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Institute for Fisheries
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Report No. 1255

A FISHERIES SURVEY OF OTSEGO LAKE, OTSEGO COUNTY, MICHIGAN

By Clarence M. Taube

Abstract

Otsego Lake, a popular retreat for fishermen and vacationists, has an area of nearly 2,000 acres, about 85 percent of which is less than 15 feet deep. A biological survey was made of the lake during June 17-July 16, 1949.

Chemical tests showed the water of Otsego Lake to be moderately "hard." Excepting the shallows near shore, aquatic plants were generally abundant, with the submergent type predominating. Principal game fish present are the northern pike, largemouth and smallmouth black bass, bluegill, pumpkinseed, rock bass, and yellow perch. Natural reproduction by these species was found adequate for maintaining the supply. Growth analysis showed bluegills, rock bass, and perch to be developing at a rate somewhat below the State average; except for several year classes of largemouth bass and pumpkinseeds, the other game species exhibited average growth. Coarse fish present are suckers and bullheads, and there are at least nine species of forage fish.

Northern pike are quite abundant here. The average length of 120 pike collected by netting was 21.0 inches and the average weight, two pounds, five ounces. This size compares favorably with that of pike from other Michigan waters. Food analysis showed that the "northerns" fed mainly on perch, while centrarchid fishes (bluegills, sunfish, bass, etc.) ranked second in importance as food.

Otsego Lake has been closed to spearing in winter since 1936; this regulation largely affects northern pike. One group of local sportsmen favors re-opening the lake to winter spearing while another group opposes removal of the ban. The issue is discussed on the basis of applicable data from Otsego Lake and other waters. If it should be decided that the lake will be re-opened to the use of spears, a long-term creel census is suggested for evaluating more definitely the effect of spearing on the quality of pike angling.

Conservation of pike spawning sites apparently has more influence in maintaining the Otsego Lake pike fishery than does the ban on spearing.

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Introduction

Location and Drainage

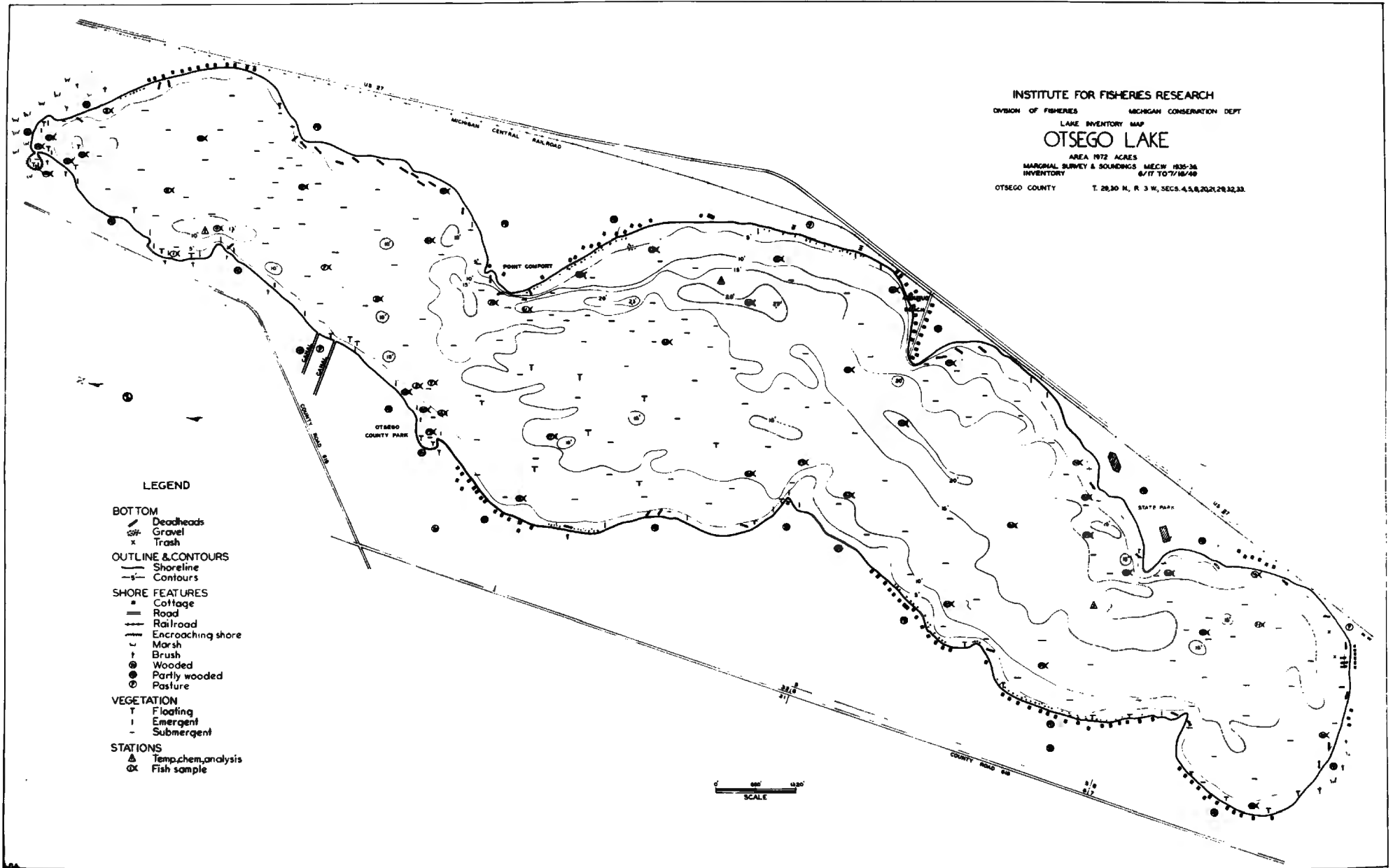
Otsego Lake lies in the north central portion of the Lower Peninsula. Its specific location is Otsego Lake and Bagley townships (T. 29, 30 N., R. 30 W., Secs. 4, 5, 8, 20, 21, 29, 32, 33), Otsego County. Highway US-27 borders the full length of the east shore, and by this road the town of Gaylord is situated three miles away to the north. The lake is within the Au Sable River drainage area but has no direct connection with the stream, for there is neither an inlet nor an outlet. There are numerous other lakes in the vicinity.

