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A PRELIMINARY SURVEY OF THE WIGGLER POPULATION OF CROOKED LAKE,
ALCONA COUNTY, AND McCOLLUM LAKE, OSCODA AND ALCONA COUNTIES, MICHIGAN

by Burton P. Hunt

Reports were received during the winter of 1948 that a considerable amount of wiggler digging was engaged in by commercial wiggler diggers on these two lakes during the winter of 1947-1948. It was stated that the digging caused unfavorable reaction among local sportsmen and land owners due to the removal of wigglers from the lakes and because of the supposed damage to the lakes resulting from the digging operations. Agitation was begun to have these two lakes closed to commercial wiggler digging. It was reported further that local fishermen dig wigglers in the lakes for use there. There is no objection to this practice.

In order to determine something of the character of the lakes and the extent of the wiggler population, the lakes were cruised and sampled on June 16, 1948, by B. P. Hunt and K. G. Fukano. The lakes have not been mapped. Sketch field maps were prepared and used for orientation during the inspection. Some quantitative samples were taken with a 6 inch Ekman dredge and sieved through a screen with 30 meshes to the inch. Numerous qualitative samples were taken by means of a long handled scoop made of 1/8 inch mesh hardware cloth.

Crooked Lake

Crooked Lake is located in Alcona County, T. 27 N., R. 5 E., Sections 8, 17, and 18. It is readily accessible since it lies about one-half mile north of state highway 72 and 9 miles east of Fairview, Oscoda County. A number of cottages have been built on the hills surrounding the lake and at least one resort is operating there. Public access to the lake is available through a township park situated at the south end of the lake. Apparently a number of people spend their summers on the lake. The general opinion seemed to be that it is a fair fishing lake for the common warm water species.

Physical Features

Crooked Lake has an area of approximately 100 acres according to a previous compilation of lake areas (areas calculated from lake outlines on county maps) in Michigan made for the Institute by C. J. D. Brown and L. E. Perry. The shape of the lake is essentially as shown by the attached sketch map.√ The lake bottom is divided into a north and a south basin, separated by a shallow sand bar extending east and west across the lake near the middle of the north-south axis. The maximum depth sounded in the two depressions was 25 feet. Deeper water may exist, since few soundings were taken in water over 10 feet in depth.

Shoal areas are in general rather narrow, ranging from 30 or 40 feet up to 100 or so feet in width. Three exceptions are found to this generality, the small bay at the north end of the lake, the sand bar across the middle of the lake and the quite extensive shoal area at the eastern end of the south basin. The contour line shown on the sketch map approximates the 8 foot contour line.

