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COOPERATING WITH THE
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FISHERIES SURVEY OF DEEP LAKE, OAKLAND COUNTY.

by

W. F. Carbine

Introduction

Location and drainage

Deep Lake, (formerly known as Starland Lake) is a small, private lake located in the northwestern part of Oakland County (T. 4N., R. 7E., Sec. 27), approximately $1\frac{1}{2}$ miles south of the Village of Rose Center, and 3 miles north of the Village of Clyde. The lake is accessible only by a private farm road which leads off a good county road known as the Holly Rd.

Deep Lake has neither inlet nor outlet, but lies within the drainage area of the Shiawassee River.

Acknowledgments

The map of Deep Lake was prepared by a regular Institute mapping party¹ in February, 1939. This map was used when the regular biological inventory² was made on July 24, 1939.

Deep Lake is owned by Messrs. James Inglis and Ben E. Young. Their cooperation in allowing the Institute to use Deep Lake for various experimental studies is greatly appreciated.

Past and Present Use

Deep Lake has been privately owned for many years. Before the present owners acquired the lake and adjoining property in about 1936, Deep Lake was a part of a resort development and people paid a small fee for fishing privileges.

¹The mapping party included: Floyd Ames, leader; Erwin Moody and Ted Monti, assistants.

²The fisheries survey party included: James Moffett, leader; W. F. Carbine, K. E. Goellner, LaRue Wesley and Frank Lydell, assistants.

Both the present owners have cottages at the lake.

In 1937 the owners of Deep Lake contacted the Institute and arrangements were made for a member of the Institute staff to examine Deep Lake and make recommendations for improving the fishing. On June 2, 1937, Dr. R. W. Eschmeyer visited Deep Lake and made a superficial survey*. On Sept. 18, 1937, Drs. R. W. Eschmeyer and C. J. D. Brown made a trip to Deep Lake for the purpose of determining oxygen and temperature conditions.

In 1938, Dr. Eschmeyer decided to use Deep Lake for a study on the life history, production and survival of the centrarchid fishes, and was immediately given permission by the owners to use the lake for experimental purposes. This work was taken over by the writer and continued until 1941, when it was climaxed by the poisoning of the lake. Deep Lake was restocked late in the fall of 1941 with rainbow trout, smallmouth bass and bluegills.

Deep Lake has never been used to any great extent for swimming, fishing or boating. Since 1936, a few friends and neighbors have been about the only people to utilize the lake for swimming and fishing. The lake was probably fished more in 1938 than in any year since the Institute started working on it. Bluegills provided the best fishing, with largemouth bass and sunfish next in importance. Most fishermen objected to the large numbers of sub-legal fish that were caught but several 5-pound bass and usually several 1-pound bluegills were removed from the lake each year by fishermen.

Physical characteristics

Geological origin

Deep Lake is undoubtedly of glacial origin and of the pit lake type (Inland Lakes of Michigan by I. D. Scott). The lake is surrounded by high, steep banks. The soil of the surrounding country is moranic in character.

Shape of basin and extent of drainage

Deep Lake has a surface area of 14.84 acres, a maximum length of 1,230 feet, in a W. N. W. - E. S. E. direction, and a maximum width of 660 feet. The lake is roughly oval in outline and consists of two depressions, an eastern, with a maximum depth of 61 feet and a western with a maximum depth of 51 feet. The intervening area averages approximately 45 feet in depth.

Deep Lake has neither an outlet nor a permanent inlet. One 6-inch tile, located at the southwest end of the lake, drains a nearby field. The water that enters the lake from this tile is fairly cold, and a good growth of water-cress is found between the end of the tile and the lake. The lake is supplied and drained principally by the seepage of ground water. The entire lake receives the run-off from less than 10 acres of land.

*For observations that were made refer to letter by R. W. Eschmeyer to Mr. Alvan Macauley, Jr. of June 3, 1937.

Most of the land in the immediate vicinity is under cultivation. There are scattered wooded fields and pastures.

Water fluctuation

The fluctuation of the lake level seldom varies more than one foot per year. The lake level fluctuation between 1938 and 1942 has not been more than $1\frac{1}{2}$ feet.

Other physical characteristics

Deep Lake has an area of 14.84 acres and a maximum depth of 61 feet. There is a steep drop-off from shore toward the center of the lake. The distance from shore to the 5-foot contour varies from 12 to 62 feet in width on the northern, southern and eastern shallow areas, and ranges from 20 to 70 feet in width on the western shallow area. The lake has a shoreline development of 1.1 which means that the shoreline is 1.1 times longer than a circular lake of the same area. Generally speaking, the longer the shoreline of a lake, the greater the productivity.

The lake bottom out to about the 15-foot contour is composed mostly of sand except in the western end where it is fibrous peat. Beyond the 15-foot contour the bottom is composed chiefly of pulpy peat and muck. The latter is found almost exclusively in the depths of the two depressions.

