	1,979	49	1,648	2,675	6,
1941	2,057	39	1,638	1,703	6,
1942	1,745	67	1,755	1,428	6,
1943	1,512	96	2,214	1,952	6,
1944	1,21.	62	2,607	1,393	6,
1945	1,832	-	3,221	4,030	5,
1946	1,273	91	4,525	5,550	3,
1947	1,032	39	3,087	5,834	2,
1948	1,035	26	5,929	8,029	1,
1949	1,361	27	7,411	6,775	
1950	1,146	22	9,291	7,492	
1951	1,136	10	15,301	8,834	
1952	1,106	9	11,098	9,691	
1953	1,117	5	11,156	6,715	
1954	1,344	9	10,568	7,725	
1955	1,856	4	13,695	6,067	
1956	1,851	9	10,913	5,731	
1957	2,041	5	14,546	3,385	
1958	1,242	1	9,563	2,026	
1959	1,987	-	7,796	965	
1960	1,416	2	12,659	233	
1961	1,942	-	12,133	177	
1962	1,206	-	11,115	116	
1963	1,277	2	7,460	41	
1964	1,320	-	5,172	14	
1965	2,016	-	2,440	46	
1966	2,714	-	3,223	49	
1967	2,542	1	4,089	48	
1968	2,352	-	10,183	93	
1969	2,119	1	8,161	57	
1970	1,935	-	5,646	12	
1971	2,465	-	5,713	4	
1972	1,126	-	5,266	3	
1973	3,211	-	4,461	3	
1974	3,244	2	1,267	6	
1975	2,859	2	924	3	

See footnotes on p. 71.

