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Institute for Fisheries
Research
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Page 277-282, 284

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

November 27, 1951

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

Report No. 1309

A FISHERIES SURVEY REPORT ON LAKE LEELANAU, LEELANAU COUNTY, MICHIGAN

By

I. A. Rodeheffer and Jason Day

Abstract

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Lake Leelanau, on scenic Leelanau Peninsula, ranks among the larger inland lakes of the State. It consists of two distinct basins which rather commonly are regarded as individual lakes. The outlet of the south basin enters the north basin, and the outlet of the latter flows into Lake Michigan. The combined area is 8,320 acres. Water of considerable depth occurs in both basins; North Leelanau, with a maximum depth of 121 feet, is the deeper.

The lakes have been mapped in detail, and a survey of their fishery resources and possibilities was made during the summer of 1949. Chemistry tests showed the water to be hard and alkaline. Good supply of dissolved oxygen extended far into the depths of both basins, even during the midsummer period when this vital gas is likely to be scarce or entirely absent in deep parts of lakes. Aquatic vegetation was found to be generally abundant on the shoal areas of South Leelanau Lake, but was considerably less common in North Leelanau. Musk grass (Chara) was the most common plant.

12

The predominant warm-water game fish species of these waters are smallmouth, largemouth, and rock bass, bluegill, pumpkinseed, yellow perch, and northern pike. Ciscoes were netted in North Leelanau Lake during the survey, and lake trout and rainbow trout are stocked here annually. The game fish in general show average growth. Minnows and other forage species are of wide variety and are abundant in both basins.

Management recommendations include installation of brush shelters and continuation of the lake trout and rainbow trout stocking program for North Leelanau Lake. Prohibition of fishing between the end of the winter season and June 25 in the Cedar Creek area at the south end of South Leelanau Lake is not considered necessary.

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Lake Leelanau, on the Leelanau Peninsula, is one of Michigan's larger lakes. It consists of two separate basins, which locally are differentiated as the south lake and the north lake. This long, relatively narrow body of water has the specific location of T. 28, 29, 30, and 31 N., R. 11, 12 W., in numerous township sections.

Part of the south basin (South Leelanau Lake) is less than two miles from the west arm of Grand Traverse Bay; the west shore of the north basin (North Leelanau Lake) lies less than a mile from Lake Michigan. Almost the entire shoreline of these basins is paralleled by good roads.

Cedar Creek, the main tributary of Lake Leelanau, enters at the south end of the south basin. The outlet of the lake is from the north basin into Lake Michigan.

Each of the basins will be considered separately in this report.

✓* With some additions and revisions by C. M. Taube.

SOUTH LEELANAU LAKE

Acknowledgements

South Leelanau Lake was mapped during the winters of 1946, 1947, and 1948 by personnel ✓ from the Institute for Fisheries Research. Unfavorable ice conditions caused considerable delay in mapping. A biological survey was conducted during the summer of 1949 by another party ✓ from the Institute. This party was aided in its work by many local residents, among whom, to mention a few, were Paul Garvin, Dr. A. H. Lehmann, W. E. Moore, Dan Perrin, and C. W. Risbridger.

Past and Present Use

The lake was an important avenue of commerce in lumbering days when tugs were used to float logs to the various mills located along the shores. It is reported that preceding 1870 a sawmill was located at the present site of the town of Leland on the west shore of North Leelanau Lake and used the falls of the outlet from this lake for power. Later a steel mill using wood for smelting took the place of the sawmill. In the immediate vicinity of South Leelanau Lake the high hills and intervening valleys were forested with hardwoods and probably also cedars and tamarack. Few native pines existed in this locality. Considerable plantings of pine are now found, however, along the highway generally paralleling the eastern shore.

✓ O. M. Corbett, leader; W. A. Allan, M. Bradford, V. Clark, R. Gilbert, L. B. King, and E. Zakrajsek, assistants.

✓ I. A. Rodeheffer, leader; Jason Day, assistant.

A considerable number of cottages attests to the popularity of South Leelanau Lake. If a sightseer traverses its waters from south to north along the eastern shore, he finds on the southeast shore Ferrin's Resort, on the south side of Ferrin's Bay, where there is a livery of about 20 boats, about 10 cottages, and a small store. About a half mile west of this resort, is Moore's Landing where about 6 boats and 1 cottage are available. As the traveler progresses north from Ferrin's Bay, he rounds Robinson's Point into Robinson's Bay, on the shores of which is located the Heimforth development of about 10 cottages with boats. Approximately a mile north of this resort, with an occasional cottage intervening, is Margie's Court with 3 cabins and 2 overnight quarters.

For a distance of about 1 1/2 miles north from the latter resort there are approximately 15 cottages. Also in this general area is a public fishing site under Department of Conservation control. From the public fishing site northward for a mile, the sightseer observes about 15 individually owned homes followed by the Gieger Resort, or Gloccamora, a development of about 15 cottages. Then comes Aushegun Resort with 20 cottages and current building development on Gordon's Point. For the following 5 or 6 miles no resorts are noted, although private homes occur at intervals up to Fountain Point Resort where many dwellings are available to the vacationist. This is one of the older resorts and was available to resorters before the advent of good roads, by means of the westward extension of the Manistee and Northeastern Railroad which ends at the village of Lake Leelanau. Near Fountain Point Resort the lake begins to narrow as the bridge on Highway No. 204 is approached.

If the sightseer reverses his direction and travels along the western shore southward, he finds a few summer homes in the immediate vicinity of the village of Lake Leelanau, but about a mile south of the town for a distance of about 4 miles summer homes are scattered, farm dwellings being the dominant type. Approximately 5 miles south of the village of Lake Leelanau is another public fishing site.

Continuing his southward course, the traveler sees only farm dwellings until he reaches Glazier's Beach. This is a small development of newer cottages, followed to the south by cottages at more frequent intervals. Included among the latter are the C. W. Risbridger development of 4 cottages and the private development of Dr. A. H. Lehmann. Southward is the encroaching shore lying to the north and south of the mouth of Cedar Creek. To the west and south from the mouth of the stream is a 2,000-acre expanse of low, treeless swampland stretching to the hills enclosing the town of Cedar, two miles distant. Most of this swampy flat is included in the Fife Lake State Forest and this is closed to private development. It is used by fishermen who fish the creek and several of its tributaries.

The sightseer has now arrived at the south shore of the lake and if he travels eastward he comes again to Perrin's Landing. By coursing the entire shoreline of South Leelanau Lake he has traveled about 25 miles and passed about 200 cottages.

Because this lake is somewhat off the north-south path of motoring vacationists in Michigan extensive resort development may be delayed. However, the beautiful topography of Leelanau Peninsula is bound to insure the popularity of the lake and will probably encourage continued development. There are very few places along the lake shore where cottages could not be built.

Physical Characteristics

General Description

South Leelanau Lake is long and narrow from south to north, probably averaging less than $3/4$ mile in width, while about 10 miles long. The widest part of the lake lies in the south portion where it is approximately two miles in width.

