Original: Fish Division
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Institute for Fisheries Research
K. L. Peterson
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February 14, 1951

Report No. 1276

A BIOLOGICAL SURVEY OF MUSKEGON LAKE

By

Kenneth L. Peterson

ABSTRACT

A biological survey of Muskegon Lake, Muskegon County (T. 10 N., R. 16, 17 W., Many Sections) was conducted during the periods June 16 to July 8, and August 28 to September 9, 1950.

Most of the shore of the lake is occupied by the cities of Muskegon and North Muskegon. The lake is subject to diverse uses. Much of the southern half of the lake has been dredged. Because of the industrialized nature of the shore, little fishing is done in this part of the lake. Natural shoals remain along the northern edges of the lake and it is there most fishermen concentrate their efforts.

Muskegon Lake does not stratify and has no layer of water that would support trout throughout the summer. Yellow perch, bluegills, and rock bass are the main species caught by fishermen, though at least 15 species were recorded in the creel census of 1948, and 31 species were collected in the present survey. Walleyes, largemouth bass, pumpkinseed sunfish, black crappies, and white bass are prominent in catches. Game fishes attain average growth rates as determined from state-wide growth data.

Pollution effects on bottom life were studied. Pollution seemed localized near the sources and of no serious danger to the fish life of the lake

as a whole. Small fish kills due to pollution have been reported in the past but measures for preventing pollution are either being taken by the offenders or are being discussed with the Water Resources Commission.

Muskegon Lake is producing abundant populations of most game fishes for which the lake is suited. Walleyes were present in relatively smaller numbers. Various ages and sizes present indicate the lake is either producing reasonable numbers or that it is recruiting a population from elsewhere. Observations and netting results seem to confirm suggestions indicated by previous studies; that high winter and spring walleye populations are recruited from Lake Michigan and that these fish enter the lake en route to spawning areas in the Muskegon River.

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A biological survey of Muskegon Lake, Muskegon County (T. 10 N., R. 16, 17 W., Many Sections) was conducted during the periods June 16 to July 8, and August 28 to September 9, 1950. Located in southwestern Michigan, and directly connected with Lake Michigan, its southerly shore is occupied by the city of Muskegon, while its northerly shore is partly occupied by the campanion city of North Muskegon.

Introduction

The most striking aspect of Muskegon Lake noted by the survey party[1] is the diverse use to which it is subjected. Economically the lake has been important to industry ever since the lumber boom of the 1870's when great rafts of logs were floated down the Muskegon River to the mills along the water's edge (Glasgow, 1939). Plants of many industries have today supplanted the sawmills. The lake is the depository for much industrial and domestic waste. Emptying into Lake Michigan, it serves as a port and harbor for lake freight carriers and passenger boats, as well as commercial fishermen.

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[1] Messrs. Kenneth L. Peterson (Leader), Donald R. Peterson, and Ellis B. Hayden, Jr. Operation of trap nets by J. H. Claridge, Henry Vondett, and Raymond Fritz.

Despite heavy industrialization of most of its shoreline and the criss-cross of shipping lanes, Muskegon Lake has attracted the summer resident, and many cottages and imposing homes line its north shore. There is little bathing in the lake because of the keen competition from Lake Michigan's clean waters and sandy beaches. But the lake serves as a harbor for pleasure craft which cruise Lake Michigan. It has had a long history of fishing popularity. Its shores are ringed with boat liveries, and it is heavily fished. It seems likely that the fish of this lake will continue to be an important attribute. This report deals with the fish populations and the physical, chemical, and biological characteristics of the lake which affect fish life.

Physical Characteristics

Muskegon Lake is generally elongate in shape on a northeast-southwest axis. It is typical of those lakes in the southern part of the lower peninsula which have originated as flooded river basins. This flooding was caused by a gradual pile-up of water in the southern ends of the great lakes as a result of an uplift of the northern part of the state following the retreat of the glacier (Scott, 1921).

Shoals along the northern edges of the lake indicate that normally the lake might have had broad, shallow shoals and a deeper, trench-like basin in the central part of the lake. Much of the southern half of the lake has been dredged to maintain shipping channels, a U. S. War Department Harbor Map indicates. Only remnants of the shallow shoals on this side of the lake remain between the docks and piers that line the south shore.

