Original: Fish Division
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Mr. Robert Fortney 11-19-41
Mr. Funk

INSTITUTE FOR FISHERIES RESEARCH
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UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

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FISHERIES SURVEY OF HORSEHEAD LAKE AND LITTLE JOHN BROWN LAKE, MECOSTA COUNTY

by

John L. Funk

I. Introduction

Horsehead Lake (T. 15 N., R. 8 W., Sec. 15, 21, 22, 27, 28) is located in Martiny Township, Mecosta County. Jensen Lake, Big and Little John Brown Lakes, and Spring Lake empty into it. Its outlet, Gilbert Creek, flows into the West Branch of the Little Muskegon River. Although not itself involved, the lake is only about 3 miles average distance from the lakes of the proposed Martiny Flooding Project. The nearest towns are Rodney and Mecosta, both on M-20, and 3 and 4 1/2 miles away, respectively.

Little John Brown Lake is closely connected to Horsehead Lake. It was surveyed at the same time as Horsehead and in this report will be considered as a part of Horsehead.

The lake was surveyed January 6-18, 1940, by a winter mapping party of the Institute for Fisheries Research.* The resulting map was used in

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*Personnel of mapping party: Richard Bohland, leader; Frank Lydell and William Mason, assistants.

charting vegetation and locating sampling stations in the subsequent biological survey. The biological survey[**] of the lake was made August 21-27, 1941. We wish to thank Jay Lowrie and Fred Redemsky for the cooperation they gave the party in providing boats, campsite and other help.

The lake seems to have been used extensively for the transportation of logs when lumbering operations were being carried on in this section. A saw mill was located at the southwest end near the outlet. A dam which may have raised the water level five feet or more is said to have been installed in the outlet at this time but was later removed. The lake is reported to have always furnished good fishing although there has been a general falling off in recent years.

Resort development on the lake is quite extensive. There are 80 cottages, 2 resorts, and 4 boat liveries. Since the shore line is very irregular and much of the marginal land is high, pleasant cottage sites are numerous. Many have sand or gravel beaches which provide good swimming. Fishing on the lake is heavy both summer and winter. Since it is easily accessible by good gravel roads, the lake is of much potential importance as a public fishing water.

II. Physical Characteristics

The outline of the lake is very irregular. The basin consists chiefly of two oblong depressions which run in approximately a west-northwest direction. They are broadly joined by a neck in which most of the water is less than five feet deep. The northern depression is roughly oval in shape with the deepest part opposite the connecting neck. Two shallower

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[**] Personnel of survey party: John Funk, leader; Eugene Roelofs and Stanley Lievense, assistants.

depressions separated by a bar extending across the lake occupy the southeastern end of this part of the basin.

The second depression occupies the main body of the lake. It runs diagonally across the basin with the deepest water in the bay in the northwestern part. This is also the deepest part of the lake. The southern end of this depression is very irregular in shape with deep holes alternating with bars and "sunken islands." In the southwestern part a shallow depression is partially cut off from the main body by a long, narrow point and a bar extending across the entrance. The outlet flows from this bay.

Little John Brown Lake is irregularly oval in shape. Its principal axis runs northwest with the deepest water near the east shore. It is connected by a narrow channel to the southeast-most bay of the northern basin of Horsehead.

The basin of the lake is undoubtedly of glacial origin. The irregularity of the lake bottom itself and of the surrounding country would seem to indicate a lake of the morainic type. The margins of the lake are mainly high, consisting for the most part of irregular ridges and knobs of poor, sandy soil. They are mostly wooded, the dominant trees being aspens but with some fine stands of birch.

The topography of the surrounding country is morainic in character and quite irregular. The soil is sandy and must be of moderate fertility since crops seem to be fair. General farming appears to furnish a livelihood for most of the people.

This lake is located in the Muskegon River drainage. It receives tributaries from Spring Lake, Jensen Lake, and Big John Brown Lake. These, with their tributaries, drain most of the central part of Martiny Township. The outlet, Gilbert Creek, flows into the West Branch of the

Little Muskegon. The West Branch joins the East Branch about 3 miles northeast of Altona to form the Little Muskegon. It in turn enters the Muskegon at Croton and the Muskegon empties into Lake Michigan. The central divide of Michigan passes just northeast of the lake. Lakes only a few miles away in the Chippewa River drainage finally empty their waters into Lake Huron.

