Original: Fish Division ✓
cc: Education - Game
Institute for Fisheries Research
C. T. Yoder
H. L. Thompson
I. A. Rodeheffer

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

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ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

March 24, 1952

Report No. 1324

A FISHERIES SURVEY REPORT OF GRAND LAKE, PRESQUE ISLE COUNTY, MICHIGAN

By

I. A. Rodeheffer and Jason Day

Abstract

Grand Lake, with an area of 5,660 acres, or slightly less than 9 square miles, ranks seventeenth in size among the inland lakes of the state. The maximum depth is only 25 feet, and water less than 15 feet deep covers about 80 percent of its area. The lake has many islands. The predominant bottom soil is marl, although a strip of sand parallels most of the shoreline and some gravel and rocks are found with the sand.

Because of the large size and relatively shallow depth, Grand Lake is not subject to stratification during the warm months of the year as are many lakes. Difference in temperature from the surface to bottom (at 22 feet) in July amounted to only 3° F. The water is fairly hard.

Nineteen species of aquatic plants were found in Grand Lake. Though the variety of vegetation is fairly wide, abundance is limited. Cover present besides vegetation includes water-logged wood dating from the lumbering era, rocks, and structures made of brush which have been introduced to provide additional cover for fish. These brush shelters, numbering 200, were installed in the lake during the winters of 1948-49 and 1949-50 by local sportsmen with the cooperation of the Department of Conservation.

The predominant sport fishes of the lake are northern pike, yellow perch, and rock bass. Also present in goodly numbers are smallmouth bass, pumpkinseeds, and walleyes. The cisco or lake herring exists in limited numbers in Grand Lake despite the relatively shallow depth; this species is more commonly found in deeper lakes. Although considerable numbers of largemouth bass and bluegills have been stocked here in the past, these species presently are either very scarce or do not occur at all.

White suckers are abundant. Gars are common, but bowfins (dogfish) and bullheads apparently are rather limited in number. Ten species of forage fish were collected during the survey. Of these, the bluntnose minnow was most numerous.

Growth rates of the game fish were found to be mostly average to above average. Only perch in the younger age-groups were sub-average. Northern pike, walleyes, and pumpkinseeds were making real good growth.

The fish were fairly free of parasites.

Since natural cover is so limited, more brush shelters have been recommended for Grand Lake. The structures now present are frequented by fish and fishermen, and it is thought that an additional number of shelters would be desirable.

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I. A. Rodeheffer and Jason Day[+]

Introduction

Location and main drainage

Grand Lake lies in Presque Isle and Krakow townships in Presque Isle County, T. 33, 34 N., R. 7, 8 E., and covers many sections. The south end of the lake is about 15 miles north of Alpena by U. S. Highway 23 and the north end lies approximately the same distance southeast of Rogers City over the same road. Along Presque Isle County Highway No. 405, paralleling the east shore of the lake, lie two communities--Bell on the southeast shore and Presque Isle off the east shore. The east shore of Grand Lake parallels Lake Huron which lies approximately 3 miles away. Closely associated with Grand Lake is the pond known as Lotus Lake which lies immediately across the highway on the east shore.

Grand Lake is not a part of any river system. It drains the adjacent area above its shores, and the outlet flows directly into Lake Huron. This stream leaves the north end of Grand Lake and is approximately 2 miles long. Several small streams enter the lake from the west and north, but some of these dry up in the summer months.

[+] With some additions and revisions by C. M. Taube

Acknowledgments

Grand Lake was mapped during the winter of 1949-50 by a party[1] from the Institute for Fisheries Research. A copy of the map is included with this report. Mapping was followed by a physical, chemical, and biological survey in June and July, 1950, also by Institute personnel.[2] The survey party was aided in its work by many local residents, among whom, to mention a few, were: Neal Curtiss, Conservation Officer; Joseph Schenk, operator of the Fireside Inn; Lewis Crosby, President of the Presque Isle County Sportsmen's Club, Inc.; and Russell Kaufman, former operator of the Fireside Inn.

Past and present use

Evidence of lumbering activity in the past around the lake is shown by stumplands. In the lake itself, slab lumber and water-logged timbers cover the bottom in the southwestern part. Some lumbering activity continues in the area at present. In the immediate vicinity of the lake, there is no evidence of agriculture. The soil above the underlying shale rock is extremely thin in most places.