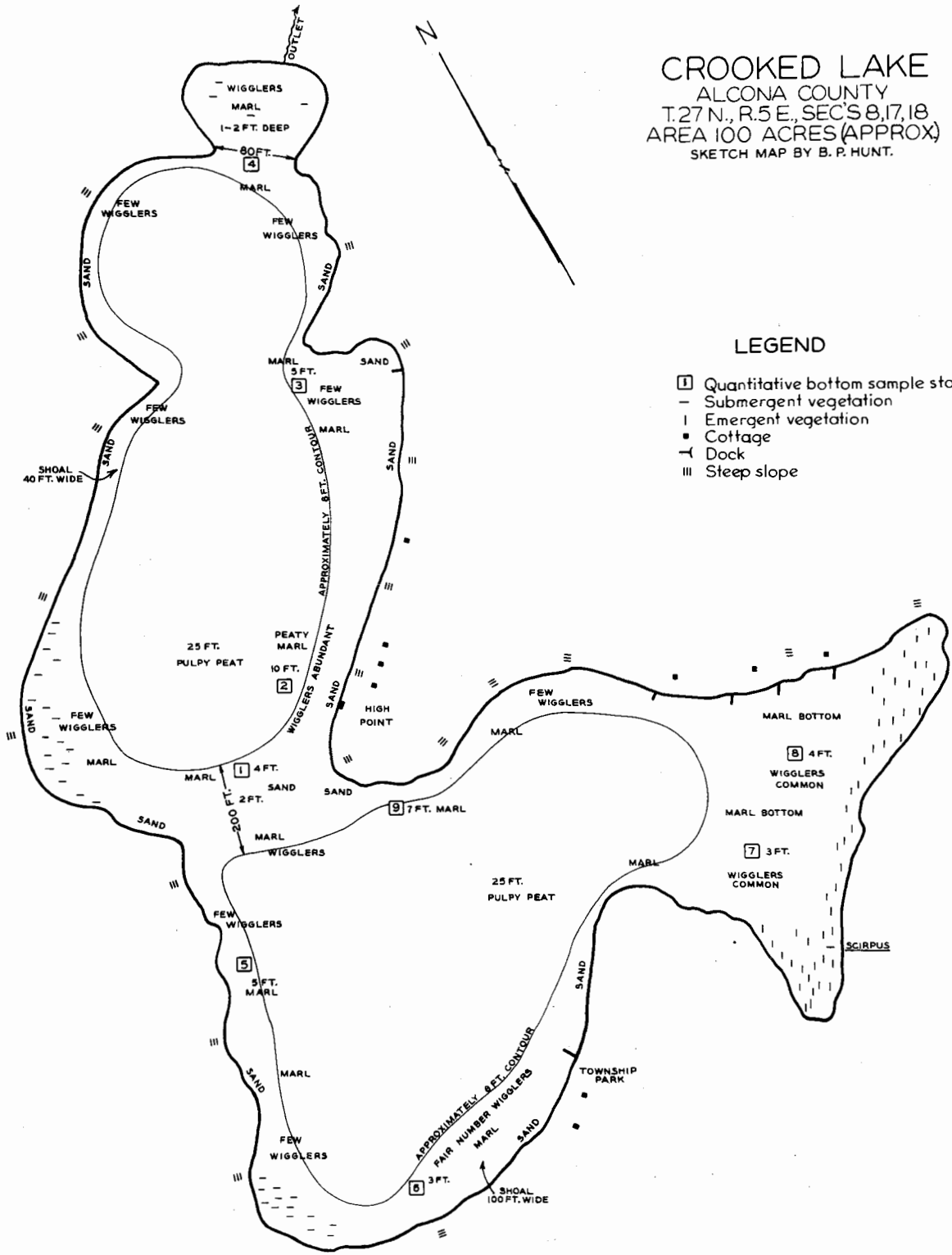
The bottom is made up of three main types of material, sand, marl and pulpy peat. A sand bottom is found along the entire lake margin and on

√ The lake will probably be mapped during the winter mapping season of 1948-49 and copies will be supplied to the Lansing, Regional and District offices concerned.

CROOKED LAKE
 ALCONA COUNTY
 T.27 N., R.5 E., SEC'S 8,17,18
 AREA 100 ACRES (APPROX)
 SKETCH MAP BY B. P. HUNT.

LEGEND

- ① Quantitative bottom sample stations
- Submergent vegetation
- | Emergent vegetation
- Cottage
- └ Dock
- ≡ Steep slope



the east-west bar separating the two basins. The sand border at the lake margin varies from a few feet to 70 or 80 feet wide and usually extends out to a depth of 2 to 4 feet. A marl bottom is found between the sandy margins and the pulpy peat of the deeper parts of the lake. The marl is usually found in water 3 to 12 feet deep. Pulpy peat comprises the bottom in water deeper than 12 feet. The belt of marl around the greater part of the lake is quite narrow. One exception to this is the bay at the east end of the south basin. Here there is a considerable shallow area (2 to 10 feet deep) that has a soft marl bottom.

Chemical Features

The lake appears to be a typical warm water lake. An analysis of surface waters gave the following data: water temperature 72° F., carbon dioxide 0.0, ph-th alkalinity 15.0, M. O. alkalinity 99.0, pH 8.2. While no chemical or temperature data were secured from the deeper waters, it is certain that the lake was thermally stratified at the time of the inspection. The temperature of the mud taken at depths of 25 feet was quite cold.

Biological Features

A belt of submerged aquatic vegetation occurs at about 8 to 15 feet deep around the greater part of the lake. Various Potamogetons appear to make up the greater portion of this flora. The sand shoals are usually barren. The marl belt was rather barren in some places, while in others it was wholly or partially covered with a sparse growth of Chara. Scirpus and a few water lilies occur in some shoal areas, usually in the small bays and indentations along the shore.