Acknowledgments

A map of Otsego Lake was prepared by the MECW in the winter of 1935-36 and a party* from the Institute for Fisheries Research made a biological survey during the period of June 17-July 16, 1949. Symbols noting distribution of aquatic vegetation, location of fish collecting and chemistry stations, and several minor contributions, were added to the original map as a result of the 1949 survey. A number of less intensive investigations were made here in previous years by Department of Conservation personnel, and reference will be made to some of these studies in the report.

*/ Clarence M. Taube, leader; James R. Nyburg and Ormond C. Pailthorp, assistants.

INSTITUTE FOR FISHERIES RESEARCH
 DIVISION OF FISHERIES MICHIGAN CONSERVATION DEPT
 LAKE INVENTORY MAP
OTSEGO LAKE
 AREA 1972 ACRES
 MARGINAL SURVEY & SOUNDINGS MECW 1935-36
 INVENTORY 6/17 TO 7/16/60
 OTSEGO COUNTY T. 29.30 N., R. 3 W., SECS. 4, 5, 8, 20, 21, 29, 32, 33.



LEGEND

- BOTTOM**
 Deadheads
 Gravel
 Trash
- OUTLINE & CONTOURS**
 Shoreline
 Contours
- SHORE FEATURES**
 Cottage
 Road
 Railroad
 Encroaching shore
 Marsh
 Brush
 Wooded
 Partly wooded
 Pasture
- VEGETATION**
 Floating
 Emergent
 Submergent
- STATIONS**
 Temp. chem. analysis
 Fish sample

0 500 1000
 SCALE

Past and Present Use

Otsego Lake was rather extensively utilized by the logging industry. Mr. Frank Shipp, of Gaylord, and Mr. James J. White, of Waters, have kindly contributed the information in the following paragraph relating to early-day lumbering activities here.

A year after a railroad had been extended to the south end of the lake in 1872, a saw mill was built on the south shore and operated for about 10 years. Another mill was erected around 1875 on the east shore, a mile or so south of where Geigler's Resort is now located. These industries used the lake for log storage. The wood consisted almost entirely of pine from land lying east of the lake. In the later 1800's a third mill was built by Lewis Jenson a short distance north of the one last mentioned above, and here mostly hardwoods and hemlock were sawed because by this time most of the local pine had been harvested. These logs came chiefly from west of the lake. They were sledded onto the ice in winter to be towed across the lake to the mill by an engine-powered, paddle wheel scow after the spring breakup. Jenson's industry functioned for approximately 25 summers. About 1890, Thomas and Richard Hartnell set up a small mill on the site of Geigler's Resort, and this operated for about 10 years.

Large quantities of timber wastes were thrown into the lake near the mills. Submerged deadheads, slabs, and chips exist in considerable abundance yet to this day.

Since the lumbering era, Otsego Lake has become a widely known resort and recreational center. Not only is the lake the life blood of commercial developments on its shores, but also it nourishes the tourist industry of Gaylord and other nearby communities. Fishing affords one of its greatest attractions, although boating and swimming are important, too.

On the shores and immediately east of US-27 are numerous cottages and dwellings. Also associated with the lake are three hotels, about 45 resorts, and around 25 boat liveries. Otsego Lake State Park and a county bathing beach are located on the east shore and a county park is found on the west shore. Fishermen and tourists use these areas extensively to gain access to the lake. Both the state park and the county park provide camping privileges and have bathing beaches.

Physical Characteristics

General Description

Otsego Lake is long and relatively narrow, its long axis lying in the north-south direction. The maximum length is about 4 1/2 miles; the maximum width is slightly less than one mile. The lake is generally shallow. About 85 percent of its area is less than 15 feet deep. It is subject to considerable wave action, especially from winds out of the north and south.

As to the origin of Otsego Lake, Scott^{*} notes that it was formed with the melting of a huge block of glacial ice in a pit. Scott presents some interesting views as to how a number of the shore features were developed, but since the discussion is largely beyond the scope of this report, it will not be given here except for the following comment regarding the "beaver dam."

The south shore of the lake is bounded by the so-called "beaver dam" which, local tradition to the contrary, is one of the best examples of a bar seen by the writer. This form... is composed entirely of sand and joins the east shore in an unbroken curve. Its crest stands slightly above the level of the higher [water] stage, except for the last hundred feet at the west end, and supports a fringe of trees which accentuates the linear character of the bar...a similar bar may be seen stretching across the triangular lagoon isolated by the "beaver dam." This bar, however, stands at a lower elevation and is poorly defined. Both of these bars were formed during the higher stage and obviously the outer bar developed first...The currents instrumental in their formation were those driven by northwest winds along the shore south of First Point [at the State Park].

^{*} Scott, I. D., Inland Lakes of Michigan, Wynkoop Hallenbeck, Crawford Co., Lansing, 1921. pp. 227-234.