Geological Origin

I. D. Scott indicates in his report^{3/} that a raising of the northwest coast of the southern peninsula of Michigan, due to warping of the earth's crust, gave rise to flooded river valleys. This resulted in the formation of Torch Lake, Elk Lake, Lake Charlevoix, and Walloon Lake. Because of the proximity of South Leelanau Lake and its sister, North Leelanau Lake, to these other lakes, it seems justifiable to assume that the west coast of the Leelanau Peninsula has also risen, with the result that the lower valley of Cedar Creek was flooded.

Surrounding Country

Mention has been made of the hilly topography of the lands about Leelanau Lake. These moraines generally run in an east-west direction to conform with the direction of ice recession northward and form a part of the Port Huron Morainic system.^{4/} The hills of gravel, sand, and heavy clay support remarkably productive farms and cherry orchards.

Drainage

The largest drainage system of this district is that of Cedar Creek, which enters South Leelanau Lake at the south end. The longest of this

^{3/} Scott, I. D., Inland Lakes of Michigan, (Wynkoop Hallenbeck Co., Lansing, 1921), p. 21.

^{4/} Scott, I. D., Inland Lakes of Michigan, (Wynkoop Hallenbeck Co., Lansing, 1921), p. 10.

stream's tributaries is Virginia Creek, a trout stream. The latter is about 5 feet wide, and after traveling approximately 6 miles in a south-westerly direction, turns east about a half mile west of the town of Cedar. Here it widens, and beginning at Leelanau County Highway No. 641, is known as Cedar Creek.

Cedar Creek is about 50 feet wide at the highway and courses approximately 2 miles to enter the lake. It runs through a swampy area of about 2,000 acres, some of which is under the control of the Cedar Rod and Gun Club. The borders of the stream are indefinite at nearly all points inasmuch as the water extends into the swampy area. Emergent, submergent, and floating vegetation is profuse throughout its length. The stream was navigable by outboard motor during the time of the survey in June and July, 1949, for about 1 1/2 miles upstream from the mouth, although in places it was necessary to go through weed growth extending completely across the stream. About one-half mile down from the highway bridge the stream became choked with weeds, and passage by outboard motor-boat was impossible, although the depth was sufficient.

About a half mile upstream from the mouth, Cedar Creek receives water from a lake to the south, by way of a channel about 50 feet wide and 1,000 feet long. Approximately 200 feet from Cedar Creek this channel receives the waters of Cedar Run, a trout stream 15 feet wide and 6 miles long. In this swampy area Cedar Run is a sluggish stream. Small tributaries enter all these larger streams or flow directly into the lake at various places along its shores. Most of these creeks are unnamed on maps.

Belnap Creek, a trout stream, flows into Perrins Bay in the southeastern part of South Leelanau Lake. This stream is 5 feet wide and 2 miles long, with its tributaries it drains an area of approximately 5 square miles. Merbex Creek, another trout stream, enters the lake north of Gordon's Point in a bay in Section 13 of Bingham Township. It is approximately 5 feet wide and 4 miles long and drains an area of about 6 square miles. The total drainage area of South Leelanau Lake is estimated to be 75 square miles.

Water Fluctuation

The water level of Lake Leelanau is controlled by an 11-foot dam at Leland which is adjustable to a fluctuation of 14 inches. This variation is set by law.

Table 1.--Physical data for South Leelanau Lake

Area in acres	5,370
Area of shoal (to 20 feet), acres	2,370
Percent shoal	44
Type of bottom -	
Shoal	sand, marl
Depths	marl
Color and extent of transparency, feet	white to 10
Maximum depth, feet	62

Physical Features in Relation to Fisheries

Much of the fish life of South Leelanau Lake is found in depths of from 1 to 20 feet, the shoal area. This is an area of approximately 2,370 acres or 44 percent of the lake bottom. In these depths is also

most of the vegetation, although in places it is found down to 26 feet. This plant life, covering almost one-half of the lake bottom, is favored as habitat by fishes and harbors food in the form of aquatic insects and other invertebrates.

Temperature and Chemical Characteristics

General Significance

The northern two-thirds of the lake is less than 40 feet deep, the deeper water ranging from 20 to 40 feet. In the upper third of the lake, which is also its widest part, there is a large area of water 40 feet or more in depth, and a small area exceeding 60 feet. A vertical series of temperatures and chemical analyses were run on July 17 and repeated on August 15, 1949. The temperatures and results of the tests are given in Table 2.

Temperature

Water temperatures are important in fisheries investigations. Each species of fish has a range of temperature toleration as well as a more restricted range of temperature in which it grows best.

The surface water in South Leelanau Lake was warm, varying from 76° F. on July 17 to 83° F. on August 15. Warm water, 70° F. or warmer, continued downward to a depth of over 30 feet on July 17 and to 37 feet on August 15.

On July 17, the temperature dropped gradually from 69° F. at the 30-foot depth to 59° F. at the 50-foot level and dropped another degree to 58° F. at 60 feet. On August 15, temperatures were 70° F. at 37 feet, 61° F. at 50 feet, with an additional drop of 2 degrees at 58 feet.

Table 2.--Temperature and chemical characteristics of South Leelanau Lake, July and August, 1949

(Oxygen, methyl orange alkalinity, and phenolphthalein alkalinity in parts per million; potential hydrogen (pH))

Depth, feet	Temperature (° F.)		O ₂ ppm		M.O. ppm		Ph-th ppm		pH	
	July 17	Aug. 15	July 17	Aug. 15	July 17	Aug. 15	July 17	Aug. 15	July 17	Aug. 15
Surface	76	83	8.6	8.0	151	142	9.0	8.0	8.2	8.2
10	76	77	...	...	...	...	...	...	...	...
20	74	76	8.4	...	155	...	11.0	...	8.0	...
25	74	76	...	...	...	...	...	...	...	...
27	72	76	...	...	...	...	...	...	...	...
30	69	76	6.4	5.4	...	...	...	...	...	7.8
35	...	73	...	...	...	...	...	...	...	...
37	...	70	...	...	...	...	...	...	...	...
40	62	67	5.9	...	...	...	...	...	7.8	...
45	...	...	...	4.6	...	...	...	...	...	7.4
47	...	...	...	...	...	...	...	...	...	7.0
50	59	61	4.0	3.5	...	...	...	...	...	6.8
58	...	49	...	1.6	...	...	...	...	...	7.4
60	58	...	3.4	...	149	160	0.0	0.0	...	...

✓ On July 17 the carbon dioxide value was 0.7 ppm, at 40 feet (bottom), and 0.0 at other depths.

In the warmer upper water of South Leelanau Lake there is an abundance of dissolved oxygen. This extends downward to a depth of 50 feet where 4 parts per million were found in July. On August 15 dissolved oxygen dropped below 4 parts per million between the 45- and 47-foot depths.

The water of South Leelanau Lake is hard. Methyl orange alkalinity ranged from 142 to 160 parts per million. Phenolphthalein alkalinity varied from 0.0 to 11.0 parts per million. In general the lake is slightly alkaline. Values of pH varied from 8.2 to 6.8.

Pollution

As far as could be observed, there was no pollution in South Leelanau Lake. Local sportsmen's groups were instrumental in having a county ordinance passed prohibiting pollution of waters in the country.

