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REPORT NO. 893

A FISHERIES SURVEY OF CROOKED LAKE,
MONTMORENCY COUNTY

by

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Introduction

Location and Drainage

Crooked Lake is located about two and one-half miles southwest of Atlanta, Montmorency County (T. 30 N., R. 2 E., Sec. 23, 24, 26).

It is readily accessible by good gravel roads from Atlanta. A fine camping spot on the high ground on the north side of the middle bay is available to the public. This picnicking area is supervised and maintained by the county. A state public fishing site has recently been developed on the west bay.

The lake is approximately four miles northeast from Avery Lakes. Good trout fishing may be had within driving distance in the upper reaches of the Thunder Bay River, Hunt Creek, Gilcrest Creek and Canada Creek.

Crooked Lake is a pot-hole lake with drainage from the surrounding land serving as the water supply, augmented by Crooked Creek, which drains Avery Lake and flows into the Thunder Bay River from Crooked Lake.

Acknowledgments

The M. E. C. W. made the outline-contour map during the winter of 1937-1938. An early examination of the lake was made by Fish Division

biologists and some data of interest were available from the study.✓
Mr. Slangster, a local resident and secretary of the local conservation club supplied information relative to the past and present history of fishing on Crooked Lake.

The fisheries inventory** was made in August (22-25) 1942, and the data collected were used in this report.

Past and Present Use

Because Crooked Lake is near to Atlanta it has been and probably will continue to be important as a public fishing lake. It is little used for bathing because the immediate shore is marshy and underlaid with muck and marl. There are fourteen cottages on the lake, all located on the ridge along the north shore overlooking the lake. Past fishing is reported to have been good for pike, largemouth bass and perch. Both northern and walleyed pike are present.

Physical Characteristics

Geological Origin

The geological origin of Crooked Lake, as is true of other lakes in this vicinity, is not known. However, the formations of the surrounding fragmentary moraines give evidence of its glacial origin.

Shape of the Basin and Extent of the Drainage

Two narrow channels literally cut the lake into three separate bowl-shaped depressions. The three depressions slant downward sharply from a depth of three feet. The clearness of the water permits one to observe the beauty of the aquatic vegetation to a depth of about twenty feet; and, no doubt, accounts for its existence at those depths.

* Lake Examination: Field No. 160 .. Metzelaar and Langlois, 7-3-25.

✓ The fisheries inventory party included: Hugo Kilpela, leader, R. D. Van Deusen, Pat Galvin, Stanley Lievense, assistants.

Crooked Creek flows northward from Avery Lakes, through Crooked Lake to the Thunder Bay River. Crooked Lake is located approximately three miles from Avery Lake to the southwest and the Thunder Bay River to the northeast.

Water Fluctuation

Water fluctuation has not been a problem in Crooked Lake in the past, but it is believed that there will be a progressive increase in the volume as the plants continue to fill up the outlet. Increasing areas of low shoreward land will be flooded to compensate for the partial stoppage of flow. However, since there are no extensive shore installations on the marshy shore, a higher level might increase productivity by enlarging the shoal area.

Other Physical Data

Crooked Lake had a surface area of 46.5 acres at the time of this survey. Local residents report that the water level has risen about eighteen inches in the last few years because of partial blockage by weed growth at the outlet. Changes were made on the map to compensate for the increased area, especially in the west bay. The maximum depth is 51 feet and approximately 56 per cent of the lake is less than 20 feet deep, most of which supports plant life. In the west basin, marl extends from the shore to the 20-foot contour and a mixture of marl and pulpy peat covers the remainder of the bottom. The north basin contains marl from the shore to about the 30-foot contour, grading into marl and muck; in the shallower end of this depression the bottom is covered with marl to the 20-foot contour and grades into marl and pulpy peat in deeper waters.

The shoreline development is 2.2, which means that the shoreline is 2.2 times as long as it would be if the lake were round and had the same area. In general, the greater the shoreline development, the greater

the plant beds and feeding grounds.

The water is colorless to light brown. The Secchi disk reading was 19 feet, indicating that light penetration is sufficient to permit plants to grow in deeper water than they do in the average inland lake in Michigan.

Wave and Ice Action

No problems concerning wave and ice action were observed by the survey party or reported to them.

Discussion of Physical Factors in Relation to Fisheries

The country surrounding Crooked Lake is sandy and poor for farming. Large acreages are controlled by state, federal and private organizations as forests and hunting and fishing properties. Jackpine and poplar are the predominant trees. The lake itself, however, has accumulated rich deposits of bottom soils and is relatively richer than the surrounding land.

The clarity of the water and the relatively rich bottom soil of the lake probably accounts for the good plant growth.

