A SURVEY OF THE LAKES OF ISRO WITH AN ACCOUNT OF THE FISHES OCCURRING IN THEM

Walter Koelz

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FOREWORD

Pursuant to the provision of the Fifty-fifth Legislature of the State of Michigan for a Survey of Isle Royale, the exploration of the lakes of the Island was assigned to me. The investigation had as its primary purpose the ascertaining of the kinds of fish occurring in these water-bodies. Incidentally much information was collected on the hydrography of the lake basins and some observations were made on the abundance of the fish and on their food. To the assistance of John Brumm and George Stanley, students in the University of Michigan, I am entirely indebted for the accumulation of the data here presented.

The party landed on the Island, August 7, 1929, and left on October 2, 1929. Thirty-eight lakes were examined in th s period. The number includes all but four or five small ponds shown on the maps, and also three, one of them of considerable size, not charted. A map of the Island, Plate I, shows all the known water bodies. A few obvious errors of mapping, all referred to in the proper places in the text, have been corrected on it.

The equipment included a 17-foot canoe, several thousand feet of linen gillnets of 2 1/2, 2 and 1 1/2 inch (stretched) mesh, common sense minnow seines, a 50-foot seine of 3/8 inch mesh, and nickel-encased Negretti-Zambra deep sea thermometer.

Each lake was sounded with the view of ascertaining the general features of the topography of the lake basin. Usually several series of depth readings were made across the lake, the number of such series depending on the degree of regularity of the contour lines. A total of more than 3600 soundings were recorded. In collecting, the shores were always explored around the entire lake and seines were drawn wherever possible. The best shoals were usually explored with the seine again after dark. Gillnets of the three meshes usually in lengths of about 200 feet for each mesh, were set in virtually all the lakes. The number of the sets made was largely determined by the hydrography of the lake basin.

Specimens of fish were preserved from each locality and all collections have been deposited in the Museum of Zoology at Ann Arbor, only the coregonids have been critically studied. These have been reported on in a paper entitled "The coregonid fishes of north-eastern America", which appeared in the papers of the Michigan Academy of Science, Arts and Letters for 1930.

In the pages that follow the lakes are described in the order in which they were explored.

DESCRIPTION

LAKES OF ISLE ROYALE

Chickenbone Lake

The lake is roughly of the shape of a wishbone with one arm abbreviated. The main arm is about 1 3/4 miles long and like virtually all of the lakes on the Island has its long axis from northeast to southwest in the direction of the strike of the strata. The short arm, which is less than a mile long, lies

in a fault trough of which the McCargoe Cove basin is part. The lake drains through this trough, but at this season the bed of the outlet was mostly dry, The outlet is immediately obstructed by logs, and a heavy deposit of silt and organic material has been accumulated in this end of the lake. A small feeder enters the lake at the southwest end. Its channel is about ten feet wide and three feet deep, and discharged on August 12, an estimated 3-4 cu. ft. per second. Not enough water was present to harbor fish except in a pool near the lake, where a small pike (6 inches long) was observed. A group of rocks projecting above the surface lies in the mouth of the short arm and three small islands lie in a row a little beyond the center of the long arm.

The shores along the outside of the arms are steepest, except that there is a low flat at the extreme southwest and through which the inlet makes its way. The inside shore of the short arm is rather low and flat, but the corresponding side of the long arm is steeper. The steep banks are often rocky at the water's edge. The uplands are covered with birch, balsam, and spruce, with an occasional white pine that has survived the numerous fires. White cedars are scattered rather commonly along the water's edge on the outside of the long arm and rushes of two species grow occasionally on some of the points. The low flat around the inlet has no trees, but is well overgrown with bushes of willow, alder, small ash, and clumps of sedge ("marsh grass"), and iris. Both shores of the short arm have a fringe of the shrub Myrica with patches of sedge near the water, most abundant around the outlet and on the east shore near the mouth.

The short arm to the inlet is about 10-13 feet deep. A depth of 10 feet

continues to very near the 300-foot wide mud flat off the outlet. The sides are relatively steep-sided, so that at 25 feet from shore the depth is 6 feet or more. The rocks in the junction of the two arms are scattered over the bottom with depths of 11 feet between, but a reef of 5 feet extends out from the inside of the "V" about halfway across from the mouth of the short arm.

The long arm across its mouth is 12-15 feet deep, but the depth soon rises to 17-18 feet over a broad central area and continues to near a large island where there is a pocket of 20-21 feet. There is another such pocket south of the middle island. Beyond the islands the depth is principally 10-15 feet. The area north of the island chain is shoal (1-7 feet). The sides of this basin are also steep. (Soundings 127)

The bottom in the three end coves is muddy and soft. In stretches mainly along both shores of the long arm, there is fine sandy mud more or less strewn with gravel and boulders. The slope to the basin is generally steep so that these areas are not broad. Snags are very common along all shores and seining is difficult. In deep water the bottom is fine blackish mud (not muck), so soft that a 10-lb. stone is completely buried in it.

Bands of eelgrass are frequent along shore to depths of about 9 feet. There are also occasional plants of spatterdock in the short arm. Clams are often abundant. The water is discolored, so that discoloration is evident in a pailful.

Eight species of fish were collected: pike, perch, walleyed pike, sucker,

spottailed minnow, Iowa darter, and two species of miller's thumbs, C. cognatus and C. b. kumlieni. All were seined except the pike. The shiners and perch occurred commonly almost everywhere. The miller's thumbs were taken chiefly from the inlet to about the middle of the south shore. The darters were found only on the sandy stretches and the suckers only off the inlet. Walleyes were seined only after dark. Pike, walleyes, and perch were caught most abundantly in gillnets, though pike bit readily on a trolling spoon.

A string of gillnets set on August 6 and lifted next day in the center of the long arm in 17 feet got (in the 2 1/2 inch) 3 perch, 2 pike, and 11 (changed to 19 by proof-reader) walleyed pike; (in the 1 1/2 inch) a walleye; (in the 2 inch) 7 walleyes and a perch. A string of gillnets set on August 11, 1929, and lifted next day, from shore to 10 feet off the inlet got in the 2 inch net 8 walleyed pike and 3 perch; in the 1 1/2 inch 1 walleye and 8 perch; in the 2 1/2 inch 8 walleyes and 2 perch. Many of the perch were very well fed and some weighed a pound.

Stomach examinations: of 11 perch, 4 had nothing; 3 had Hexagenia nymphs (1-3); 1 had a dragonfly nymph; 1 had 2 leeches; 1 had a fish; 1 had wood fragments, cedar leaf and an ant. Of 30 walleyed pike (1/2 - 1 1/2 lbs.) 13 had nothing; 4 had Hexagenia nymphs (1-7); 10 had 1-5 small fish, mainly perch; 1 had a Hexagenia nymph and a perch; 2 had a dragonfly nymph and 2 perch, each; Of 4 pike (1 1/2 - 3 lbs.) one had an empty stomach, one a leech, one a small fish, one adult insect remains.

Temperatures

Place	Depth In feet	Date	Temp. in deg. C.	Time
	Surface	Aug 9, 1929	24	1.20 p.m.
	17	Aug 12, 1929	20.1	11:15 a.m.
CENTER	Halfway	Aug 12, 1929	20	11:15 a.m.
	Surface	Aug 12, 1929	21.6	11:15 a.m.
Near shore	Surface	Aug 12, 1929	20.8	11:15 a.m.
Leeward shore	Surface	Aug 12, 1929	23.1	1:00 p.m.

Lake Livermore

Lake Livermore lies in a short trough a few rods to the south of Chickenbone Lake, and discharges its water into this lake through a small creek. Due to the fact that there is a considerable difference in elevation (the map gives the altitude of L. Livermore as 190 feet above L. Superior) and so short a space between the two, the water course is probably too steep to permit the ascent of fish. It was moreover completely dry on August 10.

The lake is less than a mile long and averages probably about 600-700 feet wide. There are two slight indentations on the northern shore; from the more pronounced one the outlet flows. The shores on the south are generally steep; elsewhere they are generally low.

Vegetation grows virtually to the water's edge, except on the points and in a few other stretches where rock is exposed, and at the two ends where there are narrow sandy shelves. The shores are timbered with the birch-balsam formation, with occasional white pines. Narrow, more or less interrupted bands of Myrica extend along the shores, these often 100 feet in length. Alders and white cedars also fringe the lake in places.

The basin of the lake also has steep sides, except at the two ends and in the two north coves where shallow flats extend out some 20 or 30 feet. There is also a short rock ledge, partly exposed, lying off the north shore about halfway between the outlet and the east end of the lake. The depth elsewhere at 20 to 30 feet from shore is nearly equal to the maximum depth found off that point. The deepest water is in the widest part of the lake. A depth of 17-19 feet extends from off the outlet westward for about half the distance to the end. The bottom slopes gently toward either end from this deep hole. (40 soundings)

The water is rather dark, so as to appear decidedly discolored in a glass.

The lake bottom in the deep water is a fine blackish soft mineral and with no apparent organic matter. Along shore the bottom is of a clean fine sand at the two ends. At other places there is commonly found fine gravel and sandy mud with plentiful boulders up to 1 or 2 feet in diameter, sometimes larger. More rarely there are stretches for 20-30 feet of soft clayey material with few stones, and in a few places bedrock forms the shore in stretches up to 50 feet. There is a heavy coating of silt and ooze over all such bottom, including the stones. Trees have commonly fallen into the water so that there is no stretch of shore line 100 feet long that is free of them.

Water vegetation is very rare. Here and there along shore, chiefly in places not accessible to the moose, are patches of Chara a few inches in circumference, a small plant of dwarf Potamogeton, eel grass, Myriophyllum or Utricularia. Clams are seldom common.

The only fish observed in the lake were pike, perch, and stripenosed minnows. The last were seen only in two places. A school of some 15 young

of the year were found along the east shore and a large school of adults was located playing around a fallen tree, in company with small perch. Perch were common in schools almost everywhere along shore, especially in the two coves and around the fallen trees. They were all small, from 1-5 inches long, with relatively few individuals of the largest size. Some dozen pike were seen in rowing around the lake, chiefly in the vicinity of the submerged trees. These also were small; none of them weighed over 2 1/2 pounds. They were uniformly hungry and never refused to bite a preserved minnow offered on a bent safety pin. One even struck at the paddle blade.

Pieces of gillnet of 2, 2 1/2, and 1 1/2 inch meshes were set on August 9, in the center of the lake from 19 feet to 10 feet, and lifted on the following day, after 17 hours. The 2-inch net, which was in the deepest water, got nothing; the 2 1/2 inch took one pike weighing about 2 1/2 pounds; and the 1 1/2 inch net took a pike (2 1/2 lbs.) and 4 small perch. All the fish were dead. The same nets were reset off the east end of the lake from one shore to the other through a maximum of 10 feet. The 2-inch net took nothing; the 2 1/2 inch took 2 pike (2 lbs. each); the 1 1/2 had one pike (1 1/2 lbs.) and 8 small perch.

The stomachs of two of the pike (very thin) were examined. One had caught a perch 1 inch long; the other had three pieces of bark and a colony of gelatinous algae (Nostoe). The perch were better fed and temporarily at least seemed to be finding sufficient food. Stomachs examined contained chiefly small caddis larvae.

The lake appears to offer but an indifferent environment for fish. The fish productivity of a body of water depends, other things being equal, solely

on its capacity to produce fish food, which consists of various species of aquatic insect larvae, mollusks, crustaceans, and small fish. Most of these organisms thrive best in or are restricted to the shoal zone to which rooted plants are confined. Many of them are dependent on these plants for food or protection. Plants require light and heat, which fall off rapidly in deep water. In this latitude a depth of 10 feet marks about the lower limit of thrifty plant growth and hence the zone of greatest fish food production.

It does not follow, however, that all shallow areas are productive. The physical and chemical properties of the bottom determine principally what organisms, both plant and animal, it will sustain. In general a sandy bottom is most favorable. The degree of water movement on these shoals is also of great importance inasmuch as currents prevent the accumulation of silt and organic debris which tend to render the environment unfit for important organisms. Hence the amount of wave action to which a shore is subjected is a factor in determining the production of fish food on it.

Now there is very little of the basin of Lake Livermore that is covered by less than 10 feet of water. Furthermore, most of that area bears very few plants, and much of the bottom is covered by silt. It is likely that the moose have been responsible for destroying the vegetation and probably at one time much more food was available for fish than now.

The temperature taken at 5:45 p.m. on August 12, 1929, was 19.5 deg. in 18 1/2 feet; 21.3 deg. at 9 feet; 21.8 deg. at 6 feet.

Lake Lesage

Lake Lesage lies in a long trough about 1/4 mile to the south of Lake Livermore. It receives through a small creek at the east end the water of

Angleworm Lake, which lies in this same trough, and drains into Lake Ritchie by a small creek taking its source in a small bayou off the south shore. Its altitude is not given, but it is probably at least as high as Lake Livermore. Both streams contained water on August 13. There are no obstructions to the movement of fish between Lake Lesage and Lake Angleworm, but a beaver dam at the outlet prevents the ascent of fish from the lower lake. (The beaver have a large house on the north shore.) The course of the stream is rather turbulent, but at least suckers navigate it, since young suckers were caught in the beaver pond just below the dam.

The lake is long and narrow, about 7/8 of a mile long, and averages, excluding the southern bayou, about 600 feet wide. Off the middle of the south shore opens a narrow pond about 1/4 mile long. A small island lies in the connecting gap and there is another off a rocky point on its western shore. The banks of the main lake on both sides are gently sloping ridges 20-30 feet high timbered chiefly with birch, with rock outcropping in places. On the ends the terrain is low. There is a cedar swamp on the west, and a mixture of poplar, birch, and conifers on the east. Around the southern pond the shores are also generally low, except for a tongue of rock dividing the western shore line, which is otherwise a swamp of drowned birch. A drowned cedar-spruce swamp forms the eastermost shore. On the southern shore of the main lake are occasional cedars and alders with scattered patches of Myrica. In the south arm there is in the end coves a growth of Myrica and Chamaedaphne and "marsh grass".

Many of these trees and shrubs are growing in two feet of water and many are dead. Apparently the beaver dam across the outlet is of relatively

recent construction. It has raised the water of the lake at least 3 1/2 feet, obliterating all beaches, and has undoubtedly converted a marsh into the south pond.

The depth of the pond is very uniformly 4-5 feet. In the main lake the sides of the basin are very steep. At 20 feet from shore a depth of 6-8 feet can usually be reached, and the descent is sharp to the broad central trough that is overlaid by 20-23 feet. This trough ends rather abruptly at the east; a depth of 9 feet is recorded 50 feet off shore. The slope from the west shore is less precipitous. (87 soundings)

The bottom in the deep water and along the shore of the main lake is much as in Lake Livermore. In the pond the shores are miry and the bottom everywhere seems to be organic ooze. The water of the pond is so muskeg that bottom could not be seen at a depth of 5 feet.

Water vegetation is commoner than in Lake Livermore, but still rare. A patch of tall-growing Potamogeton lies just off the beaver house. Here and there along the shore at depths of 6-8 feet are patches of small spatterdock and eel grass and plants of both are scattered along the shores, except in the pond. Here only an occasional small spatterdock of Potamogeton natans was observed. Utricularia and Chara probably uprooted by moose were seen adrift. Clams are relatively scarce.

The only fish found in the lake were perch and pike. Gillnets of 2, 2 1/2, and 1 1/2 inch mesh were set on August 12, and lifted next day from 16-22 feet near the center of the lake. A 2 1/2 lb. pike was caught in the center net of the gang. These nets were reset along shore just east of the last gap in

8-11 feet and when lifted on the next day the 2-inch took 7 pike and the 2 1/2 inch 9, all weighing 1 1/4 to 2 1/2 lbs. Four other pike of the same size limits were caught by trolling. The perch were seined along the shore usually with great difficulty on account of the drowned vegetation, and were taken from pike stomachs.

The stomachs of 18 pike were examined. Some of the fish were very thin and many had hard empty intestines. Six had eaten nothing; 2 had a large leech; 10 had eaten perch, 1-4 inches long. One of the 10 had caught 10-inch long perch, and two others had 4, with a burrowing mayfly larva (Hexagenia) in addition in one and a wooden-cased caddis in the other. All the rest had caught only one fish apiece.

In the pond at 5:30 p.m. on August 13, the temperature on the bottom in 5 feet was 20.8 deg. A half hour later in the main lake on the bottom in 25 feet a reading of 12.4 deg. was observed. The surface temperature here was 20.7 deg.

Lake Richie

Lake Richie occupies a rather broad depression lying less than a mile southward of Lake Lesage. Its main body is two miles long and where broadest it is a little over 1/2 mile wide. Its axis is not parellel to that of the three aforementioned lakes, but runs almost east and west. Near the center of the southern shore, a narrow arm (undoubtedly occupying a fault through) runs to the southeast. This arm is about 3/4 mile long and about 600 feet wide. Over the eastern half of the north shore of the main trough of the lake is joined another basin, about 1 1/4 miles long and at its widest about 1/4 mile

wide. A large island about 1/2 mile long lies in the opening between the basins leaving a connection through a narrow channel at each end. Three small islands are grouped off its northeastern end. The lake received two feeders, both near the western end, one from Lake Lesage and one draining some swamp land to the west. It drains through the fault trough into Chippewa Harbor. There was a slight discharge through the inlets, but the outlet was dry.

The shores all along the south are rather steep, especially between the outlet and the west inlet. To the east and north the terrain is generally low. Bedrock forms the shoreline of most of the open lake and of the islands. Here and there are stretches of broken rock, the fragments even when of gravel size with sharp edges. In the bottom of the coves, even in the broad indentation on the south shore of the large island, the shores are sandy. The sand is usually very fine and so mixed that the ground is soft, but in the cove in the extreme east end of the main trough there is a hard sand beach.