Comments of people contacted at the lake indicate the lake is no more than a fair fishing lake. At times, good largemouth bass are taken. A few yellow pikeperch are reported to be in the lake. Fish seen while cruising the lake included largemouth bass, bluegills and pumpkinseed sunfish.

The composition of the bottom fauna is very much like that of similar lakes. Organisms taken in the bottom samples included: snails, fingernail clams, leeches, scuds, dragonfly and damselfly nymphs, caddis larvae, Chaoborus (Corethra) larvae, numerous midge larvae, several genera of mayfly nymphs including Hexagenia, and crayfish. The fauna was not very rich but a decline in numbers of bottom organisms is to be expected at this time of year.

Species of Hexagenia

Only one species of burrowing mayfly, Hexagenia limbata, was found in the lake. Ephemera simulans may occur but none were taken in the samples. As grown nymphs of this species are seldom found at this time of year, its absence from the bottom samples is not very significant. This species is too small to be used as bait.

Two imago male Hexagenia collected on shore were typical H. limbata occulta; one grown nymph had a dorsal abdominal color pattern approaching that typical of H. limbata viridescens. As these two types have been found together in most waters in Michigan in which collections of Hexagenia have been made, the sub-specific designation heretofore recognized may not prove to be valid. The designation of H. limbata as the specific name for the common Hexagenia in Michigan is, I think, valid, for not only are the basic morphological characteristics similar in all specimens, but no differences have yet been observed in the ecology or life history of the various so-called subspecies in the limbata complex.

Distribution and Abundance of Wigglers

The location of quantitative samples and notes concerning the location of wigglers in Crooked Lake are shown on the attached sketch map. The distribution of wigglers was found to coincide with the distribution of marl. In fact, the wigglers are limited to the marl bottom since it alone offers a suitable habitat. None were found in the sand or pulpy peat bottom. Some are to be found in the sand and marl mixture between the marl belt proper and the hard packed sand shoals. Similarly, some are found in the transition zone between the marl belt and the pulpy peat bottom of the deeper waters. However, in general the wigglers are restricted to the marl bottom. In this respect the distribution of wigglers in Crooked Lake follows a pattern similar to that found in Big Silver Lake, Washtenaw County, which also has a bottom composed of sand, marl, pulpy peat and admixtures of the three.

The data secured from the quantitative bottom sampling is shown in Table 1. All samples were taken in the marl bottom and all contained one or more wigglers. It is indicated that the greatest concentration of wigglers occurred at 7 to 10 feet, although they were found in considerable numbers in some of the samples taken in shallower water. The average number of nymphs per square foot as determined from 9 samples was 9.6. This figure compares favorably with the average number of nymphs per square foot found in Big Silver Lake, Washtenaw County, at a comparable time of year. It is however, considerably lower than the average number found in Gun and Pine lakes in Barry County.

Table 1

Number and Volume of Hexagenia Nymphs Taken in Quantitative Bottom Samples in Crooked Lake, Alcona County, Michigan on June 16, 1948.

Sample Number	Depth, Feet	Bottom Type	Vegetation	Number Dredge Hours	Area of Sample Sq. Ft.	Total Number Nymphs	Volume c.c.
1	4	Firm Marl	None	2	0.5	4	0.60
2	10	Peaty Marl	<u>Potamogeton</u>	2	0.5	11	1.45
3	5	Firm Marl	Sparse <u>Chara</u>	2	0.5	7	0.60
4	4	Firm Marl	Sparse <u>Chara</u>	2	0.5	3	0.30
5	5	Peaty Marl	<u>Potamogeton</u>	2	0.5	1	0.05
6	3	Firm Marl	Sparse <u>Chara</u>	2	0.5	1	0.05
7	3	Firm Marl	Sparse <u>Chara</u>	2	0.5	3	0.10
8	4	Firm Marl	Sparse <u>Chara</u>	2	0.5	5	0.35
9	7	Peaty Marl	<u>Potamogeton</u>	2	0.5	8	0.25
Total				18	4.5	43	3.75

Average number of nymphs per square foot 9.6
Average volume of nymphs per square foot 0.83 c.c.

Data concerning the number of wigglers in various age and sex groups is as follows:

	<u>Male</u>	<u>Female</u>	<u>Total</u>
Number of two-year-old nymphs	7	11	18
Number of one-year-old nymphs	13	12	25
Average length of one-year-old nymphs	12.4 mm.	15.6 mm.	...
Average length of two-year-old nymphs	19.9 mm.	24.7 mm.	...

