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FISHERIES SURVEY OF CROOKED LAKE,
GREEN OAK TOWNSHIP, LIVINGSTON COUNTY

by

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Location and Drainage

Crooked Lake, Green Oak Township, lies in the southeastern part of Livingston County (T. 1 N., R. 6 E., Sec. 22). It can be reached by going two miles north on U. S. Highway 23 from the village of Whitmore Lake, then east for two miles on County Highway 408. The only road leading directly to the lake is one which is privately owned. The lake is also accessible by boat via Limekiln, Sandy Bottom and Dollar lakes.

Acknowledgments

An outline and bottom contour map of this lake was made in February, 1940 by an Institute mapping party* and the biological studies were conducted on September 1-3, 1943 by the Huron River survey party.**

Past and Present Use

As far as is known, Crooked Lake has never had any industrial use. The lake is used only lightly as a fishing and recreation area, there being only one cottage present and no boat liveries. The entire shoal area

* The personnel of the Institute mapping party consisted of the following members: Gerard Perry, Oscar Jasmin and Clifford Long.

** The biological inventory party of the Institute consisted of L. E. Perry, G. Washburn, M. Means and B. Ross.

and lake shore line being marshy, undoubtedly is a prime factor in the retardation of resort development.

According to local fishermen, Crooked Lake has never been an exceptionally good fishing lake and in recent years a marked decrease in the catch has been experienced. Fishing in the summer is moderate, and very light in winter. Ciscoes are speared in the fall by local fishermen. The predominant catch is pan fish, bass and pike, which are listed in order of importance. A few large pike (10 to 20 pounds in weight) have been reported taken in the past few years.

Physical Characters

Geological Origin

No studies have been made as to the geological origin of Crooked Lake, but it is undoubtedly of glacial origin.

Shape of Basin and Extent of Drainage

Crooked Lake is irregular in outline, having a surface area of 38 acres with a shoreline development of 2.0, which means that the length of the shore is twice as great as it would be if the lake were perfectly round.

The lake bottom is irregular, having four distinct basins, the deepest of which is 53 feet. This is located in the southeast end. The shoal area (less than 10 feet of water) is somewhat limited, comprising only 8 per cent of the total surface area. For the most part, the bottom slope of the lake is very steep, there being practically no transition zone between the shallow and deep waters.

Crooked Lake is one of a chain of five lakes whose drainage constitute a tributary to the Huron River. The lake is fed by two inlets and several springs. One of the inlets enters at the west end and is a tributary from Silver Lake. The other enters at the northeast bay and originates as a spring and seepage stream. A moderate sized stream (30 feet wide and 2 feet deep) flows out of Crooked Lake into Dollar Lake, which in turn drains into

Sandy Bottom, whose outlet flows into Fish Lake, then on to the Huron River, entering the latter at a point one-half mile west of Silver Lake.

Water Fluctuation, Bottom Soil and Turbidity

The fluctuation of the water level is insignificant, probably not more than one or two feet a year. The water is colorless and had a Secchi disc reading of 9.0 feet. The lake bottom is composed chiefly of pulpy peat and fibrous peat intermixed on the shoal area with marl. The bottoms of the depressions are composed chiefly of pulpy peat.

Discussion of Physical Factors in Relation to Fisheries

Most of the physical characteristics of Crooked Lake are favorable to fish production, the main exception being the lack of adequate shallow area, which furnishes the major amount of food, cover, and spawning facilities.

Temperature and Chemical Characteristics

Temperature

Temperature readings were taken from the surface to the bottom in each of the four main basins of the lake. The results are presented in Table 1. At the surface the water temperature averaged about 72°F., while at the bottom (50 feet deep) it had dropped to 43°F. These temperatures showed the presence of a thermocline (zone of rapid change in temperature) which began at eight feet and extended down to about 22 feet. All of the depressions showed this thermal stratification but the depth and extent of the zone varied slightly in each depression.

Table 1

Temperature and Chemistry Data of Crooked Lake Water

	Station and depth	Temperature, °F.	O ₂ p.p.m.	M.O. alkalinity p.p.m.	pH
	(0	72.5	8.9	227	8.3
	(5 ft.	72.5			
	(10 ft.	66.	8.7		8.1
	(15 ft.	55.5	6.9	212	8.0
I	(20 ft.	49.	4.6		7.6
	(25 ft.	46.7			
	(30 ft.	45.1	4.6	210	7.6
	(40 ft.	43.9	0.4	208	7.4
	(50 ft.	43.1	0.2	207	7.4
	(7.5 ft.	67.5			
	(10. ft.	64.7	9.2	220	8.2
	(15. ft.	54.5	7.4		
II	(17.5 ft.	51.6			
	(20 ft.	48.9	1.0	218	7.5
	(25 ft.	47.3			
	(31 (bottom)	46.9	0.2	216	7.4
III	(0 (surface)	72.5			
	(18 (bottom)	52.	4.5	218	7.6
IV	(15 ft.	51.8	7.2	219	7.9
	(20 (bottom)	47.4	0.5	216	7.6