The shores are timbered chiefly with birch with more or less mixture of spruce and balsam. On the north shore the conifers are chiefly replaced by poplar. Cedars are scattered along the south shores, and in places, chiefly on the high ground along the outlet arm, pines are rather common. Myrica, alders, ash, and sedges are scattered along the shores, all but the first usually only in the coves. Rushes occur sparingly on the sandy shores. The vegetation of islands is like that of the mainland.

The lake basin everywhere has steep sides. In the main body the slope is steepest along the south shore where at 50-150 feet the bottom of the trough is usually reached. Beginning at the eastern cove with a depth of 17-22 feet, the bottom gradually drops to 35-37 feet off the outlet arm and then rises

rather evenly to a broad plain overlaid with 25 feet at the western end. In general the deepest water lies along the south shore and the maximum depth here is usually some 5 feet greater than that of the center, the amount diminishing westward of the outlet arm. The central plain is rather broad and then slopes sharply toward the north shore. Off the island and near the projection to the west is found the only approach to shoals. The depth at 100-200 feet off shore is 10 feet at these places.

The south arm also has a steep-sided basin. The deepest water lies off its west shore and is reached at 50-100 feet off shore. The maximum depth (39 feet) was found near the mouth. The depth decreases rather uniformly to a point about halfway to the outlet, from which point a plain of 18-20 feet extends to near the end. The rise to shore is sharp even off the outlet.

In the north bay is found the shallowest water. A comparatively broad shelf (3-5 feet deep) extends off the northwest shore of the large island; a reef of 3-5 feet connects the two northern islands and one of about the same depth runs from the easternmost of these to shore; a broad reef lies to the east of the smallest island. Elsewhere, even in the channels between the islands, the water is 11-16 feet deep. (191 soundings)

The bottom in deep water is in general very soft fine mud as in the other lakes. Off the sand shore the bottom is usually rather soft too, overlying or mixed with clay and mud, the proportion of sand diminishing rapidly toward deep water. At depths of 10 feet near shore usually a sandy mud is found. Only off the sand beach in the east cove is there hard sand bottom in the shallow water. At other places off shore is found mud, more or less mixed

with rock fragments.

The water is rather discolored, but not so muskeg as in Lake Lesage. The thermometer disappeared at 8 1/2 feet on a bright day. Clams are present along the shores.

Water vegetation is relatively rare. A few deepwater Potamogeton remains around the islands and on the shoals to the east, but the moose are constantly feeding here in numbers and even these stray plants will probably be eaten.

Eleven species of fish were taken in the lake*: perch, sucker, pike herring, sunfish, golden, mimic, spottail and stripenosed shiners, trout-perch, miller's thumb, C. cognatus. All were taken by seining, though the first three were also caught in gillnets. The miller's thumb was found only on sand off the west inlet and the herring only in a small cove near the Lesage Creek. Pike caught in this neighborhood contained remains of herring and by diligent nocturnal seining on the few possible beaches a single specimen was taken. The other small fish, except the trout-perch and spottail, which seem rather widely distributed, appear to thrive best in the coves of the northern part of the lake.

Gillnets of 2 1/2, 2, and 1 1/2 inch mesh were set on August 13, in 17-20 feet in the eastern gap. When lifted on the following day the small-mesh net had 2 perch; the 2-inch net a pike (1 lb.) and 2 perch; and the other had one pike (2 1/2 lbs.). Two similar gangs were lifted on August 16 after one night out. In the first, from 6-15 feet in the channel north

* According to reliable reports walleyes were planted as fry about 1925.

of the two medium-sized islands, the 2 1/2 inch net at the deep end took 3 perch and 3 pike (1 1/2 - 2 lbs.); the rest took nothing. The other gang was set hard off the west bank of the mouth of the south arm in 19-37 feet. The 2 1/2 inch net ran from 19-29 feet and took 2 pike (2 1/2 lbs.) and a sucker. The rest had nothing. These nets were reset in 5-15 feet off the north shore straight across from the mouth of the south arm and were lifted on the next day. The off shore net (2 1/2 inches) took 3 pike (2 - 2 1/4 lbs.) the 1 1/2 had two small perch; and the 2 inch net in shallow water had nothing. Another gang lifted off the outlet on the same day after one night out from 6 to 20 to 10 feet two suckers in each of the 1 1/2 and 2 1/2 inch nets. A pike (4 lbs.) followed to the surface one of the fish in the net.

The two gangs were reset on the 17th and lifted next day. The one in the center of the lake off the mouth of the south arm in 34 to 35 feet took one pike (2 1/4 lbs.) in the 2-inch net at 24 feet, and nothing in the other two in deeper water. The other from 100 feet off the mouth of west feeder in 14-21 feet took 3 pike (2 1/2 - 3 lbs.) in the 2 1/2 inch, one pike (1 1/2 lbs.) in the 1 1/2 inch, and a pike (2 lbs.) and a sucker in the 2 inch. A total of six suckers, 16 pike, and 9 perch was thus taken by 7 sets involving the use of over half a mile of net.

The stomachs of the perch and pike were examined. A pike taken on the 14th had remains of two small perch. On the 16th one pike had 3 inch-long perch and a burrowing mayfly nymph; one had remains of a fish; one had only a mayfly nymph; one had 6. On the 17th one pike had a four-inch sucker; one an inch-long sucker; one a 4 1/2 inch herring. On the 18th one had a burrowing

mayfly nymph and remains of 2 small fish; one had 13 small herring. The rest were empty of food. Some of the pike were much emaciated and many had no food in the intestines. Parasites were rare in the intestional tract.

The perch had eaten nothing.

Temperatures

Place	Depth in feet	Date	Temp. in deg. C.	Time
Cove off west shore of the west gap	Surface	Aug. 19	21-23	
Center of outlet arm	23	" "	18.4	
Off the mouth of the main east cove	Surface	" "	19.6	10:00 a.m.
	20	" "	19	" "
On sand beach of above cove	Surface	" "	21-23	" "
On west shore of t his cove	"	" "	21.6	11:00 a.m.
Off shore across from south arm mouth	"	" "	19.4	4:00 p.m.
	10	" "	19.1	" "
Center of mouth south arm	Surface	" "	19.3	6:15 p.m.
	35	" "	12.7	" "
Off mouth of south arm in center of lake	Surface	" "	19.3	6:20 p.m.
	35	" "	12.7	" "
Center of mouth of south arm	35	Aug. 18	13	7:00 "
Off west feeder	21	" "	18.8	2:30 "

Intermediate Lake

Intermediate Lake lies a half mile to the west of Lake Richie. It

occupies an irregular basin, about 1 1/8 miles long and about 1/4 mile wide, except at the center where this dimension is about 3/8 mile on account of a broad bay that opens to the south. A broad promontory forms the eastern shore of this bay. Two narrow rock peninsulas extend into the lake on the west and a small shallow cove opens near the center of the north shore. A small rock island 50 x 100 feet lies off the northernmost promontory. There is no inlet. The outlet comes off the south bay and drains into Lake Siskiwit. Beavers have attempted to dam the stream, but the dam is not now effective except to hold back about 6 inches of water. Water was trickling over the obstruction.

The banks of the lake to the south are high. The west half of the north shore is also high. The shores elsewhere are generally low. Bedrock is exposed in long stretches at the water's edge, especially along the steep south shore and there are also long stretches of broken rock. In the coves at the east end of the lake and at the bottom of the southwestern one there is sand. Along much of the shore the vegetation grows to the water.

The shores are timbered chiefly with spruce-balsam with a considerable intermixture of cedar, and to the southeast of birch. Cedar surrounds the small northern cove. Growths of alder, ash, grasses, etc., occur all along the beaches, chiefly in the coves, but sparingly also in other places, and rushes occur where the shores are sandy. The small island has a sample of most of the shore vegetation.

The sides of the lake basin are very steep beyond 60-100 feet from shore there is generally but a slight downward slope. Distributed over the basin are several irregular reefs which rise equally sharply from the

surrounding plain. One of the largest lies close to the western peninsula, about equidistant from the north and south shores. There are two smaller ones to the east, one (about 5000 sq. ft.) near the center of the lake, west of the center of the mouth of the outlet bay the other (about half as large) several hundred feet west, near the south shore. The largest (over 500 feet long) is located in the center of the outlet bay. Its depth is 5-8 feet, but no depth greater than 10 feet occurs to the east shore. A few rods to the south, but separated by an 18-foot channel is another smaller shoal 5 feet deep. A 10-foot depth connects it with the south shore. All the other reefs are surrounded by deep water. The area to the west of the reefs runs from 15 feet (75 feet off the outlet) to 20-22 feet hard off the west bend, and that depth continues to the west all along the south shore to the reefs in the center of the lake. From the eastern promontory the bottom slopes gently to the 22-foot depression off the opposite bend, except that a single sounding of 13 feet occurs between the 20 and 18 foot depths. The rest of the lake basin is covered with deep water. Beginning directly to the east of the westernmost reef a trough runs east along the north edge of the two small reefs. The depth off the large reef is 24 feet; along the reefs 28 feet, and from thence it becomes gradually shallower until hard off the east promontory there is a depth of 22 feet and off the east cove shore 16-18 feet. To the north the water gradually diminishes in depth to 20 feet at the bottom of the shore slope. The three finger-like bays at the west are also deep, but the rise between 18-20 feet and the shore is less abrupt, so that in their bottoms there are shoals of about 5 feet extending 100 feet off shore. The north cove is 5 feet deep and except for a small 7-foot shelf running off the northeast end of the east promontory and a larger one

extending along the west shore there is no other shallow water. (210 soundings)

The bottom in the deep water of the lake and on the reefs is fine soft brownish mud, as in the other lakes. Along the sand shores the water-covered bottom is sandy, always rather soft. In the north cove there is chiefly organic matter. Elsewhere along shore the bottom is rocky, with mud between the rocks, or if these are broken, more or less mixed with them.

The reefs are carpeted with Potamogeton, moss, etc., but elsewhere there is little vegetation. The water is discolored, but the thermometer was visible to 7 feet. Clams occur, but are rather scarce.

Fish found in the lake include perch, pike, sucker, trout perch, golden, stripe-nosed and spottailed shiners. All were taken by seining. The trout-perch were caught after dark on the eastern sand shores; the golden shiners only off the west shore; the rest were more widely distributed.

A gillnet gang of the usual constitution, set for one night, was lifted on four occasions. A gang lifted from between the two small reefs near the center of the lake in 14-25 feet, on August 19, took a sucker in the 2-inch net. In another set on the same day across the outlet from shore to 16 feet, the 1 1/2 inch net, nearest shore, took 2 perch, and the other two nets got a pike each. On August 20, a gang set in the east neck off the east peninsula from shore to shore through 10 feet, took in the 2-inch net a pike (1 1/2 lb.), in the 1 1/2 inch 2 perch and 2 suckers. A gang set across the largest reef in 12 to 5 to 10 feet took, in the 2 1/2 inch net, 3 pike (1 1/2 to 5 lbs.), in the 1 1/2 inch a perch and a sucker, in the 2 inch a sucker. The total of fish taken by four gangs of nets is 5 perch, 6 suckers, and 6 pike.

The stomachs of the pike were examined. One contained 2 shiners and the pectoral fin of a fish that had been eaten in camp, one had 2 minnows, two had a perch each, and two were empty.

Temperatures

Place	Depth in feet	Date	Temp. in deg. C.	Time
Between center reefs	Surface	Aug. 19, 1929	19.6	5:00 p.m.
	25	" " "	18.4	" "
Off the outlet	Surface	" " "	19.9	7:00 p.m.
	16	" " "	18.8	" "
On the largest reef	Surface	Aug. 20, 1929	19.4	8:30 p.m.
	12	" " "	19	" "

Lake Siskiwit

Lake Siskiwit is by far the largest lake on the Island. Its greatest length is about 7 miles, this figure including a long narrow bay at the west end; its width is about 1 - 1 5/8 miles. The western bay is about 1 1/2 miles long and 1/4 to 3/8 mile wide. On the southeast by means of a narrow channel (35 feet) is joined Wood Lake, roughly trilobate in form, 3/4 mile long and 3/8 mile wide. There are numerous irregularities of the shoreline of the main lake forming coves, large and small principally at the east and west ends, but conditions in most of them are not much different from those of the main lake. Three large islands (1/2-1/4 mile long) lie in the eastern half of the lake: one (Ryan) near the center, the other two off the south shore. In addition, there are about a dozen small ones,

some consisting merely of rocks or groups of rocks. Two groups lie between the westernmost island and Ryan Island and three more lie to the north and east of Ryan, forming an arc that extends from the northeast peninsula across Ryan Island to the west large island. The rest are scattered along the eastern shore to the south of the bay that receives the Intermediate outlet. In the little lake, there are also several rocks. A string of five lies in the center, separating the northern lobe, and a larger one lies off the west shore.

Intermediate Lake drains into a large bay at the northeast end and Mud Lake into the long western arm. These two streams were discharging a small quantity of water. Of the four other feeders shown on the map only the one mouthing in the center of the north shore was examined. The stream was reduced to pools of dark muskeg water and a broad gravel bar had formed across its mouth. The lake empties into Lake Superior through a small short streem that rises near the center of the south shore. There are several falls in this stream that probably hinder the ascent of fish from the Great Lake. The stream was discharging when visited.

Along the north shore the lake is bordered for the most part by a low terrace with high hills in the background. The shores elsewhere are also generally low with a few exceptions: two hills rise along the west arm, high ground extends from the shore between the two large islands across to the southern shores of the small lake, and a high ridge forms the southern arm of the northeast bay. The shores are lined on the north and south chiefly by boulders, these thrown up on places into an ice rampart 3-4 feet high. Bed rock appears along most of the east shore, on most of

the small islands, on the points generally, and in stretches elsewhere. There is sand off the three large inlets and gravel stretches occur at several places chiefly along the south shore. There are conspicuous gravel beaches and spits between the two large islands and shore. For the first time here the gravel and stones are polished by wave action.

The shores, including the islands, are timbered chiefly with spruce-balsam-birch on the north with more or less intermixture of cedar, poplar, and alder, and an occasional pine. In the northwest section there is a long patch of poplar-birch, and along the south shore east to the outlet there is a heavy growth of young poplar, birch, and alder, the latter in the western part thickly lining the shore. Myrica and Heavy herbaceous growths along shore are relatively scarce. Along much of the shore line, including that of the islands, the vegetation grows to the water's edge.

The lake basin is generally steep sided and the lake has great depths. Over 370 soundings were made. In the long arm at the west there is a 2-foot bar about 250 feet wide which drops abruptly to 10-12-15 feet. On the sides the slope is less abrupt, that on the south being most gradual. A. rather wide central trough of 15-16 feet runs up to a point off the base of the peninsula that forms its northeastern shore. A few soundings of 12 feet occur here, and then the bottom slopes sharply into the main body of the lake; in the mouth of the arm off the end of the peninsula the depth is 45 feet. The two other bays to the north are chiefly 20-55 feet deep.

The vast body of the lake up to the island chain that runs southwest from Ryan Island is over 100 feet deep. (This chain lies along a conjectured fault line.) The 25-foot contour in most places along the land-bounded sides of this

basin runs within 50-100 feet of shore, except that in a few places, chiefly off the north shore, there are narrow flats of shoal water. The largest of these extends off the north central inlet where a 6-foot shelf runs for over 300 feet. There is a rather extensive plain of about 45 feet to the west of this shoal. Elsewhere the 100-foot contour runs near shore. The 120-foot contour outlines an area of similar shape, 1/3 - 1/4 thewidth of the lake, its long axis tipped slightly counter-clockwise and the whole figure nearer to Ryan Island than to the long western peninsula. In fact the deep water (140-142)feet lies nearest to the island. From the center of Ryan Island to the north shore soundings in feet run as follows: 40 (60 feet off shore), 64, 85, 65, 67, 56, 13 (75 feet off shore). This trough extends to Intermediate Creek, with slight decrease in depth up to the mouth of its bay (59 feet). On the bottom of the bay there is a wide 6-foot shelf.

The long island arc forms a ridge along the bottom dividing the lake into two main basins. This ridge is broken so far as is known only between the northeast peninsula and the rock group to the west. A depth of 68 feet is recorded in the center here (this depth is about equal to the floor of the trough along the north shore, but above the level of the plain to the south) with 36-38 feet on either side. Between the rocks and Teakettle Island are depths of 40-48 feet. A 20-foot reef bearing a cluster of rocks joins Teakettle with the northeastern end of Ryan Island. Between the southwest point of Ryan Island to the first group of rocks there is a broad channel of 48 feet. Between these rocks and the small island there is a steep-sided trough with a depth of 82 feet in the center. A depth of 89 feet lies in the channel between

this island and east end of the large one. This island is connected near its middle with the main shore by a gravel spit 2-6 feet deep. To the west lies a channel of 9 feet and to the east begins a deep trough (16-30ft.)

From the southwest island chain another deep hole extends eastward. The 100-foot contour runs to beyond Teakettle Island, and the depths diminish then toward shore. A large area to the south of Ryan Island is 140-141 feet deep. The large eastern island is separated from the mainland by a narrow channel 15-20 feet deep. Slightly to the east opens a small irregular steep-basined bay 30-35 feet deep off its mouth, the depth diminishing toward the bottom of the bay.

The islands along the east shore are separated from the shore by steep-sided channels usually 10 feet deep. The western points of many have been reduced by wave action so that shoals often extend out 100 feet or more.

The channel leading to the southern lake runs 6-10 feet deep. A sounding of 3 feet is recorded near the narrow gap. This northern lobe is shut off from the rest of the lake by a 5-13 foot reef bearing a series of rocks. Most of the lobe is 25-32 feet deep. The rest of the lake is equally deep, the bottom being tipped slightly so that the greatest depths run along the south shore. Along the west shore there are bays in which the depths run 8-15 feet.