The lake has three inlets. Spring Creek, which drains Spring Lake, is probably the most important. It is a stream approximately 10-15 feet wide and 1-2 feet deep. The current is very slow. Its mouth is so choked with swamp loosestrife (Decodon) that little open water can be seen, but the flow between the plants is no doubt considerable. The inlet from Jensen Lake is also of importance but because of a dam in the outlet of Jensen, the flow is probably slight except in times of unusually high water. This stream has formed a fan-shaped delta which is so overgrown with alder (Alnus) and swamp loosestrife (Decadon) that the stream is not discernible from the lake. The stream from Big John Brown Lake is 12-15 feet wide and less than a foot deep where it enteres Little John Brown. It had no perceptible current at the time of the survey. The neck connecting Little John Brown with Horsehead is also 12-15 feet wide, a few inches deep, with no perceptible current.

The outlet, Gilbert Creek, showed little or no flow at the time of the survey. The channel is 6-8 feet wide and could accommodate water 3 or 4 feet in depth without overflowing its banks. Fluctuation in water level of about 6 inches was reported for the 1941 season. Since this was an exceptionally dry season, the water level problem on this lake would not seem to be a pressing one.

The following table summarizes the physical characteristics of Horsehead Lake.

Area in acres	Maximum depth	Approximate % shoal	Shore development	Bottom type		Color	Secchi disc
				Shoal	Depths		
451	54 ft.	65	2.72	Marl, sand	Pulpy peat, marl	Light brown	9-10 ft.

The physical factors in this lake are all favorable for high productivity. Although the main bays run parallel with the direction of the prevailing winds, the relatively small size and high wooded shores serve to keep down destructive wave action. The shore development is 2.7. This is quite high and means that the shoreline is 2.7 times as long as that of a perfectly round lake of the same area. A high shore development is favorable to good fish production since (other things being favorable) the shoals along shore are the most productive areas of the lake. The per cent of shoal or area potentially able to produce vegetation is high. A Secchi disk can be seen to a depth of 9 or 10 feet, showing that the light necessary for plant growth penetrates to a moderate depth. This is favorable since most fish food organisms live on or among plants.

III. Temperature and Chemical Characteristics

The following is a summary of the temperature and chemical conditions found on the lake.

Station No.	1			2			3			4		5		6		7	
	Deepest part of Horsehead Lake 8/22/41			Deepest part of north basin 8/25/41			Deepest part of Little John Brown - 8/25/41			Inlet from Big John Brown 8/25/41		Inlet from Jensen Lake 8/25/41		Inlet from Spring Lake 8/22/41		Outlet Gilbert Creek 8/26/41	
	Depth ft.	Temp. °F.	O_2 ppm.	Depth ft.	Temp. °F.	O_2 ppm.	Depth ft.	Temp. °F.	O_2 ppm.	Temp. °F.	O_2 ppm.	Temp. °F.	O_2 ppm.	Temp. °F.	O_2 ppm.	Temp. °F.	O_2 ppm.
Surface	...	71	7.8	...	72	8.7	...	74	8.9	81	9.2	74	5.9	71	11.0	78	11.3
Bottom	55	43	0.0	40	46	0.0	12	72	9.1	...	...	...	...	...	...	...	...
Thermocline																	
Top	20	68	6.1	17.5	69	7.1	...	...	...	...	...	...	...	...	...	...	...
Bottom	37.5	45	0.0	30	48	0.0	...	...	...	...	...	...	...	...	...	...	...
Methyl orange alkalinity (range)	119.0 - 199.0			107.0 - 198.0			105.0 - 107.0			101.0		138.0		158.0		112.0	
pH range	7.0 - 8.4			6.8 - 8.6			8.8			8.7		7.2		8.2		8.8	

The main depressions of the lake showed definite temperature and oxygen stratification at the time of the survey. Such conditions are to be expected in lakes of this type and it is probable that the stagnation period last throughout late summer and early fall. The thermocline (zone of rapidly changing temperature) is located between the depths of 20 and 37 feet in the deepest depression and between 17.5 and 30 feet in the north bay. Circulation due to wind action, etc., does not take place below the thermocline, so that these deeper waters stagnate while the thermocline is present.

Dissolved oxygen is abundant in the surface water (5.9-11.3 p.p.m.). It will be noted that oxygen is absent from the water below the thermocline due, no doubt, to the decay of organic matter. This oxygen-free water is naturally unsuitable for fish and most other forms of life. Carbon dioxide, a product of the decomposition of organic matter, is present in the deeper waters in moderate amounts but not in sufficient concentration to produce any harmful effect even if fish should be present.

