PROBLEMS OF CONSERVATION IN THE GREAT LAKES

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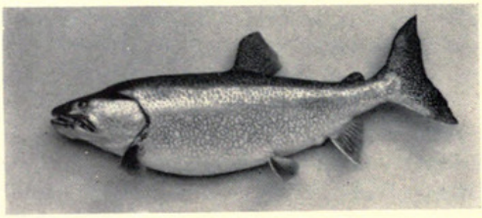
CURATOR OF FISHES

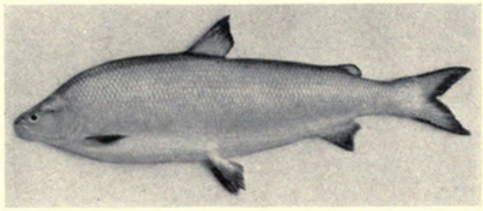
THERE EXIST, in Lake Michigan, and in the other Great Lakes, numerous complex problems of conservation as important as any in the United States today. The history of Lake Michigan fisheries reflects our lack of knowledge of the lake environment as a whole and the interactions of the whole assemblage of animals living here. The lake fisheries show effects of lack of proper use in the diminishing over-all catch and in the depletion to a point of non-profitable commercial exploitation of three of the most valuable Lake Michigan species: sturgeon, lake trout, and whitefish.

The total amount of fish produced by the United States waters of the Great Lakes fluctuates between 75 and 100 million pounds per year. In dollar value these fisheries are of considerable importance, averaging around fifteen million dollars—equivalent in value to that of the Pacific sardine industry when that fishery was at its peak. The lake trout, backbone of the lake fisheries, formerly yielded 10 million pounds annually. This was worth $4,000,000, equal to the dollar value of the U. S. codfish industry. The lake trout fishery is now gone from Lakes Huron and Michigan and is in a precarious state in Lake Superior.

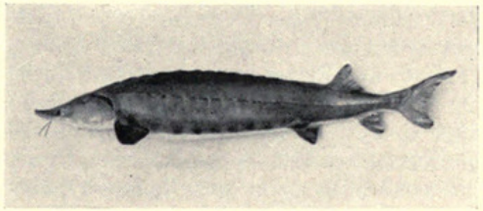
It is obvious that extensive fisheries, near such concentrations of population as border the lakes, are of prime importance because of their food value as well as their dollar value. The decline or loss of part of this resource concerns us all. Numerous other benefits are derived from the lakes: their effect on the climate of the bordering states, their use as water supplies and as power sources for cities and industry, their value as shipping lanes, their advantages as sources of recreation for residents and tourists. Sound fishing policies need to be co-ordinated with these other uses.



LAKE TROUT



WHITEFISH



LAKE STURGEON

Probably millions of the people who have eaten these three fishes have never seen what they looked like before they reach the table.

CHARACTERISTICS OF LAKE MICHIGAN

The basin of Lake Michigan is a long, narrow trough scooped out by the action of ice during the last (Wisconsin) glaciation. In years it is not very ancient, probably only 10,000 or 11,000 years old, having been its present size for less than 4,000 years. Its surface area is 22,400 square miles (about the size of West Virginia) and the median depth is 258 feet. It is clear, deep, and cold.

The lake environment appears to be fairly uniform throughout the year. Changes of temperature and turbidity affect only the surface layers and waters near shore. Below 350 feet the temperature is only a few degrees above freezing at all times. The volume of the lake is relatively constant, the fluctuation level being only ½ to 1½ feet in the course of a year, with an extreme periodic fluctuation of 6 feet, 4 inches. The currents vary in strength between 4 and 90 miles per day. Winds affect the surface and shoals causing large upwellings of cold water from the bottom layers but only rarely is there more than a mild effect in the deeper waters. Two important effects of the wind are on shore erosion and in occasionally breaking up the summer temperature stratification.

Lake Michigan has had the highest production per unit of area of the four deep members of the Great Lakes chain. This is due to the high production of Green Bay that formerly contributed between one-fourth and one-third, and now contributes from 60 to 70 per cent of the total Lake Michigan fishes caught commercially. Although it has maintained its second place position (Lake Erie is first) in commercial fish production, Lake Michigan suffered a decline of 45 per cent during the 50-year period from 1891 to 1940.

OTHER LAKES LESS DEPLETED

The per cent of decrease in production in the other lakes, though marked, has been much less (Erie 16, Huron 23, Superior 9). These figures are from years *before* the appearance of the sea lamprey and the disappearance of the lake trout or decline of the whitefish.