The inlet and outlet help to maintain the water level and also provide spawning grounds for game fish. Crooked Creek also appears to afford considerable cover for the large numbers of minnows that concentrate at the inlet and outlet of Crooked Lake.

Temperature and Chemical Characteristics

Temperature and chemical analyses were made on Crooked Lake during August (22-25), 1942, by the survey party.

A thermocline (zone of rapid change in temperature) was present in each of the three basins. The thermocline in the west basin into which Crooked Creek flows, was found between 15 and 24 feet, with tolerable oxygen down to 21 feet over the 30-foot depression; in the northern basin a thermocline was located between 15 and 33 feet over the 45-foot depression,

with sufficient oxygen down to a depth of 30 feet; in the east basin, from which the outlet flows, the thermocline was found between 15 and 33 feet, with adequate oxygen to a depth of 30 feet over the 51-foot depression.

The methyl orange alkalinity varied from 175 p.p.m. to 195 p.p.m. (moderately hard water), and the pH varied from 7.2 at the bottom to 8.0 at the surface (distinctly alkaline). The local residents have been removing marl from one end of the lake for use in agriculture.

In the north basin over the 45-foot depression, the temperature ranged from 70.1°F. at the surface to 43.7° at the bottom. The oxygen ranged from 8.1 parts per million at the surface to 0.8 p.p.m. at the bottom and from 4 to 6 p.p.m. through the thermocline. Due to the presence of an active inlet and outlet, oxygen is probably never reduced to the critical point for fish.

The majority of Crooked Lake is suitable for warm-water species of fish, such as crappies, sunfish, bluegills and largemouth bass. However, there is a rather large zone of cold water which at present is not utilized to any great extent except by ciscoes.

No pollution of any kind was found or reported in Crooked Lake.

Biological Characteristics

Vegetation

The following table lists the aquatic plants collected from Crooked Lake by the survey party.

<u>Common Name</u>	<u>Scientific Name</u> *	<u>Abundance</u>
Burr reed	<u>Sparganium chlorocarpum</u>	Few
Hardstem bulrush	<u>Scirpus acutus</u>	Common
Arrowhead	<u>Sagittaria latifolia</u> var. <u>gracilis</u>	Few
Yellow water lily	<u>Nuphar variegatum</u>	Common
White-stemmed pondweed	<u>Potamogeton proslongus</u>	Common
Flat-stemmed pondweed	<u>P. zosteriformis</u>	Common
Large-leaf pondweed	<u>P. amplifolius</u>	Common
Sago pondweed	<u>P. pectinatus</u>	Few
Pondweed	<u>P. americanus</u>	Few
Floating-leaf pondweed	<u>P. natans</u>	Common
Pondweed	<u>P. foliosus</u>	Few
Water milfoil	<u>Myriophyllum heterophyllum</u>	Common
Green milfoil	<u>M. verticillatum</u>	Common
Cocntail	<u>Ceratophyllum demersum</u>	Common
Bladderwort	<u>Utricularia vulgaris</u> var. <u>americana</u>	Common
Stonewort	<u>Chara</u> sp.	Abundant
Bushy pondweed	<u>Najas flexilis</u>	Abundant

✓ Identified by Betty Robertson Clarke

The flora of this lake is composed of all three types of aquatic vegetation, floating, emergent and submergent. The floating aquatics form a sparse band around the upper border of the dropoff. The emergents are found in narrow, scattered beds, while the submergents are most abundant and are found through the shoal area extending to about 20 feet deep. The number of species of plants in the lake is about average and many of them are established over considerable areas.

Fish Foods

Plankton samples taken over the 51-foot depression yielded a fair number of phytoplankton (plant organisms).

Due to the dense beds of vegetation on nearly all of the shoal areas, few bottom samples could be taken. Consequently the organisms on the vegetation received the most attention. The greatest number of insects were found in the vegetation on the narrow shoals, especially between one and four feet deep. The area of the lake between the five and ten foot contour, generally quite productive in many lakes, is small in Crooked Lake, thus limiting the numbers of bottom organisms. The vegetation, however,

whether in deep or shallow water, supported good numbers of organisms.

Fair numbers of chironomid (midge) and Corethra larvae were found in the depths. The organisms found in order of volumetric abundance were as follows: dragonfly larvae, damselfly larvae, mayfly larvae, midge larvae, clams, crayfish, water spiders, mosquito larvae, aquatic earthworms, flat worms, and caddisfly larvae.

A sizable population of forage fish is present in the lake and large numbers can be observed at the inlet and outlet, and in the narrow channel between the west and north basins. The common shiner, bluntnose minnow and horny-head chub predominate.

Ciscoes, which also serve as food for game fish, were collected. The predominant size collected was 12 inches.