APPENDIX V

5. LAKE MICHIGAN CATCH BY SPECIES, VARIOUS YEARS, 1879-1975
(Thousands of Pounds)

ish	Sauger	Sheepshead	Alewife	Smelt	Suckers	White Bass	Yellow Perch	Yellow Pike (Walleye)	Coho Salmon	Miscel-laneous	Total United States
-	-	-	-	-	-	-	-	-	-	17,433	23,112
-	-	-	-	-	252	-	-	-	-	13,490	23,485
-	-	-	-	-	1,729	-	2,181	-	-	1,424	26,007
-	-	-	-	-	1,801	-	1,944	-	-	6,845	26,434
-	-	-	-	-	-	-	2,645	-	-	5,893	28,339
-	-	-	-	-	1,691	-	3,452	712	-	6,255	40,723
-	-	-	-	-	-	-	6,515	-	-	3,603	42,726
-	-	-	-	-	-	-	5,959	-	-	2,792	38,212
-	-	-	-	-	-	-	6,364	-	-	3,727	47,004
-	-	-	-	-	-	-	3,079	-	-	1,573	39,634
-	55	-	-	-	1,119	-	3,234	284	-	1,029	37,547
-	12	-	-	-	1,272	-	3,597	345	-	803	36,623
-	87	-	-	-	2,809	-	3,557	209	-	1,047	47,356
-	-	-	-	-	-	-	2,072	214	-	2,298	26,493
-	-	-	-	-	-	-	2,388	164	-	3,359	24,814
-	-	-	-	-	-	-	2,935	165	-	3,674	27,091
-	-	-	-	-	-	-	2,731	225	-	5,696	28,201
-	-	-	-	-	-	-	2,790	216	-	6,084	31,642
-	-	-	-	-	-	-	2,263	275	-	2,895	21,984
-	-	-	-	-	4,035	-	2,101	196	-	501	31,674
-	-	-	-	-	-	-	1,928	121	-	3,410	27,703
-	18	-	-	-	-	-	2,490	122	-	2,515	23,922
-	16	-	-	-	-	-	2,064	116	-	2,515	19,999
-	16	-	-	-	-	-	2,105	141	-	2,425	21,978
-	3	-	-	-	1,536	-	967	64	-	2,087	19,394
-	7	-	-	-	-	-	873	99	-	2,292	15,360
-	5	-	-	-	-	-	1,083	118	-	2,591	18,316
-	12	-	-	-	-	-	1,512	93	-	3,012	21,341
-	20	-	-	-	-	-	2,266	82	-	2,657	20,494
-	2	-	-	-	-	-	1,970	59	-	2,751	23,679
-	2	-	-	-	-	-	1,515	52	-	1,663	17,996
1	3	-	-	-	2,709	-	1,379	53	-	504	26,166
1	17	-	-	-	2,281	-	1,467	64	-	486	26,962
2	7	-	-	86	2,786	-	1,288	56	-	309	24,374
1	14	-	-	98	2,224	-	955	105	-	247	19,305
1	14	-	-	909	1,890	-	1,009	167	-	261	21,002
3	10	-	-	1,031	2,206	-	1,276	161	-	253	26,005
2	12	-	-	825	2,696	-	1,740	99	-	205	24,432
3	11	-	-	1,202	2,686	-	2,508	116	-	184	24,478
-	6	-	-	1,428	2,382	-	2,490	78	-	143	25,602
-	5	-	-	1,654	1,858	3	2,204	50	-	199	24,101
-	14	-	-	1,998	1,854	1	3,090	45	-	234	22,465
1	23	-	-	4,220	2,017	-	2,576	43	-	160	22,601
1	52	-	-	4,775	1,935	-	2,416	44	-	191	22,931
1	52	-	-	3,353	2,251	-	2,648	31	-	229	21,413
-	133	-	-	2,225	2,201	-	3,135	51	-	390	22,175
1	139	-	-	5	2,223	-	2,872	77	-	405	19,252
2	137	-	-	101	2,373	-	1,469	172	-	658	22,090
-	117	-	-	267	1,895	2	1,473	237	-	430	22,392
1	78	-	-	786	1,621	-	1,399	367	-	464	24,955
-	57	-	-	1,131	1,806	-	1,513	636	-	357	27,023
-	41	-	-	1,540	1,810	-	1,378	1,120	-	273	25,573
-	24	-	-	2,417	1,228	-	1,464	1,349	-	210	27,078
-	22	-	-	3,399	1,008	-	1,441	560	-	172	27,648
-	18	-	-	5,111	744	-	1,957	301	-	252	32,061
-	16	-	-	5,181	820	-	2,236	306	-	241	28,634
1	10	-	-	5,811	609	-	2,696	509	-	217	30,291
-	6	-	-	5,416	684	-	3,550	976	-	186	30,036
-	7	-	-	7,368	640	-	3,320	801	-	101	30,795
-	2	-	220	7,024	641	-	2,988	266	-	80	27,223
-	3	-	1,356	9,102	685	-	3,441	217	-	66	27,771
-	-	-	1,264	6,004	612	-	1,977	182	-	37	20,665
-	7	-	2,370	3,267	767	3	3,285	118	-	60	24,311
-	2	-	3,195	2,152	494	-	4,959	97	-	113	25,554
-	1	-	4,742	1,546	263	-	4,050	67	-	103	23,475
-	-	-	5,396	1,203	299	-	4,672	61	-	99	21,021
1	-	-	11,744	969	215	-	5,535	35	-	99	26,201
1	-	-	14,007	927	168	-	1,296	27	-	71	26,994
-	-	-	29,004	1,110	404	-	736	24	-	73	42,764
-	-	-	41,695	1,224	391	-	1,265	16	1,484	137	58,951
-	-	-	27,194	1,789	465	-	632	10	1,999	167	45,816
-	-	-	29,248	2,481	789	-	723	14	1,144	262	47,469
-	-	-	33,461	1,977	969	-	692	12	2,243	327	53,091
-	-	-	24,654	1,343	1,387	-	736	10	5	360	44,660
-	-	-	31,033	705	431	4	1,027	6	2	368	43,771
-	3	-	36,552	382	710	4	749	4	1	512	50,705
-	2	-	45,508	1,748	508	4	1,296	6	-	565	59,595
-	3	-	35,216	1,173	341	7	744	5	1	607	46,347