Two moraines parallel much of the length of the lake, one off each side. Second-growth timber occurs on a considerable portion of the moraines and the inter-morainal depression. The soil of the region is chiefly sand.

Drainage and Water Fluctuation

Including the basin of the lake, the drainage area probably is less than 15 square miles. The lake has neither an inlet nor an outlet, but evidently intermittent connection with Mud Lake occurs during times of high water, as in early spring. Apparently long ago, when the water was at a much higher level, there was an outlet to the North Branch of the Au Sable River. Evidence of former connection consists of a non-functional channel located off the east shore, near Ken-Mar Lodge.

According to local residents, some years Otsego Lake shows marked fluctuation of level. Low levels have caused some concern at times. Scott * states that exceptionally high water prevailed in 1913.

Physical Factors in Relation to Fisheries

Shoals generally are more productive of fish-food organisms and fish than are deep areas. Since a large part of Otsego Lake consists of shoal, this is a factor in favor of the lake. The greatest depth is only 23 feet. The map shows only four relatively small areas enclosed by 20-foot contours.

The bottom soil of much of the shallows near shore consists of sand. Gravel is mixed with the sand at several locations. In some places pulpy peat extends right up to shore; pulpy peat is the principal bottom soil at depths exceeding five feet.

The water is colorless. The secchi disc (a thin metal, circular plate eight inches in diameter used to test transparency of water) disappeared from sight at depths ranging from 10 to 12 feet. Presence of a moderate bloom of

* Ibid.

plankton doubtless reduced the usual transparency to some degree, but the value found is about average, although some lakes are much clearer. Average or below-average water clarity is indicative of better fish production than is great clarity. On the other hand, degree of transparency largely determines the extreme depth at which rooted aquatic plants will be found. Light penetration, of course, depends on transparency, and vegetation requires sunlight for photosynthesis, the vital food-manufacturing process of plant life.

Table 1
Physical Data for Otsego Lake

| Area, acres | Maximum depth, feet | Percent shoal (depth less than 15 feet) | Bottom types | | Secchi disc, feet |
|-------------|---------------------|---|--------------------------|------------|-------------------|
| | | | Shoal | Depths | |
| 1,972 | 23 | 85 | Sand, gravel, pulpy peat | Pulpy peat | 10-12 |

Temperature and Chemical Characteristics

Water temperatures and dissolved gases and mineral salts are important factors affecting the productivity of a lake. Table 2 summarizes the temperature and chemical conditions found in Otsego Lake.

Table 2
Temperature--Chemical Data for Otsego Lake, July 11, 1949

| Analyses | Location of stations | | |
|--------------------------|---------------------------------|-------------------------------|----------------------------|
| | West side, north of County Park | East side, near Pleasant View | East side, near State Park |
| | #1 | #2 | #3 |
| Surface water: | | | |
| Temperature, °F | 74 | 76 | 74 |
| Oxygen, p.p.m. | 8.0 | 8.2 | 8.7 |
| CO ₂ , p.p.m. | 0.0 | 0.0 | 0.0 |
| M.O. alkalinity, p.p.m. | 70 | 70 | 70 |
| pH | 7.8 | 7.6 | 8.1 |
| Bottom water: | | | |
| Depth of sample | 9 | 15 | 11 |
| Temperature, °F | 73 | 72 | 72 |
| Oxygen, p.p.m. | 7.8 | 8.1 | 8.7 |
| CO ₂ , p.p.m. | 0.0 | 0.0 | 0.0 |
| M.O. alkalinity, p.p.m. | 70 | 70 | 70 |
| pH | 8.0 | 7.8 | 8.1 |

Temperatures and dissolved oxygen values were rather uniform from surface to bottom, and quite adequate for the resident fishes. Water temperatures ranged from 72° to 76° Fahrenheit in mid-July; dissolved oxygen varied from 7.8 to 8.7 parts per million parts of water. Four parts per million of oxygen is generally considered the minimum concentration which should be available for fishes, although they can exist with somewhat less.

Methyl orange alkalinity tests gave a value of 70 ppm, of dissolved mineral salts (mainly calcium carbonate or lime). This reading indicated that the water of Otsego Lake is moderately "hard." Still it allows good soap suds to be formed, which shows that it is not so hard as the water in many lakes and wells of the State. Lakes which have moderately hard water usually are more productive than soft-water lakes.

The pH (hydrogen ion concentration) value indicates the degree of acidity or alkalinity. The water of Otsego Lake was found to be slightly alkaline. Fish exhibit a rather broad range of pH tolerance, but waters which are moderately alkaline generally are more productive than acid waters.

No evidence of pollution was observed or reported.

Biological Characteristics

Vegetation

Aquatic vegetation is generally abundant in Otsego Lake, but except for a few sheltered locations, plants are largely lacking in the shallows near shore. This scarcity doubtless is due to the combination of strong wave action and predominance of a sand bottom in shallow areas. Plants (mainly submergents) begin to appear in appreciable abundance on the peat bottom in deeper water. For the lake as a whole, the submergent type is far more abundant than either the emergent or floating types.

Emergent vegetation occurs at scattered locations along shore and consists chiefly of bulrushes. The floating type of vegetation is sparse, although

there are beds of yellow and white water lilies, confined mostly to the north end of the lake; floating-leaf Potamogeton is found at a number of places in the central part of the lake. The predominant submergents consist mainly of pondweeds (Potamogeton). A narrow-leaved pondweed is especially common in depths from 10 to 15 feet. Other submergents include musk grass (Chara) and water star grass.