The lake has an extensive drainage system to the north and northeast, consisting primarily of Cedar Creek and the Muskegon River. The Muskegon River drains some 2,663 square miles (I. F. R. Report No. 1247). The

drainage system extends through the central part of Muskegon County which is a level to rolling plain of loamy sand that approaches the eastern and southern edges of the lake. To the north of the lake is the Whitehall moraine, which has more diverse and heavier soil than that of the central plain. The original forests of the plain were pine, while those of the moraine were hardwoods. (U. S. D. A., 1929.) To the west of the lake are post-glacial sand dunes which have for the most part become stabilized by forests and other vegetation.

Inlets to Muskegon Lake are numerous. Besides Muskegon River and Cedar Creek, there are Green Creek, Ryerson Creek, Four Mile Creek, Ruddiman Creek, Bear Lake, which is fed by Bear Creek, and two small unnamed creeks, one of which is intermittent. The lake has only one outlet which traverses some 4,000 feet of sand dunes and empties into Lake Michigan behind a breakwater. The outlet is maintained as a dredged channel 20 feet deep to facilitate shipping.

Little fluctuation of the water level was noted by the survey party. In an earlier survey (1936) it was noted that the water level may fluctuate from one to three feet during the season.

The lake has a surface area of 4,150 acres (U. S. War Department Harbor Map, 1933) and a maximum depth of 70 feet. With about ten percent shoal area, by far the greater part of the lake is over 30 feet in depth, much of this area ranging from 36 to 70 feet. Bottom soils range from sand on the shoals to muck and pulpy peat in the depths. The water is brown in color. A secchi disc reading of six feet was recorded.

Because of the shallow penetration of light, indicated by the low secchi disc reading, vegetation disappears almost uniformly at about 12 feet. By far the greater part of the shoal area is under six feet in depth, however, and vegetation is not restricted from lack of light.

Vegetation is restricted, though, by the sandy nature of the shoals. In some protected bays, where debris has collected and the soils have been enriched from the surrounding land, more profuse vegetation exists.

Temperature and Chemical Characteristics

Temperature and chemical data were obtained in mid-August, the period when lake temperatures are near the maximum for the year. These data reveal whether a lake is suited to cold-water species such as trout, and give some indication of the expected general productivity of a lake. A Consumers Power plant makes some use of the lake water for steam cooling. A series of temperatures was taken to ascertain the effect this use might have upon lake temperatures.

The lake was found to be unstratified, as it was when surveyed in 1936. This means that Muskegon Lake, during the summer, does not separate into distinct layers of water differentiated by their temperature characteristics as do many inland lakes. Generally when a lake stratifies, it contains a middle layer of water, known as the thermocline, which usually is cold enough and which may contain sufficient dissolved oxygen to support trout. Trout require temperatures not over 70° F. and oxygen to the extent of at least 3-5 ppm. Lakes which are stratified may also have a cold layer of water on the bottom which sometimes has enough oxygen to support cold-water species. The third, or top, layer of water in such a lake usually has an adequate supply of oxygen, but is generally too warm to support trout. Muskegon Lake has no layer of water that would support trout throughout the summer. On August 19, 1950, water temperatures ranged from 72° F. at the surface to 63° F. near the bottom. Dissolved oxygen content was 5.82 ppm. at the surface and dropped to 0.08 ppm. at the bottom.

Oxygen disappeared, for all practical purposes, at about 40 feet, and the large area which is deeper than 40 feet, thus becomes rather barren of fish life during midsummer. Of the warm-water species, yellow perch seem to be the only fish that consistently forage in water of low or almost no oxygen content. Catching these fish in deep water, therefore, does not necessarily mean that other warm-water species are present.

The water of Muskegon Lake is moderately hard. Methyl orange alkalinity, measured in ppm. of calcium carbonate, was 110 ppm. at the surface and 125 ppm. at bottom. The pH was 8.2 at the surface and 7.2 at bottom. Water of moderate hardness is regarded more productive biologically than soft water.

The survey party investigated a complaint that water used by the Consumers Power Company to condense steam was returned to the lake at such a high temperature that it made ice fishing in the vicinity of the North Channel (Cedar Creek) unsafe. The complaint also stated that the unusually warm water concentrated white bass which were congregating for the spawning run, making it easy for anglers to take "too many fish."