APPENDIX V

TABLE 6--U.S

Year	Carp	Catfish	Chubs (note a)	Lake Herring (note a)	Lake Trout	Lake
1879	-	-	-	34	1,465	
1885	-	-	-	325	3,488	
1889	-	-	-	382	3,367	
1890	-	-	-	199	2,613	
1893	-	-	-	-	4,342	
1897	-	-	-	694	3,794	
1899	-	-	-	1,515	3,625	
1903	-	-	-	6,751	5,592	
1908	-	-	-	5,310	2,903	
1913	-	-	-	6,878	2,386	
1914	-	-	-	9,816	1,676	
1915	-	-	-	7,022	1,373	
1916	-	-	-	5,317	2,178	
1917	-	-	-	7,194	1,983	
1918	-	-	-	8,344	2,326	
1919	-	-	-	6,418	3,463	
1920	-	-	-	6,484	2,016	
1921	-	-	-	4,809	2,124	
1922	-	-	-	3,736	2,175	
1923	-	-	-	5,231	1,901	
1924	-	-	-	6,216	2,565	
1925	-	-	-	9,002	2,655	
1926	-	-	-	9,349	3,280	
1927	-	-	-	11,506	3,051	
1928	3	-	-	9,496	2,962	
1929	1	-	-	13,288	2,804	
1930	1	-	-	11,937	2,489	
1931	-	-	-	7,563	2,993	
1932	5	-	-	6,445	3,067	
1933	-	-	-	7,338	2,493	
1934	1	-	-	13,535	3,314	
1935	-	-	-	13,588	3,476	
1936	2	-	-	12,112	3,233	
1937	-	-	-	12,059	3,085	
1938	-	-	-	10,8 3	3,167	
1939	-	-	-	13,307	2,744	
1940	-	-	-	17,117	2,677	
1941	1	-	517	17,838	2,854	
1942	-	-	502	14,844	2,959	
1943	-	-	434	13,874	3,063	
1944	-	-	369	14,227	3,740	
1945	-	-	255	14,045	3,369	
1946	-	-	356	13,142	3,444	
1947	-	-	149	10,808	2,965	
1948	-	-	210	14,735	2,954	
1949	-	-	163	13,..4	2,966	
1950	-	-	29	8,156	3,193	
1951	-	-	75	1.,424	2,911	
1952	-	-	91	12,021	2,838	
1953	-	-	69	10,439	2,413	
1954	-	-	182	11,823	2,256	
1955	-	-	154	10,134	2,101	
1956	-	-	216	10,478	1,813	
1957	-	-	266	11,355	1,191	
1958	-	-	1,161	10,216	1,066	
1959	-	-	1,264	11,512	868	
1960	-	-	1,258	10,812	380	
1961	-	-	1,186	11,457	323	
1962	-	-	1,013	9,906	257	
1963	-	-	1,589	8,419	101	
1964	1	-	789	6,187	102	
1965	-	-	2,133	4,732	124	
1966	-	-	1,957	4,508	120	
1967	-	-	1,469	3,787	201	
1968	-	-	840	3,589	206	
1969	1	-	951	2,251	211	
1970	1	-	1,319	1,351	188	
1971	-	-	1,810	1,181	196	
1972	-	-	1,395	880	221	
1973	-	-	1,427	891	220	
1974	2	-	1,620	575	328	
1975	-	-	1,520	510	419	

See footnotes on p. 71.

APPENDIX V

CH BY SPECIES AND TOTAL CANADIAN CATCH, VARIOUS YEARS, 18?
(Thousands of Pounds)

Smelt	Alewife	Suckers	Yellow Perch	Yellow Pike (Walleye)	Ma... lar...	...ed States	Total Canad...	United States and Canada
-	-	-	-	-	6	3,817	352	4,169
-	-	-	-	-	4.	8,826	1,642	10,46.
-	-	1	28	-	207	7,884	2,183	10,067
-	-	-	-	-	9!	6,116	1,943	8,059
-	-	-	2	-	1,465	7,979	2,235	10,214
-	-	-	-	-	102	6,028	2,382	8,410
-	-	-	4	13	46	6,335	3,005	9,340
-	-	164	2	82	59	13,986	2,413	16,399
-	-	283	4	117	42	9,601	2,826	12,427
-	-	-	7	62	727	10,173	2,646	12,818
-	-	-	17	61	550	12,475	2,514	15,989
-	-	-	17	71	492	9,543	8,217	17,760
-	-	-	3	30	647	8,350	5,630	13,981
-	-	347	3	25	102	9,911	5,653	15,564
-	-	-	19	45	492	11,553	7,734	19,287
-	-	-	3	17	386	10,527	4,296	14,823
-	-	-	13	14	318	9,066	3,556	12,622
-	-	-	10	22	305	7,525	2,460	9,986
-	-	260	17	28	36	6,571	2,611	9,182
-	-	-	6	22	281	7,585	4,588	12,173
-	-	-	49	23	421	9,510	3,216	12,726
-	-	-	2	19	630	12,555	3,565	16,119
-	-	-	5	25	776	13,715	4,311	18,026
-	-	-	15	24	706	15,630	5,152	20,781
-	-	-	12	23	626	13,420	5,400	18,820
-	-	226	7	22	42	16,565	4,857	21,421
-	-	94	10	22	58	14,867	4,761	19,627
-	-	16t	4	25	32	11,258	3,169	14,427
-	-	211	8	-	143	10,369	2,488	12,857
-	-	204	6	27	43	10,631	3,108	13,739
-	-	163	3	25	29	17,520	3,988	21,508
-	-	227	1	19	48	17,872	3,578	21,450
-	-	191	8	-	97	16,008	4,900	20,908
-	-	447	9	-	48	16,012	4,509	20,521
4	-	289	7	45	38	14,856	4,057	18,913
-	-	159	8	36	32	16,783	3,307	20,090
-	-	153	3	6	19	20,672	3,319	23,991
-	-	138	6	5	24	22,111	3,436	25,547
1	-	148	6	3	14	19,228	3,363	22,590
-	-	203	8	33	35	18,372	3,347	21,719
-	-	166	4	37	39	19,245	3,761	23,006
-	-	276	2	29	32	18,725	3,812	22,537
-	-	228	4	38	21	18,148	3,589	21,737
-	-	71	-	25	19	14,987	2,830	17,817
-	-	83	5	36	27	19,221	3,371	22,592
1	-	64	-	26	22	16,730	3,188	20,919
1	-	100	2	34	27	12,584	2,655	15,239
1	-	127	3	22	30	14,035	2,851	16,886
45	-	90	1	12	16	15,465	3,127	18,592
21	-	52	-	16	33	13,650	2,771	16,421
25	-	54	-	21	19	15,365	2,690	18,275
74	-	57	1	24	34	13,583	2,540	16,121
118	-	26	3	1	19	13,591	2,145	15,736
138	-	48	2	-	40	13,5.3	2,797	16,361
332	-	43	1	-	52	13,194	2,971	16,065
801	-	50	1	1	76	14,956	3,850	18,806
947	-	68	2	1	33	13,771	2,828	16,599
3,340	-	47	5	1	47	14,749	2,354	17,103
955	-	45	2	1	22	12,602	3,147	15,749
1,493	-	53	2	1	25	12,125	2,966	15,091
2,020	-	45	17	-	55	9,642	2,682	12,324
3,243	-	34	3	2	43	8,748	2,270	11,018
2,265	-	27	9	1	27	8,25.	1,646	10,104
1,496	-	39	2	1	43	7,895	2,568	10,463
1,296	-	64	2	1	47	6,573	1,365	9,938
1,067	-	64	4	-	32	5,239	2,951	8,190
1,576	-	86	-	-	39	5,009	3,382	8,391
2,231	-	56	-	-	66	6,182	3,367	9,549
1,214	-	62	-	-	90	4,471	3,656	8,127
2,112	-	68	-	-	23	5,426	3,161	8,587
2,065	-	149	-	-	93	5,524	3,512	9,036
1,368	-	51	-	-	110	4,735	3,769	8,504