The problem is not one simply of overfishing if that ever were the reason, but also probably of selective fishing. Accounts by some early explorers of Indian fishing in the northern part of the lake and by settlers as late as 1835 indicate an unbelievable abundance of fishes. Prior to 1850 fishing was largely by gill nets and large seines along shore, principally for whitefish and lake trout. In the 1850's pound nets came into use, and as a result of a reported fall-off in production in 1871 the first survey of fisheries was made. The decrease in fisheries production during the years 1858 to 1872 was estimated to be 50 per cent, principally affecting the lake trout and whitefish. The decline was blamed on: (1) capture of immature fishes by pound nets; (2) lost gill nets; (3) practice of fishermen of throwing offal on fishing ground, and (4) pollution from sawdust, slabs, sidings, etc. floating widely over the lake.

The first to go was the lake sturgeon, regarded as a pest by the early fishermen because sturgeon frequently became entangled in the nets. They were removed from the lake and piled on the beaches or buried. The fishery for sturgeon began around 1870, taking 10,000 to 20,000 fish per year. In 1885, 8 million pounds were taken. Thereafter they declined rapidly and have not been commercially important during the 20th century.

BROAD FLUCTUATION

Since World War I, annual production of Lake Michigan has fluctuated widely: the least amount, 16 million (1923) and the most, 35 million (1929). In 1952, production reached 32 million pounds without the lake trout which formerly accounted for from 4 to 6 million pounds of the Lake Michigan production. Thus it would appear that production was holding up fairly well, that an over-all decline is only temporary, and that there is no need to worry about the disappearance of one species as another will rise to take its place. This is certainly what seems to have happened. There have been considerable changes in rank of most abundant species through the years as the following tabulation shows:

1893	*1942*	*1953*
Herring	Lake trout	Chubs
Lake trout	Smelt	Lake herring (cisco)
Perch	Perch	Smelt
Whitefish	Chubs	Perch
Chubs	Carp	Whitefish
	Lake herring (cisco)	Carp

We note that by 1942 two introduced fishes (smelt and carp) are among the six more important species. By 1953 the chubs

and cisco replaced the trout. These changes plus the widely fluctuating annual production are of considerable concern. What are the ecological factors that have occurred allowing the less desirable fishes to become more plentiful as the more desirable ones grew scarce?

SUSPECTED CAUSES

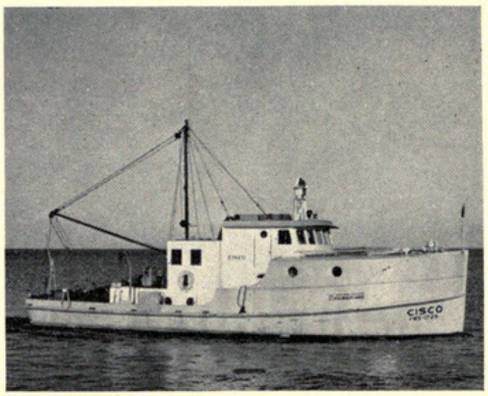
Many causes for these changes have been set forth by fishermen, and by interested observers. The truth is, no one knows. The reasons for this lack of knowledge will be discussed later. First we will examine some of the suspected causes.

1. **Climatic changes** have perhaps brought about hydrographic changes such as changes in volume. High lake levels, reaching 582 feet, are known in the years 1917 and 1918. Fish production was also high during those years, 29.3 million and 26.7 million pounds respectively. Lake levels decreased during the years 1920 to 1926 (to 577.35 feet, low record) and during all these years fish production was at an all-time low. As the lake level went up, fish production reached its peak for recent years in 1929 and again in 1952, both high level years. The trouble with this correlation is that it takes a varying number of years (2 to 6) for the different species leading the catch to reach commercial size so the causal relations are obscure. Changes in extreme range of temperature, seasons, and amounts of ice may have some effect on the survival of young.

2. Different types of **fishing gear,** regulations, and closed seasons have been tried. Here the fishery biologists have had the opportunity to actually test the type of gear and mesh size permitted and have done considerable checking on the effects of gear used. Their results did not indicate that the type of gear now in use is unduly wasteful or harmful to desirable species. However, the effect of selective fishing on the stock of the desired species and the effect on unexploited species or underexploited species of the same locality where the nets are set, has not been studied.

3. **Pollution** has often been stated as a major cause for deterioration of fishing. Quite possibly pollution has driven the whitefish from local areas of southern Lake Michigan and contributes to the fluctuation in available numbers of this species. Pollution in the form of sawdust, silt, and domestic and industrial sewage undoubtedly has influenced fish production, but to what extent is unknown. In southern Lake Michigan there was dumping of garbage, trash, and cinders, and large quantities of clay from excavations are still dumped. This material is carried in suspension so that it spreads over wide areas in the south basin of the lake covering the fishes' spawning and feeding grounds. The dumping of cinders from steamships and the pumping of oily bilge into the lake also have sometimes had local and temporary effects, but probably have not greatly changed the entire ecological complex in the lake. It is doubtful that the total biological production of the lake has ever declined significantly because of pollution or that total fish production has declined for this reason alone. Possibly certain species have been adversely affected by pollution but I know of no studies proving pollution has harmed fishing in the lake as a whole.

