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A FISHERIES SURVEY OF HALF MOON LAKE, WASHTENAW AND LIVINGSTON COUNTIES

by

Robert C. Ball and L. E. Perry

Half Moon Lake is situated on the boundary between Washtenaw and Livingston Counties. Most of the lake lies within Washtenaw County in Dexter and Lyndon Townships (T. 1 S., R. 3, 4 E., Secs. 1, 6), but the northernmost bulge of the lake lies in Livingston County, Putnam Township (T. 1 N., R. 4 E., Sec. 31). The lake is one of several that are connected by Portage Creek, a tributary of the Huron River. Pinckney, lying about five miles northeast of the lake, is the nearest town. Chelsea, a town with a population of 2,000, lies seven miles to the south of the lake. The lake is readily accessible by good gravel roads.

Acknowledgments

The outline map which was used by the biological inventory party* August 4-9, 1942, to locate chemical, vegetation, bottom sample, and fish stations was prepared by an Institute mapping party** January 10-15, 1942.

Past and Present Use

The only commercial use of the lake in the past was suggested by the presence of an abandoned dredge and areas of the shore that appeared to have been dredged for marl. At present the use of the lake is restricted to swimming, boating, and fishing, none of which is very popular on the lake. There are 37 cottages on the lake which occupy practically all of the suitable shore. The remaining shore is soft and swampy. There are no resorts and only one boat livery which has about a dozen boats for rent. A public fishing site has been purchased by the state and was being developed at the time of the biological inventory. The lake has been a good fishing lake in the past but at the present time it seems to be producing fewer fish than would be expected.

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* Biological inventory party: L. E. Perry and Robert C. Ball.

** Lake mapping party: R. Matthews, leader; L. Anderson, R. Van Deusen, J. Funk, P. Scears, R. Frank, J. Oliver, assistants.

Physical Characteristics

Geological Origin

Half Moon Lake was probably formed as a pit in the glacial outwash plain of the Valparaiso-Charlotte morainic and outwash system. No detailed descriptions of the geology of the lake are available.

Shape of Basin and Extent of Drainage

This lake has a very irregular basin with its long axis extending about a mile and a half in a northwest-southeast direction. Narrow arms exist on opposite ends of a larger central basin. The deepest part of the lake (87 feet) is near the center. The bottom of the lake is irregular. Several shallow areas or hummocks are found in the main basin. Along the west shore several deep basins are nearly isolated to the extent of becoming distinct lakes. One large bay on the south (Little Fuller Lake) is isolated sufficiently to be considered as a separate lake. On the north side of the west arm there is another small lake of about five acres, called Bounce Lake.

Approximately one-third of the shore is high and dry, the other two-thirds are marshy and partly wooded. Cottages are located on the well drained shores.

Half Moon Lake is connected with several other lakes in this vicinity by Portage Creek which drains into Portage Lake and then into the Huron River. The drainage area of Half Moon Lake is approximately 70 square miles.

Water Fluctuation

The lake has experienced some fluctuation. The water level in 1942 was considered the highest in recent years. Previously the level had been low enough to expose some of the important shallow areas. In some places as on the north side a drop of a few inches would expose a large part of the shallow bottom.

Half Moon Lake has one main inlet in the form of Portage Creek which enters the lake on the west end. This creek runs through Watson, Bass, and Patterson Lakes and is a stream of fairly large size when it enters Half Moon Lake, probably averaging 20 feet wide and 2 to 3 feet deep. Blind Lake is connected with Half Moon by a short channel entering the west arm. Several springs around the shores and drainage from marshes augment the water supply. The connection with Bounce Lake is less than a foot deep and about ten feet wide.

Portage Creek leaves Half Moon Lake on the north side and drains into Portage Lake, five miles to the east.

A dam is located in Portage Creek about two miles downstream from Half Moon Lake, backing up the water to a point less than a mile from Half Moon and forming Hi-Land Lake. The effect of this dam on the water level of Half Moon Lake is uncertain.