APPENDIX V

TABLE 7--U.S. GR

Year	New York	Pennsylvania	Ohio	Mi (n
1935	1,475	3,271	25,191	3
1936	1,290	3,899	31,083	2
1937	2,451	3,007	21,087	2
1938	2,377	2,674	22,040	2
1939	2,595	2,762	23,512	2
1940	1,970	2,295	18,996	2
1941	1,100	1,794	18,642	2
1942	897	1,901	20,338	2
1943	1,402	2,975	21,872	2
1944	2,023	2,685	23,371	2
1945	2,281	3,514	22,172	2
1946	2,640	3,665	21,[illegible]74	2
1947	1,045	1,357	16,089	2
1948	1,309	2,534	21,796	3
1949	2,305	4,436	26,682	2
1950	574	2,236	20,225	2
1951	800	736	18,700	2
1952	1,265	2,112	21,247	2
1953	891	1,903	22,949	2
1954	1,214	2,232	23,435	2
1955	2,079	3,056	20,388	2
1956	1,347	2,135	26,085	2
1957	911	1,778	25,964	2
1958	653	1,010	19,419	2
1959	500	1,071	19,518	2
1960	589	1,015	18,011	2
1961	897	1,286	15,810	2
1962	680	2,150	15,225	2
1963	502	1,412	14,223	2
1964	446	817	11,230	1
1965	442	514	11,528	1
1966	457	573	10,516	2
1967	538	478	9,831	2
1968	604	481	10,400	2
1969	561	497	9,541	2
1970	534	505	8,420	2
1971	487	377	8,111	1
1972	441	301	7,094	1
1973	536	277	7,397	1
1974	657	471	8,648	1
1975	598	312	7,305	1

See footnotes on p. 71.

APPENDIX V

ATCH BY STATES, 1935-1975
of Pounds)

Indiana (note b)	Illinois	Wisconsin	Minnesota	Total
435	1,300	16,330	8,390	87,011
544	1,369	17,740	5,676	90,570
781	1,462	17,757	6,047	81,001
763	1,156	15,348	6,261	79,299
605	1,259	16,082	7,007	82,720
524	1,943	17,006	7,811	76,588
286	1,555	18,719	6,202	76,429
139	1,777	17,093	5,140	73,563
120	1,909	17,028	5,659	76,667
49	1,657	16,675	5,595	74,167
54	1,621	19,044	4,768	77,413
33	1,505	19,636	3,781	77,192
16	1,832	18,615	3,162	68,261
24	1,620	20,372	4,177	81,968
30	1,497	18,606	4,395	83,483
34	1,576	18,400	2,708	68,906
90	1,050	19,731	2,497	68,623
21	1,233	21,613	2,940	79,663
21	1,323	20,528	2,897	75,525
21	1,668	20,854	3,092	79,748
13	1,521	20,196	2,516	75,207
8	1,567	20,444	2,726	78,948
7	1,160	18,480	3,262	74,041
6	801	18,250	3,270	68,897
1	245	16,833	2,973	63,464
16	324	18,394	2,565	65,936
14	340	21,925	2,334	67,140
6	289	19,075	2,303	61,850
6	285	16,916	2,153	55,823
11	645	18,570	2,071	53,559
7	180	20,124	1,613	54,156
87	302	32,822	1,685	67,726
874	169	38,991	1,854	81,956
202	482	29,471	1,731	67,324
204	747	32,261	1,210	66,969
335	405	37,715	1,307	70,390
785	656	34,808	2,008	62,824
428	824	32,158	1,131	58,428
321	606	39,732	1,908	66,657
213	1,090	48,690	1,880	76,990
198	240	38,781	1,214	60,657