Not much is known about the bottom in deep water. In most of the deep sets the bottom material brought up on the anchor stones was the fine soft brownish mud previously described from the other lakes. The set 400 feet west of Teakettle Island brought up a light pinkish brown clay. Along the shore the

bottom is much as in other lakes where the character of the shore is the same, except that there is less silt and organic ooze over the bottom and the rock fragments have been worn smooth. This is of course due to the greater opportunity for waves to act on the shores. The usual fallen logs are found along shore. In Wood Lake the shores are of course not so free of silt. Clams were fairly numerous in the west arm chiefly in 10-12 feet.

Water vegetation is relatively very rare. In the long west arm scattered Potamogeton and Chara constitute the most conspicuous vegetation up to 12 feet. In the channels around the east islands and in that leading to Wood Lake there are similar scattered growths, mostly again ravaged by moose.

The list of fish taken in the lake is longer than that in any other lake on the island; it consists of lake trout, lawyer, whitefish, chub, herring,* sucker, perch, pike, trout perch, log perch, miller's thumbs (C. ricei and C. cognatus), 9-spined stickleback, stripe-nosed, spottailed, and lake shiners. The trout, lawyer, whitefish, and chub were taken only by gillnets; the herring was only found dead; the rest were taken in seines, except that the sucker, perch, and pike also occurred in the gillnet lifts.

* The "herring" I regard as the young of the "chub", Leucichthys bartletti. - Carl L. Hubbs.

Gillnets were set in gangs of three kinds of net and unless otherwise indicated were lifted after one night. On August 21 a gang lifted off the south shore of the northeast peninsula, set from shore to ¾ to 16 feet took

in the 2 1/2 inch net 3 suckers (one a 2 1/2 lbs.), in the 1 1/2 inch 3 each of perch and suckers. On the same day southeast of Teakettle Island in 50-100 feet, the 2 inch net took 2 trout and a lawyer, the 2 1/2 inch took 8 trout, 3 whitefish, and a lawyer, the 1 1/2 inch took a chub. On August 23, 1929, slightly farther southeast of Teakettle Island in 112-117 feet, the 2-inch net took 2 lawyers, 2 whitefish, and trout, the 1 1/2 inch had 4 chubs, the 2 1/2 inch 4 lawyers and 2 whitefish. These nets and those mentioned next were set two nights. On the same day a gang set from the west shore of Teakettle Island to 60 feet took in the 1 1/2 inch net 1 perch; in the 2 1/2 inch 3 suckers, 8 trout, 3 whitefish, and 2 lawyers; in the 2 inch, 2 trout and 1 lawyer. On August 24, a piece each of 2 inch and 2 1/2 inch was lifted from the southwest cove of the small lake. The first got a sucker and a whitefish; the other 2 whitefish, 3 suckers, and a pike (2 1/2 lbs.). The 1 1/2 inch net was floated this night off the mouth of the northeast bay but took nothing. On August 24 off the west end of Teakettle Island in 65-71 feet the 2-inch net took one trout, the 2 1/2 inch 4 trout and 9 whitefish, and the 1 1/2 inch one whitefish. To the south of Teakettle Island on August 25, in 50-110 feet, the 2 1/2 inch net took 1 trout, 1 whitefish, 5 lawyers; the 1 1/2 inch, 6 chubs and a lawyer; the 2 inch a lawyer. On the same day in the small lake off the west shore of the north lobe a 2 1/2 inch and 2 inch net, set from shore to 30 feet, took a sucker and a whitefish, respectively. Eight gangs thus took 14 suckers, 4 perch, 1 pike, 25 whitefish, 27 trout, 19 lawyers, and 11 chubs. The trout were chiefly caught by the teeth and many weighed 3-6 pounds. The largest whitefish weighed 2 lbs.

Several pike (1 1/2-4 lbs.) were caught by trolling in the south lake and one (15 lbs.) was seined off the north shore.

The food of the trout, lawyers, and pike was noted. Of the trout, one had nine-spined sticklebacks, 6 had remains of an unidentifiable fish, 2 had eaten 3 Leucichthys (2 inches long) each, and 2 had 4 (2-4 inches long), one had 2 Cottus ricei and 2 small Leucichthys, one had Mysis, and 7 were empty.

Of the lawyers, 5 had only a few Mysis, one had a few Mysis, a wood fragment, and a small fish; one had 5 Mysis, 2 Pontoporeia and a cedar leaf; one a few Pontoporeia and 4 small fish (one Cottus ricei); one had a Cottus ricei; one 4 Leucichthys (1 1/2 inch); one had 2 fish (2 and 6 inches); one had 4 Mysis, 1 Leucichthys (3 inches) and a Cottus ricei; and four had nothing.

Of the pike examined one had fish remains; one a sucker (6 inches); and two had nothing. All had shriveled intestines, but none were emaciated.

A whitefish had its stomach filled with Pontoporeia and 3 Pisidium.

Temperatures

Z Place	Depth in feet	Date	Temperature in Degrees Cent.	Time
Intermediate Creek	Surface	Aug. 20, 1929	15.4	4:00 p.m.
Off Intermediate Creek (Strong onshore wind)	Surface	Aug. 20, 1929	19.6	4:00 p.m.
Mud cove in Wood Lake	2	Aug. 23, 1929	22.6	3:00 p.m.
Southeast off Teakettle I.	Surface	Aug. 23, 1929	18.8	9:00 p.m.
	112	Aug. 23, 1929	8.2	9:00 p.m.
West off Teakettle Island	Surface	Aug. 23, 1929	18.8	10:00 p.m.
	60	Aug. 23, 1929	9.8	10:00 p.m.
Off the N. E. Peninsula	Surface	Aug. 24, 1929	19.9	2:00 p.m.
In the north lobe of Wood Lake	Surface	Aug. 25, 1929	18.3	2:00 p.m.
	30	Aug. 25, 1929	8.6	2:00 p.m.
	32	Aug. 25, 1929	8.2	2:00 p.m.
In the southwest cove of Wood Lake	Surface	Aug. 25, 1929	21	2:30 p.m.
	23	Aug. 25, 1929	12.4	2:30 p.m.

Lake Whittlesey

Lake Whittlesey lies about 1/2 mile east of the south arm of lake Siskiwit, about parallel with the Lake Superior shore from which it is less than 1/2 mile removed, except that the western 3/8 of the lake is bent upward at about a 45 deg. angle. It is almost 2 miles long with a maximum width of less than 1/4 mile. The shore line is smooth, but on the north shore near the east end of the large island there is a tiny cove. About 1/2 mile from the west end near the center of the lake lie a group of 3 rocks. The largest is about 150 x 60 feet. At the eastern end close against and parallel to the north shore lies a very narrow island almost half a mile long. About due southeast of its eastern end opens a small stream that drains into Dustin Lake. This stream receives soon the outlet to Sholts Lake which lies but a few hundred feet southeast of the outlet. The outlet has no obstructing falls, but was found dry.

The shores of the lake are high along the northeast end and generally along the whole south shore. On the south shore along the extent of the long island there is a rock bluff 20 feet high and a stretch of still higher bluff extends farther west on this shore. Elsewhere the land along the water is low. Bedrock forms most of the shore-line including that of the islands. It is broken in significant stretches only in the western lobe. At the east and west ends, in the southwest bend and in two places on the north shore opposite the islet-group the shores are sandy. Vegetation usually grows within 4 or 5 feet of the water's edge. The principal growths are birch-spruce-balsam with considerable intermixture of cedar, especially along the south shore

Occasional white pines occur around the lake. The usual water-edge shrubs and herbs occur, but not in extensive growths.

Along the south shore the sides of the lake basin are very steep. In this area within 25 feet of shore is often found the greatest depth that occurs off that point. Along the north shore a shelf less than 12 feet deep runs out 40-50 feet in most places. The western rock-group lies on a reef 3-5 feet deep that runs north to shore. A narrow reef of the same depth runs some 250 feet off the west end of the large island, broadening then to the south and west with a depth of 10-13 feet. Between that island and the north shore the water is 10-15 feet deep. The rest of the lake basin is covered with 18-30 feet of water. Beginning in the western lobe which is 18-19 feet deep, the depth increases in the neck of the lobe to 23-24 feet and continues at that depth to the eastern end of the long island, except that there is between both island groups and the south shore an extensive area 25 feet deep. The area between the two island groups is somewhat irregular with depths of 18-24 feet. Between the south shore and the eastern end of the island the water shoals to 20 feet and that depth continues a short distance to the east before descending into the deepest water of the lake. A depth of 29-30 feet lies in the center of this eastern basin. (178 soundings)

The bottom in the deep water is the soft brownish mineral mud with a gelatinous quality, due probably to organisms growing in it. Along shore the rocks to the water's edge are thickly covered with a brown gelatinous growth. The sandy bottom is more or less mixed with mud as usual. Clams are scattered along the shores but are common nowhere. Flowering plants are rare

in the lake. In the west lobe there are sparse growths of Potamogeton and eelgrass, in bands 10 feet wide, lying about 10 feet off shore, and there are other growths on the reefs around the two island groups.

Eight species of fish were found in the lake: pike, perch, walleyed pike, sucker, log perch, miller's thumb (C.ricei), spottailed shiner, trout perch. The stripenose probably should be added to the list, since it occurs in two lakes freely connected with this. The trout perch and miller's thumb were found chiefly on sandy stretches, but the others seem to be generally distributed. All species were found by seining. The first four were also caught in gillnets and pike were taken on the trolling spoon.

Four gillnet gangs were set. The three kinds of net were used in each, and all were lifted after being one night set. On August 26, in the southwest cove in 15-23 feet, a pike perch and sucker were taken in the 2 1/2 inch net, and between the two island groups in 20-23 feet two walleyed pike were taken in each the 2 and 2 1/2 inch nets. On August 27, north of the long island in 10-13 feet only a walleyed pike was taken, and off the east end of the lake from shore to 29 feet the 2 inch net had 3 suckers and a walleye and the 2 1/2 two very thin pike (1 1/2 lbs.)

Stomachs of the walleyes and pike were examined. Two walleyes had nothing; two had remains of an aquatic insect larva; one had a larval dragonfly; one had an adult dragonfly. One pike had a 3-inch fish and a dragonfly nymph; one had a 3-inch fish.

Temperature

Place	Depth in feet	Date	Temperature in degrees Cent.	Time
Shoal on north shore	Surface	Aug. 26, 1929	20.9	10.30 a.m.
	Surface	Aug. 26, 1929	22.2	11.00 a.m.
South of center of the long island	Surface	Aug. 26, 1929	20.4	12.00 a.m.
	25	Aug. 26, 1929	18.8	12.00 a.m.
Off the southwest shore	23	Aug. 26, 1929	18.6	4:00 p.m.
Off the center of the north shore	20	Aug. 26, 1929	19.2	4:30 p.m.
Off the east shore	30	Aug. 26, 1929	11.5	6:00 p.m.

Mason Lake

Mason Lake lies about 1/4 mile north of the mouth of Chippewa Harbor and flows into it near its center. It is less than a mile long and its axis runs parellel with that of the island. The lake is roughly divided into three parts: the eastern half with an average width of a little more than 1/8 mile; the western half uniformly about 1/8 mile wide; and the narrow tail that tapers into the outlet. This area is shallow and marshy and is much trampled and channeled by moose and beaver. The outlet passes thru a little pond a few hundred feet below the lake, but its further course was not explored. At the east end of the lake is received a little feeder which was dry when visited.

The terrain around the lake is generally low, lowest on the north with narrow beaches or none. Over a broad stretch on the east and in one spot on the northwest, the shores are sandy. Elsewhere there alternate stretches of bed rock and rock fragments. The shores are timbered chiefly with conifers

with usually only minor quantities of birch and alder. Along the water's edge there are occasional patches of Myrica and along the streams of marsh grasses.

The lake basin is generally steep sides. Around the eastern lobe, and along the whole north shore extends a shelf about 10-15 feet wide covered with 2-3 feet. (At the east end a depth of 6 feet extends out about 100 feet). At 20-30 feet off shore is a depth of 9 feet from which point the descent to the basin bottom is abrupt. The ledge may be 40-50 feet wide in places along the north; on the south the width of the shelves is about half. The eastern lobe slopes down to 19-21 feet. This depth increases to 25-26 feet near the center of the west lobe and then becomes 20 feet, where it narrows to the outlet. The slope into deep water is generally steepest along the south, so that the deep water is nearer the south shore. (55 soundings)

The bottom in deep water is the soft greenish-brown gelatinous mud reported for the other lakes, overlying mud that has no greenish color nor gelatinous consistency. The bottom along shore is hard for a few feet if of sand or gravel, but it soon becomes mixed with a soft mud and at 10 feet deep is ooze. There are relatively few snags along shore so that there was abundant opportunity to draw a seine. Clams are very numerous on the shelves. There is no pronounced coating of ooze on the rocks as in Lake Whittlesey. The water is strongly muskeg, so that bottom can't be seen in 4 feet. A cup of water is strongly discolored.

Aquatic vegetation is relatively rare. A thin band of ellgrass usually grows on the second shelf out to depths of 9 or 10 feet.

The following fish were found: perch, pike, miller's thumb (C.cognatus), sunfish, golden and stripe-nosed shiner. The first three occurred generally

in the seine hauls, but the rest were taken only at the eastern end. Pike (2-3 lbs.) were caught easily on the trolling spoon along the shores.

The usual gillnet gangs lifted on August 28 in the eastern lobe from shore to 20 feet took nothing and from the western part from 8-24 ft. took one pike (2 1/2 lbs.).

The stomachs of the pike were examined. All the pike except one 3 pound fish were thin and had hard empty intestines. Two had a 1 1/2 inch perch; one had skin of a fish eaten in camp; one had a decayed Potamogeton leaf; one had a larva of a burrowing mayfly and of a caddis; two had eaten nothing.

Temperatures

Place	Depth in feet	Date	Temp. in degrees Cent.	Time
Near center of west lobe	Surface	Aug. 27, 1929	19.7	7:00 p.m.
	20	Aug. 27, 1929	14.4	7:00 p.m.
	25	Aug. 27, 1929	10.3	7:00 p.m.
Near outlet	Surface	Aug. 27, 1929	19.5	7:30 p.m.
Near eastern shore	Surface	Aug. 28, 1929	19.5	6:30 a.m.
	20	Aug 28, 1929	15.8	6:30 a.m.
In center of west lobe	Surface	Aug 28, 1929	19.7	6:30 a.m.
	24	Aug 28, 1929	10.3	7:00 a.m.

Otter Lake

Otter Lake lies almost parallel to Beaver Lake and near the outlet is separated from it by a ridge a few hundred feet across. It has about the same dimensions and shape as Beaver. There are again two coves on the north shore, the larger one near the outlet, and the other near the inlet. These

streams are in the same positions, relatively, as in Beaver Lake, and were also dry when visited.

The shore toward Beaver Lake is generally low, butalong the opposite shore a little distance back from the water, high cliffs rise. Broken rock borders the water in most places, but around the inlet there is thin sand over clay and near the outlet there is a short stretch of mud. Vegetation grows almost to the water's edge so that there are no beaches. Birch-poplar is the predominant growth around the lake, but there are occasional short stretches where conifers predominate. The water's edge shrubs and herbs mentioned for the preceding lake are plentifully found and near the inlet and in the cove near the outlet there are good growths of "marsh grass", aster, Eupatorium,et.al. Fallen trees are as abundant here as on Beaver.

The lake is generally deep. The inlet cove is shallow with a maximum depth of 7 feet in its mouth; the cove near the inlet is 2-4 feet deep; a ledge 3-4 feet deep runs out some 75 feet off the outlet-shore and an irregular reef 2-5 feet deep rises in the middle of the mouth of the outlet cove. Elsewhere at 25-50 feet off shore a depth of 10 feet is generally found. A depth of 8-14 feet surrounds the reef off the outlet and a depth of 13-14 feet runs about half the length of the lake, a depth of 12 feet, continuing then to the inlet cove. (78 soundings)

The bottom a few feet off shore is generally the soft brown mud found in most of the other lakes. In the inlet cove, however, the bottom is chiefly clay with a thin layer of fine sand. Vegetation is generally rarer than in Beaver and moose apparently do not frequent either lake.

Clams are not common. The water is less stained than in Beaver; the thermometer was visible to about 5.5 feet.

The same species of fish occur as in the neighboring lake.[1/]

1/ The young of the golden shiner was also found in checking over the shiners from this lake. - Carl L. Hubbs. The stripe noses are found in most places along shore and the small perch are usually about twice as long as those that are common on the shoals of Beaver.

Two lifts of gillnets were made on August 31 off the two large coves, the gangs extending from shore across the middle of the lake. The one to the east took 2 perch in the 1 1/2 inch net, 4 pike and 3 perch in the 2 1/2, and 2 pike and a perch in the 2 inch. The pike weighed from 1 1/2 to 2 1/2 pounds. The other in the corresponding nets took 2 perch, 9 perch and 5 pike and 4 perch. The pike weighed 2 1/2 to 2 3/4 pounds.

Both species of fish appeared well grown. The pike averaged much larger than those of Beaver. Stomachs were examined. For perch (all large fish) the findings were: a small fish (in two specimens); a small fish and a cedar leaf; a leech; a dragonfly larva; a burrowing mayfly larve; 6 burrowing mayfly larvae, a dragon fly nymph and 2 caddis larvae with cases; 3 burrowing mayfly nymphs, 2 dragonfly nymphs and a small fish; 3 burrowing mayfly nymphs; and 2 dragonfly nymphs; 5 burrowing mayfly nymphs, 1 dragonfly numph and a leech; a burrowing mayfly nymph, 3 caddis larvae (uncased) and a small fish; 3 caddis with cases; a burrowing mayfly nymph (in 3 individuals); 7 burrowing mayfly numphs and Pisidium; one had nothing.

The pike stomachs contained: 2 small fish (1" long); 5 small fish; 5 small fish and a burrowing mayfly nymph; a burrowing mayfly nymph; 11 burrowing mayfly nymphs; 21 burrowing mayfly nymphs; 4 burrowing mayfly nymphs and

wood fragment; 4 burrowing mayfly nymphs and 2 small fish; 21 burrowing mayfly nymphs and fish remains; two had nothing. The first four stomachs were from pike taken in the easternmost gang. The mayflies were apparently drawn on more heavily in the other end of the lake.