Temperature and Chemical Factors in Relation to Fisheries

Temperatures in South Leelanau Lake indicate that the upper 30 feet of water is generally warm in summer (above 70° F. late in the season) and is suitable for warm-water fish. The dissolved oxygen content is high, which is a favorable factor for fish life. In August sufficient oxygen (4 parts per million) in colder water (below 70° F.) is limited to a belt 8 or 9 feet in thickness. Water of this type occurs over a part of the southern part of the lake and is suited for trout.

The slight alkalinity and the hardness of the water are conducive to good production of animal and plant life.

Biological Characteristics

The biological characteristics of a lake of interest from a fisheries standpoint are the kinds and abundance of aquatic vegetation, fish food organisms, and fishes present. Vegetation is important because it furnishes

shelter (particularly for young fish), is used for spawning by such species as perch, supports organisms used by fish for food, and its photosynthetic activity adds oxygen to the water. Fish foods include microscopic or near-microscopic, plant and animal life known as plankton, insects, and other invertebrates. Plankton furnishes food for young fish and the larger fish-food organisms. The more important larger fish-food organisms are nymphs and larvae of insects, fresh-water shrimp, snails, clams, leeches, worms, crayfish, and minnows. Knowledge of the kinds and abundance of fish present is essential, and collection of scale samples from the game fish for growth studies is desirable.

Vegetation

For descriptive purposes, the aquatic vegetation in South Leelanau Lake may be divided into three general areas. The first may be designated as the lower, marshy end of Cedar Creek, its mouth, and the lake around the mouth of the stream. The second area is the drop-off, varying in steepness and ranging in depth from about 3 to 25 feet, along all of the western shore and parts of the eastern shore, including the somewhat protected bays. The third area is the shallower, narrow north end of the lake.

Floating, submergent and emergent vegetation occur in the lower part of Cedar Creek. The vegetation extends into the lake south of the mouth of the stream, into what is known as "the spreads," and eastward into the lake proper to a depth of about 26 feet, covering an estimated 200 acres. The commoner kinds of aquatic plants found in the creek are water milfoil, flat-stem, clasping-leaf, and sago pondweeds, white and yellow water lilies, wild celery, bladderwort, watershield, coontail, waterweed, and musk grass. Along the marshy banks are water willow, sedges, rushes, and cattails.

The band of vegetation along the drop-off of the lake varies in width from 30 to 500 feet. In the wider areas the greater part of the vegetation is Chara or musk grass, which frequently extends from 2 to 26 feet in depth but is more commonly found in 12 to 18 feet of water. Water milfoil grows to a depth of 22 feet. Waterweed, bushy, large-leaf, sago, clasping-leaf, white-stem and flat-stem pondweeds, bladderwort, and wild celery are usually found at 10- to 18-foot depths. A shallower belt of plants, in 6 to 10 feet of water, consists of floating-leaf, short-stem, large-leaf and sago pondweeds. In some of the sheltered bays along the west shore there are yellow and white water lilies. Bulrushes are scattered on the sandy shoals, in places extending out into 6 feet of water.

In the north end of the lake, commonly known as "the narrows," the maximum depth is 16 feet. Here almost the entire bottom is covered with Chara. Short-stem, sago, white-stem, flat-stem, large- and floating-leaf pondweeds, waterweeds, and water milfoil are common.

Over the lake as a whole, Chara is the most abundant plant. Of the taller plants, water milfoil is the most plentiful. Large-leaf, sago and flat-stem pondweeds follow in abundance in the order given.

It may conservatively be estimated that 1,200 to 1,300 acres of the lake bottom, or more than one fifth of the lake's area, are covered with aquatic vegetation. A list of aquatic plants found in the lake and their relative abundance is given in Table 3.

Fish Foods

The stomachs of numerous fish taken in South Leelanau Lake were examined. The chief food of northern pike and perch was minnows. In the stomachs of largemouth bass, smallmouth bass and rock bass, crayfish and minnows were found. That crayfish are abundant was evident from the many

Table 3.--List of aquatic plants in South Leelanau Lake and
their relative abundance

Common name	Scientific name	Relative abundance
Waterweed	<u>Anacharis canadensis</u>	Sparse to common
Musk grass	<u>Chara</u> sp.	Sparse to common
Coontail	<u>Ceratophyllum demersum</u>	Sparse
Water willow	<u>Decodon verticillatus</u>	Sparse
Spike rush	<u>Eleocharis</u> sp.	Sparse
Water milfoil	<u>Myriophyllum</u> sp.	Common to dense
Bushy pondweed	<u>Najas flexilis</u>	Sparse to common
Yellow water lily	<u>Nuphar advena</u>	Sparse to common
White water lily	<u>Nymphaea odorata</u>	Sparse to common
Arrow arum	<u>Peltandra virginica</u>	Sparse
Large-leaf pondweed	<u>Potamogeton amplifolius</u>	Sparse to dense
Short-stem pondweed	<u>Potamogeton angustifolius</u>	Sparse to common
Blunt-leaf pondweed	<u>Potamogeton Friesii</u>	Sparse
Floating-leaf pondweed	<u>Potamogeton natans</u>	Sparse to common
Sago pondweed	<u>Potamogeton pectinatus</u>	Sparse to dense
White-stem pondweed	<u>Potamogeton praelongus</u>	Sparse
Clasping-leaf pondweed	<u>Potamogeton Richardsonii</u>	Sparse to dense
Robbins' pondweed	<u>Potamogeton Robbinsii</u>	Sparse to common
Flat-stem pondweed	<u>Potamogeton zosteriformis</u>	Sparse to dense
Arrowhead	<u>Sagittaria</u> sp.	Sparse
Bulrush	<u>Scirpus</u> sp.	Sparse to common
Cattail	<u>Typha latifolia</u>	Sparse to common
Bladderwort	<u>Utricularia purpurea</u>	Sparse to common
Wild celery	<u>Vallisneria spiralis</u>	Sparse to common

times they were entangled in the threads of the gill nets. Shore seining for minnows, with a 20-foot common sense seine, usually produced minnows by the hundreds. A 30- to 40-foot haul often produced from a quart to one-half gallon of shore minnows. This was repeated many times along different parts of the shore. Large schools of young fish 1 inch or less in length were frequently observed in deeper water when lifting gill nets or checking aquatic vegetation. The abundance of minnows indicated that at that time food was adequate for the fish-eating game species of the lake.

Fish Present

The fish taken in South Leelanau Lake by gill netting, seining, and hook-and-line fishing are given in Table 4. Seining operations were limited because of large numbers of water-logged timbers on the drop-off. Shore seining with a 20-foot common sense seine was very successful on those parts of the shore that were clear of debris.

Gill netting was done in 7 different areas of the lake. From one to three gill nets were set in each area for a total of 1,668 net hours in all locations. (One net-hour equals one gill net, 125 feet long, set for 1 hour.) For one place near the south shore that was fished at various times by survey personnel and their families, a record of the catch was kept. In the description which follows, this location is considered as one of the collection stations.

Of particular interest was the large number of northern pike taken and their general distribution in the lake. Northern pike were caught in all 7 areas where gill nets were set. None was taken in the seining operations nor by hook-and-line fishing. The distribution of rock bass, perch, and largemouth bass was general. These fish were taken at all

Table 4.--Fish of South Leelanau Lake, listed in the order of abundance collected under each general classification.