APPENDIX V

TABLE 8--U. S. AND CANADIAN LA
(Thousan

Species	Total Great Lakes			Lake Ontario		
	U.S.	Canada	Total	U.S.	Canada	Total
Alewives	35,216	2	35,218	-	-	-
Bowfin	2	50	52	-	3	3
Buffalofish	67	-	67	-	-	-
Bullhead	197	469	666	50	349	399
Burbot	372	33	405	-	-	-
Carp	6,732	533	7,265	2	414	416
Catfish	560	239	799	1	29	30
Chubs	2,444	1,249	3,693	-	-	-
Crappie	89	-	39	3	-	3
Eels	30	370	400	30	370	400
Gizzard Shad	1	37	38	-	8	8
Goldfi	56	-	56	-	-	-
Lake	513	2,232	2,745	-	27	27
Lake T.	456	194	650	-	2	2
Minnows	12	-	12	-	-	-
Pike or Pickerel	20	60	80	-	17	17
Quillback	150	-	150	-	-	-
Rock Bass	15	116	131	15	102	117
Salmon Coho	1	-	1	-	-	-
Sauger	-	-	-	-	-	-
Sheepshead	873	406	1,279	-	8	8
Smelt	2,573	17,333	19,906	19	104	123
Sturgeon	-	14	14	-	1	1
Suckers	592	441	1,033	2	9	11
Sunfish	14	416	430	14	299	313
White Bass	1,699	2,580	4,279	-	12	12
Whitefish Common	4,517	1,203	5,720	-	5	5
Menominee	252	90	342	-	3	3
White Perch	35	381	416	35	381	416
Yellow Perch	3,036	9,419	12,455	61	599	660
Yellow Pike	133	408	541	1	5	6
Unclassified for Animal Food	-	2,154	2,154	-	30	30
Total	60,657	40,429	101,086	233	2,777	3 010

See footnotes on p. 71.

APPENDIX V

CIES AND LAKE--1975

Erie		Lake Huron			Lake Michigan (note c)	Lake Superior		
a	Total	U.S.	Canada	Total	U.S.	U.S.	Canada	Total
2	2	-	-	-	35,216	-	-	-
7	47	2	-	2	-	-	-	-
	67	-	-	-	-	-	-	-
9	153	39	1	40	74	-	-	-
	1	-	2	2	274	97	31	128
4	3,285	629	55	684	2,880	-	-	-
0	434	283	50	333	2	-	-	-
	-	-	794	794	924	1,520	455	1,975
	-	86	-	86	-	-	-	-
	-	-	-	-	-	-	-	-
9	19	1	10	11	-	-	-	-
	56	-	-	-	-	-	-	-
	-	(a)	43	43	3	510	2,162	2,672
	-	-	10	10	37	419	182	601
	12	-	-	-	-	-	-	-
3	13	-	25	25	20	-	5	5
	133	17	-	17	-	-	-	-
2	12	-	2	2	-	-	-	-
	-	-	-	-	1	-	-	-
	-	-	-	-	-	-	-	-
1	1,185	16	67	83	3	-	-	-
1	16,934	-	5	5	1,173	1,368	303	1,671
	-	-	13	13	-	-	-	-
7	114	111	183	294	341	51	222	273
7	117	-	-	-	-	-	-	-
3	4,255	-	5	5	7	-	-	-
	1	405	902	1,307	3,354	757	296	1,053
	-	-	50	50	239	13	37	50
	-	-	-	-	-	-	-	-
8	10,125	259	542	811	794	-	65	65
6	252	-	277	277	5	-	1	1
6	1,816	-	298	298	-	-	10	10
1	39,033	1,858	3,334	5,192	45,347	4,735	3,769	8,504

APPENDIX VI

NUMBER OF LAKE TROUT AND PACIFIC SALMON REARED IN GREAT LAKES HATCHERIES

Year	Lake trout	Pacific salmon		Total
		Coho	Chinook	
	(thousands)			
1958	987	-	-	987
1959	668	-	-	668
1960	1,050	-	-	1,050
1961	1,260	-	-	1,260
1962	1,853	-	-	1,853
1963	2,311	-	-	2,311
1964	2,631	-	-	2,631
1965	3,221	-	-	3,221
1966	4,996	852	-	5,848
1967	5,714	2,199	835	8,748
1968	5,252	2,146	1,011	8,409
1969	4,880	5,078	1,093	11,051
1970	5,124	5,727	2,988	13,839
1971	4,902	4,994	4,010	13,906
1972	5,628	3,440	3,786	12,854
1973	6,046	3,676	5,803	15,525
1974	6,278	5,699	6,881	18,858
1975	7,132	5,033	7,073	19,238
Total	69,933	38,844	33,480	142,257

Note: The number and quantity of other hatchery-reared fish planted in the Great Lakes were not readily available.