Fish Foods

Plankton is a highly important link in the fish-food chain. Plankters serve as forage for larger organisms which in turn are eaten by fish. Some plankton is also directly consumed by fish. When these small organisms reach such abundance as to cloud the water, a lake is commonly said to be "in bloom." A "bloom" of moderate intensity was noted on Otsego Lake beginning late in June and continuing into July.

Bottom food organisms which occur here include nymphs of dragon flies, damsel flies, and mayflies, and larvae of caddis flies and midges. While fair numbers of insect forms were apparent at the time of the survey, evidently the overall supply is proportionately small in comparison with the considerable population of insect-feeding fishes present. Crayfish were found to be common, and appeared most plentiful among the wood debris submerged off the east shore and near the north end of the lake.

The Fishes

A list of the fishes which were collected or reported from Otsego Lake is given in Table 3.

Eight species of game fish were collected during the survey. Northern pike, bluegills, and pumpkinseeds predominated among the game species caught with gill nets, hook and line, and seine. However, yellow perch, largemouth and smallmouth black bass, and rock bass were also well represented. No walleyes

Table 3

List of Fishes Taken in 1949 or Reported in Other Years,
Their Relative Abundance, and Stocking in Otsego Lake

| Common name | Scientific name | Relative abundance | Numbers stocked, 1933-1945 |
|------------------------|--------------------------------|--------------------|----------------------------|
| Game fish: | | | |
| Northern pike | <u>Esox lucius</u> | Abundant | ... |
| Yellow perch | <u>Perca flavescens</u> | Abundant | 457,500 |
| Walleye */ | <u>Stizostedion v. vitreum</u> | ... | 5,010,000 |
| Largemouth black bass | <u>Micropterus salmoides</u> | Common | 11,500 |
| Smallmouth black bass | <u>Micropterus dolomieu</u> | Common | 13,392 |
| Rock bass | <u>Ambloplites rupestris</u> | Common | ... |
| Bluegill | <u>Lepomis macrochirus</u> | Abundant | 273,750 |
| Pumpkinseed | <u>Lepomis gibbosus</u> | Abundant | ... |
| Longear sunfish | <u>Lepomis megalotis</u> | Few | ... |
| Coarse fish: | | | |
| White sucker | <u>Catostomus commersonii</u> | Common | ... |
| Black bullhead | <u>Ameiurus melas</u> | Common | ... |
| Yellow bullhead | <u>Ameiurus natalis</u> | Common | ... |
| Forage fish:**/ | | | |
| Blacknose shiner | <u>Notropis heterolepis</u> | Common | ... |
| Blackchin shiner */ | <u>Notropis heterodon</u> | ... | ... |
| Mimic shiner | <u>Notropis volucellus</u> | Few | ... |
| Common shiner | <u>Notropis cornutus</u> | Few | ... |
| Bluntnose minnow | <u>Hyborhynchus notatus</u> | Common | ... |
| Tadpole madtom */ | <u>Shilbeodes mollis</u> | ... | ... |
| River chub | <u>Nocomis micropogon</u> | Few | ... |
| Hornyhead chub | <u>Nocomis biguttatus</u> | Few | ... |
| Mudminnow | <u>Umbra limi</u> | Few | ... |
| Banded killifish | <u>Fundulus diaphanus</u> | Common | ... |
| Iowa darter | <u>Poecilichthys exilis</u> | Few | ... |
| Johnny darter */ | <u>Boleosoma nigrum</u> | ... | ... |

*/ Reported taken in former years but none collected during the 1949 survey.

**/ Identifications of 1949 series verified by Dr. R. M. Bailey, Curator of Fishes, University of Michigan Museum of Zoology.

were taken but occasional catches of this species were reported for recent years; these fish probably have been remnants of large walleye plantings made in the 1930s.

Northern pike and bluegills are most sought after by anglers who frequent Otsego Lake. Pike fishing is a big attraction. Black bass receive some attention but they do not excite anywhere near the interest here that pike do. Rock bass, pumpkinseeds, and perch each are of less importance than bluegills.

Coarse fish include the white sucker, black bullhead, and yellow bullhead. It has been thought that Otsego Lake contains a large number of suckers. However, extensive netting and seining did not bear out that opinion. The 38 gill net sets produced only seven suckers. Abundance of suckers conceivably can be overestimated when these fish concentrate on the sandy shoals to spawn.

Black bullheads outnumbered yellow bullheads ^{*} in the collections. Both species attain good size in Otsego Lake.

Seining at various locations off shore produced nine species of forage fish (see Table 3). Bluntnose minnows, blacknose shiners, and banded killifish were found in weedy areas, and for all seining stations combined these species predominated in number, although minnows and related forms as a whole were not abundant.

Three forage species collected from Otsego Lake in former years (1924 and 1925) were not taken in 1949. These species were the blackchin shiner, tadpole madtom, and Johnny darter. The recent failure to capture these fishes may have been due to scarcity rather than absence. In 1949 two species appeared which previously had not been recorded for this lake--the river chub and hornyhead chub. These stream forms quite likely have been introduced into the lake by live-bait anglers.

^{*} The two forms can be differentiated by the color of the chin barbels; the barbels of the black bullhead are blackish or brown whereas those of the yellow bullhead are white or yellowish.

None of the so-called "obnoxious" fish was seen or reported. Carp were stocked in the lake during the early 1900's but fortunately did not become established.