On July 6, this matter was discussed with Mr. John Howard, superintendent of the plant, which is located on the east end of the lake between Cedar Creek and the Muskegon River.

The generators used by the power plant are steam driven. In order to achieve full economy of operation, the plant pumps water out of a channel from which the Muskegon River has been diverted to condense steam after it has been used to power the generators. In this way pure water can be used over and over again to operate the generators.

During warm weather the plant uses 100,000 gallons per minute. This is a rate of 50,000 gallons per minute per unit (two of three units operating).

At other times each unit requires 27,000 gallons per minute.

Generally there is a rise of from 15 to 20 degrees in the temperature of the water used by the plant, Mr. Howard said. Temperatures of the water at the intake and discharge outlet were taken to ascertain what this might mean on a summer day. Water at the intake (on July 8 at 4:30 p.m.) ranged from 78° F. at the surface to 77° F. at a depth of five feet. Water at the mouth of the outlet pipe (where it enters the discharge channel) ranged from 90° F. at the surface to 91° F. at a depth of three feet. This was a rise of from 12 to 13 degrees.

To determine what effect this heated water had on the lake, if any, the party took a series of temperature readings from the mouth of the discharge pipe to a point well out into the lake. It should be noted that the discharge channel from the mouth of the outlet pipe runs about 1,700 feet to the North Channel (Cedar Creek) at a point some 1,250 feet from its mouth. Or, in other words, the heated water must run some 2,950 feet before it comes to the lake.

At the mouth of the discharge channel, where it empties into the North Channel, the surface temperature read 87° F., and at a depth of two feet the temperature was 85.1° F.

At the mouth of the North Channel the surface temperature was 85° F., and at a depth of two and one-half feet (the river bed) the temperature was 70.5° F. Compared with the temperature recorded at the mouth of the outlet pipe, this is a drop of five degrees at the surface and 20.5 degrees at two and one-half feet. The effect of the cold river water is readily apparant.

About 300 yards out into the lake two more readings were taken. The surface temperature read 82° F., and at five feet the temperature was 72.5° F.

This shows further reduction of the surface temperature, but a slight rise a few feet below the surface. Thus it would appear that the river water, including the discharge from the electric power plant, was slightly cooled at the surface when it entered the lake, but warmed slightly from the temperature recorded at two and one half feet (near bottom).

It seems likely that during the winter, when river temperatures are considerably lower, and when less water is discharged by the power plant, that the much greater volume of river water (over that of the discharge channel) would have the effect of cooling the discharge from the power plant to such an extent that it would have little warming effect for any appreciable depth of water or surface area. During the winter, the river would naturally be warmer than the frozen lake surface. This, plus the river current, would cause unsafe ice conditions near the mouth of the river.

Biological Characteristics

Almost two thirds of the north shore consists of a narrow strip of encroaching marsh. There is a heavy stand of bulrushes (Scirpus sp.) along much of the rest of the north shore at the water's edge. At either end of the lake along this shoreline are bays which are profuse with vegetation, including bulrushes, pondweeds, (Potamogeton), coontail (Ceratophyllum), water milfoil (Myriophyllum), yellow water lily (Nuphar), eel grass (Vallisneria), and hornwort (Chara). Where the shores encroach, bulrushes and cattails (Typha) are dominant. On the shoals, for the most part, vegetation is sparse and consists of Potamogeton and Chara. One exception is a central shoal that extends midway into the lake and which is heavily covered with pondweeds which in turn are blanketed with algae. In depth and bottom soil this area is similar to the sparsely vegetated shoals. No explanation for the unusually heavy growth was apparent to the party. Vegetation present in the lake seems sufficient to provide cover, habitat for food organisms, and spawning facilities for fish life.

In order to determine the possible effect of pollution[2] upon bottom fauna and flora, two bottom-sample transects were taken on either side of a pulp and paper mill (Central Paper Company) in the southwest end of the lake, and two bottom samples were taken at possible sources of pollution in the east end of the lake.

Residents complain of pollution from the paper mill. They say the fish are tainted, and that they taste like a "foul" odor that is associated with the paper mill when in operation. (Certain members of the staff of the former Stream Control Commission have stated that the pulp mill discharges a waste which may taint fish) A lime deposit on the lake bottom near the paper mill is the source of additional complaint. This waste comes from a huge sludge pile which has in the past been allowed to drain into the lake. An attempt is being made by the management to put a dike between the waste pile and the bay where the contamination is evident.