APPENDIX VII

GREAT LAKES FISHERY COMMISSION

SEA LAMPREY CONTROL PROGRAM

Concern over the decline of fish stocks, especially lake trout, attributed to the invasion of the sea lamprey was the main impetus to the 1955 Convention on Great Lakes Fisheries between the United States and Canada. The Great Lakes Fishery Commission (GLFC) was established and made responsible for formulating and implementing a program to eradicate or minimize sea lamprey populations.

To carry out the program, GLFC contracted with the Fish and Wildlife Service (FWS) in the United States and with Fisheries and Environment, Canada's Fisheries and Marine Service in Canada. Both agencies had participated in earlier control efforts initiated in 1948. These efforts, involving FWS, the States, and Canadian agencies, had yielded much basic information but were somewhat uncoordinated and experimental.

Since the lamprey by 1955 had spread and become established throughout the lakes, the task GLFC faced in trying to control it was a formidable one. The point of attack has been tributary streams. Lampreys ascend streams to spawn and thus concentrate in them, either as adults on spawning runs or as larvae (immature lampreys) burrowed in the stream beds.

One of the first steps in the program involved a survey of all streams (a total of 5,747) tributary to the Great Lakes to identify those that produced lampreys. The survey identified 400 as lamprey-producing, of which 277 were in the United States.

Initially, mechanical or electromechanical barriers were installed in lamprey-producing streams to prevent mature lampreys from reaching their spawning areas. The barrier program was started in the late 1940s and, at its peak in 1959, included about 135 barriers in the United States and Canada.

In the late 1950s, after a 7-year research effort by FWS, a control breakthrough was achieved--the development of chemical toxicants (lampricides). Since 1958 GLFC has used lampricides as the primary method of control. Electrical barriers have been continued in operation at selected sites, but only as a means for measuring control effectiveness (lamprey abundance and biological characteristics).

Lamprey-producing streams are treated with lampricides by two FWS Sea Lamprey Stations, located at Ludington and Marquette, Michigan, and by a Canadian sea lamprey control unit located at Sault Ste. Marie, Ontario. Each of the Great Lakes, except Lake Erie, has received at least one "round" of treatment--that is, treatment of all known lamprey-producing streams tributary to the lake. The first round was accomplished gradually, by lake, as shown below:

Lake	Streams	Treatment Started	Treatment Completed
Superior	125	1958	1961
Michigan	110	1960	1965
Huron	108	a/1960	1970
Ontario	44	1971	1972

a/Control was started in 1960. It was discontinued in 1962 to 1965 because of insufficient funds and resumed in 1966.

In Lake Erie, the only lake not treated, lampreys are not abundant. However, because the survey of streams showed that 12 streams tributary to Lake Erie were potentially suitable for production of lampreys, GLFC believes controls may have to be implemented.

Through fiscal year 1975, GLFC expenditures for lamprey control were about $32 million. The United States and Canada share the cost on a 69 to 31 ratio, based on average annual commercial catches of lake trout before the lamprey invasion. Their shares of expenditures through fiscal year 1975 were as follows:

United States	$21,977,121
Canada	9,873,779
Total	$31,850,900

The total annual United States-Canada cost increased from $1.3 million in 1958 to $3.1 million in 1975.

The program has achieved dramatic results.

Lamprey populations have been reduced an estimated 85 to 90 percent. In Lake Superior, where the program has been in operation longest and where its effectiveness has been most carefully evaluated, lamprey abundance has been reduced by about 90 percent. The number of lamprey

declined sharply in Lake Superior in 1962--the year after the first complete round of stream treatments in that lake. The decreases was accompanied by a marked decline in the incidence of sea lamprey wounds on lake trout and, later, by an improved survival of lake trout to older age and larger size. The same phenomenon occurred in the whitefish of Lake Michigan.

The reduction in the lamprey population has, in turn, enabled large-scale plantings of lake trout, salmon, and anadromous trout (e.g., steelheads) (see p. 28)--species that are natural prey of the lamprey.

The lamprey control program has been cost beneficial. FWS estimated that for 1970 in the Upper Lakes (Huron, Michigan, and Superior) the ratio of benefits to costs ranged from 5:1 to 8:1. In the opinion of a GLFC official, the ratio presently is much higher--he estimated 30:1--because of further development of the sport fishery since 1970.

APPROVAL OF LAMPRICIDES FOR ENVIRONMENTAL SAFETY

GLFC believes further research is needed in two aspects of the program, namely, research to obtain approval of the lampricides from the environmental standpoint and research to develop alternative control methods.