Residents speak of excellent northern pike fishing in the past, and there are reports of good catches of smallmouth bass, walleyes, and perch. Pike fishing is reported to have fallen off in recent years. Winter fishing is said to be good, especially for large perch. Residents speak of limit catches of smallmouth bass, and strings of these fish, together with a mixture of rock bass and perch, were observed by the survey party.

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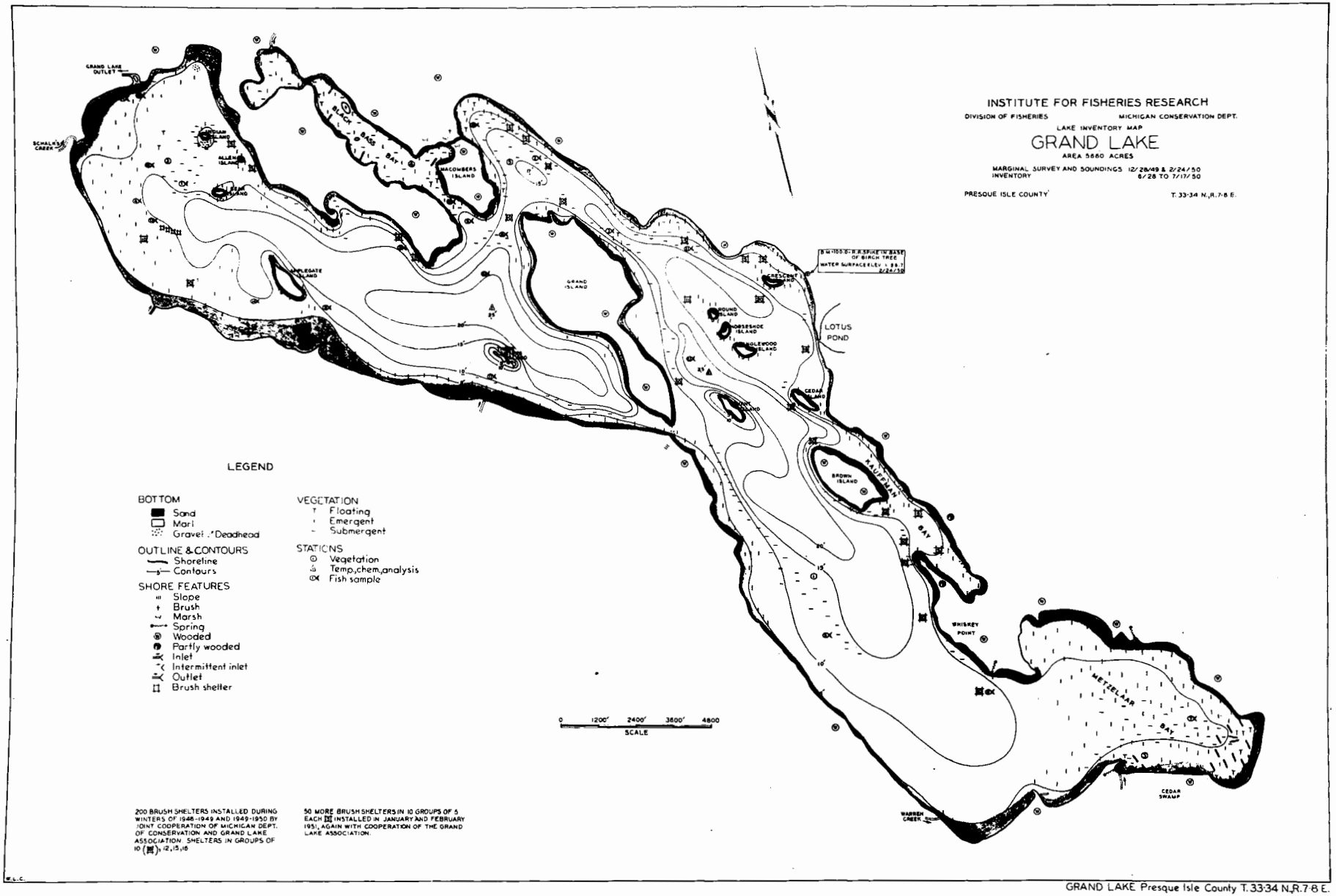
[1] O. M. Corbett, leader; E. G. Stensrud and E. S. Shaedig, assistants.