Temperatures

Place	Depth in feet	Date	Temp. Degrees Cent.	Time
Off east cove	Surface	Aug. 31, 1929	19.8	8:00 a.m.
	12	Aug. 31, 1929	19.4	8:00 a.m.
Off the west cove	Surface	Aug. 31, 1929	19.9	9:30 a.m.
	14	Aug. 31, 1929	19.2	9:30 a.m.

Beaver Lake

Beaver Lake lies along the north shore of the Island east of Todd Harbor, about 1/4 mile from Lake Superior. It is about 3/4 mile long and generally not over 1/8 mile wide. A broad cove with a small grass-covered island in its mouth comes off the northwest end and the lake continues them to the northeast at about a third the average width. There is also a shallower (200-300 foot deep) indentation in the center of the shore. A feeble stream at the northwest end drains the lake into Todd Harbor. There is a small feeder at the opposite end of the lake. Both streams were found dry.

The terrain about the lake is generally high, highest along the south. The shores are lined with bedrock and rock fragments with an occasional stretch of mud. Trees usually grow to the edge of the water so there are no beaches.

Birch is the predominant growth around the lake, with an intermixture of the usual conifers and with alder, Myrica, et al., scattered along shore. Bands of rushes (Equisetum, Scirpus) often 5 feet wide and in stretches of 500 feet occur, especially along the northern shore.

There is very little shallow water in the lake. The small cove on the north is not over 4 feet deep, on the two sides of the large cove such depths run 50 feet, and on the opposite side a little rock-sand reef 1 foot deep runs out 75 feet. Elsewhere there is a shelf of 3 to 10 feet and then abrupt descent to the bottom of the basin (at 25 to 30 feet off shore the water is usually 6-10 feet deep). The deepest water (16-17 feet) extends to about the little island. The rest of the lake and the large cove are 13-15 feet deep. (66 soundings)

The bottom beyond 3-5 feet is generally soft brownish mud. In deep water the greenish brown gelatinous mud overlies this. The shores are heavily strewn with trees and there are no important stretches of submerged sand or rock, thenimmediately along the shore the bottom is hard. Water vegetation is not abundant, except that in several places in the large cove and off the inlet in depths of 8-13 feet the bottom seems heavily carpeted with moss. Occasionally a remnant of a Chara patch (a foot square), an occasional Potamogeton or Vallisneria is seen along shore. Clams are abundant in most places at 3-5 feet on the slope. The water is discolored.

Four species of fish were found in the lake: pike, perch, spottailed, golden and stripenosed shiners.[1]/ All were taken in seines and a few pike were caught on a trolling hook. Except for the stripenoses, which were found only in the large cove, the rest seem generally distributed along shore.

1/ One young golden shiner was found on resorting the collection from this lake. - Carl L. Hubbs.

Schools of perch 3/4 inch long were common.

Two lifts of gillnets were made on August 30, 1929; one off the outlet from shore to 16 feet, and one from shore on the southwest promontory to a depth of 15 feet off the little island. In the first set the 2 1/2 inch net (shore to 14 feet) had 7 perch and 7 pike; the other two nets had 2 pike each. In the second set the 2 1/2 inch net took 6 perch and 4 pike; the 1 1/2 inch took nothing; the 2 inch took 3 perch and 2 pike. The pike caught ran small (1-2 lbs.) and some dozen others seen along shore were no larger.

Stomachs of the perch and pike were examined. Of the perch one had 14 3/4-inch perch; one had the head of a dragonfly; two had 5 dragonfly nymphs; one had one dragonfly nymph; one had 2 each of dragonfly nymphs and burrowing mayfly nymphs and a small fish; one had 2 burrowing mayfly nymphs and one dragonfly nymph, one had 13 3/4-inch perch, 18 burrowing mayfly nymphs and a Sphaerium; one had a stone and a ball of ochre, each as large as a pea and a burrowing mayfly larva; one had a dragonfly nymph, 2 burrowing mayfly nymphs and 3 small perch; one had two large leeches and a burrowing mayfly nymph; one had 7 large Physa (intestines also full of Physa shells); and two were empty.

The pike had eaten as follows: one leech, a cedar leaf, 2 inch spot-tail; 2 clumps of gelantinous algae; one leech, 6 burrowing mayfly larvae, 13 3/4-inch perch; a minnow and 2 burrowing mayfly larvae; 2 one-inch fish; 2 one-inch fish; 5 3/4-inch perch; alder leaf, cedar cone, balsam needles and wood fragments; 2 one-inch fish cedar cone, cedar leaf, deciduous leaf fragment, 2 balls of gelatinous algae, one burrowing may fly nymph. Six had empty stomachs.

Temperatures

Place	Depth in feet	Date	Temp. in Degrees Cent.	Time
Large Cove	15	Aug. 30, 1929	18.6	12:00 M
Shore of large cove	1	Aug 30, 1929	20	9:00 a.m.
Off outlet	Surface	Aug. 30, 1929	19.4	12:30 p.m.
Off outlet	16	Aug. 30, 1929	18.8	
Off outlet	5	Aug. 30, 1929	20.2	2:00 p.m.
Near center of lake	Surface	Aug. 30, 1929	19.8	2:15 p.m.
Near center of lake	6	Aug. 30, 1929	19.2	2:15 p.m.
Near center of lake	12	Aug. 30, 1929	19.1	2:15 p.m.
Near center of lake	16.5	Aug. 30, 1929	18.4	2:15 p.m.

Lake Harvey

Lake Harvey lies about half a mile from Todd Harbor near the middle of the North shore. It is elongate in shape (a little over a mile long) broadest (1/4 mile) over the eastern half, narrowing to 1/8 mile over the western half and ending in a heterocercal fish-tail. The east shore is sinuous forming three coves. Two large elongated islands lie to the east of the center of the lake in one direction and south of the center in the other. The islands are roughly parallel to each other a nd the shores, and are separated by a narrow channel. Between the west end of the southern island and a sharp bend in the south shore, nearest the latter, lies a smaller island. Two masses of bedrock about 200 square feet in area lie to the south of the west end of the former island, connected with it by a 2-foot bar. The lake drains into Todd Harbor thru a small stream coming off the middle of the north shore. In the small lobe of the fish-tail, a tiny stream enters. The outlet was dry, but a little water remained in the inlet. This lake is 168 feet above Lake Superior, according to the chart.

The shores of the lake are generally low, but considerably above the lake level. Broken rock meets the water for the most part. In two of the east coves the shoreline is sandy. Vegetation usually grows within about 3 feet of the water's edge, so there are no beaches. The shores are timbered chiefly with conifers, among them good examples of cedar and several small groves or Norway and a few White pine, trees which have obviously escaped recent fires. On the large islands there are splendid examples of these trees. On the northeast shore alone birch is conspicuous. The usual water-margin growths of Myrica, alder, et al are relatively rare.

There are extensive shoals in the lake: a shelf off the outlet, the channel between the large islands, the western half of the channel between the south island and shore up to the bend and around the small island, a large part of the 3 eastern coves and virtually all of the fish tail up to the narrowest part of the lake are not deeper than 5-6 feet. (There are broad shoals in the western lobes that are only 2 or 3 feet deep.). A narrow tongue of 11 feet runs close to the north shore for a short distance into the fish-tail area and that depth continues to the island group. A broad stretch of 13 feet runs between the largest island and the north shore from west of the outlet to the northeast cove and then in a narrow lobe to the center of the eastern basin. The water on the other sides of this central lobe is from 10-12 feet deep.(190 soundings)

In two of the eastern coves, the bottom is partly sandy and part peaty. Elsewhere there is mud. Snags are very abundant along shore. Clams are rather scarce. The water is rather muddy so that the thermometer disappeared at 3 feet.

Potamogeton is the one common water plant. It grows rather abundantly out to depths of about 10 feet. A few plants are visible, but it is most in evidence as a mat on the bottom, parts of which the sounding stone brings up. The moose have been feeding on it so heavily that it is now undoubtedly much less common than formerly.

Five species of fish were found in the lake: sucker, perch, stripenosed minnow, Margariscus and fathead. The first two were taken chiefly in gillnets, the small perch were found with the shiners in places. The stripe noses were found principally on the sand in the east coves. Examples were taken 85 mm. long to the base of the caudal, a record size for the species.1/

A gang of gill nets was set for one night in the east basin from the north shore to 13 feet in the center. When lifted on September 1 the 2-inch net had 18 suckers and 11 perch; the 1 1/2 inch net had 2 suckers and 51 perch; the 2 1/2 inch net had 90 suckers and 14 perch. The nets were reset off the west shore to a depth of 6 feet at 2:30 p.m. and lifted 3 hours later. The 2 1/2" net had suckers and a perch; the 2-inch 8 suckers and 5 perch; the 1 1/2 inch 5 suckers and 15 perch. Both perch and suckers were in general very thin.

The stomachs of the perch were examined: fish scales 5 mm. in diameter; 2 one-inch fish; 2 two-inch fish; 50 midge larvae; 2 midge larvae; one minnow and fragment of Potamogeton leaf (2 individuals); 17 had developing dragonfly eggs varying in quanitity from traces to size of a pea; fish remains (3 individuals); midge larvae and fragment of Potamogeton leaf; fragment of Potamogeton

1/ I regard this giant race of "stripnose" as a distinct subspecies, and also refer the "fathead" and the Margariscus to distinct subspecies apparently confined to this lake. Young spot-tail shiner was found in one of the collections from this lake. - Carl L. Hubbs.

leaf bearing a few insect eggs; 2 fish and Potamogeton leaf fragments; 58 had eaten nothing.

Temperatures

Place	Depth in feet	Date	Temperature degrees Cent.	Time
Near center of east basin	Surface	Sept. 1, 1929	20.4	11:00 a.m.
	13	Sept. 1, 1929	20	11:00 a.m.
Northeast cove	1	Sept. 1, 1929	22.5	11:30 a.m.
East center cove	1	Sept. 1, 1929	23.2	12:00 a.m.
Cove by small island	1	Sept. 1, 1929	23.4	12:30 p.m.
Northwest cove	1	Sept. 1, 1929	25.8	1:30 p.m.
Off inlet	6	September 2, 1929	20.2	12:30 p.m.

Hatchet Lake

Hatchet Lake lies about 2 miles southwest of Lake Harvey, about a mile and a quarter from Todd Harbor into which it drains by a stream rising at its east end. The lake is rather spindle shaped, less than 1 1/2 miles long, with a maximum width of 1/4 mile. The map gives its elevation as 191 feet above Lake Superior. There are several abrupt falls in the course of the outlet so that fish can probably not now ascend from the Great Lake. The outlet is at times at least an important trout stream but when visited was dry in places. Trout, some a pound and more in weight, were seen in the larger pools. In smaller pools dead trout were found. A small feeder enters the lake at the west end.

Very high ridges run along the south shore and low hills border the north.

The outlet and inlet ends are low and flat. Around the outlet there is a good sand beach and around the inlet floating vegetation covers mud. Elsewhere broken rock in stretches 1-4 feet wide meets the water's edge at most places, except along the south shore there are two stretches of sandy beach about 100 feet long and 10 feet wide. Along the east end of the lake there is a strip of conifers that escaped the conflagration that burned the area around the lake. The usual birch-poplar succession obtains in the burned area, but rather sparsely. On the south only there is a growth of cedar and some balsam. Evidently pines were formerly common in the burned-over area. Luxuriant growths of Myrica, 6 feet high, in bands 10 feet wide, line the north shore, particularly the eastern half. There are also along the north shore, especially over the western half, thick growths of alder. These shrubs occur only sparingly on the south. Around the inlet swamp vegetation occurs.

In the outlet cove are found the broadest shoals. A shelf about 1 foot deep runs out some 50 feet, changing to 4 feet then until at a distance of 200 feet the depth becomes 10 feet. The inlet cove is as shallow and the slope toward deep water much more gradual. Elsewhere around shore there is a narrow shelf with a depth of 1-4 feet that varies from 10 to 60 feet wide, usually not over 25. The descent from this depth to deep water is rapid, so that at 75 feet the maximum may be reached. A depth of 15-16 feet begins several hundred feet off the outlet and extends to the beginning of the western lobe. For a short stretch in the second quarter (numbering east to west) a depth of 17-18 feet covers the basin. (80 soundings)

The bottom off the outlet in shallowwater is hard clean sand; off the inlet bottomless peat-mud. Along the north shore the bottom on the shoal shelf

is hard, being composed in long stretches of sand, mixed more or less with rather clean gravel and boulders; at one point rocks run out 50 feet. The south shore is in general the same except that the bottom is softer. Outside the shelf there is soft brownish mud. Snags are present on the shoals but not in great quantity. No clams were seen. The water is strongly muskeg. The thermometer disappeared in 3 1/2 feet.

Vegetation is confined to a few Naias, dwarf Potamogeton, et al that can grow on the hard bottom. An occasional plant of a large species of Potamogeton was seen off the north shore.

The roster of fish found in the lake follows: horned dace, sucker, brook trout, Margariscus, fathead minnow, nine-spined and brook stickleback, and trout perch. All were taken by seining and most of them, except the brook sticklebacks are probably of general distribution. The latter were not found on the outlet beach and,but rarely along the other shores. The center of abundance is probably around the inlet.

A gang of nets, set for one night, was lifted on September 3, from 5-15 feet off the outlet. The 1 1/2 inch net took 17 suckers, 5 dace and 3 brook trout; for the 2 inch net and the 2 1/2 inch net the figures were 2,9, 4, and 3, 2, 4, respectively. Some of the dace were as large as the species is known to get (225 mm. to the base of the caudal). The trout weighed about a pound, except for three that weighed 2 1/2 to 3 pounds. The temperature of water was near the supposed limit of endurance for the species.

The stomachs of the brook trout were examined. Five had nothing; one had three 2 1/2-inch fish; one had one such fish; and 2 had fish remains.

Temperatures

Place	Depth in feet	Date	Temp. degrees Cent.	Time
Off outlet	1	Sept. 2, 1929	20.9	10:00 p.m.
East central part	Surface	Sept. 3, 1929	20.5	10:00 a.m.
East central part	13 *	Sept. 3, 1929	20.35	10:00 a.m.
East central part	18	Sept. 3, 1929	19.8	10:00 a.m.
Off outlet	Surface	Sept. 3, 1929	20.1	10:15 a.m.
Off outlet	15	Sept. 3, 1929	19.8	10:15 A.m.

* This figure was typed as 12 but changed to 13 in blueblack ink.

Lake Desor

Lake Desor is the second largest lake on the Island being almost 3 miles long. It lies with its long axis almost east and west about a mile from Lake Superior in the northwest sector of the Island. It narrows over the west to an arm over 1/2 mile long and about half as wide and over the east to an arm 1 mile long and about 3/8 mile wide. The west arm opens abruptly on the south to a bay indented on the west shore by a small cove and more gradually on the north to a bay from which the outlet departs. Through these two bays the width of the lake is about a mile and a half, this dimension decreasing gradually into the eastern cove. Two small coves lie along the north shore east of the outlet bay, and opposite them are two broad indentations of the shore line. In both cases the eastermost of these coves is the most indented. There are several islands in the lake. A group of three, one a few hundred feet long and two narrow ones about 1/4 mile long lie in a chain off the south shore, the

first in the mouth of the large bay and the last off the first cove to the east. Another small island lies off the easternmost cove to the east of the outlet, north of the median line of the lake at that point. An island of about the same shape but smaller than the two large islands to the west lies near the east shore. A reef 2-4 feet deep extends off its north and to shore and on this reef three emerging rocks are borne. Another large rock lies off the south shore at the beginning of the east arm. The outlet flows into Todd Cove to the northeast. There are no important feeders.

The shores except in the coves rise at least 15-50 feet from the lake. along the south there extend high ridges. Narrow sandy beaches occur in all the coves, but elsewhere the shore line is rocky, in many places in the form of an ice rampart 2-3 feet high. The principal vegetation along shore and on the islands is the birch-spruce-balsam-cedar combination. A few hundred feet back from the water on the promontory that projects from the west shore and on that which forms the south shore of the outlet bay and on the high ridges south of the lake there are magnificent growths of maple. The usual wateredge vegetation is not much in evidence except that a thick bed of small rushes grows in the west cove.

There are extensive reefs in the bottom of all the coves. A depth of 5 feet or less extends out 200 or 300 feet in the bottom of the bays and small coves, and for a greater distance in the west bay. At the east end this shoal water is confined to the north reef off the island. At other places along shore, including the island shores, a depth of 10 feet is found within 50-100 feet of land, and except in a few places where there are terraces, the descent to the central basin is abrupt. A vast part of the lake's basin is enclosed by

the 38 foot contour. The line curves around the west promontory, dips slightly into the south bay, then runs along the north shore of the islands, bends back around the easternmost one for about its length, thence runs along the south shore to the big cove, but dodges back around an irregularity of the bottom here (22-31 feet) and extends in a narrow tongue in the center of the channel to a point east of the small island; from here the line runs west around the island, then bends back between the island and the north shore; it continues across the coves, extends broadly into the outlet bay about to its eastern bend and follows roughly the north shore line and extends slightly into the west bay. The maximum known depth found by more than 170 soundings is 55 feet.

In the two west bays a rather broad terrace of about 20 feet edges the deep hole. In the westernmost one, the descent to deep water is rather steep. In the southerly one, the bottom slopes into the 25-29 foot channel between the small island and the central large one and then dips east into the tongue of deep water that extends westward here along the south shore. Due south of the west tip of the central island the channel has become 20-25 feet deep. The two large islands in this area are separated by a channel 5 feet deep.

The east bay is from 25-30 feet deep between the island at its mouth and the large one. South of the large island the water has shoaled to 15-20 feet and depth of about 15 feet continues to the east shore.