Common name	Scientific name
Game fish:	
Yellow perch	<u>Perca flavescens</u>
Rock bass	<u>Ambloplites rupestris</u>
Northern pike	<u>Esox lucius</u>
Largemouth black bass	<u>Micropterus salmoides</u>
Bluegill	<u>Lepomis macrochirus</u>
Smallmouth black bass	<u>Micropterus dolomieu</u>
Pumpkinseed	<u>Lepomis gibbosus</u>
Longear sunfish	<u>Lepomis megalotis</u>
Course fish:	
Brown bullhead	<u>Ameiurus nebulosus</u>
White sucker	<u>Catostomus commersoni</u>
Black bullhead	<u>Ameiurus melas</u>
Obnoxious fish:	
Longnose gar	<u>Lepisosteus osseus</u>
Bowfin	<u>Amia calva</u>
Forage fish: ✓	
Sand shiner	<u>Notropis deliciosus</u>
Bluntnose minnow	<u>Hyborhynchus notatus</u>
Blackchin shiner	<u>Notropis heterodon</u>
Mimic shiner	<u>Notropis volucellus</u>
Golden shiner	<u>Notemigonus crysoleucas</u>
Logperch	<u>Percina caprodes</u>
Common shiner	<u>Notropis cornutus</u>
Blacknose shiner	<u>Notropis heterolepis</u>
Johnny darter	<u>Boleosoma nigrum</u>
Iowa darter	<u>Poecilichthys exilis</u>
Pugnose shiner	<u>Notropis anogenus</u>

✓ Identifications verified by Dr. R. M. Bailey, Curator of Fishes, University of Michigan, Museum of Zoology.

stations, excepting that no largemouth bass were caught with hook and line. Smallmouth bass were taken at each station with the exception of the area at the mouth of Cedar Creek. Bluegills and pumpkinseeds were taken in all but one of the areas. Only 3 longear sunfish were caught. Suckers were found in 3 areas. Brown and black bullheads were found only in the upper southwest end of the lake, near the mouth of Cedar Creek. Longnose gars were taken in 6 areas but were netted in greater numbers in shallow water. Only 4 bowfins were caught and all of these were taken near the mouth of Cedar Creek.

Some comment concerning gar netting seems in order at this point. Local residents mentioned two locations where gars were frequently seen, and the majority of this species were taken at these places in shallow water. In one of these areas 3 125-foot gill nets fished for a total of 474 hours took 70 gars; in the other area 2 125-foot gill nets which fished 96 hours caught 16 gars.

The gars were most often caught in the 2 1/2- and 3-inch mesh (stretch measure) and usually were held fast in the region of the pelvic fins. In some instances they were caught by the teeth. The hard, sharp scales sometimes cut the mesh of the net, and apparently some fish escaped as a result. Most of the gars taken measured from 27 to 35 inches long.

As for forage fish, the sand shiner is the most plentiful and the most generally distributed species. It was taken or observed along all parts of the shoreline. Other common species are the bluntnose minnow, blacknose shiner, blackchin shiner, and common shiner. Logperch, Johnny darters, and Iowa darters are common on the sandy shoals.

Table 5 gives the number of game fish of various sizes taken in gill nets in South Leelanau Lake.

A number of the game fish were examined for parasites. The findings are tabulated in Table 6.

Black-spot (Neascus) occurred on northern pike within the size range of 11 to 24 inches, and many of the smaller specimens were severely infested. Pike over 24 inches long were free of black-spot.

Black-spot and yellow grubs were found on perch, but no severe infestations were observed. Some white-spot, black-spot, and yellow grubs were found on smallmouth bass, but severe infestations were not evident. One smallmouth apparently had been sterilized by tapeworm. Only a moderate amount of parasitism occurred among largemouth bass, bluegills, and pumpkinseeds. The livers of some rock bass were severely infested with grubs.

Natural Propagation

The lower part of Cedar Creek offers a large spawning area for northern pike. Aquatic vegetation along the drop-off and in sheltered bays furnishes adequate spawning areas for perch. Smallmouth bass undoubtedly use the stony and gravelly bottom along various parts of the east shore and in a few places along the west shore. This furnishes ample spawning area. The gravel and sand bottoms are also used by largemouth bass and in addition this species probably uses the root stalk of water lilies in "the spreads" and a small lake near the mouth of Cedar Creek. Although only little evidence of spawning activity was seen in these areas in July, the presence of young bass indicated that these sheltered areas are used to some extent for spawning.

Table 5.--List of game fish by size groups taken in South

Leelanau Lake in 1,668 net hours of gill netting. ✓

Length in inches	Northern pike	Perch	Smallmouth bass	Largemouth bass	Blue-gill	Pumpkinseed	Rock bass
3 - 3.9		4			2	1	2
4 - 4.9		5			4	1	4
5 - 5.9		29	4	4	9	9	19
6 - 6.9		55	2	2	27	8	39
7 - 7.9		27	2	1	16		51
8 - 8.9		11	1	6	1	1	41
9 - 9.9		6	2				13
10 - 10.9			3	5			11
11 - 11.9	2			1			
12 - 12.9	4		2	2			
13 - 13.9	8			1			
14 - 14.9	12		3	3			
15 - 15.9	10						
16 - 16.9	6						
17 - 17.9	6						
18 - 18.9	7						
19 - 19.9	9						
20 - 20.9	7						
21 - 21.9	12						
22 - 22.9	8						
23 - 23.9	7						
24 - 24.9	3						
25 - 25.9							
26 - 26.9	1						
27 - 27.9	1						
28 - 28.9	1						
29 - 29.9	1						
30 - 31.9							
32 - 32.9	1						
33 - 33.9	1						
Total	107	137	19	25	59	20	180

✓ One net hour represents one 125-foot gill net set for one hour.

Table 6.--Number of South Leelanau Lake game fish, by species checked for parasites and the number found infested.

Species of fish	Number checked	Number infested with:			
		Black-spot	White-spot	Yellow grub	Tapeworm
Northern pike	106	52			
Yellow perch	137	20		8	
Smallmouth bass	19	3	2	2	1
Largemouth bass	25	3	4	1	7
Bluegill	59		19	11	
Pumpkinseed	28		21	3	
Rock bass	180	13	145		

The sandy and gravel shoals offer numerous spawning sites for bluegills and pumpkinseeds. Water-logged timbers on these same shoals offer ideal spawning facilities for rock bass.

Growth Rate of Game Species

Scale samples were taken from game species for age and growth determinations by microscopic examination. This study showed that largemouth, smallmouth, and rock bass and pumpkinseeds of South Leelanau Lake were making average growth, whereas growth of bluegills and perch fell below the state average for these species. The numerical data are given in Table 13 in the North Leelanau Lake section of this report; the growth of South Leelanau fishes is also discussed further in that section.

General Discussion

In general, South (upper) Leelanau Lake offers good fishing. There is an abundance of fish and a great deal of natural food. It may be that minnows are so plentiful that they interfere with fishing success. Fishing intensity is moderate. One may frequently see 15 to 20 boats on the lake. The south end is most frequented.