[2] I. A. Rodeheffer, leader; Jason Day, assistant.



GRAND LAKE Presque Isle County T. 33-34 N.,R.7-8 E.

On the east shore are 5 hotels catering to the vacationist, and each of these operates a boat livery. Approximately 300 cottages are located on the lake, about 250 of which are found on the east side. One resort lies on the west side of the peninsula that juts into the lake from the north end. On the north shore there is a combined resort and boat livery not far from the only development of this kind on the west side of the lake. The latter is near the north end. Strung along the shore east of U.S.-23 to the south from these resorts are about 40 private cottages which are included in the total approximation previously given for such dwellings. There is a great deal of room for more cottages and resorts but further development probably will be slow as the lake lies to one side of the main vacation trails.

Public access may be attained by way of the various boat liveries and at several places along U.S.-23, although only one of these spots is known to be state-owned. This area, which lies immediately west of Three Sisters Island, is used for camping and picnicking, and is provided with a roadside table. Also, a parcel of state land borders the southeast end of the lake.

Physical Characteristics

General description

Grand Lake is comparatively shallow. The maximum depth found by the mapping party was 25 feet. The long axis extends in a northwest-southeast direction. Whereas the lake is about 10 miles long, its greatest width does not exceed 1 3/4 miles.

There are 19 islands which rise above the water surface an average of about 4 feet. At no point observed were these heights estimated to be over 10 feet. The islands are mostly heavily wooded with poplars, birch, conifers, and shrubs. Nearly all of them have narrow stony beaches and ice ramparts which average about 3 feet in height. No sharp drop-offs approach any of the islands. Several bear cottages.

Bays and coves are numerous. The large embayment at the southeast end of the lake, formerly known as South Bay, was renamed Metzelaar Bay in 1931 in honor of Dr. Jan Metzelaar who drowned near the bay. Dr. Metzelaar was the first full-time fisheries biologist employed by the Fish Division of the Michigan Department of Conservation.

The north, east, and south shores of the lake consist mainly of low plainland which has a maximum height of about 10 feet above the lake level. At the south end there is some swampland. On the west side the land is generally higher than that of the other shores, probably approaching 50 feet in elevation. These bluffs are composed of shale rock and lie an average distance of about 200 feet from the lake shore. Below the bluffs the intervening forested shelf slopes gradually to the lake level.

The bluffs found here are similar to those on the west side of Long Lake which lies only 2 miles south of Grand Lake. These two lakes are assumed to have the same geological origin. Writing on the formation of Long Lake, Scott[3] says: "The basin lies on the exposed terrace of Lake Algonquin whose shore stood just west of the lake. The terrace in this locality consists of a series of troughs and ridges which run parallel to the glacial striations found on the bed rock. It is probable that the ridge-and-trough topography existed previous to glacial times and was modified, but not obliterated, by the passage of the ice over it."

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[3] Scott, I. D. Inland Lakes of Michigan; Wynkoop, Hallenbeck, Crawford Co., Lansing, 1921. p. 242.

Drainage

Grand Lake drains the slopes about its shores and also receives water through small streams from adjacent land, especially to the west. The total drainage area is estimated to be about 30 square miles, including the surface area of the lake.

The outlet, at the north end of the lake, has low, swampy banks in its upper and lower reaches, whereas in the middle section the banks are somewhat higher. In the middle section, the stream bed is covered with rocks about the size of a tea cup. There was very little flow in the outlet at the time of the survey.

Only two of the inlet streams were found to have flowing water at the time of the survey. One of these was Warren Creek which enters the lake on the southwest side of Metzdaar Bay. This stream is small and drains an area of about 4 square miles. It has cut a deep valley through the hills west of the lake. The stream is reported to dry up in the late summer months.

The other stream which contained water was Schalks Creek. It empties into the lake near the junction of U. S. Highway 23 and the road to Posen. In late June and early July of 1950, its volume of flow was very small. However, it does not completely dry up, according to reports of residents.

The beds of about a dozen small streams are found along the west side and at the north end of the lake. Doubtless these creeks carry drainage to Grand Lake in the spring, but at the time of the survey all were either dry or contained only small isolated pools.

On the east side of the lake, neither flowing nor inactive inlets were observed, and it was assumed that most of the drainage in this area flows directly to Lake Huron.