In 1971, GLFC's lamprey control program was broadened to include comprehensive studies of the immediate and long-term effects of lampricides on the environment. The studies were intended to demonstrate, in accordance with the requirements of Federal environmental laws, that the chemicals used are not hazardous to humans, the aquatic ecosystem, fish, and wildlife. Research has indicated that the environmental effects are very small, and researchers are confident that Environmental Protection Agency (EPA) approval will be forthcoming.

The primary lampricides had been approved as environmentally safe sometime prior to 1970 by the Department of Agriculture, which at the time administered the Federal Insecticide, Fungicide and Rodenticide Act. Subsequently, however, Agriculture advised GLFC that the approvals would be canceled on December 31, 1970. We were advised that the action resulted from new legislation calling for review

and re-registration (approval) of the chemicals being used. Review and approval actions were to be carried out by EPA.

In early 1971, EPA granted an extension of the registration so that the research necessary to support re-registration might go forward. The research has been conducted for GLFC by the FWS Fish Control Laboratory, LaCrosse, Wisconsin, in accordance with a 5-year research plan developed in early 1971.

An FWS official informed us that the research had been expected to be completed in 1976, but that it might continue through 1977--he could not estimate a completion date.

The FWS official told us the effort to obtain EPA approval of the lampricides has been prolonged by

--changes in EPA requirements;

--the large volume of technical data involved;

--EPA's workload, which hinders prompt EPA review of data submitted.

According to the director of the FWS laboratory involved, research results to date have been very favorable, and he was confident EPA approval would be obtained. The matter is of critical importance to the sea lamprey control program. If the lampricides now used as the primary control method are not approved by EPA, alternative methods will have to be developed and adopted--a time-consuming process, during which the sea lamprey may regain its former abundance and seriously reduce stocks of valued species of fish.

RESEARCH TO DEVELOP ALTERNATIVE CONTROL METHODS

GLFC recognizes the need for continuing research to develop a fully integrated control program to further reduce sea lamprey abundance in the Great Lakes. The present control program has substantially reduced sea lamprey populations but has not entirely eliminated them. The program, using present methods, may have to be continued indefinitely and at increasing cost.

While the lamprey population has been substantially reduced, it remains a stubborn problem. In some localities, lampreys have on occasion increased from ea lier low

populations achieved by control efforts. For example, the 1976 spring collection of adult lampreys from five Canadian barriers on streams tributary to Lake Huron increased 82 percent over the number collected for a similiar period in 1975. According to a GLFC official, more frequent chemical treatments will be needed, and the price of chemicals has risen sharply.

Research to develop alternative control methods is being conducted for GLFC by the FWS Great Lakes Fishery Laboratory at its Hammond Bay (Michigan) Biological Station. We were advised by an FWS official that such research accounts for about 95 percent of the station's effort. Station costs in fiscal year 1975 totaled about $175,000. The laboratory director believed that funding was adequate, but that there will be a continuing need for the research.

While the future direction of the control effort is still uncertain, GLFC expects that a fully integrated control program will eventually include supplementary or alternative methods, such as the construction of permanent barriers on selected streams and the use of biological controls.

APPENDIX VIII

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
[illegible]
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

July 12, 1977

Mr. J. P. Glick
U. S. General Accounting Office
CEDD
WSC Building 1
Room 214
Rockville, Maryland 20852

Dear Jack:

During the recent visit of Messrs. John Gillner, Richard Schaefer, John Carr, and yourself we discussed at length the Great Lakes commercial fishing industry and the potential of the Great Lakes to support significant fisheries in the lakes. Further, we discussed the role that the NMFS, as well as other federal agencies, should fulfill in the Great Lakes.

I am hopeful that the following will be helpful:

The current condition and future potential of commercial fisheries in the Great Lakes is an important concern to the National Marine Fisheries Service. As Director of the Northeast Region, I have a responsibility to provide the same services of NMFS to the commercial fishing industry of the Great Lakes as to the coastal area of the Atlantic seaboard. An important distinction, however, is the total absence of Federal management responsibility in the Great Lakes. Each of the eight states which border the lakes have complete jurisdiction over the fishery resources within its boundaries. The application of NMFS resources toward assistance to the industry in the lakes is, therefore, dependent on the policies of the states in regard to the role of commercial fisheries.

The establishment of the NMFS Great Lakes Liaison Office was accomplished on the basis of a demonstrated need by the industry and the assurance of the Natural Resources Directors of each of the Great Lakes states that commercial fisheries has a continuing role in their fishery management plans. The state directors also foresaw an evolution in the management of the commercial fishery with a reduction in the number of fishing units, particularly part-time fishing operations, with a corresponding improvement and stability in the economic status of the industry.