Northern pike are barely exploited at all. Some trolling is done, but otherwise there is little fishing for this species. When this fact was mentioned to one of the local residents, he claimed that pike would not bite; but when informed of what was considered a good fishing area, he tried this place and in one evening had seven pike "runs" and caught three pike.

Certain areas are fished intensively for bass, and certain other areas doubtless could be covered more thoroughly with profit. Rock bass and perch offer good fishing. Since stomach analyses showed crayfish to be a favorite food of black bass, rock bass, and perch, wider use of crayfish for bait suggests encouraging possibilities.

Members of the local Rod and Gun Club have in the past sponsored spearing parties for taking gars and bowfins. Continuation of this activity is encouraged, more from an educational standpoint than for the control of these undesired species.

Management Suggestions

Designation of Lake

The present legal designation of South Leelanau Lake appears satisfactory. Year-round fishing is permitted except for some species which are protected during a part of the year. Continued closing of the lower part of Cedar Creek and two lakes associated with that part of the stream prior to the bass season is not recommended. This point will be developed further in an appended section dealing specifically with this area.

Stocking

No stocking is recommended for South Leelanau Lake. Natural reproduction of warm-water species is adequate. While temperatures and chemical tests indicate tolerable conditions for trout in a part of the lake, the abundance of northern pike is an unfavorable factor since pike are known to prey extensively on trout.

Control of Predators and Parasites

Fish predators observed in South Leelanau Lake included some turtles, blue herons, gars, and bowfins. Members of the local rod and gun club have in the past sponsored spearing parties for taking gars and bowfins; continuation of this activity is encouraged. No further control of these species is considered necessary. At the time of the survey, turtles were being removed by commercial trappers. This activity should keep the turtle population within bounds.

No control of parasites appears feasible or necessary.

Cover

Since there is a general abundance of aquatic vegetation and water-logged timbers, there seems to be no need for adding artificial cover.

Regulation of Water Level

Control of the water level has been set by court action, and is affected by the dam in the outlet from North Leelanau Lake. All indications were that a satisfactory level was being maintained at the time of the survey.

Spawning Facilities

Natural reproduction of South Leelanau fishes appeared adequate and there seemed to be no need for improvement of spawning facilities.

Consideration of Cedar Creek and Associated Waters as Spawning Area

Lower Cedar Creek and some of its tributaries for several years have been closed to fishing during the spring up to June 25. The intended

purpose of this regulation was to protect black bass during their spawning season. The affected area includes Cedar Creek down from the Manistee and Northeastern Railway bridge to South Leelanau Lake, and tributary waters in Sections 8 and 9 of Township 28 North, Range 12 West. These tributaries comprise that portion of Cedar Run Creek which flows through Section 9, and two unnamed lakes in the same section.

Although local demand prompted closing this area to spring fishing, some people do not favor the ban. One of the various functions of the Lake Leelanau survey was to determine whether the regulation is necessary.

A preliminary examination of the protected area was made on May 13, 1949,⁵ when it was thought that bass would be spawning here. On the afternoon of May 13, and also that night, observations were made on Cedar Creek from the mouth to the junction of Cedar Run Creek, in the outlet channel connecting an unnamed lake south of Cedar Creek with Cedar Run Creek, and on this lake itself. During the investigation at night, a tally was kept of all black bass seen. Conditions for observing with artificial light were good. In the stretch up Cedar Creek from the mouth to the unnamed lake south of the creek, and once around the lake, 75 largemouth bass were counted. The majority of these bass were judged to be less than 12 inches long. About 25 were estimated as being at least 12 inches long. The latter appeared to range up to a length of around 17 inches.

⁵ Members of investigating party: E. L. Basford, J. R. Nyburg, and C. M. Taube of the Department of Conservation, and Dan Perrin, Earl Perrin, and C. W. Risbridger, local observers.

No evidence of spawning activity was observed that night. Two nests which may have been made by bass were seen in the shallow lake. According to the local men who assisted with the investigation, bass were more numerous in the area about two weeks earlier.

The survey crew also examined this area during June and July, 1949. By this time lower Cedar Creek was mostly overgrown with vegetation, although an open stretch about 15 feet wide would permit passage of boats equipped with outboard motors. A row-boat circuit of the lake south of Cedar Creek revealed schools of minnows, some fingerling largemouth bass and bluegills, a few fair sized rock bass and perch, and three northern pike about 20 inches long. A check was also made of the unnamed lake north of Cedar Creek. This body of water could be reached only after some difficulty presented by the shallowness of the outlet channel, along with obstructions of logs and vegetation. There was only little vegetation in the pond, and the bottom soil was noted as consisting mostly of soft marl. The depth did not appear to exceed two feet anywhere. This pond was considered to have very little significance from a fisheries viewpoint.

While largemouth bass do frequent the protected area, relatively little spawning activity was evident here at the times of examination. There seems to be no valid reason for believing that opening these waters to fishing in the spring would detract from the quality of bass fishing in South Leelanau Lake. Hence it is recommended that year-round fishing be permitted in the area which for several years has been closed in early spring.

NORTH LEELANAU LAKE

Acknowledgments

North Leelanau Lake was mapped during the winter of 1948 by Institute personnel. ^{6/} Another party ^{7/} conducted a biological survey of the lake in the summer of 1949. The latter group was aided by various local residents, including A. J. Kelsch, Jacob Schwartz, Joseph Schwartz, and Harold Weinert.

Past and Present Use

It was reported that previous to 1870 a sawmill was located at the present site of Ieland and used the falls of the outlet from North Leelanau Lake for power. Later a steel mill, using timber for smelting, took the place of the sawmill. More recently an electric power plant was operated here, but this is now abandoned.

Just below the dam on the shore of Lake Michigan are found today the workshops of fishermen. Their tug boats lie at anchor in a canal known as "the inner harbor." The tourist trade and commercial fishing are two of the main industries of Ieland.

Local residents are of the opinion that the numbers of fishermen have increased considerably during recent years. They also say that fewer bass are taken today than in the past. This was reported to be especially true since the discontinuance of plantings from the rearing pond located near the village of Lake Leelanau and which is now used as a public trout fishing pond.

^{6/} O. M. Corbett, leader; W. E. Allan and L. King, assistants.

^{7/} I. A. Rodeheffer, leader; Jason Day, assistant.

Three resorts have been developed within the past few years. One of these, Cedar Haven, is the property of Harold Weinert, who permitted the survey party to use his beach for boat storage. The resort has 6 cottages and 7 boats. It lies on the southwest shore of the east arm of the lake, about 500 feet south of a county park. Immediately north of this park is another resort, Dandale Lodge, which has about 8 boats and 5 cottages (2 duplexes) for rental purposes. Bellevue, the third resort, is straight across the southeast arm from Dandale Resort. Available here are about 5 boats and as many cottages.

Leelanau Lodge, a resort catering to a select clientele, lies on the west shore of the south arm. Four or 5 cottages were noted, but no boats.

The public may also gain access to the lake at the boat wells of Jacob Schwartz and at a county development just south of the mouth of Houdek Creek. The Department of Conservation has acquired a public fishing site in the vicinity of the latter development, and also at the county park on the southwest shore of the east arm of the lake.

Except for the places noted, public access to the lake is much restricted by large shoreline estates. Boats of the Chris-craft type are used for fishing. Sailboats are also numerous.