The sewage plant of the city of Muskegon was the subject of the following:

> The State Health Department in a letter to the (Muskegon) city manager, November 6, 1945, stated as follows ".....to meet the requirements of this Department, a degree of treatment approximating and certainly not materially less than is currently attained should be provided. It appears that, to provide this degree of treatment, additional sedimentation capacity, sludge handling facilities, chlorination equipment and various miscellaneous items are immediately necessary." The Muskegon disposal plant has been overloaded, but neither the Water Resources Commission nor its predecessor, the Stream Control Commission, have adopted an order to declare the plant inadequate. (L. F. Oeming.)

The plant is located between the Middle and South channels of Muskegon River, west of Highway U.S. 31. Treated sewage empties into both channels of the river. The Middle channel has been diverted by the Consumers Power Company plant so that it flows into the South channel some 900 feet from its mouth. This has the effect of concentrating any pollution near the mouth of one channel only.

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[2] The following several paragraphs dealing with the pollution aspect were reviewed by Mr. L. F. Oeming, Chief Engineer, State Water Resources Commission, and several of his contributions to the section are appropriately identified. Mr. Oeming's assistance is appreciated.

An offender named by the former Stream Control Commission (now Water Resources Commission) is the Continental Motors Corporation. This factory is located at the mouth of Ryerson Creek in the east end of the lake. Four waste pipes were observed emptying into the lake at the plant site. Three of these carry some type of waste, while one apparently carries hot water only. Two of the waste pipes empty into a lagoon at the mouth of Ryerson Creek. Bushes and other vegetation on a finger of land that demarks the lagoon from the rest of the lake have been killed and are blackened as if by oil and grease.

> Construction of facilities for treatment of oil waste is now approaching completion at Continental Motors. (L. F. Oeming.)

Ryerson Creek has been known to carry some pollution, the sources of which are described by Mr. Oeming, as follows:

> Sources of pollution primarily sewage and storm water mixtures from combined sewer overflows during periods of surface run off. Domestic wastes from individual residences and businesses having sewer connections direct to the creek are probably present also. No known discharges of industrial wastes. (L. F. Oeming.)

The first bottom-sample transect taken in Muskegon Lake was begun in a bay just west of the paper mill. The first two samples, taken in two and seven feet of water, contained lime. Only one small plant was observed on the shoal where the first sample was taken, and only dead or dying vegetation was found where the second sample was taken. The first sample contained one gastropod and one chironomid. The second contained nothing but empty snail shells and caddis cases.

The third, fourth, and fifth samples, taken in line with the first two and extending out into the lake, contained 3.2, 5.9, and 2.6 cubic centimeters of organisms, respectively. The third sample was obtained at a point about 500 yards from shore and the fifth a little more than three-fourths of a mile.

The bay in which the transect was begun has a sand shoal and a slight beach. It is barren of vegetation and of fish, too, apparently. Immediately west of this bay are boat liveries and docks built in tiny bays separated by fingers of land. In these small bays, cut off from the effects of the paper mill effluent and wave action, vegetation is profuse and sunfishes spawn.

A second transect was taken in a bay just east of the paper mill to determine the effects of possible pollution on that side of the mill. This bay presents an entirely different biological picture. The shore is encroaching; the bottom is sand, pulpy peat, and detritus; and the bay is well vegetated. On the day the bottom samples were taken, fish were noted feeding over the entire bay. Further comments concerning this bay follow:

> Bay to east of mill receives all pulp and paper mill wastes. Fish killings occurred twice in 1950, on August 3 and on September 13. Observations disclose extensive sludge deposits of paper mill origin. Company called to Commission conference November 21, 1950. Commitment made for program of waste disposal improvements. (L. F. Oeming.)

Whereas pollution does not seem to have affected fishes and plant life on the east side of the mill, the volume of bottom organisms obtained was less in all samples than the least of the last three samples taken in the transect west of the mill. Random observations of the bottom in front of the paper mill indicate that the pollution has little effect beyond 250 to 300 feet out into the lake from the mill, or in about 53 feet of water.