A total of 43 nymphs is a small number to base averages on. However, these figures are comparable to those secured from other lakes where more data were used. The sex ratio here is approximately equal. In other studies it has been found that the sex ratio is nearer 45 males to 55 females. The number of one-year-old nymphs is greater than the two-year-old's as is to be expected. The samples were taken during the emergence period and the number of two-year-old nymphs could be expected to decrease sharply within the next few weeks. The average number of one-year-old nymphs per square foot sample was 5.6 and the average number of two-year-old nymphs was 4.0. With the completion of the current emergence a fair number of wigglers will still remain in the lake. In late July and August, nymphs hatched from eggs deposited during the present mating season should appear in the lake in considerable numbers.

The number of wigglers in Crooked Lake appears to be no more than average for a lake with a limited amount of productive bottom. In general its wiggler producing capacity appears to approximate that of Big Silver Lake, but falls far short of that of Pine and Gun lakes, which produce great numbers of wigglers.

Wiggler Removal

Commercial wiggler diggers were reported to have been very active on Crooked Lake during the winter of 1947-1948. Thousands of wigglers were reported to have been removed and transported out of the county for sale. The lake was not visited during the winter to determine the extent of the digging operations. Several local people were questioned concerning wiggler digging the past winter but apparently no one lives on the lake in the winter and those questioned knew nothing of the bait collectors' activities.

A survey of the lake failed to reveal any considerable disturbed bottom areas. This was not unexpected, since a marl bottom soon becomes well packed after being disturbed and shows little evidence of having been "plowed up" even in heavily dug areas. Judging from the distribution of the wigglers and taking into consideration the bottom type in relationship to water depth, it can be concluded that the areas most likely to have been dug are the shallow bay on the east side of the south basin and in the deeper water on either side of the sand shoal dividing the north and south basins. Some digging could have been done almost anywhere around the lake but would have been restricted pretty well to the narrow belt of productive bottom at depths of 3 to 10 feet. Effective digging operations are pretty well limited to water between 4 and 8 feet deep and the amount of bottom that could be worked effectively is small in comparison to the entire area of the lake.

It is impossible at present to adequately evaluate the effect of the physical disturbance of the lake bottom caused by the activities of wiggler diggers. It is believed, however, that the destructive effect of

winter digging on the bottom fauna and vegetation is less than one might expect. Chara, which is the usual vegetation growing on areas likely to be dug, seems to rapidly re-establish itself and, experimentally at least, the bottom fauna rapidly becomes re-established after the bottom material has been disturbed by screening. Since the exact areas dug and the extent of the digging are unknown, it is difficult to pass judgment on the possible effect of the wiggler digging during the past winter or to estimate how many wigglers might have been removed. It is clear, however, that a considerable number of wigglers which were of bait size last winter are still in the lake, and that what is considered to be a normal number of small wigglers are present. Certainly not all wigglers can be removed even through intensive digging and the economic law of diminishing returns for amount of effort involved can be counted on to discourage digging before a critical reduction could be made in the wiggler population.

Summary

Nymphs of the burrowing mayfly Hexagenia limbata are well established and occur in considerable numbers in the marl bottom of Crooked Lake.

Wigglers are largely restricted to the marl bottom. Sand and pulpy peat bottoms do not form a suitable habitat.

The wiggler population density is considerably below that of very productive lakes such as Gun and Pine in Barry County but compares favorably with Big Silver Lake, Washtenaw County.

No visible evidence of extensive digging operations remain on the lake bottom. This is not indicative of the amount of digging, since a marl bottom rapidly packs down after digging and scooped out areas are seldom visible after a month or two.

Considerable numbers of two-year-old nymphs which were bait size last winter were found in the samples. An adequate number of one-year-old nymphs to insure sizeable mating flights next summer are present.

The exact location and extent of areas worked by wiggler diggers in the winter of 1947 and 1948 are unknown, and no estimate of the area covered or the number of wigglers removed can be made.

It is doubtful if past digging operations were of sufficient magnitude to seriously deplete the wiggler population.

There is no evidence that sufficient damage was or is being done by wiggler diggers or that the wiggler population is being reduced to the point where it is advisable to close the lake to further digging.