The dam was originally built to supply a grist mill which was later converted to an electric power plant, but at present the sole purpose of the dam is to maintain a proper level of Hi-Land Lake for the benefit of cottage owners on the lake shore. The height of water at the dam when investigated was approximately that of the rights purchased for the power plant. The lake level was 13 1/2 inches below the top of the cement retaining wall of the dam and approximately 12 feet above the old stream bed. A moderate flow of two to four inches of water was passing over the dam. If the flow of this water dropped as happens during drier summers, it is very possible that this dam could maintain the same satisfactory level for Hi-Land Lake and yet the drop in water flow would cause the level of Half Moon to lower perceptibly. During dry years the outlet of Half Moon is reported to be reduced considerably in size. Otherwise it is believed that the Hi-Land dam has little effect on the level of Half Moon Lake and that precipitation in the drainage area of the chain of lakes is the main factor.

A summary of the physical features of Half Moon Lake is given in Table I.

Table I
Summary of Physical Features of Half Moon Lake

Area (acres)	Maximum depth (feet)	Shore development	Dominant bottom types		Color of water	Transparency (Secchi disc in feet)
			Shallows	Depths		
236*	87	2.1	Marl, sand.	Pulpy peat, marl.	Pale brown.	14

* Excluding Bounce and Little Fuller Lakes.

Shore development expresses the number of times the length of shoreline is greater than that of a perfectly round lake of the same area. The greater the shore development the greater the number of protected areas for the growth of plants and development of small fish.

Wave action is probably not extreme in Half Moon Lake. While the long axis is parallel to the path of the prevailing winds from the northwest, there is hardly any noticeable effect other than slight wave action in the East Arm.

Discussion of Physical Factors in Relation to Fisheries

Half Moon Lake is moderately large with a fairly great depth compared to other lakes of southern Michigan. Extensive shallow areas and irregularities in the shoreline are favorable to the growth of plants. The rather high transparency of the water makes it possible for plants to grow at fairly great depths. A variety of bottom types, sand, gravel, marl, and peat provides the necessary spawning facilities and adds to the productivity. In general, the physical factors are conducive to high productivity.

Temperature and Chemical Characteristics

Temperature

A series of temperatures was taken from top to bottom near the deepest point in the lake on August 6, 1942. The upper fifteen feet of water showed little change in temperature. From this point to a depth of approximately thirty feet there was a zone of rapid change in which the temperature dropped from 75 degrees to 49 degrees Fahrenheit. Below this point the change was gradual, reaching a minimum temperature of 42 degrees at 75 feet. The zone of rapid change in temperature is known as the thermocline. This area has a tendency to isolate the lower part of the lake and prevent circulation of surface and deep waters.

Oxygen

Chemical examinations were made at the time of the survey when oxygen content of the lower waters was near its minimum for the summer. Oxygen extended from the surface to the depths of the lake in sufficient amounts to maintain fish life. There were 8.1 parts per million of oxygen at the surface and 3.0 parts per million at a depth of 75 feet. It approaches the minimum amount required by fish at depths of 40 feet and below.

Alkalinity and pH

The water of Half Moon Lake is hard (methyl orange alkalinity 180-185) and is alkaline from the surfaoe to the bottom (pH 7.5 to 8.3). Moderate to hard waters are generally more productive than soft waters but in Half Moon Lake there appear to be other factors which cause the calcium carbonate to precipitate on the plants and bottom in the shallow areas to such a degree that it prevents proper growth of the plants. The factors causing such a phenomenon are not well understood, as in many lakes with a total alkalinity greater than that found in Half Moon Lake there is little or no precipitation and the plants flourish.

Pollution

No pollution of any kind was reported or observed for Half Moon Lake.