The bottom along shore where sand meets the water is fine sand, usually rather hard, with more or less mixture near land of gravel. At other places near shore rocks form the bottom, these, if boulders, worn smooth and with no conspicuous silt or ooze coating. In places where the moose have sunk between

the rocks a pink-yellow clay is revealed. The bottom in deep water appears to be different from that described for the other lakes. In the west cove at 20 feet nothing came up on the anchor stone of the nets; in 25-30 feet off the largest island the anchor stone could be heard clicking against the bottom as it was dragged behind the drifting canoe; south of the east cove island the bottom in 20 feet was sandy mud. The bottom thus is probably sandy and in places at least is rocky. Clams are rather scarce, especially on the sandy bottom. The water is little discolored, but the thermometer disappeared in 6 feet.

Water vegetation is scarce and is confined to scattered plants of such species as Chara, Naias, Potamogeton, that generally occur on hard bottom.

Relatively few kinds of fish were found in the lake, though the number of individuals of most was high. The list comprises whitefish, herring, brook trout, sucker, trout perch, ninespined and brook stickleback, two miller's thumbs (C. ricei and C. cognatus), Couesius and Margariscus. All but the first three were taken in seines. Except for the brook stickleback which was found most commonly in the west bay, all the species are probably widely distributed in the lake.

Gillnets of the usual kind were lifted on September 9 after one night out from shore to 20 feet, south of the eastern island. The 2-inch net had 25 suckers, 20 whitefish and a herring; the 1 1/2 took 8 suckers and 2 whitefish; the 2 1/2, 25 suckers and 10 whitefish. A gang lifted after two nights on September 10 off the north shore of the large central island, from shore to 45 feet took in the 2 1/2 inch net (to 21 feet) 21 suckers, 116 whitefish and a herring; in the 1 1/2 inch to 30 feet, 12 suckers and 18 whitefish.

In the mouth of the west bay from 20-24 feet, a gang lifted September 10 after one night, had in the 2 1/2 inch net 4 suckers and 3 whitefish; in the 1 1/2 inch net 13 suckers; in the 2-inch net 8 suckers and 4 whitefish. A 2 1/2 inch net lifted from 5 feet off the outlet on September 11 after having been set one night took 4 suckers, 18 whitefish and a brook trout. The largest whitefish caught weighed about 2 pounds. It appears thus that whitefish and suckers are very abundant. Individuals of both species were thin and from an examination of the stomachs of the whitefish, given next, it appears that the food supply is inadequate.

Of a total of 117 individuals, 30 had eaten nothing, 51 had eaten only fish, never more than two (nine-spined stickleback, 17: Cottus 5; herring 3 and 4 inches long, 2; unidentifiable, 27). Seven others had eaten fish and incidentals such as sticks, gravel, balsam needles, stinkbug, juvenile Corixa, Pisidium, maple keys. The 29 remaining fish had a mixed diet: flywing, 3 one-half inch moths, very fresh; 4 gravel and 2 cedar leaves; gravel (4 individuals); 1 Physa; 3 Pisidium (2 individuals); 12 water mites; midge larvae; 1 juvenile Coriza; piece of sponge; piece of $CaCO_3$ from clam shell; piece of wood 2 cm. long (3 imdividuals); 1 inch stick, piece of bark, cedar leaf, gelatinous alga colony; piece of bark, cedar leaf, gelatinous alga colony; piece of Potamogeton stem 3 inches long (2 individuals); granite pebble one-half inch in diameter (2 individuals) cedar leaf (2 individuals).

Temperatures

Place	Depth in feet	Date	Temp. degrees Cent.	Time
Extreme east end	Surface	Sept. 9, 1929	17.4	6:00 p.m.
	10	Sept. 9, 1929	17.4	6:00 p.m.
	20	Sept. 9, 1929	17.4	6:00 p.m.
In westernmost cove	24	Sept.10, 1929	16.6	9:00 a.m.
North off east end of largest island	Surface	Sept.10, 1929	17.2	9:30 a.m.
	40	Sept.10, 1929	17.2 1/	9:30 a.m.

1/ Violent northeast winds, accompanied by incessant rain, had raged for the preceding 36 hours.

Amygdaloid Lake

Amygdaloid Lake is on Anygdaloid Island and lies west of its center in a narrow rift that parallels the outer shore, separated from this by only a few rods. It is a little over a half a mile long. Over the western half the width of the lake is about 80 feet, but it expands beyond the center, with a maximum width of about 200 feet.

The shores are generally rocky except at the two ends where there is mud. There are cliffs 10-15 feet high over the eastern half of the south shore; at other places the slope of the rocks is at an angle of about 45 degrees. The shores are timbered within a foot of the water's edge with a mixture of spruce, cedar, balsam and birch. A few alder bushes skirt the water, especially on the north and iris is rather common.

The lake basin is generally very steep-sided. Along the south shore

there are three or four short stretches where a depth of 2 feet extends out 15 feet; the bottom here is of rather hard sandy mud with an occasional boulder. These flats bore Eriocaulon commonly and were undoubtedly submerged as a result of the fall rains which began September 9. At each end there is a bar of less than 5 feet, which extends out for about 100 feet, but at other points along the shore at 15-30 feet off shore the water is 10 feet deep. Beginning off the outlet bar the bottom slopes to a depth of 29 feet beyond the center, continues for several hundred feet at 27-29 feet and then rises to the eastern shore. The channel is broad and the greatest depth is about in its center (71 soundings)

The bottom of the lake basin is very soft brownish mud, becoming blackish ooze in the deepest water. (The stones used to anchor the nets sank deep). At the ends this mire extends to shore, but at other places near land the bottom is usually of sharp rocks out to a depth of 2 feet. Along the north shore bedrock extends out for 30-40 feet in two places, but elsewhere here beyond the rim of shallow-water boulders the bottom is sandy mud, rapidly changing to soft mud. On the south shore the bottom may be rocky for 5-6 feet beyond the shore line. Clams occur sparingly. The thermometer disappeared at 8 feet.

Water vegetation is very rare. An occasional plant of Potamogeton, Myriaphyllum, Spatterdock (seedlings) occurred here and there in shallow water.

Five nets were set for a night and lifted on September 14. A 2 1/2 inch net set in the west part from 10 to 15 feet took only a pike. The other nets set as follows caught nothing: 1 1/2-inch at the west end, north shore to center (12 ft.); 1 1/2-inch near the center 25-28 feet; 2 1/2 inch east of

center lake, south shore to 24 feet; 2 inch east end, south shore to 13 feet.

Only three species of fish were found in the lake: perch, spot-tail minnow and pike. One specimen of the last was seen: the sample caught in the gillnets. The other species were taken only seines. A school of perch about 3 inches long was observed off the outlet and similar schools were observed at other places. At least 50 schools of small perch, heavily parasitized, were seen swimming near the surface, always within 30 feet of land. There were about a third as many schools of small shiners, but these were always nearer shore and never at the surface.

Two temperature readings were made at 10:00 a.m. on September 14. On the east shoal in a foot of water the thermometer registered 15.6 degrees; in 29 feet 14.7 degrees.

Patterson Lake

Patterson Lake lies in the same narrow trough that bears Ahmeek Lake, but a quarter of a mile farther inland. It is also about half a mile long, with a maximum width of about an eighth of a mile. The outlet end (east) is rounded and the sides are gently sinuous so that the width of the lake is fairly uniform. A small feeder enters at the west end. At the mouth, it is 25 feet wide, but there was only a foot or two of water in it when visited. The bottom is mire and the beavers are chiefly responsible for the channels in it.

Along the west half of the earth shore there are two knolls about 20 feet high and two smaller ones that border the lake. The rest of the shores are low, but not swampy except at the ends and for a short stretch

near the middle of the south shore. Bed rock borders the lake in short stretches on both shores and there are also stretches of sharp-edged broken rocks. In other places vegetation grows to the water's edge.

The knolls bear principally poplar and birch and the swamps have spruce, much of it dead. Elsewhere, there is the characteristic mixed timber. "Marsh grass" and associated herbs line the end shores and are scattered along the others. Myrica, Chamaedaphne, alders occur in interrupted growths around most of the lake, the latter often as a conspicuous fringe. Rushes and iris are also not uncommon in places.

The slope to deep water is rather abrupt. At the ends there are broad muddy shoals of 1-2 feet, which rather gradually slope to the basin bottom, the slope being much more gradual on the east. The water at 15-40 feet off land at other places is 6 feet or more in depth. The greatest depth (13 feet) lies out from the westernmost knoll and extends to about the center of the lake. From here the bottom slopes very gently to the east, so that most of the lake basin is covered by depths of 9-13 feet. (63 soundings)

The bottom along shore is almost invariably very soft mud beyond the narrow rocky border. At the ends it is mire. In deep water it is also very soft and has the gelatinous texture so often previously referred to. Clams are scattered. The water is very strongly discolored; the thermometer disappeared at 3 feet. Water plants are rare.

Two pieces of 2 1/2 inch gillnet were lifted on September 15 after one night, one set southwest of the center of the lake from land to 10 feet, the other east of the center to 9 feet. The former took a pike, the latter nothing. A piece of 1 1/2 inch net, lifted from the north shore to 13 feet.

near the center of the lake, took a small pike and a perch.

These were the only fish seen in the lake. Attempts to seine were made with difficulty and were invariably fruitless.

The temperature of the surface at 10:00 a.m. on September 15 was 13.8 degrees; on bottom in 13 feet 13.6 degrees; on bottom in 9 feet 13.7 degrees.

Ahmeak Lake

Ahmeek Lake lies at the extreme northeast end of the Island just south of and parallel to the long tongue of Stockly Bay. It receives the water of Patterson Lake through a short stream at the west end and drains into Lake Superior through a stream arising at east end. It is about half a mile long and about 400 feet wide; the south shore is unbroken. The north shore runs west at a slightly divergent angle, but a little beyond the center breaks at a double echelon and after running about parallel to the south shore for several hundred feet bends at right angles and tapers to the end of the lake. A little island lies hard off the outlet.

The shores on the north are 15-20 feet high and bedrock edges the water in several places there. The other shores are low and at the two ends there are swamps. "Marsh grass" and ecological allies, including iris, line the south shore of the lake and the ends. The same formation occurs in patches along the north, especially in two places where tongues of swamp reach the water. Myrica and Chamaedaphne are also present on the north usually as scattered plants: on the west a band of Myrica backs the grass-zone and on the south are scattered elders. The timber around the lake is chiefly coniferous; at the west end there is a dead spruce swamp.

The lake is relatively shallow. At the ends for about 100 feet and at

other places for about 15 feet the water is less than 4 feet deep. The rest of the lake except for a small hole of 9-10 feet between the two bends of the north shore is 4-5 feet deep. (60 soundings)

The bottom is generally very soft brownish gelatinous mud. Clams are scattered. The water is both muddy and discolored, and the thermometer disappeared at 3 feet. Occasional plants of spatterdock, ellgrass and several species of Potamogeton persisted here and there.

Perch and pike were seen along shore and individuals of the former were caught by seining. The gillnets took only pike. A piece of 2 1/2 inch net lifted on September 15 after one night, off the island from 3-4 feet took 7 pike (1, 1 1/2 lbs.); a piece of 1 1/2 set in 7-9 feet got nothing; a piece of 2 1/2 inch net set from 5-9 feet took 4 pike (1 1/2 lbs.)

The stomachs of the pike were examined: 3 had 1 1/2 inch perch, 1, 2, and 3 in number; one had 2 such perch and 2 dragonfly nymphs; one had 2 cc. of fine roots; 2 had nothing.

The temperature of the surface water at noon on September 15 was 13.1 degrees; at 7 feet on the bottom 12.7 degrees.

Lake Eva

Lake Eva lies at the northeast edge of the Island, parallel to Pickerel Cove and only a few rods removed from it. It is elongate in shape and of approximately uniform width, the long shores running nearly parallel to each other. Its dimensions are about 5/8 mile x 1/8 mile. At the east end a broad rounded promontory extends into the lake forming with either shore two coves. At the west end the north shore bends down to meet the opposite

shore line and about half way first turns sharply west again, forming a pronounced bay. A string of three bedrock islands, becoming smaller from west to east, only a few feet apart run from the west shore bend toward the center of the lake. The largest is about 75 x 30 feet. A little moose pond lying a few rods off the southwest end drains into the lake. The outlet, diagonally opposite, flows to Lake Superior. Access to fish from the Great Lake is probably prevented by a series of small falls.

The shores immediately around the lake are formed by low ridges to the north and south with low land at each end. They are wooded to the water's edge with the usual mixed growth of cedar, balsam, spruce and birch and an occasional white pine. The two largest islands have trees also, but the smallest has only shrubs and perennials. Bedrock and broken rock meet the water in most places.

The lake basin is generally steepsided, so that at most points along shore a depth of 10 feet is reached at 25-100 feet off land. The basin is also deep. The region west of the smallest island is covered in the main by a depth of 10-18 feet. East of the islet the basin has a broad central area uniformly covered by 24 feet. From here the bottom slopes gently so that across the mouth of the two eastern coves the depth is about 10 feet. The coves are not particularly shallow; they are 7 feet deep about 120 feet from the end, and 5 feet deep 90 feet off. (111 soundings)

The bottom in several samples was found in the deep water to be soft blackish mud. Off the eastern promontory the shoals were firm, of cobblestones. Elsewhere near land the bottom is hard out to 2 or 3 feet and then the mud of the central basin begins. Numerous fallen trees line the shore everywhere.

Water plants are rare. Sparse growths of eelgrass in bands 3 to 10 feet wide grow in depths of 5-10 feet, especially in the end coves.

The water is dark so that the thermometer disappeared at 3 feet.

Only four species of fish were found in the lake: pike, golden, spottailed and stripenosed shiners. The shiners especially the first two, occurred commonly along the north shore in schools of individuals up to an inch long. Occasionally larger individuals were among them, mostly among the branches of fallen trees.

Three pieces of gillnet were set on September 15 and lifted next day. The 2" net from shore to 16 feet got a pike (2 1/4 lbs.); the 2 1/2 inch net from shore to 23 feet got 2, 2-lb. pike; the 1 1/2 inch net set in 5 feet got nothing.

Temperatures

Place	Depth in feet	Date	Temp. degrees Cent.	Time
In Southwest cove	16	Sept. 16, 1929	14.5	5:00 p.m.
In southwest cove	Surface	Sept. 16, 1929	14.6	5:00 p.m.
Off outlet	5	Sept. 16, 1929	14.6	6:00 p.m.
Off south shore	23	Sept. 16, 1929	14.4	6:15 p.m.

McDonald Lake

McDonald Lake lies westward of McCargoe Cove, about half a mile from Lake Superior. It is not charted on Lane's map. In form it is elongate with two shallow indentations on each of the long shore lines, the pairs lying about opposite each other. The length over all is about 1/2 mile and the greatest width about 600 feet. A slight stream comes in at the east end and another

leaves at the west, draining presumably into Otter or Beaver Lakes.

The terrain at the east and west ends is low. At the east a broad grassy marsh abuts on the lake and plants of that formation line most of the indentation and coves. Alder is a common shrub behind these herbaceous growth but on the upland birch is in the main predominant.

The bottom near land is accordingly very muddy, except along half of the southeast shore where there is a narrow sandy shelf. In deep water the usual soft brownish mud was found as in the other lakes.

The lake basin is rather regular with the deepest water in the middle. Most of the central area is covered by 13-14 feet, and the depth diminishes regularly until off the mouth of the two end coves it is 9 or 10 feet. The small western one is only about 5 feet deep at deepest, but at the east depths of 9 feet continue to within 50 to 100 feet of shore. Along the long sides of the basin, the descent to deep water is rather abrupt. At 35 to 50 feet off shore 5 or 6 feet is reached. (68 soundings)

Water vegetation is rare, but a few plants of Myriophyllum, Potamogeton spatterdock, et al, occur. Masses of colonial gelatinous algae (Nostoc) impeded seining on the southeast shore. Clams are occasionally found along shore.

Only two species of fish were found in the lake: pike and perch. The latter were seined along shore and the former taken gillnets. A piece of 2 1/2 inch net set on September 16 from land to 12 feet and lifted next day took 4 pike. A piece of 2-inch net set from shore to 10 feet got 3 pike. A piece of 1 1/2-inch from shore to 6 feet caught nothing.

The temperature on the bottom in 12 feet on September 17 at 10:00 a.m.

was 13 degrees C.; on the surface 13.4.

Shesheeb Lake

Shesheeb lies a little east of Brady Cove, a branch of McCargoe Cove. It is roughly pendant-shaped about half a mile long and has a small island within 30 feet of the northeast shore. Drainage is through a small stream, which the beavers have dammed with a resultant raising of the water level of the lake of 4 or 5 feet.

As usual with the lakes of the Island, the ends are low country and low ridges form the sides. Birch constitutes the principal forest growth and here and there shrubs of Myrica and patches of grass have been established along the water's edge. The shore is however almost everywhere lined with trees and shrubs which have succumbed or are nearly dead from the drowning effected by the beaver dam.

Due to the sharp slope of the enclosing ridges, the activity of the beavers though increasing the lake's volume has not greatly changed its area and shore shoals are virtually absent. The outlet end which apparently was once a bog is now 5-7 feet deep. Where it begins to widen into the main lake the depth in the center rises to 15 feet and at that point about equidistant from either end, and the depth is 18-20 feet. From the west end of the island the water becomes gradually shoaler. Off the center of the island to the south shore, the greatest depth is 14-15 feet. (62 soundings)

The bottom in deep water is the usual soft brownish mud. The water is strongly discolored. The thermometer was out of sight in 4 feet. Water vegetation is rare.

Three species of fish were taken: golden shiner, perch, and pike. 1/ The first two were taken in seines and the last two in gillnets. The shiners were to be had in schools in favorable places along the shores, usually in a pocket between drowned bushes.