The water in Deep Lake is very clear. A Secchi disk when lowered into the water, disappears from view at depths of 20 to 24 feet. The degree of transparency of Deep Lake is much greater than average for southern Michigan lakes. The extent of light penetration is closely correlated with the depth at which the higher aquatic plants will grow in lakes.

Temperature and chemical characteristics

Temperature

A temperature series taken from top to bottom in Deep Lake on the date (7/24/39) of the survey showed the presence of a thermocline (zone of rapid change in temperature). The presence of a thermocline is important in lake biology because it acts as an insulator between the upper warmer water and the lower colder water. The thermocline extended from 16 to 39 feet. The water temperature was 79° F. at the surface, 74° F. at the top of the thermocline and 45° F. at the bottom of the thermocline. The temperature of the water just off the bottom (61 feet) was 43° F.

Chemical conditions

Oxygen analyses made on water samples from various depths at the time of the survey gave the following results: 8.5 ppm. at the surface and at the top of the thermocline, 13.5 ppm. at the bottom of the thermocline, and 0.35 ppm. at

the bottom. Oxygen was found in sufficient quantities to support fish life to depths of about 48 feet.

On Aug. 18, 1941, Mr. John Greenbank made a complete chemical analyses of the water in Deep Lake. At this time 3.8 ppm of oxygen were found at a depth of 50 feet.

The alkalinity (Methyl Orange) varied from 84 to 93 parts per million at the time of the survey, indicating that Deep Lake can be classified as a moderately "soft" water lake. The pH ranged from 8.6 at the surface to 6.9 at the bottom (61 feet). This indicates that the water in Deep Lake is moderately alkaline. Usually moderately hard, alkaline waters are more productive than soft, acid waters.

Pollution

No pollution of any kind could be found in Deep Lake.

Temperature and oxygen conditions are more favorable for cold water fish than for warm water fish. Sufficient oxygen, and suitable temperatures are present and trout should find conditions favorable throughout the year in the thermocline and in part of the water between the thermocline and the bottom. Except in summer trout can range over the entire lake. Although the water is not very alkaline, Deep Lake is still moderately productive, considering the limited shoal areas.

Biological characteristics

Aquatic vegetation

The aquatic vegetation in Deep Lake is fairly abundant considering the steep drop-off and the sandy, narrow shoal that is present. A list of aquatic plants collected is given in the following table.

List of aquatic plants found in Deep Lake

Common name	Scientific name*	Relative abundance
Water Marigold	(<u>Megalodonta Beckii</u>)	Sparse
Coontail	(<u>Ceratophyllum demersum</u>)	Medium
Swamp Loosestrife	(<u>Decodon verticillatus</u>)	"
Bushy pondweed	(<u>Najas flexilis</u>)	"
Needle rush	(<u>Eleocharis acicularis</u>)	"
White water lily	(<u>Nymphaea odorata</u>)	"
Yellow water lily	(<u>Nuphar advena</u>)	"
Pickereel weed	(<u>Pontederia cordata</u>)	"
Pondweeds:	(<u>Potamogeton americanus</u>)	"
	(" <u>amplifolius</u>)	"
	(" <u>angustifolius</u>)	"
	(" <u>gramineus</u>)	"
	(" <u>gramineus</u>)	"
	var. <u>graminifolius</u> f. <u>myriophyllus</u>)	"
	(<u>Potamogeton natans</u>)	Dense
	(" <u>Vaseyi</u>)	Medium
	(" <u>zosteriformis</u>)	"
Bulrush	(<u>Scirpus validus</u>)	"
Cattail	(<u>Typha angustifolia</u>)	One patch - dense
Chara	(<u>Chara</u> sp.)	Medium

* Identifications by Betty Robertson Clarke.

There is probably enough vegetation in Deep Lake to provide the necessary cover for the fish, especially during the summer months. Perhaps a few brush shelters should be installed to provide cover for the fish during the early spring and late fall. Aquatic plants are found down to about 25 feet.

Fish foods

The small, free floating organisms (plankton) were fairly abundant in Deep Lake. Plankton varies considerably from time to time and a single sample may not be an index of productivity.

Bottom food organisms were abundant in the shallower water, and fairly abundant in the deeper water. The bottom organisms in the shallow water are an important source of fish food.

No minnows were found in Deep Lake. On the whole, fish food conditions in Deep Lake are only fair.

Fish present

A list of the fish found in Deep Lake is given in the following table. The list presented is undoubtedly complete, having been compiled from the results of the poisoning on Sept. 12, 1942. The fish are listed according to their relative abundance in the lake prior to poisoning.

Game fish

Bluegill
Pumpkinseed
Largemouth bass
Rock bass
Bluegill x pumpkinseed hybrids
Yellow perch
Green sunfish
Green x pumpkinseed hybrids
Green x bluegill hybrids

Coarse fish

Yellow bullhead
Common sucker*

Obnoxious fish

Mud pickerel

Forage fish

Mud minnow*
Golden shiner*

*When Deep Lake was poisoned, 5 common suckers, 3 mud minnows and 1 golden shiner were taken. These fish were undoubtedly introduced by fishermen, as bait.