3. **Exotic species:** Since World War II there has been a great amount of publicity given to the *sea lamprey* and its detrimental effect on the lake trout and other species. The whitefish had already disappeared from Lake Huron by the time the lamprey appeared in large numbers. In the 1920's the cisco disappeared from Lake Erie. Very likely the sea lamprey is the principal cause for the disappearance of the trout, other factors being trap net fishing, rise and decline of smelt, appearance of the alewife, disease, etc. We are assured that means of controlling the sea lamprey are available and it is only a matter of time until this pest is no longer the destructive agent it was between 1940 and 1955.



RESEARCH VESSEL 'CISCO'

In 1954 and 1955 this ship of the U. S. Fish and Wildlife Service made a number of cruises on Lake Michigan collecting materials and data for studies of fishery and hydrographic conditions.

Several other species of fishes are established that were not in Lake Michigan in any numbers before 1900. Probably the most abundant of these is the *smelt*, which became established throughout Lake Michigan by 1936 (see BULLETIN, March, 1954). By 1942 smelt production reached 3.5 million pounds and then the fish died out in 1943, gradually recovering until now more are taken annually than in the former peak year of 1942. Smelt were one of the principal foods of the lake trout. The effect of the decline of smelt on lake trout is not known. The presence of the *carp* is an unknown factor in the lake. Most likely its effect is important only in very shoal waters, bays, lagoons, and along shores.

The effect of the *rainbow trout*, introduced and established in the northern end of the lake, is unknown. Its numbers are not large and its effect, if any, probably small.

The *alewife* has recently invaded and become established in Lake Michigan but its numbers are unknown. It is considered to be a menace because it competes for food with the lake herring and with young fishes.

Two other exotic species, the eel and Atlantic shad, have been reported in Lake Michigan but very likely are not established here.

Enough has been said to delineate the gradual change in the fish fauna of Lake Michigan. Some kinds are reduced in numbers, some kinds, especially the smaller species (smelt, chubs), have become exceedingly abundant. Kinds new to the lake have entered the scene resulting in new predators (sea lamprey, rainbow trout), in new food sources for the fishes (smelt, alewife), and in new competitors for food (smelt, alewife).

OVER-ALL SURVEY NEEDED

The principal need of the fisheries is an over-all study of the lake, a complete limnological survey to determine total biological productivity. Such a study should analyze communities rather than individual species, and should include studies of the environment and its seasonal changes. Particularly there is a need to study the interactions among species—how each is affected by changing environmental conditions as well as by selective fishing pressure. Recently, a comprehensive survey was made by the U. S. Fish and Wildlife Service staff on their research vessel *Cisco*, working in the southern half of Lake Michigan in 1954 and the northern half in 1955. This work should be continued for a number of years. Such background studies are needed to learn the inner workings of the lake and the factors that influence the sudden abundance or scarcity of particular species. The central need in the lakes is for biological understanding based on adequate factual information. This can only be arrived at by a long-term biological survey.

There is an immediate need to develop an educational program that follows closely with the development of a research program. Particularly we need an *enlarged basic research program.* A backlog of basic information will help in meeting the problems that will arise with the completion of the St. Lawrence Seaway such as continuing invasion by lampreys, alewives and white perch, and the problems of increasing industrial expansion with its increased pollution.

The various states surrounding the lake have generally concerned themselves with their inland waters and only occasionally contributed staff and funds to Lake Michigan studies. The Fish and Wildlife Service has been restrained in its research program

by reduced and fluctuating budgets, a small staff and lack of oceanographic equipment. Recently however a beginning has been made by the Fish and Wildlife Service along several lines. In 1953 the Fish and Wildlife research vessel *Cisco* began work in Lake Superior on the lamprey and lake trout. In 1954 the *Cisco* was in Lake Michigan studying chubs to see if this species was becoming stunted or poor.

INSTITUTE ESTABLISHED

Recently, the Great Lakes Research Institute was established at the University of Michigan to promote basic research particularly in Lakes Erie, Huron, Michigan and Superior. Associated with the Great Lakes Research Institute is the Great Lakes Research Committee of Canada.

In January, 1956, the Great Lakes Commission was established by the states bordering the lakes "to promote the orderly, integrated and comprehensive development, use, and conservation of the water resources of the Great Lakes Basin."

In addition to the Great Lakes Commission consisting of the border states, there recently was established a Great Lakes Fishery Commission between the United States and Canada. The commission will have as one of its major activities the application of sea lamprey control. In addition it is expected that this Fishery Commission will co-ordinate many of the disjointed efforts to do research on the Great Lakes.