Stocking

As shown in Table 3, yellow perch, walleyes, smallmouth bass, largemouth bass, and bluegills were stocked during 1933-1945. There has been no artificial stocking here since 1945, the last year in which extensive plantings of warm-water fishes were made in Michigan. This change in policy was based on results of investigations which convincingly showed that stocking of warm-water species is not necessary where they are already established. The following discussion discloses the adequacy of natural reproduction in Otsego Lake.

Natural Propagation and Spawning Facilities

Spawning facilities are adequate for the game fishes of Otsego Lake. Extensive shoal provides numerous suitable spawning sites for centrarchids (black basses, rock bass, bluegill, pumpkinseed). Active redds of centrarchids were observed during the survey, and large numbers of young appeared in July. Evidence strongly suggests that spawning of bluegills has not only been adequate but that in some respects probably has even been too successful. Marked abundance, together with sub-average growth rates, are indications that the number of bluegills present exceeds the effective carrying capacity of the lake for this species. This point will be more fully developed in the succeeding section on growth.

Capture of goodly numbers of young black bass and rock bass indicated that spawning facilities are adequate for these species. Although few young perch were observed, general abundance of 5- and 6-inch perch afforded ample evidence of extensive propagation.

The abundance of northern pike attests to the success of their reproduction, and at present the spawning area for "northerns" is sufficient. However, in

evaluating possible future eventualities, some qualifications will be mentioned later under the heading "Management Suggestions."

Growth

Scale samples were collected from game fish for growth studies. Microscopic examination of the scales revealed that the growth rate of bluegills, rock bass, and perch in Otsego Lake is somewhat below the average for the State. Although this lag is not extreme, slower than average growth indicates that spawning and survival are somewhat too successful for production of a more desirable crop. Unbalanced fish populations present an extremely involved problem insofar as control is concerned, but several experiments are now in progress which carry hopes of eventually affording some measure of solution in lakes where control is desired.

Pumpkinseeds and largemouth bass on the whole showed about average growth, although stunting was indicated among pumpkinseeds of age group IV and largemouth bass of age groups I and II. The limited number of smallmouth bass samples indicated average growth for this species. Growth of the northern pike compared favorably with that of samples from a number of other Michigan waters.

Growth data are presented in Table 4. Age-groups are represented by Roman numerals and these numerals indicate the number of year-marks or annuli which were found on the scales. For example, listings under group III show that fish of this classification had lived through three growing seasons; they had begun the fourth growing season when collected.

Interpreting the tabular data further, the state averages for growth were determined from a large number of specimens from different waters on a state-wide basis (Beckman, 1949). The number in parentheses following the average length was the number of Otsego Lake fish found for each age-group.

Table 4. Growth Rate of Otsego Lake Fishes ^{*/}

| Species | Age-group | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Growth index |
|-----------------|------------------------|---------|----------|----------|---------|---------|---------|---------|--------|--------|------|--------|--------|--------------|
| Largemouth bass | Average length, inches | 3.0(5) | 7.3(7) | 11.0(3) | ... | 14.4(2) | 14.7(1) | 16.8(1) | ... | ... | ... | ... | ... | ... |
| | State average | 6.1 | 8.7 | 10.0 | ... | 13.7 | 15.1 | 16.1 | ... | ... | ... | ... | ... | ... |
| | Deviation | -3.1 | -1.4 | +1.0 | ... | +0.7 | -0.4 | +0.7 | ... | ... | ... | ... | ... | ... |
| Smallmouth bass | Average length, inches | 3.1(1) | 9.4(1) | 11.3(1) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | State average | 5.9 | 9.0 | 11.2 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | Deviation | -2.8 | +0.4 | +0.1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| Rock bass | Average length, inches | 1.8(1) | 3.8(12) | 4.4(32) | 5.7(14) | 6.7(5) | 7.1(2) | ... | ... | ... | ... | ... | ... | -0.6 |
| | State average | 3.2 | 4.3 | 5.2 | 6.2 | 7.3 | 7.9 | ... | ... | ... | ... | ... | ... | ... |
| | Deviation | -1.4 | -0.5 | -0.8 | -0.5 | -0.6 | -0.8 | ... | ... | ... | ... | ... | ... | ... |
| Bluegill | Average length, inches | ... | 3.9(1) | 4.8(9) | 5.2(41) | 6.2(60) | 7.2(8) | ... | 7.8(4) | 8.2(5) | 8.4 | 9.2(1) | 8.4(2) | -0.9 |
| | State average | 3.1 | 4.3 | 5.4 | 6.6 | 7.3 | 7.7 | 8.2 | 8.4 | 8.7 | 8.9 | ... | ... | ... |
| | Deviation | ... | -0.4 | -0.6 | -1.4 | -1.1 | -0.5 | ... | -0.6 | -0.5 | -0.5 | ... | ... | ... |
| Pumpkinseed | Average length, inches | 1.9(1) | 3.6(1) | 4.3(9) | 4.8(74) | 5.8(52) | 6.9(7) | 8.1(1) | ... | ... | ... | ... | ... | -0.4 |
| | State average | 2.9 | 4.1 | 4.9 | 5.7 | 6.2 | 6.8 | 7.3 | ... | ... | ... | ... | ... | ... |
| | Deviation | -1.0 | -0.5 | -0.6 | -0.9 | -0.4 | +0.1 | +0.8 | ... | ... | ... | ... | ... | ... |
| Perch | Average length, inches | ... | 4.3(1) | 5.7(35) | 6.2(47) | 7.6(9) | 9.4(2) | ... | ... | ... | ... | ... | ... | -1.0 |
| | State average | ... | 5.8 | 6.4 | 7.5 | 8.5 | 9.5 | ... | ... | ... | ... | ... | ... | ... |
| | Deviation | ... | -1.5 | -0.7 | -1.3 | -0.9 | -0.1 | ... | ... | ... | ... | ... | ... | ... |
| Northern pike | Average length, inches | 14.9(8) | 19.7(61) | 23.4(28) | 23.8(9) | 24.4(8) | 25.9(5) | 30.4(1) | ... | ... | ... | ... | ... | ... |

*/ See the text under the heading "Growth" for interpretation of this table.