Further checking should be done on the lake. In the event of further wiggler digging, a check of the areas dug and the extent of digging and exploitation of the wiggler population should be determined.

McCollum Lake

McCollum Lake is located in Oscoda and Alcona counties, T. 27 N. and 28 N., R. 4 E. and 5 E., Sections 1, 6, 36, and 31. It lies 3 miles north of state highway 72 and 8 miles east of Fairview, Oscoda County. The land around the lake is all privately owned and there is no public access to its waters. The public is allowed by the land owners to gain access to the lake. One owner maintains a boat rental service. No resort development has been made on the lake. It is considered by some individuals to be an excellent fishing lake for warm water species.

Physical Features

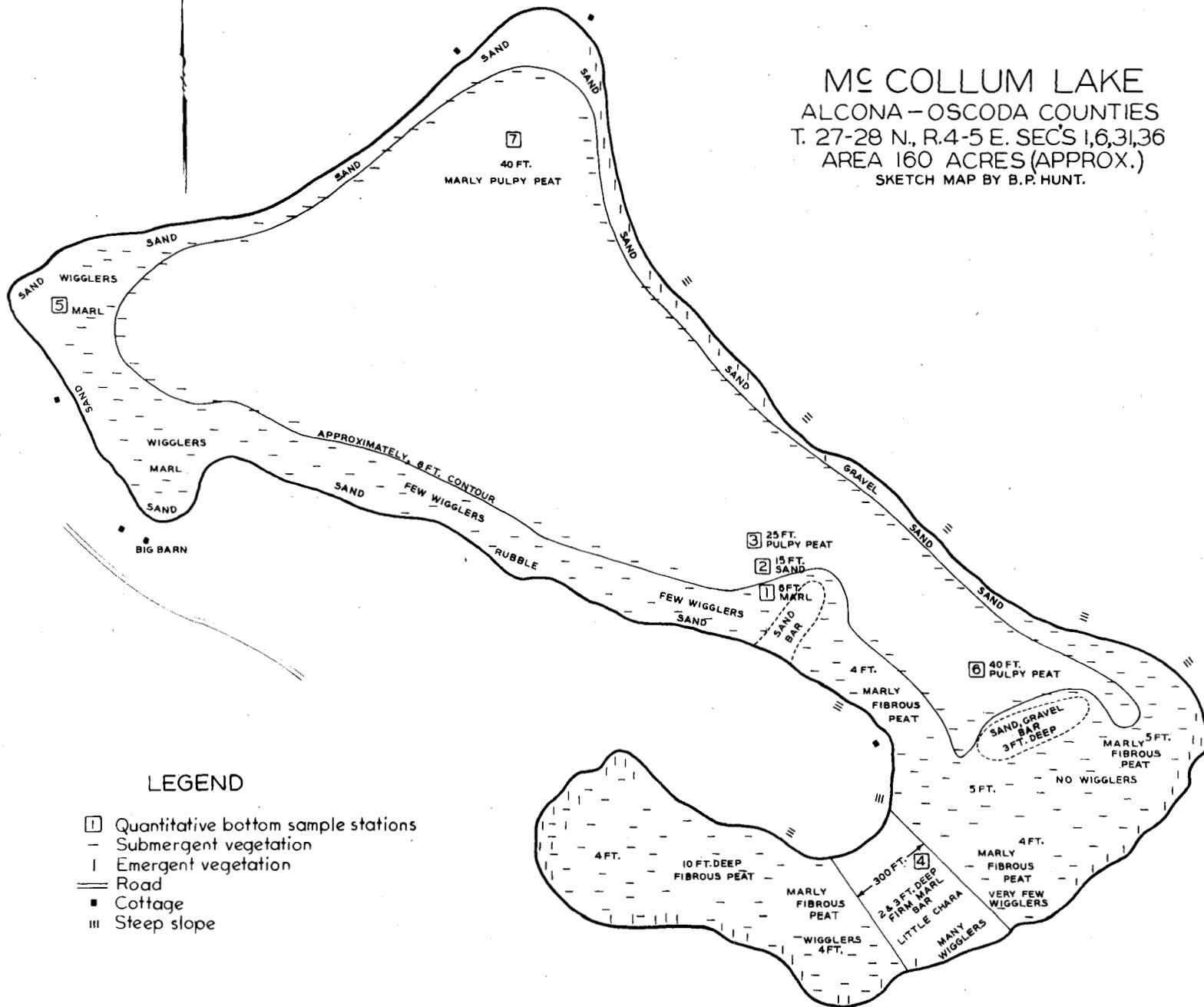
According to a previous compilation of lake areas (areas calculated from lake outlines on county maps) in Michigan made for the Institute by C. J. D. Brown and L. E. Perry, this lake has an area of approximately 160 acres. The shape of the lake is essentially that of a J, as shown on the attached sketch map. ^{2/} The long axis runs northwest to southeast with the tail of the J bending westward from the southeast end. Two soundings, one near the southeast end and one near the north corner, gave depths of 40 feet. Deeper water probably occurs. The extent of shoal area in different parts of the lake varies considerably. Along the northeast, north and northwest side of the lake, the shoal is sandy and narrow. Along the west side, the shoal is somewhat wider. The south and west end of the lake is all shoal.