Chemical Conditions

An abundance of dissolved oxygen (over 8.0 p.p.m.) was found in the zone above the thermocline and an adequate supply throughout the thermocline zone. A steady decrease in dissolved oxygen was found as the depth increased below the thermocline, becoming nearly exhausted at the bottom. This belt of water below the thermocline does not have a sufficient dissolved oxygen during the summer and possibly in the winter to support fish life.

The water in Crooked Lake was found to be moderately hard (methyl orange alkalinity, total hardness as calcium carbonate, 207-227 p.p.m.) and alkaline (pH 7.4-8.3).

The temperature and oxygen conditions found in Crooked Lake are favorable for trout, though at present the lake is only utilized by warm-water species with the exception of a population of ciscoes.

Biological Characters

Vegetation

Table 2 gives a list and the relative abundance of the aquatic plants collected in Crooked Lake.

Table 2

Aquatic Vegetation of Crooked Lake

<u>Common name</u>	<u>Scientific name</u>	<u>Relative abundance*</u>
Pondweed	<u>Potamogeton angustifolius</u>	S
Mud Plantain	<u>Heteranthera dubia</u>	S
Coontail	<u>Ceratophyllum demersum</u>	M
Water Milfoil	<u>Myriophyllum exalbescens</u>	S
Sago Pondweed	<u>Potamogeton pectinatus</u>	M
Pondweed	<u>Potamogeton amplifolius</u>	M
Swamp Loosestrife	<u>Decadon verticillatus</u>	M
Pickereel Weed	<u>Pontederia cordata</u>	M
Yellow Water Lily	<u>Nuphar variegatum</u>	D
WhiteWater Lily	<u>Nymphaea tuberosa</u>	S
Bulrush	<u>Scirpus</u> sp.	M
Smartweed	<u>Polygonum</u>	S
Stonewort	<u>Chara</u> sp.	S
Bur Reed	<u>Sparganium</u> sp.	S
Wild Rice	<u>Zizania aquatica</u>	S
Common cattail	<u>Typha latifolia</u>	S
Bushy Pondweed	<u>Najas flexilis</u>	S
Water Shield	<u>Brazenia Schreberi</u>	S
Cutgrass	<u>Leersia</u> sp.	M
Pondweed	<u>Potamogeton filiformis</u>	S
Pondweed	<u>Potamogeton zosteriformis</u>	S

* S = Sparse, M=Medium, D = Dense.

Identification by L. E. Perry and G. N. Washburn.

Aquatic plants were found to be present down to a depth of eight feet. In most instances the beds were small and sparse, the exception being in the northeast shoal area where a dense bed is located. The pondweeds (Potamogeton) were found along the drop-off intermixed with coontail and water milfoil. The predominant floating type of vegetation is the yellow pond lily, which envelopes half of the shoreline as a narrow belt (6 to 8 feet wide). This lack of good plant beds undoubtedly influences the fish productivity of the lake, as aquatic plants furnish cover and harbor large numbers of fish food organisms.

Fish Foods

Plankton samples taken at the surface and down to a depth of 40 feet revealed an abundance of this type of food. The following is a list of the organisms according to relative abundance: Zooplankton; Nauplius, Diaptomus, Daphnia, Cyclops and Bosmina-- Phytoplankton; Ceratium, Dinobryon, Fragiliaria and Asterionella.

Samples of bottom food organisms included the following groups: Bloodworms, scuds, mayflies, and sow bugs. Very few crayfish and clams were taken or observed to be present.

Only one species of forage fish (Brook silversides) was taken from the lake; at least two other species ^{belonging} ~~belong~~ to the Notropis genus were observed, but not collected. As a whole, the forage fish population was very scarce.