The temperature of the upper water is suitable for warm water fishes such as bass, bluegill, etc., and should permit almost maximum growth. Since the colder, deep waters are without oxygen, they cannot be utilized for cold water fish.

The water is rather hard, as indicated by Methyl Orange Alkalinity ranging from 101.0-199.0. The presence of the dissolved solids, which cause this hardness, is considered to favor plant growth and hence is beneficial from the fisheries viewpoint. The pH indicates moderate alkalinity and is about average for productive lakes. In general, the thermal and chemical characteristics of this lake are favorable for high productivity.

IV. Biological Characteristics

Abundant vegetation generally indicates a productive lake. Twenty-one species of aquatic plants were collected from Horsehead Lake. Musk grass (Chara) covers most of the marl shoal to a depth of 10 or 15 feet. Bushy pondweed (Najas) is also common in the same area. On the solid shoals and bars, especially where the bottom is sandy, bulrushes (Scirpus) occur extensively. Six species of pondweeds (Potamogeton) were collected on the lake. Most of them grow in the deeper water in the vicinity of the drop-off. The variable pondweed (Potamogeton gramineus) was most general in its distribution. Other plant species occurring frequently were pickerel-weed (Pontederia), swamp loosestrife (Decodon), and arrowhead (Peltandra) along the margins. Both white and yellow water lilies (Nymphea, Nuphar) were present. Milfoil (Myriophyllum) and coontail (Ceratophyllum) occurred in some places in the deeper water.

A list of the plants found in the lake with abundance and bottom type is given in the following table.

Species	Abundance	Bottom type
Waterweed (Anacharis canadensis)	Rare	Marl, pulpy peat
Coontail (Ceratophyllum demersum)	Few	Marl, pulpy peat
Swamp loosestrife (Decodon verticillatus)	Few	Marl, pulpy peat
Milfoil (Myriophyllum sp.)	Few	Marl, pulpy peat
Bushy pondweed (Najas flexilis)	Abundant	Marl, pulpy peat
White water lily (Nymphea odorata)	Few	Marl, pulpy peat
Yellow water lily (Nuphar variegatum)	Few	Marl, pulpy peat
Arrow arum (Peltandra virginica)	Rare	Marl, pulpy peat
Smartweed (Polygonum sp.)	Rare	Marl, pulpy peat
Pickerel weed (Pontederia cordata)	Few	Marl, pulpy peat
Large-leafed pondweed (Potamogeton amplifolius)	Rare	Marl, pulpy peat
Pondweed (Potamogeton angustifolius)	Rare	Marl, pulpy peat
Variable pondweed (Potamogeton gramineus var. graminifolius, f. myriophyllus)	Common	Marl, pulpy peat
Floating-leaf pondweed (Potamogeton natans)	Rare	Marl, pulpy peat
Sago pondweed (Potamogeton pectinatus)	Few	Marl, pulpy peat
Flat-stemmed pondweed (Potamogeton zosteriformis)	Few	Marl, pulpy peat
Big bulrush (Scirpus acutus)	Abundant	Marl, pulpy peat
Three-square bulrush (Scirpus americanus)	Rare	Marl
Bladderwort (Utricularia vulgaris americana)	Rare	Floating
Wild celery (Vallisneria americana)	Rare	Marl, pulpy peat
Musk grass (Chara sp.)	Abundant	Marl, pulpy peat

This vegetation is beneficial in a number of ways. First, is the well-known fact that the photosynthetic activity of the plants increases the oxygen supply of the water. The large amounts of oxygen shown at the Spring Lake inlet and the outlet may be accounted for by the dense beds of vegetation in the vicinity of these stations. Second, the plants offer support and cover the large numbers of organisms utilized as food by fish. Finally, the fish themselves find protective cover among the plants. Every fisherman knows the best fishing spots are near weed beds.

Plankton was moderately abundant in the water at the time of the survey. This consists of floating plants and animals of microscopic or near-microscopic size which fish food organisms and young fish use for food. In this lake plant organisms or phytoplankton was most abundant. Since plankton concentration is known to vary from day to day and from place to place in the lake, this information is only of general value.

Bottom foods were sampled in two ways. One method was to remove a definite area (1/2 square foot, etc.) of the bottom soil, wash out the debris through a screen, sort and count the animals which remain. This method was used in deep water or where vegetation was sparse. In the shallow water in this lake scuds and mayflies were common and a few snails, beetles and midge larvae were found. In the deeper water organisms were scarce. One sample from 40 feet contained no animals. In others, midge larvae were rare. Since fish are not in these areas, this is not particularly significant.