A 1 1/2-inch net set in the outlet end from shore to 8 feet on September 18, 1929, and lifted next day caught a 10-inch pike and a perch. A 2 1/2-inch net set in the middle from shore to 16 feet took 10 pike (2-3 1/2 lbs.) A 2-inch set off the lower end of the island from shore to 18 feet, got 2 pike (3-4 and one 3-2 lb.). A piece of 1 1/2 set in 18 feet took nothing.

The pike were well-fed and were the best-nourished examples seen up to this time, with the exception of those from Lake Biskiwit. Of 10 stomachs examined (8 males, 2 females) 5 were empty and each of 5 more had a perch 2-4 inches long.

The temperature at the surface at 5:00 p.m. on September 19 was 13 degrees C.; at the bottom in 8 feet 12 degrees; at the bottom in 16 feet 11.7 degrees.

Linklater Lake

Linklater Lake lies a few rods north of Shesheeb and flows into it. Its level has been raised also by the beaver dam. It is about a mile long, with a width of about 1/8 mile. Along the south shore at about its center there is a slight cove and farther along near the east end there is another more pronounced but smaller. A little island, about 10 x 25 feet lies off the outlet, and rock 6 x 6 feet lies near the eastern end.

1/ One stripenose shiner (Notropis atrocaudalis heterolepis has been found among the golden shiners. - Carl L. Hubbs.

A low ridge forms the north shore, but the south shore is dry level ground. The ends are rather swampy, especially the outlet end which is a band of floating "marsh grass" 50-100 wide. The principal plant growth of the upland is birch-poplar on the north and southeast and birch on the south. A short band of Myrica mixed with marsh grass borders the lake at the northwest and another at the east. Scattered plants of the same grow in the two coves. All plants that were once at the water's edge are now flooded and many, including trees, are dead. The larger islet has trees but the smaller has only Myrica, alder and herbs. Vegetation on both shows the effects of drowning.

The area between the islet and the outlet is 2-5 feet deep. From the island to the north shore the water is principally 6 feet deep, to the south shore 5 feet. Beginning in the middle of the center cove sounding to the north shore read in feet 3, 4, 5, 6, 10, 10, 15, 15, 21, 20, 15, 6. The last three soundings are 50, 30, and 10 feet off shore, respectively. A line of soundings across the lake made halfway between the cove and the east end shown a maximum depth of 15-16 feet, and through the southeastern cove below the islet a maximum of 10, with no more than 5 in the cove itself. From the islet to the east end depths of 13-15 feet were found. Apparently a reef of which the rock is part extends across the basin here. (71 soundings)

The bottom in deep wateris the usual soft brown mud.

Aquatic vegetation is relatively scarce the eelgrass, spatterdock, et al, are occasionally seen at the surface. A heavy surface bloom was present in the coves. Rushes occur not uncommonly, scattered among the drowned shrubs along the north shore. Clams are occasionally present. The thermometer disappeared at 4 feet. The water is not strongly muskeg.

Four species of fish were found: Stripenosed and golden shiners, perch and pike. The first three were seized along shore and the last was taken in gill nets. The golden shiner was the commonest fish observed and occurred in large schools at places in the coves. a 1 1/2-inch net set on September 18, and lifted next day from shore to 6 feet took a small pike. A 2 1/2 and 1 1/2-inch net set off the north shore from shore to 21 feet took 2 pike. Of 6 stomachs examined half were empty; one had fish remains and one had 3 perch 2 1/2 inches long.

The bottom temperature in 21 feet at 3 p.m. on September 18 was 11.8 degrees C.; surface 13 degrees.

Sargent Lake

Sargent Lake lies a half mile east of McCargoe Cove and drains into it. It consists of two irregularly elongate lobes joined by a narrow strait which is blocked by two islands. The shore of both lobes is sinuous, and many small peninsulas and coves are formed. Numerous islets and rocks lie off some of the peninsulas. The overall length is about 2 3/4 miles and the maximum width is only about 1/4 mile. Two or three small feeders come into the lake and a short stream connects it with McCargoe Cove.

The north shore of the lake is for the most part of low ridges 10-20 feet high. The south shore is much higher. Bed rock is very common on the north, and most of the remaining shore line is of boulders. There are, however, perhaps a dozen stretches of sandy shore where the bottom is soft fine sand. Off the Wagejo Outlet there is a stretch of good sand beach. Snags occur abundantly all along shore. Birch and poplar are the predominant

forest formation on the north shore and on the west half of the south shore. Cedar and balsam are more plentiful over the east half, and often elsewhere in the bottom of coves. Myrica is a very common plant along the water edge, particularly in the indentations and rushes occur as dense growths 10 feet or more wide in stretches of several hundred feet along hard shores. On the sandy beaches Eriocaulon, Elocharis, Isoetes, et al, usual in such situations grow commonly.

The shores almost everywhere slope abruptly into deep water, especially in the western section where depths of 10-25 feet are commonly attained within 25 - 30 feet of land. Even in the numerous bays there is seldom shallow water, so that pond conditions are chiefly confined to the bottom of a few of the smallest coves. The eastern division is shallowest. The basin that is formed at the extreme east end by the two long points and the connecting chain of islands is in the main 13-15 feet deep. Between the islands the water is as a rule shallow, but in the widest gap there is a 14 foot depth. The rest of the basin to the north and west is chiefly 16-21 feet deep.

The western section is the deeper. The channel that is left by the two islands in the mouth of the connection between the two parts is 9 feet deep. The strait beyond the islands at once deepens to 19 to 22 feet and in the open lake to 26 feet. Most of this part of the lake is 25-45 feet deep. The bottom appears to be slightly irregular: two basins of 40-45 feet occur in this area, a small one in the center off the outlet and another occupying a large part of the eastern half of the lobe, the two separated by a stretch 30-35 feet deep. The long narrow bay east of the outlet is 25 feet deep at its mouth and continues over most of its extent 15-16 feet deep. (237 soundings)

The bottom is occasionally of bed rock near land, and a fine silty sand that at depths of 2 1/2 to 3 feet becomes very soft is common, especially in coves. In these places the moose have usually converted the material into more. There is off the Wagejo outlet a strip of hard sand 50-70 feet wide, 1-2 1/2 feet deep, which drops suddenly to deep water and mud. In general the bottom near shore is a mixture of stones and sand that gives a hard bottom, this, however, changes within a few feet of land to the soft blackish brown mud of the main basins.

The rocks in shallow water are covered with a thick growth of gelatinous brown algae, as in Lake Whittlesey. In the east part there are occasional patches of Potamogeton and strips of eelgrass, but in the west part there is little such growth, except that in the bottom of some of the coves in this area sparse growth of a dwarf Myriaphyllum, et al, occurs in shallow water.

Clams are found occasionally along the shores, but are common in some of the sheltered situations.

Nine species of fish were captured in the lake: stripe nosed, spot-tailed and golden shiner, Iowa darter, miller's thumb (C. cognatus). herring, pike, perch and sucker. The shiners were not as abundant as in some other lakes; the golden shiner was rare. The darter and miller's thumb occurred rather commonly, principally on the sandy bottom. Perch were observed in greatest numbers and were present in large schools in every sheltered place. they were, however, seldom over 3" long and often smaller. The herring, pike and sucker were caught only in gill nets.

Nets were set in various situations in the lake and left one night . In

the east section a piece of 2 1/2 from land to 15 feet off the middle of the south shore took 5 pike (2-2 1/2 lbs.); another off the two islands between the two lake parts at the same depths got a very emaciated pike and a 2-lb, sucker; a 2 1/2 and 1 1/2 set off the north side of the central islet of the east-end island chain from shore to 15 feet got only a sucker, in the 1 1/2; a 2 1/2 inch net set south of the largest island from shore to 11 feet took 2 pike (2 1/2 lbs). In the west part a 2 1/2 and 1 1/2 inch net off the strait from shore to 29-33 feet took 5 pike (1 1/2 to 2 1/2 lbs.) in the 2 1/2 and a herring in the small-meshed net; off Wagejo outlet a 1 1/2 inch net set to 7 feet and a 2 1/2 inch to 12 got only one sucker in the outside net; off the outlet a 1 1/2 inch net from 5-8 feet and a 2 1/2 from 8-20 feet took a sucker in the shallow net and 3 pike (2 3/4-3 lbs.) in the other; off the opposite shore a 2 inch net from shore to 15 feet and a 1 1/2 inch net 15 to 19 feet took 3 pike (2-2 1/2 lbs.) in the large-meshed net and 7 perch and 3 herring and a sucker in the other.

Many of the pike were much emaciated. Of the 8 taken in the eastern part, none had anything in their stomachs. In the western part, of 9 examined all had empty stomachs except two that had eaten one and two herring.

Temperatures

Place	Depth in feet	Date	Temp. in deg. C.	Time
Off central islet	15	Sept. 19,1929	12.9	8:00 a.m.
in east lake	Surface	Sept. 19,1929	13.2	8:00 a.m.
Off outlet	20	Sept. 19,1929	13.6	5:00 p.m.
South shore opposite	34	Sept. 19,1929	11.2	11:00 a.m.
Outlet	Surface	Sept. 19,1929	14.3	11:30 a.m.

Lake Wagejo

Lake Wagejo is an ovoid pond that lies on the ridge east of Sargent Lake. A Small stream comes in at the west end and the outlet which drains to Sargent Lake comes off at the northeast. A beaver dam has raised the water about 18 inches. The shores are principally lined with birch and poplar on the north and south and with cedar and balsam on the ends. Around the outlet there is a broad expanse of "marsh grass" and a narrower rim extends almost completely around the lake. Myrica and iris are mixed commonly.

The lake is 9-10 feet deep in the middle and most of it is 6 feet deep. (46 soundings). The bottom is uniformly a soft black to brown mire. Water plants are confined to a few scattered Potamogetons. No clams were seen. At numerous places along shore clouds of Cladocerans were observed collected about wood fragments. The thermometer disappeared at 6 feet.

Only pike were found in the lake. A 2-inch net set off the outlet from shore to 5 feet and lifted on September 20, 1929, after one night out caught 3 pike (1 1/2-2 lbs.). A 1/1/2 inch set in 9-10 feet got nothing and a 2 1/2 inch from shore to 10 feet took 31 pike (2/4-1 1/2 lbs.).

The pike were found to be subsisting chiefly on dragon fly larvae and small Crustaceans. Tho they averaged very small they appeared well-fed. Of 29 stomachs examined all had food. All but 3 had eaten dragonfly nymphs; these had food as follows: 2 leeches; 1 leech and tablespoon of amphipods; teaspoon of amphipods. Twelve of the other had eaten only nymphs, usually at least 5 sometimes 9 large examples. The rest had eaten as many nymphs but other things also, chiefly Hyalella. Stomachs of three were

crammed with these little amphipods. One or two leeches occurred along with the insect larvae in 4 stomachs and in one several balls of gelatinous algae accompanied. In another, a piece of wood 1/8 inch long had been ingested.

The temperature at the surface at 3:00 p.m. on September 20 was 11.8 degrees; at the bottom in 10 feet 10.2 degrees.

Angleworm Lake

Angleworm Lake is roughly spindle-shaped, about 2 1/4 miles long with a maximum width of less than 1/4 mile. A little stream enters at the east end and at the opposite end it drains into Lesage Lake through a small creek.

The north shore has numerous roches moutonnees that are usually bare of trees and project with a bedrock front into the lake. An undulating shoreline thus obtains. The opposite shore is formed by a low, wall-wooded ridge and the shore line is rather straight and lined with broken rock. The timber around the lake is chiefly birch-poplar, with a few oaks on the north. Along the south, alder and Myrica grow occasionally along the water's edge. Similar growths are found in the slight coves formed between the knolls of the north shore and there are occasional thin patches of rushes bordering the water.

The bottom in shallow water is usually a sandy mud strewn with boulders. In depths of 2 feet this becomes soft. In the basin the bottom is soft brownish mud. Water vegetation is relatively rare, but at the ends there are thin beds of Potamogeton, Myriophyllum and eel grass. Clams are present. The thermometer is visible to 15 feet.

The lake basin is steepsided, more so on the south than on the north. At a distance of 30 to 50 feet off shore a depth of 15-20 feet is commonly reached. The bottom slopes toward a narrow central groove, as is evidenced by the finding of only one maximum sounding in a cross section. The greatest depth (30 feet) is about in the center of the lake. A stretch of several hundred feet here is 28-30 feet deep and then the water shoals gradually toward both ends. Bays with depths of 2-4 feet are formed at the narrow ends. (115 soundings).

Only two species of fish were found by extensive seining and gill netting: perch and pike. Perch were taken in every seine haul and schools of them were often seen at the surface, even in the center of the lake. Gillnets were set on September 20 and lifted next day. Off the east end a piece of 2 1/2-inch net set from shore to 12 feet took 3 pike (1 1/2-21/2 lbs.). A piece of 1 1/2 inch and 2-inch set from the middle of the south shore from land to 25 feet took only 2 pike (2 1/4 lb.) in the net of larger mesh. A 2 1/2 inch net set off the outlet through a weedbed from shore to 13 feet got 9 pike (2-3 lbs.) and a 1 1/2 inch from 13 to 18 feet got nothing. A string set off the northwest shore out to 20 feet got nothing in the first two nets (2 and 1 1/2 inch) and a 2 lb. pike in the 2 1/2 inch net. Off the northeast shore a 1 1/2 inch net set from land to 17 feet took 2 perch; a piece of 2 1/2 from 17-25 feet took nothing.

The stomachs of twelve pike were examined. Five had eaten nothing. the rest had fed as follows: 2 leeches; 10 dragonfly nymphs and a leech; 2 Hexagenia nymphs and a leech; 2 dragonfly nymphs and a Hexagenia nymph; 4 leeches; 1 dragonfly nymph; 2 Hexagenia numphs and a dragonfly nymph.

Temperatures

Place	Depth in feet	Date	Temp. in degrees C.	Time
East end	Surface	Sept. 21, 1929	13.8	9:00 a.m.
East end	12	Sept. 21, 1929	13.4	10:00 a.m.
Center	28	Sept. 21, 1929	13.2	10:00 a.m.
East end	24	Sept. 21, 1929	13.6	10:00 a.m.

Lake Benson

Lake Benson lies to the east of Angleworm Lake, separated by a distance of a few thousand feet. The lake is rather regularly elongate in outline except that a broad bay comes off the center of the south shore. An island 25 x 40 feet lies in its mouth and a smaller one lies along the shore just westward of the bay. Maximum dimensions are about 1 x 1/2 miles. Drainage is through a small stream into Rock Harbor.

The shores are generally low ridges 10-20 feet high, wooded with birch-poplar except at the two ends where there is a marshy formation with sedges and Chama edaphne bordering the lake and cedars growing behind. The north shore has the roches moutonnees of Angleworm Lake. Sedges and grasses, Myrica, alder, red osier, et al, are found more or less commonly at the lake border, the latter most commonly on the south shore. The shores are frequently of bedrock on the north and southwest and of sandy mud on the southeast.

East of the bay the lake bottom is a flat covered mainly by 5 feet of water. Between the island and the north shore occurs the deepest water, 14 feet, but the central third of the lake is mostly at least 10 feet deep. The west end is like the outlet end, with depths of only 4 or 5 feet. The cove is shallow; soundings across its mouth show a maximum of 7 feet. (98 soundings)

Water vegetation is not common, but occasional plants of Chara, spatterdock and Potamogeton occur. Clams were observed. The thermometer was lost to view in 3 feet.

The bottom along shore is in places sandy mud. In the main basin it is very soft brown gelatinous mud, into which the nets sand deep: those of fine mesh came up often loaded with it.

Three species of fish were found: perch, fine-scaled dace and stripe-nosed shiners. All were seined at the outlet end and in the south bay, but perch were also taken in the gill nets.

Nets were set on September 21, 1929, and lifted next day. A string of 2 1/2 and 1 1/2 inch net from 6 to 12 feet got 36 perch, in the large meshes and 20 in the other. In another such string set from shore to 6 feet, the large meshed net got 122 perch and the other 22. The perch occurred often in clusters 5 to 6 to a foot of netting. It is apparent from the captures made by the gill nets that the lake is a very favorable place for perch. Of the fish so taken 68 were males and 110 females.

The food of many perch was examined. Of the fish caught in the 2 1/2 inch nets, 60 had eaten nothing; 8 had eaten Hexagenia nymphs (1-10); one had eaten a shiner and 12 had a small perch each; 5 had Hyalella (5-25); 16 had dragonfly nymphs (1-5, but one had 13 large ones); 20 had small Phryganid larvae (1-69); 3 had a leech each; 10 had unidentifiable remains of aquatic insect larvae; 2 had midge larvae; 20 had some combination of 2 or more of the above-listed elements. Of the small fish caught by the 1 1/2 inch netting, 7 had empty stomachs; 3 had a dragonfly nymph each, 2 had caddis larvae (1, 3); 6 had fed more or less heavily on midge larvae.

The temperature at the surface at 3:00 p.m. on September 21, 1929, was 13.1 degrees C.; at the bottom in 12 feet, 12 degrees; in 14 feet 11.2 degrees.

Forbes Lake

Forbes Lake is a small elongate pond about 1/4 mile long, 1/4 mile east of Benson Lake. It is known to many of the local fishermen as Perch Lake. The perch found by the gill netting were so small that it is not clear how fishing for them could have ever been popular. There is no outlet to the lake.

The shores on the north and the southwest are bedrock knolls and on the south low ridges, 10-20 feet high, sloping steep to the lake. The east end is a spruce swamp and strips of spruce swamp a few rods wide occur at both ends of the north shore. The principal vegetation of the upland is birch-poplar. A sedge border grows along the east end and along the swamps elsewhere.

The basin is relatively steep-sided and deep. The greatest depth, 20-21 feet overlies a considerable part of the center. Over half the lake's area is covered by at least 15 feet. At both ends there is a rather broad flat where the water is 6 feet deep, but at other places along shore at 25-50 feet off land a depth of 10 feet is reached. (52 soundings)

The bottom is in the deep water soft gelatinous brown mud. On the 6-foot flat at the east end, it is covered by decayed Potamogeton. Near land there is usually mire beyond 1 or 2 feet. On the south shore, there are occasional sandy, gravelly or stony stretches inside this limit, uniformly covered by a heavy silt deposit.