Water Fluctuation

The inlets do not affect the water level of the lake appreciably except in the spring. According to the U. S. Geological Survey data, for the period of 1942 to 1949, the average fluctuation of Grand Lake from the high-water period in spring to a low-water period in the fall has been 1.24 feet. At the time of the survey, a makeshift dam in the outlet, with a head of about 6 inches probably exerted a stabilizing effect upon the water level of the lake.

Morphometry

As shown in Table 1, Grand Lake has an area of 5,660 acres of which 80 percent, or 4,530 acres, is 15 feet or less deep. Water of this depth is classed as shoal area. The maximum depth is 25 feet. The bottom is of sand, gravel, rocks, and marl on the shoal and marl in deeper places. The water was silty, and a black and white disk used for checking transparency of water could be seen to a depth of only 8 feet.

Shore development was determined to be 2.67. This figure indicates that Grand Lake has a shoreline irregular enough to exceed by 2.67 times the length of the shoreline if the lake had the form of a perfect circle.

Discussion of physical features in relation to fisheries

The extensive shoal area is a point in favor of Grand Lake since shallows are more productive of fish-food organisms and fishes than is deep water. However, the bottom soils are exclusively of the inorganic types and these are less fertile than organic soils, such as peat and muck. Also, vegetation is generally sparse; this condition may be tied in with limited productivity. High shore development, as shown by Grand Lake, is thought to favor productivity.

Table 1.--Physical data for Grand Lake

Area in acres		5,660
Approximate area of shoal (to 15 feet), acres		4,530
Percent shoal		80
Types of bottom -	Shoal	Rocks, sand, gravel, marl
	Depths	Marl
Color and extent of transparency, feet		White with silt to 8'
Maximum depth, feet		25
Length of shoreline, miles (including that of island)		35.1
Length of shoreline, miles (exclusive of islands)		28.1
Shore development		2.67

An adequate number of suitable spawning sites are available to most of the fish species inhabiting the lake. The smallmouth bass, if possible, chooses gravel for its spawning bed, and there is much gravel along the shores. There is little doubt but what walleyes also spawn on these areas in this lake. On the underside of logs and boards and rocks along the shoreline in shallow water, the bluntnose minnow deposits its eggs. In some of the bays, such as Black Bass Bay, the northern pike may spawn among the rushes in early spring. Pike are reported as also migrating to Lotus Lake.

The temperatures of Grand Lake at various depths were found uniformly warm, ranging from 66.9° F. at the bottom to 70° F. at the surface in July. Apparently the entire body of water circulates during the summer, which makes the lake better suited for warm-water fish than cold-water fish. (Table 2.)

There was an abundance of dissolved oxygen. The quantity varied from 7.8 to 7.9 parts per million, which is adequate for the various forms of aquatic life found in the lake.

The water is moderately hard, methyl orange alkalinity tests showing 125 to 129 parts per million of dissolved mineral salts (mainly calcium carbonate or lime). The pH value range of 8.2 to 8.4 also shows the alkaline character of the water. Water of moderate hardness and alkalinity (such as that of Grand Lake) is regarded as more productive of fish than soft and acid water.

So far as could be determined, there was no pollution in Grand Lake.

Table 2.--Temperature and chemical characteristics of Grand Lake, July, 1950.

(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
Surface	70	7.8	127	6.0	0.0	8.2
12	68.7	7.8	125	5.0	0.0	8.4
15	68.7	...	...	...	...	...
20	68.2	...	...	...	...	...
22	66.9	7.8	129	6.0	0.0	8.4

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. Plant life is of importance in furnishing shelter, particularly for very young fish. Plants use inorganic material in the manufacture of food, and through them this material becomes available in digestible form for animals. The larger plants harbor insects and snails. They are also used for spawning by such species as perch and pike. The photosynthetic activity of plants adds oxygen to the water.

Fish foods include microscopic or near-microscopic plant and animal life known as plankton, insects, and other invertebrates, and small fishes. Plankton is free-floating or free-swimming and furnishes food for young fish and the larger fish-food organisms.

A study of the kinds and abundance of fish present is obviously important. Also of importance is a large collection of scale samples from the game fish for establishing an index of their growth and success in a given lake.

Vegetation of Grand Lake

The vegetation of Grand Lake generally is limited to a maximum depth of 12 feet. Along the shores and extending to a depth of 7 feet, the bull rush (Scirpus validus) is common, although usually sparse in density. There are occasional small areas where it is quite dense. Chara or muskgrass, varying in density, is found over much of the lake bottom up to 12 feet in depth.