It is questionable whether fishing pressure will greatly increase here unless there is a considerable increase in the number of public resorts. Fishing now is not heavy when compared to that on many northern lakes which are more accessible to the public.

Physical Characteristics

The shape of the basin of North Leelanau Lake is roughly in the form of a leg and foot, with the toe extended southeastward, the heel, westward, and the leg, northward. The leg and heel contain the larger part of the lake and the deeper water. The greatest depth is found in the north end where 121 feet was recorded by the mappers. Throughout the length of the leg extends a channel in which water 80 to 121 feet deep is found. The heel has some water 60 feet deep. Excluding the heel, the water of much of the foot is less than 20 feet deep. A narrow channel along the north shore of the foot is from 20 to 40 feet deep. The toe of the foot is shallow, with little water over 5 feet in depth. This is a swampy area through which the channel from the south lake leads into the north. Except in the channel, vegetation is dense here.

I. D. Scott indicates in his report⁸ that a raising of the northwest coast of the southern peninsula of Michigan, due to warping of the earth's crust, gave birth to flooded river valleys. This resulted in the formation of Torch Lake, Elk Lake, Lake Charlevoix, and Walloon Lake. Because of the proximity of North Leelanau Lake to these other lakes, it is justifiable to assume that the west coast of the Leelanau Peninsula has also risen, with the result that the lower valley of Cedar Creek was flooded, resulting in the formation of Lake Leelanau. The country about the lake is very hilly. These hills represent glacial deposits in the form of moraines, generally running in an east-west direction to conform with the direction of ice recession northward and form a part of the Port Huron meranic system.⁹

⁸ Scott, I. D., Inland Lakes of Michigan, (Wynkoop Hallenbeck Co., Lansing, 1921), p. 21.

⁹ Scott, I. D., Inland Lakes of Michigan, (Wynkoop Hallenbeck Co., Lansing, 1921), p. 21.

Here the hills consist of gravel, sand, and clay, and many of them still appear fertile, judging from the good crops they produce.

North Leelanau Lake lies in the drainage of Cedar Creek. The lake receives the waters of this drainage system by way of South Leelanau Lake and from here the flow is northward into the canal at Leland, whence it continues into Lake Michigan.

A few small streams contribute water to the lake. Houdek Creek is one of these. This stream enters the lake in Section 35 of Township 31 North. It is approximately two miles long and at its mouth is about five feet wide and one foot deep. Trout were seen at this point. Other creeks of similar size enter the lake. No names for these appeared on available maps.

Including the slopes of the hills about the lake, the drainage area of North Leelanau Lake is about 20 square miles. This figure does not include the Cedar Creek drainage nor that of South Leelanau Lake. The drainage system and the two lakes together drain an area estimated at 100 square miles. (Table 7)

Temperature and Chemical Characteristics

Temperature and chemical data for North Leelanau Lake are presented in Table 8.

The upper 30 feet of water was warm, surface temperatures varying, of course, with the air temperatures. The temperature was 72° F. at 30 feet on July 18. Between the 30- and 35-foot levels the temperature dropped 12 degrees. This considerable volume of water from 32 feet to the bottom of the lake was below 70° F. and cold enough for trout.

Table 8.--Temperature and chemical characteristics of North Leelanau Lake, July and August, 1949.

(Oxygen, methyl orange alkalinity, phenolphthalein alkalinity, and carbon dioxide in parts per million; potential hydrogen (pH).)

Depth, feet	Temperature (° F.)		O ₂ ppm.		M.O. ppm.		Ph _{th} ppm.		CO ₂ ppm.		pH	
	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	July 18 - August 15	
Surface	74	83	8.2	8.1	145	146	15	10	0.0	0.0	8.2	8.2
20	74	...	...	...	...	...	...	...	...	...	...	...
30	72	73	8.5	7.6	149	...	1.5	...	0.0	...	8.2	8.2
35	60	...	...	...	...	...	...	...	...	...	...	...
40	58	59	...	...	...	...	...	...	...	...	...	...
45	56	...	...	...	...	...	...	...	...	...	...	...
50	54	56	9.0	7.9	...	...	...	...	...	...	...	7.0
70	52	...	8.3	7.0	...	...	...	...	...	...	...	7.8
100	51	...	5.9	...	159	...	0.0	...	0.1	...	...	...
110	...	...	...	4.2	...	...	...	...	...	...	...	6.8
115	...	51	...	3.5	...	157	...	0.0	...	0.5	...	7.6

There is an abundance of dissolved oxygen in North Leelanau Lake for fish and other aquatic forms. Only at depths below the 110-foot level did dissolved oxygen drop below 4 parts per million in August. The good supply of oxygen and cold water in the deeper parts of the lake provide good conditions for trout.

There was no free carbon dioxide near the surface, and less than 1 part per million near the bottom. The water was found to be hard, methyl orange alkalinity values varying from 145 to 157 parts per million. In general, the lake is slightly alkaline. Tests for pH varied from 6.2 to 6.8.

As far as could be observed, there is no pollution in North Leelanau Lake.

Biological Characteristics

Vegetation

Vegetation in general is limited to a narrow belt along the sharp drop-off, except in the south end of the lake. Here there is a large area of aquatic vegetation which increases in density in the narrower part of the south end. This area harbors virtually all species of plants which occur in the lake. Along the east shore of the south end there are patches of bulrushes in the shallows. Along the west shore, in a shallow area, locally known as "the flats," vegetation in general is sparse. Chara is the most common plant found here.

Along the southwest and west shores vegetation is limited to a narrow belt along the drop-off, except in the small bay near the north end of the lake, known locally as "Cemetery Bay," where vegetation grows profusely. The plants occur to an extreme depth of 20 feet,

except Chara which was found as deep as 33 feet. The large shoal area in the northeast end of the lake, known to fishermen as "the sunken island," harbors sparse growths of Chara and short-stem pondweed.

About one-fifth (600 acres) of the total area of the lake supports vegetation. Plants found here are listed in Table 9.

Fish Foods

Stomach analyses showed that northern pike were feeding on minnows and perch. Perch, largemouth bass, smallmouth bass, and rock bass contained crayfish and minnows. Sand shiners, young common shiners, and bluntnose minnows were very abundant in the lake. Numerous hauls made with a 20-foot common sense seine took large numbers of minnows. The forage fishes in one typical haul were counted and found to total 1,700. These included sand shiners, common shiners, spottail shiners, bluntnose minnows, logperch and darters.

The food available for game fishes is considered adequate in North Leelanau Lake.

Fish Present

Table 10 gives the species of fish collected or reported. Perch and rock bass are the dominant species. There are also considerable numbers of largemouth bass. Apparently largemouth bass do well here. According to information gathered from local residents, this always has been a good largemouth bass lake. This species is frowned upon by many cottage owners who want smallmouth bass. The number of smallmouth bass apparently is limited, since only few were taken with the nets and few young were observed along the shore. According to local reports,

Table 9.--List of aquatic plants in North Leelanau Lake
and their relative abundance.