Fishes Present

Table 3 lists the fishes which were collected or reported from Crooked Lake. Largemouth bass of this year's hatch were the most abundant fish in the lake. Large schools, composed of 100 to 500 each, were observed at numerous places, along the shoal area. Very few yearlings or older bass were seen or taken. Ciscoes appeared to be quite plentiful judging

Table 3

List of Crooked Lake Fishes and Their Relative Abundance

Name	Relative abundance
Game fishes:	
Largemouth bass	(young) abundant
Great northern pike	Common
Black crappie	Common
Bluegill	Common
Pumpkinseed	Common
Rock bass	Rare
Yellow perch	Few
Ciscoes	Common
Coarse fishes:	
Carp	Observed
Forage fishes:	
Brook silversides	Few
Noxious fishes:	
Long-nosed gar	Few

by the capture of some in each gill net set. Northern pike, bluegills, pumpkinseeds and black crappies were found in moderate numbers. Many large carp were observed along the weedy shoal areas, but attempts to collect them failed. These carp appeared to be all large fish, and probably are migrants from the Huron River below. There was no evidence of natural reproduction by carp in Crooked Lake.

According to the stocking records no fish have been planted in Crooked Lake since 1937.

Age and Growth of Game Species

Age and growth determinations were made on all the game fish collected (the results are presented in Table 4), and while collections are not as large as would be desirable, they are large enough to give significant information on the subject. In general, the growth of the various Crooked Lake game fish is approximately equal to the tentative State

Table 4

Age and Growth of Game Fishes From Crooked Lake

Name	Number of specimens collected	Age*	Average total length in inches	State average total length in inches**	Average weight
Largemouth black bass	10	0	3.1	3.6	...
	1	III	12.5	10.8	15 oz.
Black crappies	19	0	2.37
	1	I	6.5	5.3	2.2 oz.
	3	III	9.4	8.7	6.1 oz.
	6	IV	9.6	9.2	7.7 oz.
Bluegills	11	0	1.5	1.7	...
	7	I	4.3	3.0	0.65 oz.
	7	II	4.5	4.3	0.91 oz.
	5	III	7	5.6	3.75 oz.
	2	IV	8.7	6.7	6.75 oz.
Pumpkinseeds	15	0	1.5	1.9	...
	4	I	2.6	2.7	...
	7	II	3.2	4.4	...
	1	III	4.5	5.8	...
Ciscoes	1	I	8.5	...	3.5 oz.
	1	II	10	...	5.75 oz.
	9	III	11.3	...	8.1 oz.
	5	IV	12.2	...	10.2 oz.
	1	V	11.9	...	8.4 oz.
	1	VI	13	...	8.5 oz.
	1	VII	12.2	...	9.6 oz.
Northern pike	2	II	17.1	...	15.5 oz.
	4	III	18.2	...	16 oz.
Yellow perch	1	0	2.75	2.9	0.8 oz.
	1	I	4.1	4.7	1.1 oz.
	2	II	6.75	6.2	1.8 oz.
	2	III	7.5	7.1	2.6 oz.

* Age of fish determined by G. N. Washburn
 ** State average determined by W. C. Beckman

average. Largemouth bass, black crappies and bluegills were slightly above the State average, while the yellow perch was approximately equal to it. No comparative growth data are available for the ciscoes and pike but these fish seem to be growing well.

Management Proposals

Designation of Lake

Crooked Lake is in the "all other lakes" designation, and there is no good reason at present why this should be changed.

Stocking

It is suggested that a fall planting of 12,000 fingerling (4 to 6 inch) rainbow trout be made each year for three consecutive years beginning at a time when the State acquires a public fishing site. For further information see "Other Recommendations."

Predators and Parasites

There was no evidence of serious fish predation or parasites.

Shelters

It is recommended that brush shelters be installed at various intervals in 6 to 15 feet of water along the barren shoal areas. Crooked Lake lacks sufficient cover for good fish production, and artificial shelters should help in correcting this condition.

Regulation of Water Level

The water level of Crooked Lake does not fluctuate enough to warrant any control measures.

Spawning Grounds

Adequate spawning grounds are available for those game species present in the lake. If, however, rainbow trout are introduced, no spawning facilities will be available in this lake, but may be present in streams tributary to one of the other connected lakes. This problem should be investigated when the remaining lakes are surveyed.

Other Recommendations

It is suggested that the State acquire a public fishing site on Crooked or on one of the adjacent connecting lakes in order to ensure public access. At present the entire shoreline of Crooked Lake is controlled by three property owners and the only access is by boat from one of the other connected lakes.

A partial or complete survey of the remaining three connected lakes-- Limekiln, Sandy Bottom and Round (Dollar)--would be desirable since these lakes are reported to have cisco populations and may also be suitable as trout waters.

Periodical checks by creel census, angling, or other methods should be made in order to determine the success of trout plantings.

Occasional fish samples from the lower connected lakes should be taken and inspected for the presence of rainbow trout as there is a possibility that the trout may migrate from Crooked Lake to these other lakes.

INSTITUTE FOR FISHERIES RESEARCH

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