Over much of the lake, but particularly in Metzelaar Bay, large-leaf pondweed and floating-leaf pondweed grows sparsely in from 5 to 10 feet of water. In the deeper water, Sago pondweed is common in some areas in water 8 to 10 feet deep. In water 8 to 13 feet in depth, white-stem, flat-stem and Robbin's pondweeds, coontail, waterweed, water milfoil, bushy pondweed, bladderwort, and wild celery occur frequently but sparsely. There are some areas where these submerged plants form fairly dense beds; these places are favorite fishing spots. Some of these areas are located as follows: a large bed, lying generally west of Indian and Bear islands in the north end of the lake, a small bed along the west shore of the peninsula which extends out from the north shore of the lake, and somewhat southeast of Bear Island; a large area, known as Murphy's weed bed, lying between the mouth of Black Bass Bay and Grand Island; a submerged bed in Brady's Bay, one in the small bay east of Brady's Bay, and another along the northeast shore of Grand Island; a small bed southeast of Three Sisters Islands and another along the west shore, west of the southern tip of Grand Island; a large bed in the southern end of the lake, between the 10- and 15-foot contours, along the west shore lying directly west of Whiskey Point. It is in these areas where most of the fish are caught, with the possible exception of the rock bass taken around the brush shelters.

There is some indication that the brush shelters installed in the winters of 1948-49 and 1949-50 are providing sheltered areas where vegetation can become well established. However, it will take several more years to give conclusive evidence of the effect of the shelters on vegetation.

In summary, approximately 1,000 acres of the bottom of Grand Lake supports aquatic vegetation which is general sparse in density. Most of the vegetation occurs in water from 1 to 12 feet in depth.

Aquatic plants found in Grand Lake are listed in Table 3.

Fish foods

No plankton samples were collected. Plankton organisms vary in abundance from season to season and from time to time within a season so that a few samples, such as could be collected during a routine survey, do not give a true picture of plankton production in a lake.

Stomach examinations of perch and rock bass revealed that these fish were feeding almost entirely on crayfish and minnows. Northern pike were feeding on suckers, minnows, and perch.

Upon our arrival at Grand Lake (June 24, 1950) the entire shore was covered with a windrow from 3 to 15 inches wide and from 1 to 5 inches deep of dead "fish flies" (the large burrowing mayfly) and maggots. The odor from these dead mayflies was bad, and a little stirring of the windrow showed it to be composed almost entirely of maggots feeding on the mayflies. From June 24 until July 15, it was a daily occurrence to see mayflies coming to the surface of the lake to fly away. Probably these insects add substantially to the diet of the fishes in Grand Lake.

Bluntnose minnows, mimic shiners, and common shiners are the most abundant forage species in the lake. Large schools of large common shiners were seined up on several occasions. The blacknose shiner, as well as the Johnny darter, hornyhead chub, and creek chub were also taken in seine collections. Young suckers were frequently taken. Crayfish and fresh-water shrimp were found in great numbers among the rocks and in the shallow water. All evidence showed an abundance of fish food in Grand Lake.

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

Common name	Scientific name	Relative abundance
Waterweed	Anacharis canadensis	Sparse to common
Coontail	Ceratophyllum demersum	Sparse
Spike rush	Eleocharis sp.	Sparse
Water milfoil	Myriophyllum sp.	Sparse to dense
Bushy pondweed	Najas flexilis	Sparse
White water lily	Nymphaea odorata	Sparse to common
Yellow water lily	Nuphar advena	Sparse to common
Reed grass	Phragmites sp.	Sparse to dense
Large-leaf pondweed	Potamogeton amplifolius	Sparse
Floating-leaf pondweed	Potamogeton natans	Sparse to common
Sago pondweed	Potamogeton pectinatus	Sparse to common
White-stem pondweed	Potamogeton praelongus	Sparse to common
Flat-stem pondweed	Potamogeton zosteriformis	Sparse
Robbin's pondweed	Potamogeton Robbinsii	Sparse to common
Soft-stem bulrush	Scirpus validus	Sparse to dense
Cattail	Typha latifolia	Sparse to dense
Bladderwort	Utricularia purpurea	Sparse to common
Wild celery	Vallisneria spiralis	Sparse to common
Muskgrass	Chara	Sparse to common

Fish present in Grand Lake

The kinds of fish found in Grand Lake are given in Table 4.