Potamogeton is rather common on the end flats. Elsewhere plants are rare in the water. Clams occur along the shores. The thermometer disappeared at 9 feet.

Only three species of fish were found: stripe-nosed minnow, Margariscus and perch. All were taken by seining and the last two were caught also by means of gillnets. A 1 1/2 inch gill net 50 feet long set on September 21 and lifted next day from shore to 13 feet got 69 perch and 9 Margariscus. A piece of 2 1/2 inch from 6 to 18 feet got nothing.

Of the perch caught 16 were males and 39 females. All were adult, but 4 of the females. The stomachs of 22 were empty; 1 had a perch; 11 had unidentifiable fish; 8 had midge larvae (6-20); 5 had Hexagenia larvae (1-4), 2 had a caddis larva each; 2 had a few Hyalella; 3 had a combination of two of the above elements.

The temperature on September 22, 1929, at noon was 13.2 degrees at the surface and at the bottom in 21 feet 12.2 degrees.

Wallace Lake

Wallace or Cranberry Lake lies a few thousand feet from the bottom of Rock Harbor into which it drains. It is a small elongate bog lake, a little over 1/4 mile long. The eastern half is about twice as wide as the western and is also deeper.

A cranberry-pitcher plant marsh border encircles almost the entire lake. Along a short stretch on the southwest shore broken cliffs 10-20 feet high, abut on the lake, but except where the face of the rocks is precipitous, the marsh plants have crept along the base. Alders grow abundantly behind the marsh plants on the north, but cedars and spruce are commoner at other places.

The lake is of rather uniform depth. The center of the eastern half is uniformly 9 feet deep. Near the middle the depth diminishes to 8 and then continues at 7 over the western half. The slope to the center is rather sharp; off the cliffs maximum depth is attained within 10 feet. (43 soundings)

The bottom is mire. Eel grass, spatterdock and P.natans are occasional. The latter occurs even in the deepest water. The thermometer disappeared at 3 feet.

Six species of fish were found in the lake: stripenosed and fathead minnows, sucker, brook stickleback, Chrosomus [1], and fine-scaled dace. All were taken by seines. A piece of 1 1/2 inch gill net set on September 23, 1929, from shore to 9 feet and lifted next day got only a large sucker.

The surface temperature on September 23, at 8:00 a.m. was 13.4 degrees C.; on the bottom in 9 feet 11.6 degrees.

Sumner Lake

Sumner Lake is a small elliptical bog lake less than half a mile long near the outside shore of Rock Harbor. Drainage is into Conglomerate Bay.

About a fourth of the lake at each end is bordered by a broad floating sedge-cranberry marsh, behind which grow the usual succession plants, Chamaedaphne, alder, spruce. The other shores are formed by rather high ridges, but scattered patches of marsh vegetation grow even here. The birch-poplar formation reaches the lake on the southeast and on the north;there is a fair grove of Norway and white pine.

Most of the lake is shallow. The outlet quarter is 2-4 feet deep and a line through the center shows a uniform depth of 5 feet. About in the middle of the western half, nearer the north shore, there is a hole that is 9-12 feet deep; this rises rather rapidly on the west to a broad 5 foot flat which extends

1/ Doctor Carl L. Hubbs who has seen these dace identifies two of them as hybrids between Chrosomus eos and Pfrille neogaea.

extends off the west shore. (46 soundings)

The bottom is everywhere mire even off the hard shores. Scattered water plants occur in the western part of the lake.

Four species of fish were found in the lake; brook stickleback, fine-sealed dace, fathead minnow, and stripenosed minnow. All were found in seining pockets in the marsh. Sometimes these pockets were teeming with fish, chiefly the fathead minnows. A piece of 2 1/2 and 1 1/2-inch gill net set on September 22, and lifted next day from land to 12 feet took nothing.

The temperature of the surface water at 5:00 p.m. on September 22, 1929 was 14.5 degrees C.; on the bottom in 12 feet 12.3 degrees.

Newt Lake

Newt Lake is a small pond, about 400 x 300 feet, that lies on the ridge between Wallace and Sumner Lakes. It is surrounded, except for a short strip of bedrock on the south by floating bog bearing scattered cedars. Bog plants even fringe the rock front.

No soundings were made, but off the bedrock there are depths of at least 4 feet. The bottom is more.

No gillnets were set, but a seine was operated by means of sticks wherever possible. Only newts were caught. They were seen jumping commonly all over the surface.

Lake John

Lake John is a small elongate lake, less than 1/2 mile long lying a few rods from the shore of Lea Cove. It is of rather uniform width (about 250 feet) with two narrow coves coming off at the east end.

From one of these, the outlet takes its origin. A small feeder enters at the opposite endof the lake.

The south shore is formed by cliffs 20-30 feet high. The opposite shore is low with more gentle slope to the water. Spruce-balsam is the predominant growth around the lake with scattered cedar and birch on the north and the ends. Myrica occurs in scattered growths next the water. Much of the shore is lined with bedrock and most of the rest by boulders.

The water is generally deep. The coves are 5-6 feet deep becoming 7-9 feet off their mouths and then dropping quickly to 19-20 feet. The bottom is tipped slightly toward the south so that the deepest water lies off the cliffs. At 6 feet off shore 10-14 feet may be reached. From the north shore the slope to deep water is more gradual, but even here a 9-foot depth was found at 15 feet off. At the west is found the only shallow water. The incline is rather gentle and there is a relatively broad belt outside the 6 foot contour. (66 soundings)

The bottom is generally very soft mud within a few feet from land. Off the outlet there is a stretch of bedrock. Everywhere in shallow water there is a heavy deposit of brown silt. Snags and windfalls are common all around the lake.

The water is brownish, but clear; the thermometer was visible to 8 feet. Clams occur along shore. Water vegetation is rare at the surface, but at 8 feet, the sounding stone once brought up a fine leafed Potamogeton in abundance.

Four species of fish were caught: pike, sucker, perch and stripenosed minnow. The last two were caught in seines; a 1 1/2-inch gill net set off the east shore to 8 feet on September 25, 1929, and lifted on the 28th took 2 perch. A piece of 2 1/2 inch net set off the outlet to 10 feet got 7 perch, 4 suckers and 4 pike.

The temperature on the surface on September 25 at 10:00 a.m. was 14.4 degrees C.; on the bottom in 20 feet 10.5 degrees.

Lake Theresa

Lake Theresa is a bog lake of irregular outline, about 1/4 mile long, lying a little southeast of Lake Mason. It drains into Epidote Lake.

The lake is almost completely fringed with a border of marsh plants, including Chamaedaphne. On the north, occasional low roches moutonnees approach the lake and on the southwest a short stretch of cliffs meet the water. The upland is forested chiefly with spruce-balsam.

The eastern half is not over 4 or 5 feet deep. Off the cliffs is a broad basin that is covered by 6-8 feet. (90 soundings)

The bottom is more everywhere. Clams occur. Potamogeton natans and spatterdock are seen occasionally.

Gill nets of 1 1/2 and 2 1/2 mesh set in 4-6 feet from September 25 to 28 took nothing, but schools of stripenosed minnows were common along shores. Brook sticklebacks were frequently found also.

The bottom temperature in 7 feet was 15 degrees C. at 2:00 p.m. on September 25.

Epidote Lake

Epidote Lake is a little ovoid pool about 350 feet long, about 100 feet from Lake Superior, intimately joined with it by a small stream. A small stream enters at either end. A small rock island lies off the outlet.

The Lake Superior side is bedrock, but the opposite shore is of boulders. Sandy mud borders the lake at the ends. A heavy fringe of cedar with intermingled sedges, Myrica, alder, et al, line the shores. The upland bears chiefly

conifers with minor quantites of birch.

The lake is generally not over 3 or 4 feet deep over the western half except for a narrow strip against the north shore which is covered by 5 feet. A few feet off the center of the north shore is a very small pocket of 10-11 feet which slopes abruptly to 4 feet on the south. The eastern third is rather uniformly 506 feet deep. (61 soundings.)

The bottom is generally soft. Occasional aquatic plants visible. Clams occur. The water is strongly muskeg, but clear, so that the thermometer was visible on the bottom in 10 feet.

Two species of fish were found in the lake: pike and perch. The latter was found by seining. A 1 1/2 and 2 1/2 inch gill net set in 4 feet on September 25, and lifted on September 28 got 4 pike (2-3 lbs.). In the stomach of one of the pike was found a perch and in another a dragonfly nymph.

The temperature at the surface at noon on September 25, was 14.6 degrees C.; on the bottom in 10 feet 11.6 degrees C.

Lake George

Lake George lies about 300 feet from Lake Superior eastward of Lake Whittlesey. It is narrowly and rather irregularly elongate in form, less than half a mile long and drains into Lake Superior by a short stream coming off the west end. Lane's Chart incorrectly shows a long stream flowing westward to join the outlet of Dustin Lake.

The shores that meet the lake are generally relatively low, but they slope at a sharp angle to the water. Bedrock and boulders border the water, but in most places vegetation has encroached to the water-line. The dominant growth is spruce-balsam with minor quantities of birch and cedar. At the ends alder, iris, and sedges occur near the water.

The lake basin is steep-sided, but with a flat bottom. Most of the lake is 9-10 feet deep. Maximum depths are often reached at 25 feet from land. There are no shoals, not even at the ends. 45 soundings were made.

The bottom along shore is usually stony, except in the end coves where there is mud. In the deep water, the usual mud is found. Clams occur. Visible water vegetation is rare.

Only two species of fish were found: pike and perch. A 1 1/2 inch net set on September 25, 1929, and lifted the next day from shore to 10 feet got a perch. A 2 1/2 under the same conditions got a pike.

The temperature on the surface at 5:00 p.m. on September 25 was 14 degrees C.; on the bottom in 10 feet, 14.4 degrees.

Dustin Lake

Dustin Lake is a small water body lying near Lake Superior eastward of Lake Whittlesey. It is rather regularly elongate with a length of about a quarter of a mile. It receives the outflow from Lake Whittlesey at the northwest end and discharges to Lake Superior at the southwest. The outlet is probably not traversable by fish on account of the steep descent. Except at high water, there is no open communication, because the mouth is blocked by beach gravel.

The south shore is formed cliffs 10-40 feet high. The other shores are the usual low ridges and knolls. Vegetation is spruce-balsam-birch, except that there is a fair growth of jackpine on the south. Cedar , alder, Myrica, Ledum, Chamaedaphne, etc., grow along the water. Vegetation of some sort grows to the water's edge in many places, and in the rest bed rock or boulders are exposed.

The descent to deep water is very abrupt. Wading is impossible virtually everywhere at 20 feet off land. There is a rather broad flat of 4-6 feet off both ends. At the west, the slope to deep water is more abrupt so that the deepest water is in the western half. A broad flat covered by 19-22 feet lies west of an imaginary cross-bisector. To the east of this line, the slope to the east shore is very gradual. (44 soundings.)

Bottom along shore is generally stony, changing soon to soft mud. In the east cove there is an expanse of sandy mud. The rocks are heavily coated with brown gelatinous alga as in Lake Whittlesey. Visible aquatic vegetation is relatively scarce. Clams occur. The thermometer disappeared at 6 feet.

Six species of fish were found: pike, perch, suckers, logperch, stripe-nosed minnow and walleyed-pike. Only perch were at all common and these were evident principally as minnows, not over 2 inches long, swimming near land. A 2 1/2 inch net set off the east shore on September 26, 1929, to 10 feet when lifted next day got 2 perch and a walleye. A piece of 1 1/2 inch net under the same conditions got nothing. A piece of 2 1/2 and 1 1/2 inch set off the outlet under the same conditions took nothing. The lake apparently is not much suited to fish and the relatively high number of species harbored is probably due to the free connection with Lake Whittlesey

The temperature on the surface at 10:15 a.m. on September 26 was 12.8 degrees C.; on the bottom in 22 feet 11.8 degrees.

Sholts Lake

Sholts Lake is a small water-filled slit between ridges 20-25 feet high, lying a few rods southeast of the easternmost end of Lake Whittlesey. It is connected with the outlet of this lake. Its dimensions are about 80 x 900 feet.

The south shore is steeper than the north, but the ends are marshy. Occasionally a 10-15 foot cliff abuts on the water on the south. The upland is forested with mixed deciduous and coniferous growths with mountain ash common on the south, and jackpine on the north. The ends are formed by sedge bands 20 feet or more wide and the alder, Myrica, Chamsedaphne, iris, sedge formation is almost continuous around the lake. Cedars grow along the water not uncommonly, mainly on the south.

The lake's greatest depth is 5 feet. (56 soundings). Most of it is not over 3 or 4 feet deep and the western quarter is seldom over 2 feet deep. The bottom along shore to a depth of 1-3 feet is clean rock (undoubtedly exposed except at high water) but beyond this depth the bottom abruptly changes to soft mud. Trees that fall into the lake soon become buried in it. Aquatic plants are rare.

Four species of fish were found: stripenosed minnow, perch, pike and sucker. Four schools of the former were seen in a circuit of the lake. The rest were seen also on this occasion, but only rarely. A 2 1/2 inch net set to 5 feet on September 27 and lifted next day got 4 pike and a sucker.

Mud Lake

Mud Lake, about a mile southwest of Siskiwit Lake, is about 1/2 mile long by 1/4 mile wide. It drains into Lake Siskiwit. Two small feeders enter the lake.

The south, southeast and northeast shores have high ground sloping to the lake. Marshes border the lake almost everywhere else. Even where high ground meets the water, the bottom is miry and a band of marsh vegetation usually borders the water. Back of this zone is an almost uniform fringe of alder. Myrica, red osier, Chamedaphnae, Ladum, etc., are scattered through the border. The

upland is forested with a mixed growth, birch usually predominating.

The bottom everywhere is mire. Even at high water after the fall rains the lake was found to be only 1 1/2 feet deep, except that a small pocket a few rods square off the northwest shore was 3 feet deep. Islands of sedges are scattered through the lake.

Three species of fish were found: pike, sucker and stripenosed minnow. The minnows were found in schools at several points along shore. Four pieces of gill net were set on September 28, and lifted next day. One piece of 2 1/2 inch net got nothing; the other caught a pike and a sucker. One piece of 1 1/2 inch got a large sucker and the other a small pike.

The temperature recorded 6 inches below the surface at several places in the lake between 8 and 9 a.m. was 9.4 degrees, 10.6 degrees, 10.5 degrees.

Halloran Lake

Halloran Lake is in T. 63 N., R. 37 W., sec. 9. It is rather regularly rectangular in shape, a little over a mile long and about 3/8 of a mile wide. It drains into Siskiwit Bay.

The ends of the lake are low, especially on the west where an extensive spruce swamp abuts on the lake. The sides are high ground 10-30 feet above the water level. The timber is mixed deciduous-coniferous formation, with conifers predominating where the drainage is poorest. The shores are mud at the ends and broken rock elsewhere, often in a low rampart. There is very little bedrock at the water's edge.

The lake is one of the shallowest on the island. Off the west shore for 40 feet out the depth is less than 2 feet. Beginning near the northwest shore a basin about 200 feet wide and 8-10 feet deep runs eastward toward the center,

reaching the middle about at the border of the eastern third of the lake. A shorter, but somewhat wider basin (8-9 feet) lies off the south shore in the central third of the lake. The depth elsewhere is 5-4 feet. (95 soundings)

The bottom at the ends is soft mud, usually mixed with wood and peat. Along the long shores, there is generally a sandy-mud that is often hard and boulder-strewn. Dead trees have fallen abundantly into the shallow water, especially on the east end, but in spite of these obstacles, there was more opportunity for seining than in most of the other lakes. In deep water the usual soft brownish mud obtains.

The water is not much discolored and the thermometer is visible to 7 feet. Clams are common.

Growths of Chara and colonial gelatinous algae were found rather common on some of the hard-bottom shoals. In deep water the nets were filled with "nigger wool" (Cladophora sp.). Flowering plants were rather scarce in the water. Four species of fish were collected: stripenosed and golden shiners, perch and pike. The first three were found by seining. Only perch were at all common and these were seen principally on the east and west the one school was seen at the surface in the middle of the lake. Seining along the apparently favorable south shore netted absolutely nothing. Gillnets were set on September 29, and lifted next day. A piece of 2 inch and 1 1/2 inch set near the center in 8 feet got 4 pike (2 1/2 - 3 lbs.) in the 2-inch net. A piece of 1 1/ 2 from the east shore to 7 feet got one pike. A piece of 2 1/2 from the center of the south shore to 7 feet got 4 pike. Three of the pike were very thin. Stomachs of 5 were examined: one was empty; the rest had perch: one had 5, one to four perch; the rest on each (3 inches).

The surface temperature in the center of the lake at 9:00 a.m. of September 30, 1929, was 11 degrees C.; at the bottom in 8 feet 11.1 degrees.

Stickleback Lake

Stickleback Lake

Stickleback Lake is in a spruce swamp in T. 63 N., R. 37 W., sec. 9, SE. 1/4. It is surrounded by floating bog, is elongate ovoid in shape, and measures overall about 600 feet.

The water is rather uniformly 3 feet deep. (12 sounding). The bottom is mire. Occasional spatterdock and Potamogeton natans grow in it.

The only fish found were brook sticklebacks. These were not uncommon.

Lake Feldtmann

Lake Feldtmann lies at the west end of the island about 3/4 mile from the shore of Lake Superior. It is roughly rectangular in outline about 1 1/2 miles long and 3/4 mile wide at the widest. Drainage is through a small stream at the west end. Though the autumn rains had come, there was no water in its bed. There are no feeders.