Common name	Scientific name	Relative abundance
Waterweed	<u>Anacharis canadensis</u>	Sparse to common
Coontail	<u>Ceratophyllum demersum</u>	Sparse
Muskgrass	<u>Chara</u> sp.	Sparse to dense
Water milfoil	<u>Myriophyllum</u> sp.	Sparse to dense
Bushy pondweed	<u>Najas flexilis</u>	Sparse to common
Yellow water lily	<u>Nuphar advena</u>	Sparse to common
White water lily	<u>Nymphaea odorata</u>	Sparse to common
Large-leaf pondweed	<u>Potamogeton amphifolius</u>	Sparse
Short-stem pondweed	<u>Potamogeton angustifolius</u>	Sparse
Blunt-leaf pondweed	<u>Potamogeton Friesii</u>	Sparse to common
Floating-leaf pondweed	<u>Potamogeton natans</u>	Sparse to common
Sago pondweed	<u>Potamogeton pectinatus</u>	Sparse to common
White-stem pondweed	<u>Potamogeton praelongus</u>	Sparse to common
Clasping-leaf pondweed	<u>Potamogeton Richardsonii</u>	Sparse to common
Robbins' pondweed	<u>Potamogeton Robbinsii</u>	Sparse
Flat-stem pondweed	<u>Potamogeton zosteriformis</u>	Sparse to common
Bulrush	<u>Scirpus</u> sp.	Sparse to common
Bladderwort	<u>Utricularia vulgaris</u>	Sparse
Wild celery	<u>Vallisneria spiralis</u>	Sparse to common

Table 10.--Fish of North Leelanau Lake, listed in the order of abundance collected under each general classification.

Common name	Scientific name
Game fish:	
Yellow perch	<u>Perca flavescens</u>
Rock bass	<u>Ambloplites rupestris</u>
Largemouth black bass	<u>Micropterus salmoides</u>
Pumpkinseed	<u>Lepomis gibbosus</u>
Bluegill	<u>Lepomis macrochirus</u>
Northern pike	<u>Esox lucius</u>
Cisco	<u>Leucichthys artedii</u> ✓
Smallmouth black bass	<u>Micropterus dolomieu</u>
Lake trout	<u>Cristivomer namaycush</u>
Rainbow trout	<u>Salmo gairdnerii</u>
Coarse fish:	
White sucker	<u>Catostomus commersonii</u>
Burbot ✓	<u>Lota lota</u>
Bullhead ✓	<u>Ameiurus</u> sp.
Obnoxious fish:	
Bowfin ✓	<u>Amia calva</u>
Gar ✓	<u>Lepisosteus</u> sp.
Forage fish: ✓	
Sand shiner	<u>Notropis deliciosus</u>
Bluntnose minnow	<u>Hyborhynchus notatus</u>
Common shiner	<u>Notropis cornutus</u>
Spottail shiner	<u>Notropis hudsonius</u>
Logperch	<u>Percina caprodes</u>
Johnny darter	<u>Boleosoma nigrum</u>
Iowa darter	<u>Poeciliichthys exilis</u>

✓ Reported only.

✓ Identifications verified by Dr. R. M. Bailey, Curator of Fishes, University of Michigan, Museum of Zoology.

smallmouth bass are not native to North Leelanau Lake but were introduced. Northern pike are common in the southern end of the lake where there is an abundance of aquatic vegetation. To our knowledge there is little fishing done for northern pike. Pumpkinseeds and bluegills also are common in this part of the lake, and also little fishing is done for them. A planting of 5,000 legal-size rainbow trout was made here in 1949. One marked rainbow was netted during the survey. The residents said there had been little fishing done for them. A few were caught in the spring of the year. There is some trolling for lake trout. One fisherman who trolls consistently caught 53 trout in 1948 but up to the time of the survey, had caught only 8 in 1949.

As mentioned earlier, forage fishes are abundant. Suckers, burbot and bullheads are also found in the lake. Of the obnoxious fishes, longnose gars are common and bowfins (dogfish) are caught occasionally. The gill nets did not take any of these latter species

A number of the game fish were examined for parasites but no severe infestations were found. The findings are given in Table 11.

Table 12 lists the number of game fish and their sizes taken in 912 net hours of gill netting in North Leelanau Lake. Of the 912 net hours, 352 represented sets in 30 to 120 feet of water for lake trout. Only 2 lake trout, 1 rainbow trout, and 9 ciscoes were caught in these deep sets.

Growth Rate of Game Species

Growth analysis data for both North and South Leelanau lakes are presented in Table 13. A growth index number shows the comparative development of each species from the two lakes. This number resulted

Table 11.--Number of North Leelanau Lake game fish, by species,
checked for parasites and the number found infested.

Species of fish	Number checked	Number infested with:			
		Black-spot	White-spot	Yellow grub	Tapeworm
Northern pike	11	1	0	0	0
Yellow perch	57	8	0	0	0
Smallmouth bass	5	0	0	1	2
Largemouth bass	29	7	0	0	3
Bluegill	11	0	0	0	0
Pumpkinseed	21	6	0	0	0
Rock bass	54	5	44	0	0
Lake trout	1	0	0	0	1

Table 12.--List of game fish by size groups taken in North
Leelanau Lake in 912 net hours of gill netting. ✓

Size in inches	Northern pike	Perch	Large-mouth bass	Small-mouth bass	Bluegills	Pumpkinseeds	Rock bass	Rainbow trout	Mackinaw trout	Ciscoes
3 - 3.9						4				
4 - 4.9					4	4	3			
5 - 5.9		8	11	1	1	12	13			
6 - 6.9		11	4		2	1	12			8
7 - 7.9		10		2	2		20			1
8 - 8.9		8	4		2		5			
9 - 9.9		2	7	1			1	1		
10 - 10.9		1	1				2			
11 - 11.9							1			
12 - 12.9										
13 - 13.9			1	1						
14 - 14.9										
15 - 15.9									1	
16 - 16.9			1							
17 - 17.9										
18 - 18.9	1									
19 - 19.9	3									
20 - 20.9	2									
21 - 21.9	2									
22 - 22.9	1									
23 - 23.9	2									
Totals	11	40	29	5	11	21	57	1	1	9

✓ Each net hour of gill netting represents one 125-foot gill net set for 1 hour; 352 hours of the total time was spent in netting specifically for trout in water 30 to 120 feet deep.

from deviation values--the latter consisting of the difference between the average length of each age-group and the State average for that age-group. Where the State average is exceeded, the deviation is a plus value; where less than State average, it is minus. Averaging the sum of the deviations for all age-groups represented by significant numbers of specimens gives the index number for the species in the lake under consideration. Only these deviation values have been considered for this analysis where at least 5 fish were represented.¹⁰ For example, two deviation values (+0.2 and +1.2) met this standard for the largemouth bass of South Leelanau Lake; by adding these figures and dividing by two, the growth index (+0.4) was evolved.

Values within the range of +0.5 to -0.5 of the index are regarded average growth variation for rock bass, bluegills, pumpkinseeds, and perch; the range for largemouth and smallmouth bass is +1.0 to -1.0. From the table it is seen that only the bluegills and perch of South Leelanau Lake and the rock bass of North Leelanau fell below these standards. Some samples were too small (smallmouth bass and bluegills from North Leelanau Lake, for example) to afford conclusions on growth. (Table 13)

Accelerated growth in 1947 and 1948 was generally shown by all game species of both lakes that were studied, excepting ciscoes. No explanation for the acceleration in these years can be given, although an increase of the food supply seems the most logical cause.