The deviation represents the difference between the average length of Otsego Lake fishes and the state average--a minus value if less than state average and plus if above. Average deviation values for any one species gives the growth index for that species in the lake under consideration, as explained by Beckman (1950). A range of +0.5 to -0.5 of the growth index is considered average growth range for species such as bluegills, pumpkinseeds, and perch; for largemouth and smallmouth bass, a range of +1.0 to -1.0 is regarded within the average. As suggested by Beckman (1950), in this study only those deviation values were used for determining the growth index number where at least five fish were represented under an age-group heading. For example, four deviation figures (-0.5, -0.8, -0.5, -0.6) were considered for the rock bass; by adding these figures and dividing by four, the growth index (-0.6) was evolved.

The Northern Pike of Otsego Lake

The pike seems to deserve some detailed consideration in this report because of the considerable play it receives from anglers and also because of local controversy over how pike fishing should be regulated on Otsego Lake.

Abundance and Fishing Success

There is little question that Otsego Lake ranks among the better pike lakes of the State. The collecting done in June and July of 1949 revealed this species to be abundant and well distributed throughout the lake, since almost everywhere nets were set they caught pike. Despite abundance and broad distribution, however, fishing is at times disconcertingly unproductive, although again at other times good catches are taken consistently, and on the whole there is good success.

Random checks made by Conservation Officers, beginning in 1928 and continuing to the present, have provided some records on pike fishing success at Otsego Lake, and analyses of some early data are given in two Institute reports (Hubbs, 1934 and Eschmeyer, 1935). Data collected when this lake was open to

spearfishing show that for different seasons the average time required to spear one pike varied from slightly less than two hours to a little over five hours. The mean for five seasons gave the ratio of 1:3 (one pike per three hours). During the period of 1928-1932 (when spearfishing in winter was legal), summer angling produced one pike for about every 1 1/2 hours of effort. Figures from random checks in January, May, and June, 1949, (the only applicable data of recent years available) indicate that in these months combined, about three hours were required to catch one northern pike with hook and line. For January alone the approximate ratio was 1:2.

The Institute conducted a creel census on the Fletcher Floodwater on the Thunder Bay River throughout the 1948 winter and summer fishing seasons. This investigation showed that spear fishermen in winter spent on the average slightly less than four hours to catch one pike, whereas anglers in spring, summer, and fall caught one pike for about every five hours of fishing (Shetter and Vondett, 1948 and 1949). The summer effort included some fishing for other species, but the winter effort was confined almost entirely to pike.

These various data show that pike fishing success is inclined to vary greatly from year to year. While the records offer some comparisons between spearfishing and angling, no real conclusive evidence of the relative effectiveness of the two methods is apparent.

Size

The 120^{*} northern pike collected with gill nets during the survey of Otsego Lake averaged 21.0 inches long and weighed an average two pounds, five ounces (or 2.31 pounds). The largest pike captured was 30.4 inches long and weighed 5 3/4 pounds.

^{*} A total of 121 pike was actually taken; one of this total is disregarded in the length, weight, and growth data.

A check of 190 pike from Otsego Lake by Conservation Officer Thomas Marlatt during the winter of 1934-35 showed an average length of 20.3 inches; 676 pike checked by C.C.C. personnel that same season were reported as averaging 18.6 inches (Eschmeyer, 1935).

The pike examined during the creel census of the Fletcher Floodwater in 1948 had an average size of 20.1 inches and 1.84 pounds in winter, 19.7 inches and 1.77 pounds in summer (Shetter and Vondett , 1949).

Table 5 lists the size frequency distribution of the 1949 Otsego Lake collection.

Table 5

Length-Frequency Distribution and Average Weight by One-Inch Size Groups of
Otsego Lake Northern Pike

(120 fish collected with gill nets, June and July, 1949)

| Size group. Total length in inches | Number of pike | Average weight in pounds and ounces | Percent of total pike in size group |
|--|-------------------|--|---|
| 13.0-13.9 | 1 | 0-10 | 0.8 |
| 14.0-14.9 | 3 | 0-12 | 2.5 |
| 15.0-15.9 | 3 | 0-13 | 2.5 |
| 16.0-16.9 | 0 | ... | ... |
| 17.0-17.9 | 7 | 1-4 | 5.8 |
| 18.0-18.9 | 7 | 1-7 | 5.8 |
| 19.0-19.9 | 21 | 1-11 | 17.5 |
| 20.0-20.9 | 22 | 1-14 | 18.3 |
| 21.0-21.9 | 10 | 2-5 | 8.3 |
| 22.0-22.9 | 8 | 2-10 | 6.6 |
| 23.0-23.9 | 15 | 2-15 | 12.5 |
| 24.0-24.9 | 7 | 3-2 | 5.8 |
| 25.0-25.9 | 10 | 3-11 | 8.3 |
| 26.0-26.9 | 2 | 4-1 | 1.6 |
| 27.0-27.9 | 2 | 4-11 | 1.6 |
| 28.0-28.9 | 1 | 4-15 | 0.8 |
| 29.0-29.9 | 0 | ... | ... |
| 30.0-30.9 | 1 | 5-12 | 0.8 |

Food Habits

Some stomachs of the net-caught pike were preserved for a food habits study. Use of gill nets for obtaining food habits materials admittedly is not one of the better collecting methods. During the struggles of fish in nets some food is apt to be disgorged; also, digestion may function for a number of hours following the last meal, which further reduces the original volume. Nevertheless, these stomachs have afforded some reliable data.