Fish Present

<u>Species</u>	<u>Abundance</u>
Game fish:	
Rock bass	Abundant
Largemouth bass	Common
Cisco	Common
Walleye	Common
Bluegill	Few
Northern pike	Few
Perch	Few
Pumpkinseed	Few
Smallmouth bass	Reported
Brook trout	Reported
Forage fish:	
Common shiner	Abundant
Bluntnose minnow	Abundant
Hornyhead chub	Abundant
Blacknose shiner	Common
Creek chub	Common
Iowa darter	Common
Johnny darter	Few
Blackside darter	Few
Least darter	Few
Mud minnow	Few
Rainbow darter	Few

Coarse fish:
Common sucker

Common

Obnoxious fish:
None

Other fish:
None

There are 22 species of fish in the lake. Rock bass, largemouth bass, ciscoes and walleyed pike are the most abundant game fish and the common shiner, bluntnose minnow, harnyhead chub, creek chub and blacknose shiner the most abundant forage fish. The common sucker is the only coarse fish in the lake.

Stocking records for the past five years are given in the following table:

	<u>1937</u>	<u>1938</u>	<u>1939</u>	<u>1940</u>	<u>1941</u>
Walleyed pike	...	120,000 F [*]
Largemouth bass	...	800 5M	...	500 LM	...
Smallmouth bass	500 LM 105 A	500 LM 117 A	136 A
Bluegills	10,000 5M	10,000 3M	10,000 3M

* F - Fry
A - Adult
M - Month

Creel Census

No creel census data are available.

Growth Rate of Fish Collected in Crooked Lake[✓]

<u>Species</u>	<u>Age</u> [✓]	<u>Number Specimens</u>	<u>Ave. Total Length (in.)</u>	<u>Ave. Total Weight (oz.)</u>
Northern pike	I	2	18.06	22.5
Largemouth bass	I	4	7.4	96.7
Walleyed pike	V	3	20.8	46.3
Bluegill	III	1	7.0	3.97
	IV	2	7.1	3.4
Rock bass	III	1	4.13	0.68
	IV	5	5.13	1.44
	V	5	5.78	2.26
	VI	4	6.47	3.09
Cisco	III	2	13.19	10.31
	IV	6	13.06	12.37
	V	1	12.63	11.05

*✓ Age analyses made by L. E. Perry.

**✓ Add one year to the above to determine the actual number of growing seasons.

Two few specimens of each species of fish were collected to permit a very significant comparison with the average growth of Michigan fishes. However, growth of all game fish with the exception of rock bass seems to be satisfactory.

Spawning Facilities

Although very little gravel is found in the lake proper, there appears to be natural reproduction in largemouth bass, bluegills, pumpkinseed sunfish and rock bass. Northern pike, perch and suckers also appear to be reproducing naturally. There seems to be no suitable place in the lake for walleyed pike to spawn, but it is possible that they may spawn either in the inlet or outlet.

Management Proposals

Designation of Lake

Crooked Lake is classified in the "all other lakes" group. It is suggested that this be changed to the "pike" lake designation since walleyes

are a dominant species and since a May 15 opening is ideal for rainbow trout. The temperature, chemical and food conditions appear to be suitable for trout although there are large predacious fish, the northern pike and walleyed pike, in the lake. The presence of the northern pike and walleyed pike has been considered in the past as ample reason for not stocking trout in a lake. However, it would be desirable to stock such a lake with trout for several consecutive years and determine by close observation the progress of the trout.

Stocking:

It is recommended that 2,000 rainbow trout of legal size be stocked in the fall of each year for three years. The stocking of largemouth bass should be discontinued as natural reproduction appears to be adequate. Neither bluegills nor smallmouth bass appear to be producing fishing in proportion to the plantings that have been made and further planting of these species should be discontinued. The lack of gravel bottom probably explains the failure to establish smallmouth bass. Walleyed pike should not be planted for three years. At the end of this period the future management policy will be based on the success of the trout plantings and the ability of the walleyed pike to maintain itself in the lake.

Predators and Parasites

No predator problems are known in Crooked Lake. The fish are relatively free of parasites.

Shelter

No additional shelter is suggested as the shoal vegetation appears to be adequate. Further shelter by vegetation will be naturally developed if the lake level continues to rise.

Regulation of Water Level

No regulation of the lake level is recommended for the present time. Although the lake level is slowly rising due to the blocking of the outlet by vegetation, this condition is considered to be beneficial in that it will provide additional shoal area and do no damage to property owners. The increased shoal area will serve to increase the quantity of fish food and provide more spawning grounds.

INSTITUTE FOR FISHERIES RESEARCH

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