¹⁰ These procedures follow the methods and suggestions given in Institute Methods Memo No. 8, "Methods in Fish Growth Analyses" By W. C. Beckman.

Table 13.--Growth rates of Leelanau Lake fishes. ✓⁺

Species	Age-group ✓ ⁺⁺					
	I	II	III	IV	V	VI
Largemouth bass, South Leelanau	5.8 (5) ✓ ⁺⁺⁺	8.9 (9)	11.2 (7)	14.1 (4)		
North Leelanau	5.7 (14)	9.0 (12)		15.1 (2)		
State average	6.1	8.7	10.0	12.1		
Smallmouth bass, South Leelanau	5.7 (6)	8.6 (3)	10.7 (7)	13.6 (3)	14.0 (1)	
North Leelanau	5.5 (1)	8.0 (3)		13.5 (1)		
State average	5.9	9.0	11.2	13.3	15.0	
Rock bass, South Leelanau		3.8 (2)	4.7 (7)	5.7 (20)	6.8 (37)	7.7 (76)
North Leelanau			4.3 (5)	5.4 (8)	6.4 (22)	7.4 (14)
State average		4.3	5.2	6.2	7.3	7.9
Bluegill, South Leelanau		3.8 (3)	4.8 (4)	6.3 (12)	6.4 (21)	6.8 (15)
North Leelanau		4.0 (1)		4.9 (3)	4.6 (1)	7.3 (6)
State average		4.3	5.4	6.6	7.3	7.7
Pumpkinseed, South Leelanau		4.2 (4)	5.3 (20)	6.2 (2)	8.7 (1)	
North Leelanau		3.9 (5)	5.3 (13)	5.9 (3)		
State average		4.1	4.9	5.7	6.2	
Perch, South Leelanau		4.0 (7)	5.8 (7)	6.2 (82)	7.4 (26)	7.8 (16)
North Leelanau	3.7 (10)	4.7 (20)	6.2 (10)	7.5 (17)	7.8 (8)	
State average	4.1		6.4	7.5	8.5	9.5
Cisco, North Leelanau			6.7 (9)			

✓⁺ Age determinations made by J. E. Williams.

✓⁺⁺ Number of annuli or completed growing seasons.

✓⁺⁺⁺ Total length in inches; number of samples examined, in parentheses.

					Growth index
VII	VIII	IX	X	XI	
					+0.4
					+0.1
					-0.3
8.4 (17)	9.4 (7)	10.1 (10)		10.6 (1)	-0.3
8.6 (3)	7.7 (1)	10.2 (3)	10.8 (1)		-0.8
8.8	9.0	9.9	10.5		
					-0.7
					-0.4
					+0.4
					+0.1
	9.4 (1)				-1.3
					-0.5
10.4	10.8				

Natural Propagation

The extreme south end of North Leelanau Lake is shallow and marshy, and forms a natural spawning area for northern pike. Also in this end and along the drop-off, aquatic vegetation abounds, offering ample spawning facilities for perch.

Gravel at proper depths for smallmouth bass spawning is limited to two or three small areas along the east shore, one small area along the west shore, along the north shore, and on part of the large shoal area on the northeast end of the lake. All of these grounds are on exposed shores and are subject to a great deal of wave action. Natural reproduction of the smallmouth bass may be limited by an inadequate number of spawning places.

It is probable that largemouth bass spawn in the weedy south end of the lake, and in some of the depressions on the sandy shoal along the southwest shore, many of which have the bottom covered with wood debris. Bluegills and pumpkinseeds find good spawning grounds in the south end and along the southwest shore. Rock bass find many water-soaked timbers in the shoal area beside which they can build their nests. These timbers likewise offer exceptionally good spawning facilities for bluntnose minnows.

General Discussion

North Leelanau Lake is a good fishing lake. The southern end offers good northern pike and perch fishing. Perch are fished for but no pike fishermen were seen, and the survey party was informed that in general little pike fishing was done. Apparently anglers here

favor smallmouth bass and lake trout above all other species. This seems to apply particularly to those who own large power boats and cruisers. These people troll for trout but more frequently bass fishing with bait is practiced. They catch a surprising number of smallmouth and largemouth bass, the smallmouth being preferred. Members of this group represent a rather small percentage of the fishermen on the lake, but they are the ones who mostly favor smallmouth bass fishing. It is this group that is particularly desirous of reopening the pond on the southwest side of the lake (presently a trout fishing pond) for rearing smallmouth bass. However, the investigators believe that efforts of this group would be much more productive if directed toward providing gravel spawning areas along the protected southwest shore of the lake. Also, brush shelters could be placed on the large, rather shallow area along the southwest part of the lake, locally known as "the flats," and on the shoal area along the northeast shore known as "the sunken island." This would tend to concentrate the fish, making them more available to the anglers.

Management Suggestions

Designation of Lake

The present designation of the lake is satisfactory. This permits year-round fishing except for those species which are protected during certain times.

Stocking

No stocking of warm-water species is recommended. The stocking of lake trout should be continued. Continued stocking of rainbow trout is also recommended.

Mr. Joe Schwartz and Mr. Jake Schwartz of Leland, Michigan, are very anxious to change the now existing trout pond near the west end of the lake to a smallmouth bass rearing pond. Joe Schwartz made a verbal statement to the survey party members that they would gladly take care of all expenses involved. They would get their own stock, raise the bass and plant them in North Leelanau Lake if they could get permission from the Conservation Department to do so.

Predators

A few painted turtles were seen. It was said that there are many burbot (Lawyers) in the lake. However, over 900 net-hours of netting failed to produce a single burbot. Moreover, this can hardly be classed as a predacious species. Gars and dogfish are said to be present but none was taken in nets, nor is there any serious complaint about these fish.

There is no need for predator control on North Leelanau Lake.

Cover

Aquatic vegetation covers approximately 600 acres of the lake bottom. In addition there are many water-soaked timbers along the drop-off which provide cover for fish. But since there is considerable complaint that people cannot catch smallmouth bass, shelters are suggested for concentrating the fish in certain areas. Such shelters could be of two kinds. One kind could be made of brush which is available from the countryside. The other possibility is that waterlogged timbers be concentrated. These timbers should make attractive havens for bass. They are abundant on the lake bottom, although scattered at present. Areas suggested for shelters are "the flats"

along the southwest shore and the "sunken island" off the northeast shore. This work should be a splendid undertaking for local sportsmen and one that would undoubtedly prove very much more effective than planting smallmouth bass.

Regulation of Water Level

Water level is controlled by the dam in the outlet. A court order allows a 14-inch variation in lake level and this arrangement appears satisfactory.

Improvement of Spawning Facilities

Possibly smallmouth bass are restricted in numbers due to limited spawning areas. Smallmouth bass require gravel for spawning. While there are some gravel shoals in the lake, these are in exposed locations subject to much wave action. Gravel placed on the shoals along the sandy southwest shore may favor increased production of smallmouth bass. This area has over two miles of shoreline which is fairly well protected from prevailing winds.

INSTITUTE FOR FISHERIES RESEARCH

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