The bottom varies considerably but consists of four main types, and mixtures of them. They are: sand (gravel, rubble), marl, pulpy and fibrous peat. The shore line for the most part is sand or sand and gravel.

^{2/} The lake will probably be mapped during the winter mapping season of 1948-49 and copies will be supplied to the Lansing, Regional and District offices concerned.

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MC COLLUM LAKE
 ALCONA - OSCODA COUNTIES
 T. 27-28 N., R. 4-5 E. SECS 1, 6, 31, 36
 AREA 160 ACRES (APPROX.)
 SKETCH MAP BY B. P. HUNT.



LEGEND

- Quantitative bottom sample stations
- Submergent vegetation
- | Emergent vegetation
- == Road
- Cottage
- || Steep slope

Several sand and gravel bars are found in the southeastern end of the lake. In at least one area a clean sand bottom was found at a depth of 15 feet. Marl was usually found in the deeper water bordering the sand of the beach. A marly pulpy peat comprised the bottom in the deepest areas. A strange mixture of marl and plant remains, which has some of the characteristics of fibrous peat, was found on most of the shoal areas. As these areas were densely covered with rank growths of plants, a great deal of plant debris was mixed with the bottom material. One area of firm greyish marl was found at the south end of the lake. This bar of marl, covered with 2 to 3 feet of water, was about 300 feet wide and extended entirely across the lake (see sketch map). A scanty growth of sparse Chara occurred here. The remainder of the bottom of the southwest end of the lake is composed of the marly fibrous peat mentioned previously and supports a luxuriant plant growth.

Chemical Features

An analysis of surface waters gave the following data: temperature 72° F., carbon dioxide 0.0, ph-th alkalinity 16.0, M. O. alkalinity 120.4, pH 8.3. No vertical physical-chemical series was taken so nothing is known of the deeper waters. It is certain thermo-stratification occurs. The condition of the marly pulpy peat bottom at 40 feet suggests the possibility that oxygen depletion may not be complete in the deeper waters.

Biological Features

A striking characteristic of McCollum Lake was the density and extent of the submerged vegetation. The shoal areas were densely covered with rank growths of a number of species of Potamogetons, Elodea, Ceratophyllum, Myriophyllum and others. Dense growths of Chara occurred in only a few

places, usually over a sandy or sandy marl bottom. The entire southeastern and the southwestern ends of the lake were shallow and covered with dense growths of vegetation. The single area of firm grey marl previously mentioned, was the only comparatively clear section in this end of the lake.

The density of the vegetation made it difficult to obtain good bottom samples with the Ekman dredge. A Peterson dredge would have proved more satisfactory.

The bottom fauna was similar in composition to that of Crooked Lake except that no crayfish were taken. Caddis larvae appeared to be more numerous.

The fish population is reported to consist of the common warm water fishes including crappies. Numerous bluegill and pumpkinseed sunfish were seen while cruising.

Distribution and Abundance of Wigglers

No adult Hexagenia were found although mature nymphs with black wing pads were taken in the bottom samples. The nymphs were identified as Hexagenia limbata.