Another method used was to wash off thoroughly a collection of submergent plants. These samples, particularly from the fine-leafed plants, are frequently teeming with life. Most of the collections made at Horsehead were of this type. Snails and midge larvae were common with mayflies and amphipods of secondary importance. In addition, numerous other animals are listed as few or rare. One sample showed 14 different types of organisms. Clams were observed to be common on some of the shoals and considerable evidence of the activities of crayfish were noted although neither show up to any large extent in the samples. Many large leeches were seen under stones, old boards, etc. By comparison with other lakes of the same type, bottom food organisms in Horsehead Lake would seem to be abundant.

A summary of the fish taken or reliably reported follows.

Species	Abundance	Plantings 1936-40
GAME FISH		
Bluegill (Lepomis macrochirus)	Abundant	57,200
Pumpkinseed (Lepomis gibbosus)	Common-abundant	...
Largemouth bass (Huro salmoides)	Common	3,200
Rock bass (Ambloplites rupestris)	Common	...
Yellow perch (Perca flavescens)	Few-common	7,500
Smallmouth bass (Micropterus dolomieu)	Few	...
Long-eared sunfish (Lepomis megalotis peltostes)	Few	...
Northern pike (Esox lucius)	Rare	...
Walleyed pike (Stizostedium vitreum)	Reported rare	500,000
FORAGE FISH		
Silversides (Labidesthes s. sicculus)	Abundant (predominant)	
Blunt-nosed minnow (Hyborhynchus notatus)	Abundant	
Log perch (Percina caprodes semifasciata)	Common	
Black-nosed minnow (Notropis h. heterolepis)	Common-few	
Black-chinned shiner (Notropis heterodon)	Few	
Johnny darter (Boleosoma nigrum)	Few	
Mimic shiner (Notropis v. volucellus)	Few-rare	
Iowa darter (Poecilichthys exilis)	Rare	
Pug-nosed shiner (Notropis anogenus)	Rare	
Black-nosed dace (Rhinichthys atratulus)	Rare	
River chub (Nocomis micropogon)	Rare	
Lake emerald shiner (Notropis atherinoides)	Reported (?)	
COARSE FISH		
Common sucker (Catostomus commersonnii)	Rare - (reported common)	
Yellow bullhead (Ameiurus natalis)	Few-rare	
Brown bullhead (Ameiurus nebulosus)	Rare	
Black bullhead (Ameiurus melas)	Rare	
OBNOXIOUS FISH		
None taken, seen, or reported.		

The lake shows a wide variety of game fish. Bluegills are most abundant, but largemouth bass are frequently caught. Some fine perch are also taken and pike and smallmouth bass are caught occasionally. A few catches of walleyed pike were reported, but these fish seem to be relatively rare.

Silversides or skip-jacks are by far the most abundant forage fish. The blunt-nosed minnow was also abundant and log perch and mimic shiners were common. Lake emerald shiners (Great Lakes shiners) were reported to be numerous, but this is thought to have been a case of mistaken identity.

Although few suckers were taken they are reported to be quite numerous. Perhaps their conspicuous spawning activity in the spring gives an exaggerated idea of their numbers. No gars, dogfish or other obnoxious fish were taken, seen, or reported in the lake.

Scale samples were taken on the game fish and from this study the following growth rate chart was made. Since these fish had completed most of an additional season's growth, and additional year should be added to the age group number to arrive at the true number of growing seasons of the fish.

Growth Rate Table

Species	Age group	Number of specimens	Length in inches	Weight in ounces
Northern pike	0	1	9.0	2
	I	1	11.1	4
	II	2	18.6	20
	III	1	16.8	16
	IV	1	20.3	28
	VII	1	29.0	80
Yellow perch	I	2	3.8	0.5
	II	2	4.9	0.8
	III	4	5.3	1.0
	IV	3	7.5	2.7
	VII	1	12.5	13.0
Smallmouth bass	I	1	6.7	2.8
Largemouth bass	II	1	7.6	3.0
	III	5	9.5	6.0
	IV	2	12.1	13.3
	V	1	12.1	13.5
Bluegill	III	22	4.6	1.1 (21 weighed)
	IV	7	5.8	2.5
	V	5	6.5	3.6
	VI	4	7.5	4.9
	VII	6	7.6	4.8
	VIII	12	7.9	5.5
	IX	1	8.0	5
Pumpkinseed	II	1	3.5	0.5
	III	17	4.5	1.1
	IV	16	5.3	2.2
	V	5	6.0	2.9
Rock bass	II	3	4.2	0.8
	III	6	5.0	1.4
	IV	4	6.4	3.8
	V	1	5.8	2.3
	VI	1	8.0	6

In most cases the series of fish studied is rather small. However, we believe that they give us a representative cross-section of conditions in the lake. In general the fish seem to be growing rather slowly as compared with average growths in similar lakes.