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Mr. J. P. Glick

July 12, 1977

In order to properly allocate NMFS resources to the Great Lakes, we are continually assessing the needs of the industry and its future under new management policies and environmental alterations. The following comments, by specific issues, pertaining to the Great Lakes commercial fisheries, are our current assessments of the industry and its future:

Landings - Based on the best available studies the total landings (weight) will probably increase in the next five to ten years. Increases will occur primarily in species now considered underutilized such as carp, suckers, freshwater drum, smelt, alewives, and burbot. Increases are also expected to occur in landings of perch, lake trout and round whitefish because of better management of the stocks, new methods of harvest, and improved natural reproduction.

Value of landings - The dockside value should also continue to increase with higher prices for each species commensurate with increased landings.

Number of producers - The total number of fishermen will decline or stabilize with the implementation of various types of limited entry programs by the states which are designed primarily to phase out most casual fishing operations. Changes in harvesting methods will require less manpower in the production sector. Employment in the processing and marketing sector may increase with the expected development of processed products from underutilized species, and the rising trend toward custom retail fish markets.

Need for stock assessment - In order to manage for optimum yield, an increase in both the effort and quality of stock assessment must occur. Current assessment efforts by the states, universities, and the Fish and Wildlife Service are not adequate to establish reliable estimates of harvestable surpluses for most species. The absence of sufficient information in this area is a primary cause of conflict between the users and the management agencies. The inability of state management agencies to specify the harvestable surplus has hindered the development of a fishery for many species.

Sport-commercial conflicts - The issues in this conflict are more emotional than real. Actually, only three major species (lake trout, perch, and walleyes) are actively sought after by both groups. In 1976, lake trout and walleyes accounted for only three percent of the total value of the U. S. Great Lakes production. Yellow perch landings were 23 percent of the total. Conflicts over perch have been minimized by closing commercial fishing in the prime sport fishing areas.

Conflicts over large incidental catches of sport species are being resolved by changing the type of gear used.

The major conflict between competing users occurs over the issue of determining harvestable surplus. The arguments usually have the commercial fishermen pushing for the high estimate and the management agencies and the sports fishermen for the low estimate. Estimates of harvestable

surpluses, when made, usually have a range of several hundred percent. An improved data base on population dynamics would reduce significantly this conflict, with the added benefits of better protection of the stocks as well as the improvement of the economic stability of the industry.

Contaminants - The problem of chemical contaminants in Great Lakes fish has received much publicity in the news media, and has usually been overstated. The problem is real enough without exaggeration. The present primary effect on the commercial fishery of contaminants exceeding FDA tolerance levels is the PCB level in Lake Michigan lake trout. The PCB level in these fish exceed the current FDA action level of 5 ppm by the time they reach 12 to 15 inches. If these fish did not exceed the guideline, a small assessment fishery would probably be allowed and the value to the commercial fishery would be about 200-300 thousand dollars. High PCB levels in carp in southern Green Bay have curtailed this fishery with a loss of 50 to 75 thousand dollars.

Perhaps, the greatest loss of revenue due to contaminants is to the State of Michigan. If [illegible] and salmon eggs taken by the state during the fall spawning run could be sold for human consumption, the state could receive in excess of 1 million dollars. The expected reduction from 5 ppm to 2 ppm in action level for PCB in fish by FDA will have only a slight effect on the commercial fisheries because few fish now are in the range of 2 - 5 ppm. Since the highest levels of PCBs are in the sport species, salmon and lake trout, the psychological effect on the public of lowering the action level could reduce sport fishing and perhaps require the states to review current stocking practices and reconsider their plans for the construction of new hatcheries.

Required actions to enhance commercial fisheries include:

1. Better coordination of current stock assessment activities toward a clearly defined goal of determining the harvestable surplus of those species in greatest demand by the users.

2. Continued research efforts by Great Lakes universities, especially those with Sea Grant funds, in the areas of: creation of products and development of markets for the underutilized species; improved techniques for measuring size of fish populations; innovative use of mathematical models to estimate optimum sustainable yields of fish stocks; development and adaptation of more economically efficient and selective methods of harvest.

3. More concentrated efforts by the water pollution control agencies (state and federal) to locate and control sources of contaminants.

4. Increase the intensity and improve coordination of chemical analysis for contaminants in fish to better define the areas, species, and size of fish which will meet FDA guidelines for human consumption.

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5. A more meaningful and objective role for the commercial industry in management decisions.

In summary, I believe there is a bright future for the commercial fishing industry in the Great Lakes. The renewed determination of the states to scientifically manage the Great Lakes fishery resource will enhance the economic viability of the industry, as well as provide the greatest benefit to the citizens of the eight Great Lakes states. Lastly, it is my view that a concerted effort must be undertaken by the Federal and state governments in order to achieve success. I believe that such an effort would be justly rewarding to the nation.

Sincerely,

William G. Gordon
Regional Director

(06032)