The contents were determined as consisting entirely of fish. Predominance of fish in the diet of northern pike is characteristic of the species. Traces of vegetation (leaves and stems of Potamogeton) occurred in a few stomachs, but apparently fragments of plants had been taken only incidentally along with fish.

Table 6 summarizes the findings which resulted from the food habits study.

Table 6

Stomach Contents of 38 Northern Pike Collected During June and July, 1949,
from Otsego Lake *

| Kind of food item | Number of items | Volume in c.c. | Number of stomachs with food | Percentage of occurrence | | |
|---|-----------------|----------------|------------------------------|--------------------------|-------------|-----------------------------|
| | | | | Number | Volume | In what percent of stomachs |
| Yellow perch | 17 | 118 | 17 | 37.9 | 47.8 | 47.4 |
| Northern pike | 1 | 21 | 1 | 2.2 | 8.5 | 2.6 |
| Pumpkinseeds | 2 | 58 | 2 | 4.4 | 23.5 | 5.3 |
| Centrarchids (undifferentiated- in addition to identified pumpkinseeds) | 7 | 25.5 | 7 | 15.5 | 10.3 | 18.4 |
| Bluntnose minnow | 1 | 2 | 1 | 2.2 | .8 | 2.6 |
| Fish, unidentified | 17 | 22 | 16 | 37.8 | 8.9 | 42.1 |
| Totals | 45 | 246.5 | 38 | 100.0 | 99.9 | ... |

*
Seventeen additional stomachs were empty.

As shown in Table 6, perch apparently were most frequently eaten by the pike collected in June and July, and perch also made up the greatest volume of food (47.8% of the total). Centrarchid fishes ranked second in volume (33.8%). Since it appears likely that centrarchids as a group considerably outnumber perch in the lake, actual preference for the latter may be indicated.

A food habits study of pike from Fletcher Floodwater (collected with spear in January and February, 1944) showed that perch comprised 46.1 percent of the total content of 28 stomachs while minnows made up 23.5 percent and centrarchid fishes 12.5 percent (Livingston, 1946b). A similar study of Houghton Lake "northern" (collected with hook and line and spear in January and February, 1939) showed perch, centrarchids, and minnows comprised 37.1, 14.5, and 24.4 percent of the total food content, respectively, of 39 stomachs (Livingston, 1946a). Creel census data reveal predominance of perch over centrarchids in the Fletcher Floodwater, a fact which may have accounted for the prevalence of perch over centrarchids from that location. In Houghton Lake, however, relative abundance of these same groups apparently was reversed, so here again a preference for perch may be indicated.

It is suggested that the body shape of perch may influence choice of this species for food when the alternative lies between perch and centrarchids. It is logical to assume that the compressed form of the sunfishes does not allow them to be so easily swallowed. Of course this factor would seem to apply mostly to fish of the larger sizes and may have considerably less influence when small specimens of both groups are involved. The general length of perch found more or less intact in the stomachs of Otsego Lake pike was estimated to have been between four and five inches; two pumpkinseeds averaged 4 3/4 inches.

Only one minnow was found in the 38 stomachs which contained food. The rarity of this item may well reflect the general scarcity of minnows noted during the survey.

One northern pike was the victim of cannibalism. This fish was judged to have been about 10 inches long.

Management Suggestions

Designation of the Lake and the "No Spearing" Order

Fishing laws which generally apply to non-trout lakes north of M-46 are in effect on Otsego Lake. One exception here to the blanket regulations is the ban on spearing. By special order of the Conservation Commission, Otsego Lake has been closed to spearing, beginning in 1937. This order was prompted by local demand, and late in 1949 was renewed again in spite of considerable opposition to continue through 1954. The law affects northern pike almost exclusively since suckers are virtually the only other species which would be available to spear fishermen, and suckers are only of minor significance.

An analysis based on creel census and growth data was made of the Otsego Lake pike spearing question some years ago (Hubbs; Cooper, 1934). Following is a one-paragraph summary of the report on that study.

Two hundred sixty-three of the 474 Otsego Lake fish reported in the general creel census for the summers from 1928 to 1933 were pike (55.5%). There was a recording of 339 pike for the 1931 winter season, and 161 for the winter of 1934, each group apparently representing only a small portion of the total catch for each of these winters. Virtually all of the pike were speared. The average size of 499 pike reported in 1930, 1931, 1933, and 1934 with estimated lengths was 19.1 inches. Scales of 10 northern pike collected in January, 1934, showed four fish of age group II and six of age group III. Since the growth rate of these pike compared favorably with that of pike from other waters, it was decided that the small average size of Otsego Lake "northern" was accounted for by their youth rather than by dwarfing, and the prevalence of

young pike apparently was due to close cropping. The report concluded, "Prohibiting winter fishing, or at least winter spearing on this lake, would be expected to increase the summer catch of pike."

The authors of this earlier report were aware of the limitations of the available data, and the conclusions depended considerably upon logical deductions from these data. When comparing the more recent records with those earlier ones, little significance can be seen in the difference between the 19.1-inch ^{*} average based on estimated lengths and the 21.0-inch average for the 1949 collection which was measured. Also, the majority (50%) of the pike of 1949 were in age-groups I, II, and III; from this it would appear that the ban on spearing has had little, if any, effect in allowing the population to attain an older age (and consequently a generally larger size of individual fish) than prevailed when spearing was permitted. Reliable evidence showing whether subsequent closing of the lake to spearing (in 1937) did or did not increase the summer catch of pike is not available.