The land surrounding the lake is high ground, but the ridges do not meet the lake. There is generally a narrow border of lowland, which is rather swampy at the east. The ridges to the north are about 30 feet high and on the south about 75 feet. On the west there is a good broad sand-gravel beach that extends about a quarter of the way along the north and south shores. Along the north shore, however, the beach is narrower and is backed by a rampart 4-5 feet high, now overgrown with trees and other vegetation. Similar beaches occur in patches along the rest of the long shores. The upland growths are mixed, with conifers predominating on undrained soil. Clumps of grass are scattered along shore and formerly a species of large bulrush grew commonly along the beaches, but it is evident now only through its dead roots and a rare plant or two that the moose have overlooked.

The lake is one of the shallowest on the island. The western half has the deepest water. Most of this section is over 7 feet deep. The bottom appears to be slightly uneven so that a line of soundings across reads 3,5,7, 8.9. 10,9,9,9,8,7,7,7,7,7, 8,8,7,7,8,8,6,3. A few small patches of 10 feet lie off the outlet. The eastern sector is rather uniformly 6-7 feet deep except that a small hole of 8 feet lies off the southeast shore. (170 soundings)

The bottom along the western beaches is usually rather hard sand for about 100 feet from land. Over the eastern half of the lake the stretches of hard sand along the long shores are narrower in the main, especially on the north, and at the east end there is mainly soft mud. In depths of more than 4 feet the bottom is soft brownish mud.

Sparse growths of chara are found on the shoals. In deep water "nigger-wool" was common in the gill nets. Other aquatic plants were not conspicuous. Clams were not found. The water is not discolored, and the thermometer could be seen still at 7 feet.

Three species of fish were found: pike, perch and sucker. The perch occur in large schools of individuals usually not over 2 inches long. They are all more or less heavily parasitized with one or more conspicuous yellowish cysts that enfeeble the fish so that they can often be caught in the hand. Many fish were found dead also. These small perch are very numerous and were taken in virtually every seine haul. No large examples were found and it is probable that noneoccur since maturing adults were found 44 mm. long to the base of the caudal. An occasional sucker was also taken thus.

In the gill nets set on September 30, 1929, and lifted next day the chief

catches were pike. A piece of 1 1/2 and 2 inch net set in the middle in 7 feet got 5 pike in the 2 inch. A similar gang set off the northwest shore in 5 feet, got a sucker in the 1 1/2 and 5 pike in the other net. Another gang off the outlet in 5-6 feet got nothing in the 1 1/2 inch and 7 pike in the 2 1/2 inch. The pike weighed 1 - 2 1/2 lbs.

The stomachs of 13 pike were examined: 2 had nothing, 5 had dragonfly nymphs (1-5); 2 had 2 small perch; the rest had both perch and nymphs.

The temperature on October 1, 1929, at 8:00 a.m. was 11.4 degrees C. at the surface; on the bottom in 8 feet 11.6 degrees.

The Fish Fauna of the Lake

1. The number of species of fish found on the island in the 38 examined lakes is 30. 1/

2. The log perch, sunfish, fathead, horned dace and the mimic shiner are very near the known northern limits of their range. Dymond (1926) did not find the sunfish and horned dace in his survey of the Lake Nipigon area.

3. Lake Siskiwit, the largest lake, has 16 or 17 species (the brook trout undoubtedly occurs, at least sparingly, but was not taken). Lake Desor and Richie have 11 each. None of the others have more than 9, and many, including some of the larger ones, have only 2 or 3. One of the smallest has 6. It appears thus that size alone is not the important factor that determines the number of species one of the lakes may contain.

4. The lakes may be classified according to stage of development with those that harbor Coregonidae in Class I, those with bog borders and chiefly

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1/ 35 counting subspecies, including the three confined to Lake Harvey.

less than 5 feet and not over 10 feet deep in Class III and the rest (not boggy and chiefly 8 feet or more deep) in Class II.

Class I has the four deepest lakes and excepting Lake Feldtmann, the largest lakes on the island: Siskiwit, Richie, Desor and Sargent. In class II are most of the lakes. These are all 10 feet or more in depth, and vary in size from Feldtmann (one of the 5 largest) to the little pond Wagejo. Class III contains 7 small bog lakes: Ahmeek, Wallace, Sumner, Theresa, Sholts, Mud, Stickleback. In such a classification we see that the largest and deepest lakes (Class I) have the most species (9-16). Those in Class II have from 1 to 8 and in Class III, 1 to 6.

5. Excluding Newt and Stickleback Lake that are clearly not suited to any but bog-tolerant species, the pike and perch occur in all but 8, or 28, of the lakes. Stripenose is found in 22 lakes and the sucker 15. The rest of the species run as follows: spottail and golden shiner, 10 each; trout perch, Cottus cognatus and brook stickleback, 5 each; Margariscus, herring and fathead, 4 each; walleye, finescaled dace, ninespined stickleback, log perch and Cottus ricci, 3 each; sunfish, brook trout, darter and whitefish, 2 each; lawyer, chub, lake trout, horned dace, Chrosomus, mimic shiner, lake shiner, Couesius and Cottus bairdii kumlieni, 1 each.

6. It is not easy to explain the unequal distribution of the various species. We do not know enough about the life history of any of our fish to say that a given species is absent in a given body of water, because condi tions are unsuited. The case of the pike, a very adaptable fish throughout its range, some comments appear permissible.

The pike does not occur in Harvey, Hatchet, Desor, Benson, Forbes, Wallace

Sumner or Theresa. The last three are bog lakes and conditions may not be suitable. The rest, together with Angleworm, Lesage, Livermore and Wagejo are the highest lakes on the island and hence were probably the first to be exposed by the recession of the Great Lake that once covered the island.

7. The fauna of these high lakes may give some clue to the population of this ancestor of Lake Superior. In table 2 is given the approximate altitude of these lakes, together with a list of species known to occur in them.

All these high lakes, except Desor and Hatchet have perch. Livermore, Lesage, Angleworm and Wagejo are the only ones that have pike. Of the remaining 16 species, 9 are now common inhabitants of the shores of Lake Superior and the other 7 are pond or stream dwellers. If we assume that the 9 Great Lakes dwellers constituted the original population of the ancestor of Lake Superior, we may easily account for the 7 pond and stream forms by assuming that they had access to high waters through ponds and streams now extinct.

If the pike is to be left out of this list of early-settlers, it must be explained how it got into part of the lakes. The pike could have got into Angleworm and Lesage. Suckers are known to ascend the outlet of Lesage from Richie and it is possible that pike can do likewise. It remains only then to account for their presence in Wagejo and Livermore. The stream connecting the former with Sargent and that connecting the latter with Chickenbone have both a steep gradient. It is possible, however, that fish can still ascend both, the offhand it would seem as great an undertaking as the ascent of some of the streams that join the other high lakes with Lake Superior. Pike of course are decidedly positively rheotropic in spring and the con-

centration of pike around the mouth of the creeks opening into Chickenbone and Sargent would undoubtedly be greater than that around the mouth of the streams opening into the deep cold bays of Lake Superior, so that the chances of penetration are more favorable in the inland streams.

It would not be worth while to discuss the absence of pike in such detail if it were not known that pike are absent from certain high lakes near the south shore of Lake Superior: in the Huron Mountain and Porcupine Mountain areas. In rather thorough collecting in the lakes of the Huron Mountain region by Doctor Carl L. Hubbs and me (see Hubbs: The Fishes in Book of Huron Mountain), no pike were found in Trout, Canyon, Ives, Mountain, Ann and Cliff Lakes, lying at elevations of 153 feet from Ives and 233 to 315 feet above Lake Superior for the rest. The population of these lakes was found to consist of 9 species: Leucichthys (2 species), redsided sucker, brook and lake trout, blunt-nosed minnow, brook stickleback, Couesius, and perch. All but two are Great Lakes shore forms. The perch occurred in two and may not have found congenial conditions in the rest.

Ruthven gives the fish fauna of Carp Lakes in the Porcupine Mountains (altitude about 500 feet) as sucker, horned dace, spottail, trout perch and perch (see Ruthven, A. C.: An Ecological Survey in Northern Michigan, 1906).

There is thus in these high lakes a relatively low number of species and most of those found belong to the open shore fauna of the Great Lakes. The pike is absent from most of them though it occurs in lower lakes offering apparently no more favorable conditions. It is probable then that the pike has been late in entering the Great Lakes Basin.

8. There are other points of distribution worthy of mention:

(a) The Iowa darter occurs only in Chickenbone and Sargent lakes, the sunfish only in Richie and Mason Lakes and the log-perch only in Siskiwit Whittlesey and Dustin. The lakes of each of the three groups are close together and the connection between them undoubtedly has been rather intimate.

(b) Cottus bairdii Kumlieni has been found only in Chickenbone to which it probably has been able to ascend from the Great Lake.

(c) The spot-tailed shiner does not occur in the high lakes, nor in Feldtmann and Halloran, although conditions in many of these lakes seem to be favorable. The absence of many forms where they might be expected is striking, as for example, the absence of Couesius and walleyes in Lake Siskiwit, and of all minnows in Lake Feldtmann.

(d) It is noteworthy that the redsided sucker does not occur in the lakes of the Island. It is found in Lake Superior and in some of the high lakes of the Huron Mountain region. In the latter lakes, the common sucker which is the usual one on the Island is absent.

(9) Most of the lakes are rather poor places for fish. Even where the number of species is rather high, the number of individuals is low. In many lakes with only 2 or 3 species there are relatively few fish. The exceptions are in the main summarized below:

(a) Perch grow large (1 lb) in Chickenbone, Otter, Beaver and Benson. They appear to be abundant in some other lakes: Forbes, Angleworm, Feldtmann, Livermore, Harvey, but they do not grow large in these, and in most appear to be exceedingly dwarfed.

(b) Siskiwit Lake seems to offer favorable conditions for most salmonoids. The trout and whitefish appear to be rather common and to attain

a size comparable with that reached by Great Lakes individuals.

(c) In Lake Harvey occur the largest examples of stripenosed shiners on record. Margariscus is abundant and suckers and perch are exceedingly common - so abundant in fact that individuals taken are generally much emaciated.

(d) In Hatchet Lake are found numbers of large brook trout and horned dace of approximately maximum size for the species. The temperature of the lake becomes rather high.

(e) Desor Lake Supports a very large population of whitefish. Suckers are also common.

(f) Wagejo Lake supports a large number of pike, the only fish found in it.

(g) In Lake Sumner fatheaded minnows are very abundant. Thirty-five hundred individuals were caught with one dip of an improvised cheese-cloth dip net.

10. Eradication by the moose of the higher aquatic plants has undoubtedly had serious consequences for the fish. These plants are important in affording them food and shelter.

11. It appears that food is generally scarce for the larger fish. In virtually every lake except Siskiwit, Wagejo and Shesheeb, the pike were thin, often extraordinarily emaciated, with no infestation of parasites to account for loss of flesh. Stomachs in all pike were found with little food except those of Wagejo which were feeding almost exclusively on Crustaceans and aquatic insect larvae.

Stomachs of perch and walleyes were generally found with little food.

The whitefish of Lake Desor have apparently been driven by absence of Crustaceans and molluscs to a predatory habit and many stomachs contained only fish, principally the nine-spined stickleback.

12. The fish fauna of the Island's lakes has been seen to be relatively large and to consist of a rather high number of warm water or pond-loving fish. Geologists do not know that the Island has been connected with the mainland, since it began to emerge from the depths of Lake Algonquin and the Island's biota, according to this view, has been transported by water. It seems improbable that many of the species of fish could have traversed the stretch that separates Isle Royale from the nearest mainland. A journey of 25 miles across a depth largely over 600 feet deep, in water that for most of the year is near freezing is hardly to be expected from fish that do not regularly grow larger than 3 inches and prefer to live on warm shoals.

Appendix

	Scientific names of fishes referred to in the text by common names or generic names
Bluntnosed Minnow	Hyborhynchus notatus (Rafinesque)
Chrosomus	Chrosomus eos Cope
Chub	Leucichthys bartletti koelz
Cousesius	Couesius plumbeus (Agassiz)
Darter, Iowa	Poecilichthys exilis (Girard)
Dace, Fine-scaled	Pfrille neogaea (Cope)
Dace, Horned	Semotilus atromaculatus atromaculatus (Mitchell)
Fat head Minnow	Pimephales promelas promelas Rafinesque 1/

1/ The Lake Harvey race I separate as P. p. harveyensis. - Carl L. Hubbs.

Herring	Leucichthys artedi sargenti Koelz in Sargent, Richie and Siskiwit lakes
	Leucicthys artedi huronicus Koelz in Lake Desor.
Lawyer	Lota maculosa (Le Sueur)
Log perch	Percina caprodes semifasciata (De Kay)
Margariscus	Margariscus margarita nachtriebi (Cox) 2/
Miller's thumb	Cottus cognatus Richardson Cottus bairdii kumlieni (Hoy) Cottus ricei Nelson
Perch	Perca flavescens Mitchill
Pike	Esox lucius Linnesus
Shiner, Golden	Notemigenus crysoleucas crysoleucas (Mitchill)
Shiner, Lake	Notropis atherinoides Refinesque
Shiner, Minic	Notropis volucellus volucellus (Cope)
Shiner, Spottailed	Notropis hudsonius selene (Jordan)
Shiner, stripenosed	Notropis, strocaudalis heterolepis Eigemann and Eigemann 3/
Stickleback, Brook	Eucalia inconstans (Kirtland)
Stickleback, Ninespined	Pungitius pungitius (Linnaeus)
Sucker, common	Catostomus commersonnii (Lacepede)
Sucker Redsided	Catostomus catostomus (Forster)
Sunfish	Eupomotis gibbosus (Linnaeus)
Trout, Brook	Salvelinus fontinalis fontinalis (Mitchill)
Trout, Lake	Cristivomer namaycush (Walbaum)
Trout, Perch	Percopsis omisco-maycus (Walbaum)
Walleyed Pike	Stizostedion vitreum (Mitchill)
Whitefish	Coregonus clupeaformis dustini Koelz in Lake Desor
	Coregonus clupeaformis neo-hantoniensis Prescott in Lake Siskiwit

2/ The Lake Harvey race I separate as M. m. koelzi. - Carl L. Hubbs.

3/ The Lake Harvey race I separate as N. a. regalis. - Carl L. Hubbs.

Table 1. DISTRIBUTION OF FISH IN LAKES OF ISLE ROYALE

	Pike	Perch	Stripenose shiner	Sucker	Spottail shiner	Golden shiner	Brook Stickleback	Trout perch	Cottus cognatus	Herring	Fathead Minnow	Margariscus	Fine-scaled dace	Walleye	Log perch	C. ricei	9-spine stickle-	Sunfish back	Iowa darter	Brook trout	Whitefish	Chub	Lake Trout	C. b.kumlieni	Cowesius	Horned dace	Lawyer	Chrosomus	Lake shiner	Minic shiner		No. of species in each lake
1. Chickenbone	x	x		x					x					x					x				x								8
2. Livermore	x	x	x		x																											5
3. Lesage	x	x																														2
4. Richie	x	x	x	x	x	x		x	x	x								x											x			11
5. Intermediate	x	x	x	x	x	x		x	x																							7
6. Siskiwit	x	x	x	x	x			x	x	x					x	x	x			?	x	x	x				x		x			16
7. Whittlesey	x	x		x	x			x						x	x	x					x											8
8. Mason	x	x	x			x			x									x														6
9. Otter	x	x	x		x	x																										5
10. Beaver	x	x	x		x	x																										5
11. Harvey		x	x	x							x	x																				5
12. Hatchet				x			x	x			x	x								x					x							8
13. Desor				x			x	x	x	x	x	x				x	x			x	x				x							12
14. Amygdaloid	x	x			x		x	x	x	x		x				x	x															13
15. Patterson	x	x																														2
16. Ahneek	x	x																														2
17. Eva	x		x		x	x																										4
18. McDonald	x	x	x																													3
19. Shesheeb	x	x	x	x																												4
20. Linklater	x	x	x	x		x																										5
21. Sargent	x	x	x	x	x	x			x	x									x													9
22. Wagejo	x	x																														3
23. Angleworm	x		x																													3
24. Benson		x	x	x									x	x																		5
25. Forbes			x	x								x																				4
26. Wallace				x	x		x				x			x														x				6
27. Sumner				x			x				x			x																		5
28. Newt																																0
29. John	x	x	x	x	x																											6
30. Theresa				x	x		x																									4
31. Epidote	x	x																														2
32. George	x	x																														2
33. Dustin	x	x	x	x										x	x																	6
34. Sholts	x	x	x	x																												4
35. Mud	x		x	x																												3
36. Halloran	x	x	x				x																									4
37. Stickleback								x																								1
38. Feldtmann	x	x		x																												3
No. of lakes inhabited by each species	28	28	22	15	10	10	6	6	6	4	4	4	3	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1		

Table. Distribution of fishes in certain lakes at high elevations on Isle Royale and on the south shore of Lake Superior

Altitude		Brook trout	Lake trout	Whitefish	Herring	Leucichthys hubbsi	Sucker	Redsided sucker	9-spined stickleback	Brook stickleback	Trout perch	Cousius	Horned dace	Margariscus	Fine-scaled dace	Fathead	Bluntnose	Stripenose	Spottail	Cottus ricei	C. Cognatus	Pike	Perch
ISLE ROYALE																							
235	Desor	x		x	x		x		x	x	x	x		x						x	x		
191-142-147*	Hatchet	x					x		x	x	x		x	x		x							
190	Livermore																					x	x
About 190	Lesage																					x	x
About 190	Angleworm																					x	x
About 190	Wagejo																					x	
About 190	Forbes													x				x					x
About 190	Benson														x			x					
168	Harvey						x							x		x		x					x
Huron Mountains																							
153	Ives			x		x	x		x				x										x
233	Canon												x										
234	Trout		x	x							x	x					x						
240	Mountain			x		x			x								x						x
243	Anne				x				x														
Porcupine Mountains																							
500 carp	Carp							x				x		x						x			x

*Figures supplied by Doctor George Stanley, who says that all the above listed Isle Royale lakes lie above the Fort Brady beach.