We were unable to find any records of game fish ever having been planted in Deep Lake. During the first week in May, 1937, the owners purchased 1,000 bluntnosed minnows and golden shiners for Deep Lake. These minnows failed to reproduce in the lake, and were never taken by seining after 1937.

Creel census

No creel census has been taken at Deep Lake. During the more than four summers that the writer spent at Deep Lake, fishing was just about average as compared with the state as a whole. Great numbers of sub-legal fish were usually caught. Bluegills made up the bulk of the fish taken by most fishermen.

Growth rate of game species

Ages, and estimates of the growth rate of fishes are obtained from a study of the scales. From 1938 through 1941, a good series of scales was taken from the most important species. When Deep Lake was poisoned in 1941, scales were taken from a random sample of fish of all game species. A separate report will be prepared in the near future dealing with the rate of growth of the fishes present before the poisoning. In view of this more comprehensive study to come, only a summary of the growth rate will be given at this time. The average lengths

given for Deep Lake fish are not exactly comparable to the tentative state averages because the Deep Lake fish were all collected on Sept. 12, 1941 and therefore had practically completed a full seasons growth, whereas the fish used to compile the state average were collected nearer the middle of the summer.

Name of fish	Age	Average total length in inches	Tentative average length in Michigan*
Bluegill	I	2.5	3.0
	II	4.2	4.3
	III	5.4	5.6
	IV	6.4	6.7
	V	8.1	7.4
	VI	8.9	7.8
	VII	9.3	7.9
	VIII	9.9	8.3
Pumpkinseed	I	2.2	2.7
	II	3.7	4.4
	III	4.6	5.8
	IV	5.3	6.4
	V	5.9	6.8
	VI	6.6	7.1
	VII	6.7	7.8
Largemouth bass	I	5.9	5.5
	II	9.5	8.4
	III	10.6	10.8
	IV	11.5	12.1
	V	12.9	13.3
	VI	13.7	14.4
	VII	15.4	16.8
	VIII	18.0	---
	IX	20.7	---
Rock bass	I	2.9	3.2
	II	4.7	4.3
	III	6.0	4.9
	IV	6.5	5.6
	V	7.3	6.6
	VI	8.2	8.3
	VII	8.0	8.7

*Prepared by W. C. Beckman

From an examination of the table it can be seen that pumpkinseeds were growing slower than the average for the state, while the largemouth bass were growing slightly faster. Except during the first 4 years bluegills grew at a better than average rate. On the whole the growth of the rock bass was

probably less than the state average. Yellow perch were seldom taken in Deep Lake because they were present in such small numbers. Green sunfish seldom reached legal size in Deep Lake.

Natural propagation

Large numbers of small bluegills, pumpkinseeds and largemouth bass were present in Deep Lake. Several reports have been written on the nature and extent of the spawning facilities in Deep Lake and it might suffice to mention here that spawning facilities were adequate for all of the important species.

Management proposals

Designation of the lake

Deep Lake is privately owned, therefore no special designation is needed.

Any fish, regardless of size, may be taken at any time of year but cannot be removed from the premises if protected by state law at that time. For example if trout are caught outside the legal state season (last Saturday in April thru Labor Day) they must be consumed on the premises. Bass and bluegills could not be removed from the property except from June 25 to March 1 inclusive.

The Institute was given permission to conduct a series of experiments on this lake and will continue to carry on certain management studies. As has been mentioned previously, Deep Lake was poisoned September 12, 1941. The lake was restocked with rainbow trout, smallmouth bass and bluegills late that same fall (see Institute for Fisheries Research Report No. 721). At that time management suggestions were also made.

Stocking

No species of fish should be planted in Deep Lake unless authorized by the Institute, after a careful study of the existing population. This has been agreed to by the owners.

Predators and Parasites

No predators have been observed in or in the vicinity of Deep Lake. Parasite infestations were small and in no way inhibit the growth of the fish. None present is harmful to man.

Shelter

Deep Lake has ample shelter for fish during the summer in the form of plant beds. Additional shelter should be provided by the installation of brush shelters around the lake. It is recommended that between 12 and 15 brush shelters be constructed in water between 4 and 8 feet in depth. Other improvements will be suggested as their need becomes apparent.

Regulation of the water level

No serious fluctuation in the water level occurs.

Improvement of spawning facilities

Spawning facilities are considered ample for all fish present in Deep Lake at present except the rainbow trout. It has been suggested to the owners that a channel be dug from the tile previously mentioned to the lake and that gravel be placed in this channel. This may be utilized by the rainbow trout for spawning.

INSTITUTE FOR FISHERIES RESEARCH

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