Several intensive creel censuses showed conclusively that winter fishing by no means excessively exploited the fishes of the lakes investigated (Eschmeyer, 1937; Hazzard and Eschmeyer 1937 and 1938), and this conclusion appeared applicable to Michigan lakes in general. Because of this finding, and also because many people enjoy ice fishing, these authors concluded that no justification could be seen for restricting the winter sport.

The survey of 1949 showed that pike are presently abundant in Otsego Lake, judging from the numbers of them caught in standardized netting operations. As compared to results of netting on scores of other lakes (records in Institute files), nets in Otsego took a large number of pike. In other words, the abundance of pike in Otsego compares favorably with that of the better pike lakes in the State. Rapid growth is characteristic of pike during the

^{*} Other average lengths (also based on estimates) given for Otsego Lake pike when spearing was legal were 18.6 inches and 20.3 inches, both for the winter season of 1934-35 (see page 15).

first few years, and in Otsego it approximates the normal. Furthermore, the average size (21.0") and age (II-III, mostly) of pike in the Lake compare favorably with other pike lakes in the State, indicating that the Otsego Lake population is not being exploited to an unusual degree.

The present ban on spearing for Otsego Lake is based on the Discretionary Power Act (Act 230, P.A. 1925) which delegates certain powers to the Conservation Commission, including the regulation of taking or killing fish in such waters where any species are determined to be "in danger of depletion or extermination and require additional protection."

There now appears to be no justification for the ban, on the score of depletion. ^{*} The available evidence (although circumstantial) leads to the conclusion that opening the lake to spearing would not have a disastrous effect on angling. The lake was open to spearing prior to 1937 and pike fishing held up well. Pike spearing on many other Michigan lakes, in effect for many years, has not produced disastrous effects on angling in those waters.

The real issue on Otsego Lake is one of conflicting interests between winter and summer fishermen, the latter claiming that spearing would be detrimental to the quality of pike angling. While there is no reason for believing that a disastrous effect would result from re-opening the lake to spearing, there is lack of concrete data showing whether winter spearing would or would not detract anything at all from pike fishing during the open-water season. So if removal of the spearing ban on Otsego Lake is contemplated, and if the Department of Conservation wishes to evaluate more definitely the degree of conflict between spearing and angling here, a creel census is considered necessary. This census would have to be an intensive, long-term study,

^{*} "Depletion" as used by the writer in this report follows Van Oosten's (1949) definition: "...a reduction, through overfishing, in the level of abundance of the exploitable segment of a stock that prevents the realization of the maximum productive capacity."

carried on while the present ban is in force and also for an equal period of time after its lifting. If this course of action is taken, the census should be started soon--preferably yet this year.

Stocking in Otsego Lake

Artificial stocking in Otsego Lake is not recommended. Natural reproduction among the resident fishes is adequate and in some cases even appears to be somewhat too successful, as indicated by the slower-than-average growth rate of some species.

Predators

Only a moderate number of fish predators occur here. Some turtles, a few kingfishers and herons, and occasional herring gulls were observed. If anything, these animals probably exert beneficial rather than harmful effects on the lake, and no control is recommended. Scavenger services provided by the reptiles and birds would seem to outweigh considerably the live fish they eat.

Parasites and Natural Mortality

The fishes of Otsego Lake are not heavily parasitized. A small amount of "black-spot" (Neascus) was observed on some centrarchids and perch, but apparent parasitism is on the whole not common.

A mysterious fish mortality has occurred on this lake in some years. There are records for mortalities in 1937, 1943, and 1948; there was also evidence of a light kill in June, 1949. Such die-offs have been reported for a number of lakes in the State. The cause is unknown, although it has been suspected that some physical or chemical change in the water, associated with the seasonal temperature rise, may be responsible. Species affected at Otsego Lake have included perch, bluegills, pumpkinseeds, bullheads, and, to a lesser extent, bass; in 1937, bullheads were estimated to have comprised

about 85 percent of the total kill. In no year has the loss been dangerously large, nor has the fishing quality been noticeably affected by it. Moreover, from the anglers' point of view, these periodic losses may actually be beneficial by serving as a check on the tendency toward over-population of several species.

Cover

Vegetation and wood debris afford adequate cover for the fishes.

Regulation of Water Level

Sub-normal water levels in some years have been reported for Otsego Lake. While several lake property owners expressed concern about the condition, no practicable means of artificial control is apparent. Provision of a control dam in the outlet stream has proved to be an effective means of regulation on some lakes, but lack of an outlet for Otsego Lake forestalls application of this method here. The level of Otsego Lake is largely dependent on the quantity of precipitation the locality receives and the height of the ground water table.

Spawning Facilities

Spawning facilities at present are adequate for the fishes of Otsego Lake. With regard to northern pike, however, the future status of spawning sites of this species should be given some consideration.

The marsh off the north and northeast shores obviously is the pike "factory" of Otsego Lake. It follows that preservation of this area appears of utmost importance, and seems to have greater bearing on the quality of pike fishing than does the problem of spearing. Filling in of the marsh--as for real estate development, for example--might well exert a disastrous effect. While filling done to date on several lowland areas around the lake has had no noticeable effect on pike production, extension of such development to the north marsh definitely should be discouraged.

INSTITUTE FOR FISHERIES RESEARCH

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