> Presence of gas-lifted sludges has been reported in the past. Waste formerly discharged through outlet direct to lake on this frontage. (L. F. Oeming.)

Throughout the survey plankton was noted as abundant. An examination of bottom samples indicated that aquatic earthworms (Oligochaeta) predominate in the pulpy peat soils of the depths, though midge larvae are present in goodly numbers. On the shoals, caddis fly larvae, midge larvae, dragon fly nymphs, and mayfly nymphs were the dominant insects forms. Scuds and crayfish

are common. In one area every bit of detritus was literally alive with scuds. Minnows are generally common, with one or two forms dominant (Table 1).

Fish were collected during the survey to determine the relative abundance and kinds (Table 1). Scale samples were taken from game species to compare their average growths with the state-wide averages which have been obtained for seven species (Table 2). Thirty-one species and two hybrids were collected by four different methods; gill net, trap net, seine, and hook and line.

Netting returns and reports from fishermen and boat liverymen show that Muskegon Lake has an abundant population of game and panfish other than walleyes. Northern pike, white bass, and largemouth bass, dominate the game fish population. Yellow perch, bluegills, rock bass, black crappies and pumpkinseeds lead the panfish population. Bullheads, sheepsheads, smallmouth bass, and warmouth bass are taken in lesser numbers than other fishes.

Rough and obnoxious fish are present in large numbers. They are carp, redhorses, bullheads, sheepsheads, suckers, bowfins or dogfish, and longnose gars. The bowfins and gars seemed concentrated in the east end of the lake, as were the carp, though carp appeared distributed throughout the lake.

It seems safe to say that Muskegon Lake has a most satisfactory abundance of fish life. These fish are for the most part concentrated on the northern shoals of the lake and hence removed from the shipping lanes and industrialized areas of the lake. There are fish to be had even along the Muskegon city shoreline, however, and residents on that side of the lake utilize these fish.

An extensive examination of the shoal areas was made to determine the extent of suitable spawning areas for the walleye and other game fishes. It has been noted before that these shoals are of a sandy nature. Walleyes seem to prefer rubble and boulders for spawning areas, though they will use finer gravel. Very little gravel was noted, and this was scattered. On the industrialized shores of the lake some parts of the shore have been extended out

Table 1. Muskegon Lake Fishes[3/]

Game species	Size range inches	Percent of collection Summer survey 1936	1950	Number	Total
Northern pike (Esox lucius)	13.9-39.4	0.2	1.8	52	
White bass (Lepibema chrysops)	12.5-13.5	...	0.4	12	
Yellow perch (Perca flavescens)	2.9-10.5	32.2	22.8	620	
Walleye (Stizostedion vitreum)	7.2-21.8	0.9	1.4	40	
Sauger (Stizostedion canadense)	...	0.2	0.5	16	
Largemouth bass (Micropterus salmoides)	8.0-15.6	...	3.7	110	
Smallmouth bass (Micropterus dolomieu)		0.2	0.3	8	
Bluegill (Lepomis macrochirus)		43.9	40.9	1,200	
Pumpkinseed (Lepomis gibbosus)		17.4	10.6	312	
Rock bass (Ambloplites rupestris)		3.2	8.2	240	
Black crappie (Pomoxis nigro-maculatus)		0.9	8.3	244	
Warmouth bass (Chaenobryttus coronarius)		...	.03	1	
Pumpkinseed x bluegill	6.9- 9.1	...	1.0	29	
Pumpkinseed x warmouth	...	...	.03	1	2,935
Coarse fish					
Common white sucker (Catostomus commersonnii)	8.0-21.0			140	
Redhorse (Moxostoma)	12.5-23.7			69	
Freshwater sheepshead (Aplodinotus grunniens)	...			16	
Northern channel catfish (Ictalurus lacustris)	...			3	
Northern black bullhead (Ameiurus melas)	...			85	
Northern brown bullhead (Ameiurus nebulosus)	4.7-10.7			37	
Northern yellow bullhead (Ameiurus natalis)	4.8-13.3			12	362
Forage fish					
Western golden shiner (Notemigonus crysoleucas)	...			28	
Northern blacknose shiner (Notropis heterolepis)	...			83	
Bluntnose minnow (Hyborhynchus notatus)	...			126	
Northern brook silversides (Labidesthes sicculus)	...			1	
Western banded killifish (Fundulus diaphanus)	...			10	
Northern log-perch (Percina caprodes semifasciata)	...			1	
Iowa darter (Poecilichthys exilis)	...			8	
Tadpole madtom (Schilbeodes mollis)	...			1	258
Obnoxious fish					
Northern longnose gar (Lepisosteus osseus oxyurus)	17.2-33.4			27	
Bowfin (Amia calva)	17.4-24.0			26	
Carp (Cyprinus carpio)	6.1-24.2			78	131
					3,686

[3/] Collected with gill net, trap net, seine, and hook and line.