Discussion of Chemical and Temperature Factors in Relation to Fisheries

The known chemical factors are favorable to fish life and to the organisms upon which the fish feed. The amount of hardness in the water is not in itself a deterring factor in this lake's productivity but the heavy deposition of marl on the plants cuts out the light to such an extent that very few submerged aquatic plants are able to survive through the summer.

Biological Characteristics

Vegetation

There was a total of 20 species of plants collected in the open water

and along the shore of Half Moon Lake. A complete list of the species with their relative abundance appears in the following table.

Table II
Aquatic Plants Collected in Half Moon Lake

Common name	Scientific name*/	Abundance
Water shield	(Brasenia Schreberi)	Rare
Button bush	(Cephalanthus occidentalis)	Few
Cladium	(Cladium mariscoides)	Few
Musk grass	(Chara sp.)	Abundant
Water willow	(Decodon verticillatus)	Few
Water milfoil	(Myriophyllum exalbescens)	Few
Bushy pondweed	(Najas flexilis)	Few
White water lily	(Nymphaea odorata)	Few
Yellow water lily	(Nuphar variegatum)	Few
Pickerel weed	(Pontederia cordata)	Few
Large-leaf pondweed	(Potamogeton amplifolius)	Few
Pondweed	(Potamogeton angustifolius)	Common
Floating-leaf pondweed	(Potamogeton natans)	Rare
Flat-stemmed pondweed	(Potamogeton zosteriformis)	Few
Hardstem bulrush	(Scirpus acutus)	Abundant
Three-square bulrush	(Scirpus americanus)	Few
Common cattail	(Typha latifolia)	Rare
Bladderwort	(Utricularia vulgaris)	Rare
Wild celery	(Valisneria americana)	Rare
Wild rice	(Zizania aquatica)	Rare

*/Plants identified by Betty R. Clarke.

Chara was the only plant in the lake in any abundance at the time of the survey. This was found in scattered patches along the shallow areas of the lake. Pondweeds, which are usually so abundant in southern Michigan lakes, were nearly absent. The presence of aquatic plants is one of the best indicators of lake productivity that is known because they harbor the most important fish food constituents and offer shelter and spawning facilities for fish.

Fish Food

Collections from nearly all types of habitat in the lake indicated the same condition--an extreme paucity of food for the non-predacious fishes. Large samples of Chara, which often under favorable circumstances, yield a multitude of aquatic forms, were nearly devoid of invertebrate organisms. Vegetation beds and consequently fish food organisms were nowhere abundant. Food for the predacious fishes was somewhat more plentiful in the form of minnows. The examination of bottom and plant samples strongly indicated that there is not sufficient food present in the lake to support an abundant fish population.

Fish Present

A list of the fish collected at Half Moon Lake is presented in Table III with notations on the relative abundance and stocking.

Table III
Names and Relative Abundance of Fish Found in
Half Moon Lake

Species	Abundance	Stocking, 1935-41
GAME FISH		
Northern pike	Common	...
Perch	Reported	18,000 (7-9 mo.)
Walleye	Reported	332,000 (fry)
Smallmouth bass	Few	...
Largemouth bass	Common	4,750 (3-4 mo.)
Bluegill	Common	63,000 (3-6 mo.)
Pumpkinseed	Few	...
Rock bass	Few	...
Black crappie	Common	...
Long-eared sunfish	Rare	...
Cisco	Common	...
COARSE FISH		
Warmouth bass	Rare	...
Green sunfish	Rare	...
Bullhead	Reported	...
OBNOXIOUS FISH		
Long-nosed gar	Common	...
Dogfish	Reported	...
Carp	Common	...
FORAGE FISH		
Black-nosed shiner	Few	...
Mimic shiner	Common	...
Blunt-nosed minnow	Common	...
Menona killifish	Few	...
Blackstriped top-minnow	Few	...
Log perch	Few	...
Iowa darter	Rare	...
Silversides	Common	...

Our investigations indicate that Half Moon Lake has a small population of fish. Probably the most common species is the largemouth bass. Gill nets set for four nights failed to produce a good catch of game fish. Seining accounted for a fair number of bluegills. It was always possible to catch ciscoes in deep water below the thermocline.