The northern pike reach legal length early in their third summer. This is near average for the state. The perch, however, do not reach six inches until late in their fourth or early in their fifth summer, about twice as long as the average over the state. The average Michigan large- and smallmouth bass become keepers in their third summer but the largemouth in Horsehead must require over four years to reach legal size. While only one smallmouth was studied, the indications point to a growth rate similar to that of the largemouth. The average Michigan bluegill reaches legal size in its fourth growing season and pumpkinseeds and rock bass have similar growth rates. In this lake the bluegills became legal early in their sixth season, pumpkinseeds late in their sixth and rock bass in their fifth season of growth. While in no case is this slow growth marked enough to be considered serious, it does indicate that fish growth in this lake is only fair.

Spawning facilities seem to be adequate for all species in the lake. The pike very probably utilize the weedy marsh areas near the outlet and the inlets, particularly those from Spring Lake and Big John Brown Lake. The weedy shoal in the southwestern part of the main basin should be ideal for perch. There are numerous weedy areas with soft bottom suitable for largemouth bass, while smallmouth, bluegills, pumpkinseed, and rock bass, which prefer sand bottom, can find abundant facilities in many places, notably most of the east shore. It would seem that natural propagation should be adequate to maintain the population of all species present.

This is an unusual lake in that it combines the features of a good fishing lake and those of a good resort lake to a degree not frequently found. The high wooded shores, clean sand beaches and clear water place it well above the average as a resort lake. At the same time it has many weedy shoals and submerged weed beds which are characteristic of good fishing lakes. The habitats are so varied that a large variety of fish are found. Perhaps this very variety of factors and species explains why the lake is only fairly productive. Just as a man who is jack of all trades is master of none, so a lake which shows such a variety of characteristics cannot be expected to rank at the top of a scale measuring only one characteristic.

V. Management Suggestions

The results of the survey would seem to indicate the present designation of "all other lakes" to be satisfactory. The present stocking policy for bluegills (5,000-10,000 fingerlings per year) and largemouth bass (1,000 per year) cannot be justified in the light of our present knowledge of natural propagation. Natural means are almost surely more than adequate to keep this lake up to its maximum productive capacity. Since perch are doing poorly in the lake and since there are certainly adequate spawning grounds, it is suggested that stocking of this species be discontinued.

The large walleyed pike occasionally taken must date from a planting of 180,000 fry made in 1933. It seems apparent that this experiment was not successful in establishing the species. Of course it is too early to expect any results from the 1940 planting. Past experience has shown it to be risky to plant walleyes in small lakes where bass are having any degree of success. In several cases where the walleyes have become established, they have completely exterminated the bass and other fish.

This provides good walleye fishing for a time but when the supply of forage fish becomes exhausted the walleyes themselves are greatly reduced in size and numbers. Such might not be the case if the walleye become established in Horsehead Lake, but it hardly seems worth risking the possibility. It is therefore suggested that no more plantings of walleyes be made.

Herons, bitterns, loons, kingfishers, and turtles were observed on the lake by the survey party. The number of these so-called predators does not warrant any control measures. Their effect in reality is probably benificial as they may prey on injured or diseased fish which need to be removed for the good of the population as a whole.

Few parasites were found in the fish examined. Those present were certainly harmless to humans and probably caused little inconvenience to the fish.

Cover on the lake is probably adequate. There is an abundance of dense weed beds, while the early logging activities left numerous snags and deadheads scattered over the shoals.

Water level fluctuation seems to be slight (6 inches). There is agitation among the property owners to have a dam installed in the outlet and the level raised. This seems to be prompted more by the desire of some to improve their facilities for landing boats than the possibility of improving conditions for fish. The most important consideration from the fisheries standpoint is that the level be kept as constant as possible. Even slight fluctuation may expose large areas of shoal which the fish utilize for feeding and spawning.

Spawning facilities seem to be adequate and should permit a maximum of natural propagation.

INSTITUTE FOR FISHERIES RESEARCH
By John L. Funk

Report approved by: A. S. Hazzard
Report typed by: V. Andres