Table 2. Growth Rate of Muskegon Lake Fishes[1]

Species	I	II	III	IV	V	VI	VII	VIII	IX	Growth index
Walleye	7.1 (2)	11.6 (7)	13.4 (3)	16.3 (4)	17.7 (2)	16.6 (6)	16.6 (4)	20.1 (7)		
Yellow perch	3.4 (28)	5.7 (15)	6.4 (8)	8.0 (16)	8.9 (7)	9.4 (5)	10.4 (1)	10.5 (1)		+0.2
Largemouth bass	5.8 (4)	9.3 (29)	11.3 (8)	13.0 (10)	14.3 (5)					+0.8
Bluegill	2.3 (9)	4.1 (23)	5.6 (7)	5.2 (2)	6.3 (2)	6.5 (8)	6.8 (3)			-0.5
Pumpkinseed	2.4 (9)	3.9 (21)	5.7 (11)	5.9 (8)	4.5 (1)					+0.1
Rock bass	2.9 (1)	4.0 (10)	5.6 (26)	7.3 (18)	7.5 (11)	...	8.1 (4)	9.9 (2)	9.2 (2)	+0.1
Black crappie	3.4 (2)	6.3 (7)	7.5 (1)							-0.1

[1] Those species for which state-wide averages have been determined, except walleyes. Growth indices are the average deviations of year classes from the state average. For panfish any deviation within the range +0.5 to -0.5 is considered normal--and is average growth. For game fish such as largemouth bass, a deviation of one inch or +1.0 to -1.0 is allowed. Any index figure within this range also is considered average growth.

into the lake by the dumping of debris and wastes. In some cases broken fragments of concrete and other rubble extend down into the water from these piles. Despite the extreme drop-off caused by these fills, it may be possible that limited spawning areas are available at some of these places. Other possibilities for spawning on substitute material exist in water of about 12 feet where rubble, usually in the form of cinders and similar material, has been dumped into the lake. Walleyes usually spawn in water three feet deep or less, however. Extensive clam beds have been reported in the lake, and many clam shells were retrieved by the survey party from their nets. If such beds do exist, they may also offer spawning areas. But from all appearances, spawning areas in the lake for walleyes are limited in number and extent. The Muskegon River, however, should offer adequate spawning grounds especially in the upstream areas of faster water and gravel bottoms.

Areas for those sunfishes which prefer gravel for spawning are extremely limited. Redds of pumpkinseeds and bluegills were noted in pure sand. Each redd contained several small snail shells (snail shells are abundant), however, these apparently proving to be a satisfactory substitute for gravel.

One indication of the congestion on spawning grounds is the extensive hybridization between bluegills and pumpkinseeds. Sunfishes such as large-mouth bass and bluegills have been noted to spawn around the roots of vegetation where gravel is lacking. Apparently such spawning takes place in Muskegon Lake. Rock bass seem little bothered by the lack of gravel and utilize bits of debris that are always to be found along the shoals. Dense vegetation and marshy areas seem to be providing satisfactory spawning areas for perch and northern pike. It should be noted that the lake recruits a sizeable portion of its yellow perch from Lake Michigan, and the "run" provides residents with excellent fishing.

The survey netting showed that the walleye is limited in abundance during the summer. The various ages and sizes of those which were collected indicate that the lake is either producing a reasonable number of walleyes or that it is recruiting a small population from elsewhere.