Walleyes were planted in the lake as fry, but have never been seen nor reported since. Mr. Forney of Northville reported the planting of several thousand brown trout fry and fingerlings a few years ago. They likewise have never been seen since the planting. The failure of these plantings may be due to the small size of the fish when stocked or to unfavorable conditions in the lake.

Half Moon Lake has a fairly large population of gars and carp which are considered undesirable by local fishermen. Many complaints were received regarding the nuisance and damage of these fish. Attempts at

reducing the population have been made by spearing under permits of Conservation Officer K. Brushaber. A report shows that the removal of a fair number of large gars up to about five pounds has been achieved. Also, the lake has been netted in the past by the Department of Conservation in other attempts to control the gars and carp. The success of these measures is uncertain. Although carp were not seen in great abundance, many shallow areas showed signs of their having been present.

Forage fish were fairly abundant at the time of the survey. Schools of several species of minnows were found in the shallow areas. Undoubtedly the ciscoes provide a good source of food for fish that frequent the waters of their habitat.

Growth of Game Species

Table IV gives a summary of the ages, weights, and lengths of the game fish caught in the lake. The last column gives the tentative average lengths at various ages for the State of Michigan.

Table IV
Growth of Game Fish in Half Moon Lake

Species	Age	Number	Average length (inches)	Average weight (lbs. - oz.)		State average length* (inches)
Northern pike	II	3	20.8	1	10.0	...
	IV	1	27.0	5	1.0	...
Smallmouth bass	III	1	11.5	...	...	10.7
Largemouth bass	0	1	3.0	...	0.2	3.6
	II	1	7.8	...	3.0	8.4
	III	2	10.1	...	5.2	10.8
	IV	1	11.4	...	11.3	12.1
	V	3	12.7	...	14.5	13.3
Bluegill	II	9	4.3	...	0.8	4.3
	III	4	5.5	...	1.8	5.6
	IV	7	6.2	...	2.4	6.7
	V	3	7.3	...	4.3	7.4
	VIII	1	9.5	...	...	8.3
Pumpkinseed	II	1	4.1	...	0.7	4.4
	III	3	5.4	...	2.0	5.8
	IV	1	5.0	...	1.3	6.4
Black crappie	II	3	8.2	...	4.9	5.9
	III	2	9.1	...	6.1	8.7
Rock bass	II	4	4.3	...	0.9	4.3
	III	2	5.3	...	1.6	4.9
	IV	1	6.5	...	...	5.6
	V	1	7.1	...	3.9	6.6
Long-eared sunfish	II	2	3.9	...	0.7	...
	IV	1	4.5	...	1.1	...
Green sunfish	IV	1	5.1	...	1.5	...
Warmouth bass	IV	1	5.7	...	2.1	...
Cisco	IV	2	12.6	...	10.4	...
	V	10	13.1	...	11.7	...
	VI	2	13.2	...	11.8	...

* Determined by W. C. Beckman.

Although an insufficient number of fish was obtained to give a definite picture of their growth, the data in the table show in a general way the present growth rate of game fish present in the lake. The largemouth bass grows a little slower than average for the state; however, the difference is not great. The pumpkinseed also grows slower than average. The growth of the bluegill is about average and that of the rock bass and black crappie is better than average. Little was ascertained concerning the growth of northern pike, long-eared sunfish, green sunfish, and warmouth bass. The scales from the one smallmouth bass* showed the fish to have better than average growth, but this is insufficient to draw conclusions on the population. The growth of the ciscoes appears to be satisfactory. No state average has been determined for this species.

Natural Propagation

Young specimens of large- and smallmouth bass, bluegills, and rock bass were collected, thus indicating natural reproduction. Spawning facilities in the lake indicate that natural reproduction is probably adequate for all the species of game fish collected. Pike have access to the neighboring marshes for spawning, and the bass, crappies, and all sunfishes should find conditions favorable in the lake.