The attached sketch map indicates where wigglers were found and where quantitative samples were taken. It is probable that some wigglers are found over most of the shoal areas, but repeated sampling by means of the screen scoop revealed few nymphs in the marly fibrous peat bottom previously described which covers much of the southeastern end of the lake. Although the water over much of this bottom was only 3 to 5 feet in depth, it did not appear very suitable for the nymphs. Areas of firm grey marl which were found along the northwest shore and in the wide bar extending across the southern end of the lake (see map) were heavily populated with nymphs. Adjacent areas of marly fibrous peat contained

few nymphs although the depth of water over the two types of bottom was the same (2 to 4 feet).

Table 2 shows the number of nymphs secured in the quantitative bottom samples. As previously mentioned, the density of the vegetation precluded taking an adequate number of bottom samples to determine the probable density of the wiggler population. It is undoubtedly greater in the favorable bottom than the samples indicate. A separation of the nymphs secured in the dredge samples and by means of the scoop into sex and age groups show the following:

	<u>Male</u>	<u>Female</u>
Number nymphs two years old	2	6
Number nymphs one year old	1	4
Average length of two-year-old nymphs	16.0 mm.	18.0 mm.
Average length of one-year-old nymphs	22.9 mm.	27.0 mm.

An insufficient number of nymphs was secured to give conclusive data on the composition of the population. The small number of one-year-old nymphs as compared to the number of two-year-old nymphs is probably not significant due to the small size of the sample.

With the exception of the few suitable areas of bottom which harbored a considerable number of nymphs, most of the shoal area appeared to be an unsuitable habitat for the nymphs. The lake as a whole appears to be quite unproductive of wigglers.

Wiggler Removal

It was reported that commercial wiggler diggers operated on the lake for only one day. They were ejected from the lake by the property owners and apparently did not attempt to operate on the lake thereafter. It was

Table 2

Number and Volume of Hexagenia Nymphs Taken in Quantitative Bottom Samples
in McCollum Lake, Alcona and Oscoda Counties, Michigan on June 16, 1948.

Sample Number	Depth, Feet	Bottom Type	Vegetation	Number Dredge Hours	Area of Sample Sq. Ft.	Total Number Nymphs	Volume c.c.
1	6	Firm Marl	Thick <u>Chara</u>	2	0.5	1	0.05
2	15	Sand	Sparse <u>Chara</u>	2	0.5	None	...
3	25	Marly Peat	None	2	0.5	None	...
4	2.5	Firm Marl	Sparse <u>Chara</u>	2	0.5	4	0.45
5	3	Firm Marl	Sparse <u>Chara</u>	2	0.5	2	0.30
6	40	Pulpy Peat	None	1	0.25	None	...
7	40	Pulpy Peat	None	1	0.25	None	...

Average number of nymphs per square foot in samples containing them 2.3

Average volume of nymphs per square foot in samples containing them 0.27 c.c.

further reported that local fishermen dig wigglers for bait for use on the lake.

No evidence of digging was observed. This was expected, since the total amount of digging was undoubtedly small.

Since commercial wiggler diggers can gain access to the lake only by trespassing, it is not likely that further digging will be attempted. The fact that the area of the lake productive of wigglers is apparently very small would preclude it from becoming an important source of bait even though it should be open to commercial digging.

Summary

The nymphs of the burrowing mayfly Hexagenia limbata occur in McCollum Lake but were found to be present in considerable numbers only in a few areas where the bottom was composed of firm grey marl.

Most of the shoal area has a bottom composed of marly fibrous peat which sustains a heavy growth of submerged plants. Few wigglers were found in these areas.

The only sizeable area containing a considerable number of wigglers was found in the south end of the lake and consisted of a somewhat barren grey, firm, marl bar about 300 feet wide extending across the lake. This area was bordered on both sides by marly fibrous peat bottom containing few nymphs.

The lake as a whole appears to be quite unproductive of wigglers.

There is no public access to the lake. Commercial wiggler diggers were ordered from the lake on one occasion by local land owners. No further attempts were made to dig wigglers for the commercial market.

It is doubtful if the lake would prove to be an important source of bait even if open to commercial wiggler digging.

Since the local property owners can prohibit commercial wiggler diggers from gaining access to the lake, and need not exclude the fishing public, there is no reason for the lake to be closed to wiggler digging by departmental action.

INSTITUTE FOR FISHERIES RESEARCH

by Burton P. Hunt

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