Boat livery operators report that the last good walleye fishing existed in Muskegon Lake about four or five years ago. The largest numbers of these fish reported recently in the general creel census were in the years 1946 and 1947, although walleyes in numbers were reported during the period 1933 to 1936. Some of the livery operators believe that the population is on the upswing, that it goes in cycles. These men reported an increasing abundance of small walleyes from five to seven inches and 10 to 14 inches caught through the ice by perch fishermen during the winter of 1949-50. A good catch of walleyes in the diverted channel of the Muskegon River was reported during the spring of 1950. These fish reportedly ranged from 10 to 17 inches. The size of the walleye population in the summer is not necessarily related to the number of walleyes found in the lake in the winter and spring, since it is known that there is a large spawning run through Muskegon Lake.

Perch seem to be the fish most utilized by the angler. Bluegills and rock bass were also noted as prominent in catches. A special creel census in 1948 and twelve years of general creel census records from 1933-1949 (exclusive of some years) confirm these observations (I.F.R. Report No. 1246). In 1948 the special creel census showed that yellow perch, bluegills, and rock bass were caught in largest numbers, and in that order of abundance. Angling success, measured in catch per hour, compares favorably with records from other southern Michigan lakes. Average catch per hour for twelve years in the general creel census was 1.87. The catch of yellow perch seems to have been the influencing factor in the yearly catch per hour in recent years.

During the 1948 census period, May to September, a total of fifteen species of fish were caught by anglers. Besides the three species mentioned, game fish taken were; largemouth and smallmouth black bass, walleyes, and northern pike. Other panfish caught included pumpkinseed sunfish and black crappies. Non-game fish taken were suckers, white bass, bowfins, catfish, bullheads and saugers.

Records show that panfish are caught in largest numbers. They comprise 91.4 percent of the catch. Game fish make up 6.8 percent of the catch. Still fishing was the method employed by the large majority of fishermen. Trolling and casting were the next most frequent methods used, while closely following these were anglers using a combination of methods.

It was estimated that about 40,000 angling days were spent on Muskegon Lake in 1948 during which anglers fished 138,000 hours and caught 133,000 fish.

A summary of creel census records taken in twelve years between 1933-1949, shows the same end results as the 1948 census indicated. Yellow perch, bluegills, and rock bass, in that order, were caught in most numbers. In various years, however, the number of walleyes, bluegills, or rock bass exceeded those of yellow perch. In 1933-1934 walleyes topped the list. In 1935 rock bass were most numerous in the catch. In 1942, 1944, bluegills took the honors.

The number of walleyes taken declined after 1936. They have been reported in small numbers ever since. Of the other fishes reported in the general creel census during the twelve years, black crappies, pumpkinseed sunfish were prominent. Northern pike, white bass and bullheads were reported in lesser numbers, and other fish were of little significance.

The survey party noted that anglers tend to fish well out into the lake near the drop-off both when still fishing and when trolling. Yet along much of the shore where bulrushes and cattails encroach there are small, protected

bays, in which many legal perch, bluegills, pumpkinseed, largemouth bass, and bluegill-pumpkinseed hybrids were either taken by seine, hook and line, or observed in the shelter which these encroaching shores provide. Few fishermen were noted utilizing this "edge" or "bay" fishing.

This large fish population of Muskegon Lake may be overlooked and hence not fully utilized where anglers are concerned with one species of fish only, such as the walleye. If it is true that spawning facilities are limited, that the walleye population is recruited from Lake Michigan and that walleye populations are subject to fluctuation, then it seems that the angler might well concentrate on other game fish when these factors combine to cause a temporary decline in the walleye population.

No management regulations are being made. Those species of fish for which the lake is suited are reproducing satisfactorily and are present in adequate numbers. Vegetation, deadheads, and piling provide the needed shelter. Pollution is either being controlled or measures for its control have been proposed. Special as well as general fishing regulations apply to the lake and are adequate.

Summary

Muskegon Lake has had an historical association with commerce and industry. It seems that the commercial use of the lake will continue to be of primary importance.

The lake produces an abundant fish population, and it is heavily fished. Game fish attain average growth. Yellow perch, bluegills, and rock bass make up the bulk of the catch. Still fishing is the predominant method of angling. Angling success, measured in catch per hour, compares favorably with other records from southern Michigan lakes. The perch is responsible for fluctuation in catch per hour.

Walleyes are limited in abundance during the summer. Various ages and sizes of those collected indicate that the lake is either producing a reasonable number of that it is recruiting a small population from elsewhere.

Pollution has affected fish life locally along the south shore of the lake, but is either being controlled, or measures for its control have been proposed.

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