Previous attempts to carry on large-scale basic research on the lakes have failed largely because of a lack of strong, active, organized leadership. This need appears to have been met. Now the need is for support. To date only minimal amounts of money have been allotted to government agencies for research on the lakes and these allotments principally for investigation of some immediate critical problem such as sea lamprey control. The establishment of organizations devoted to research on the lakes should have as one function that of educating the public at large and thereby gaining support and funds for furthering basic research.

Effective conservation measures for the Great Lakes fisheries can be brought about only when there is international and interstate agreement regarding regulations, gathering of statistics, and co-ordinated research.

Acting Auditor Appointed

Miss Marion K. Hoffman has been appointed Acting Auditor of the Museum, due to the vacancy occurring with the recent resignation of Robert A. Krueger, Auditor.

Miss Hoffman joined the Museum staff in 1952 as Bookkeeper, and was promoted to Assistant Auditor in 1955. She was formerly employed in a similar capacity in a business concern.

Mr. Krueger left the Museum's employ to accept a commercial position.

LECTURES FOR ADULTS ON FOUR SATURDAYS

Four illustrated lectures on travel and science remain to be given on Saturday afternoons during April in the spring series provided by the Edward E. Ayer Lecture Foundation Fund. These lectures all begin at 2:30 P.M., and are presented in the James Simpson Theatre of the Museum. Admission is free, and no tickets are required. While only adults can be accommodated, the Raymond Foundation provides free entertainment for children on the mornings of the same Saturdays.

Members of the Museum are each entitled to two reserved seats at all lectures. Reservations may be made by telephone (WAbash 2-9410) or in writing. Seats will be held in the Member's name until 2:25 p.m.

Following are the dates, subjects, and lecturers in the adult series:

April 7—The Challenge of Everest
Norman G. Dyhrenfurth

April 14—Saga of the Swamplands
Earl L. Hilfiker

April 21—Penguin Summer
Olin Sewall Pettingill, Jr.

April 28—Blizzards to Blossoms
William Parsons

Daily Guide Lectures

Free guide-lecture tours are offered daily except Sundays under the title "Highlights of the Exhibits." These tours are designed to give a general idea of the entire Museum and its scope of activities. They begin at 2 P.M. on Monday through Friday and at 2:30 P.M. on Saturday.

Special tours on subjects within the range of the Museum exhibits are available Mondays through Fridays for parties of ten or more persons. Requests for such service must be made at least one week in advance.

Venezuelan Botanist Here

Leandro Aristeguieta, botanist at the Instituto Botanico of the Ministerio de Agricultura y Cria in Caracas, Venezuela, has come to the United States for two years to study the Compositae (Sunflower Family) as represented in Venezuela.

Mr. Aristeguieta, after studies at the New York Botanical Garden and the Smithsonian Institution in Washington, is now engaged in work on collections at Chicago Natural History Museum, and consulting with Dr. Julian A. Steyermark, Curator of the Phanerogamic Herbarium.

EXHIBIT TELLS THE FACTS ABOUT CROCODILIANS

The Museum's program of exhibition of crocodilians—the group including alligators, caimans, crocodiles, and gavials—began in 1923 with the Marshall Field Expedition to Central America. One of the prime purposes of the field party, which consisted of Dr. Karl P. Schmidt, Curator Emeritus of Zoology, and former Taxidermist Leon Walters, was the gathering of materials for a habitat group of the American crocodile. The successful result of the trip was the excellent Lake Ticamaya habitat exhibit that has been on display in the Hall of Reptiles (Hall 18) since 1926.

Two years later Mr. Walters went to southeastern Georgia and collected the female alligator and nest, which he made into one of the fascinating exhibits of the Hall of Reptiles. In the intervening years, two models of small Central American crocodilians have been prepared.

A new screen on crocodilians, recently installed, rounds out our exhibition of this ancient and interesting order of reptiles. Prepared by Taxidermist Ronald J. Lambert according to plans developed by the Division of Reptiles, this screen emphasizes those aspects of the biology of crocodilians not covered by other exhibits. About one-third

SKULL OF MAN-EATER

This specimen, decorated by Filipino tribesmen who killed the crocodile, now is featured in the center section of new exhibits in Albert W. Harris Hall (Hall 18). The small cut-outs convey an idea of the size range of crocodiles and relatives.

of the screen is devoted to the basic adaptations of the order to its aquatic environment: propulsion by a flattened tail and exclusion of water from body openings by special valves. Another section presents some of the differences between crocodiles and alligators. Size, another topic that seems to interest the public, is also treated. And, finally, the question of man-eaters among the crocodiles is dealt with.

ROBERT F. INGER
Curator of Amphibians and Reptiles