Management Proposals

Designation of the Lake

Half Moon Lake is in the "all other lakes" classification and the findings of the survey show no reason for a change of designation.

Stocking

The stocking of all species of fish now found in Half Moon Lake should be discontinued. There are ample spawning facilities for these fish and the limiting factor seems to be food; therefore, it would be undesirable to put more fish in the lake than can be fed by natural means. If the food supply should increase by a change in natural conditions, the population of fish will most surely increase in proportion to it.

Half Moon Lake has an adequate supply of oxygen in its cold, deep waters, as evidenced by analyses and the presence of ciscoes. In view of this, an experimental planting of 3,000 legal rainbow trout is recommended for each of the next two years. The results should be followed by subsequent examinations and, if warranted, regular successive plantings should be made in following years.

Predators and Parasites

No important predators other than the gar pike were seen around the lake in numbers sufficient to be of any consequence. Numerous gars were seen in the lake but these are probably an asset to the lake in keeping the centrarchids under control. With the adequate spawning areas and

* The scales from a smallmouth bass and several other fish were mailed to the Ann Arbor office by Mr. C. C. Read, a resident of Half Moon Lake.

limited food supply an uncontrolled increase in the bluegills might result in an unbalanced population and subsequent dwarfing of the panfish. The gars may be effective in controlling the population and keeping it within limits of the food supply. For this reason we believe that no drastic control of the gars is desirable at present.

Very few parasites were found on the fish. This can probably be attributed in part to the extreme scarcity of snails in the lake.

Shelter

Due to the almost total absence of natural shelter in the lake the installation of brush shelters would be beneficial in protecting both fish and plant life. These shelters should be placed at intervals around the lake on the shoal areas and near the "drop-off."

Regulation of the Water Level

The water level as it was at the time of the survey is adequate for all interests concerned. The period during which the survey was made is reported to be a high water period for the lakes of that area. A drop of a foot or more would bare a large portion of the shoal area, but there is no means of maintaining a desired water level in the lake at the present time. The establishment of a higher water level may prove to be desirable at a later time.

Improvement of Spawning Facilities

None recommended.

Other Suggestions

From the results of the biological survey we believe that any management proposal to increase the fish catch on the lake must take into consideration the increase of the plants of the lake. An increase in the plant beds above the present very low level would have manifold results including the increase of fish food and shelter for small and large fish.

Several reports from what we believe to be reliable sources indicate that until the summer of 1940 there was an abundant growth of aquatic vegetation over most of the shoal areas.

During the past two summers almost no submergent vegetation has been produced in the lake. We do not know the cause for the sudden decline of the plants of the lake but believe that an effort to bring them back would aid in increasing fish production for the lake. Any project such as this would be entirely experimental and the results could not be predicted with any certainty. We would suggest that several types of experimental plantings of submergent vegetation be made on the shoal areas of the lake in conjunction with lake improvement devices such as the hollow square type submerged shelter, as the lake at present is nearly devoid of cover for fish.

From the pock-marked appearance of the shoal areas and the known presence of many carp in the lake it is evident that any plantings of aquatic vegetation would have to be protected from the ravages of these fish. Carp control is at best difficult. We do not believe that seining in this lake or spearing would result in any noticeable reduction of the carp. We do suggest that either before or during the time any of the management proposals for the lake are undertaken, some effort should be made to reduce the number of carp or to effectively screen them away from the experimental plantings. It is believed that baited traps such as are in use in Minnesota* would be feasible on the extensive shoals of the south central area of the lake, and might be effective in reducing the carp population to such an extent that the plants would be able to get a start. Such a removal project would have to be intensive rather than sporadic and would entail regular examinations while the traps were in operation.

The results of such an experiment would be applicable to several other similar lakes of low productivity in the same general region.

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* The Conservation Volunteer. September, 1942. Pp. 34-36.

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