Perch, rock bass, and northern pike are the most abundant game fishes in the lake. Perch are caught in large numbers and many of these run from 10 to 13 inches in length. Still, fishermen complain of an over-abundance of 5- to 6-inch perch. Rock bass are also numerous, many being caught in the larger beds of vegetation but probably more are taken around the brush shelters. The northern pike is the dominant big game fish. Pike were taken in all netting locations except in depths of over 20 feet. Their sizes ranged from 4 to 40 inches. The survey crew considered pike fishing to be good although frequently slow. Local residents say that pike fishing is not nearly so good as it used to be.

Smallmouth bass are common in Grand Lake. As frequently happens, netting took few of these fish, but the number seen on fishermen's strings and young smallmouths observed around docks is evidence that there are a considerable number of these fish present.

The walleye is also common in abundance. In the past, over 4,000,000 fry have been planted. Walleyes are frequently caught on the vegetation beds when fishing is done for pike, but trolling is the favorite method of fishing for them. Netting took this species in a variety of places, in all depths of water.

Pumpkinseeds are common and are sought by fishermen. Favorite fishing spots seem to be in or near beds of Sago pondweed.

Despite the shallowness of Grand Lake, ciscoes appear to be quite common here, and were netted at several places. They were taken in the shallows as well as in deeper water. So far as is known, little fishing is done for ciscoes. Some angling for them during the winter months has been reported.

Table 4.--List of fish, taken or reported, their relative abundance and stocking in Grand Lake.

Common name	Scientific name	Relative abundance	Stocking record 1933 - 1948+
Game fish:			
Northern pike	Esox lucius	Abundant	10
Yellow perch	Perca flavescens	Abundant	208,991
Walleye	Stizostedion vitreum	Common	4,320,000
Smallmouth bass	Micropterus dolomieui	Common	16,994
Largemouth bass+++	Micropterus salmoides	...	24,050
Pumpkinseed	Lepomis gibbosus	Common	5,202
Rock bass	Ambloplites rupestris	Abundant	240
Longear sunfish	Lepomis megalotis	Few	...
Bluegill++	Lepomis macrochirus	...	340,700
Cisco	Coregonus artedi	Common	...
Coarse fish:			
White sucker	Catostomus commersonni	Abundant	...
Longnose sucker	Catostomus catostomus	Reported	...
Brown bullhead	Ameiurus nebulosus	Few	70(species?
Obnoxious fish:			
Longnose gar	Lepisosteus osseus	Common	...
Bowfin	Amia calva	Few	...
Carp	Cyprinus carpio	Reported	...
Forage fish:+++			
Blacknose shiner	Notropis heterolepis	Common	...
Mimic shiner	Notropis volucellus	Abundant	...
Common shiner	Notropis cornutus	Abundant	...
Bluntnose minnow	Pimephales notatus	Abundant	...
Mudminnow	Umbra limi	Few	...
Banded killifish	Fundulus diaphanus	Few	...
Logperch	Percina caprodes	Few	...
Johnny darter	Etheostoma nigrum	Common	...
Hornyhead chub	Hybopsis biguttata	Few	...
Creek chub	Semotilus atromaculatus	Few	...

+ The last extensive stocking was done in 1945; only a few fish were planted in 1948, and none in 1946, 1947, 1949, and 1950.

++ Stocked in previous years but apparently absent in 1950.

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

Longear sunfish, while listed as game fish, are of such small size that they have little value for sport or food. A few longears were caught by seining.

White suckers are abundant. In the winter of 1945-1946, almost 5,000 suckers were removed by a commercial fisherman under special permit. Both young and adults were taken with seines by the survey crew. Adults were commonly taken in gill nets. The young of this species undoubtedly furnish food for the game fishes. According to local residents, suckers spawn in great numbers along the east shore in early spring.

Only one brown bullhead was caught in Grand Lake. However, in Lotus Lake, which is connected to Grand Lake by a culvert, 81 of this species were taken in one gill net.

The longnose gar is common. It was taken at 5 of the 24 net locations. Local anglers do not consider the gar a menace to their fishing. The bowfin is present but not abundant. Although 83 bowfins or dogfish were caught, these were all young taken in one seine haul.

Carp are said to be present in Grand Lake. They were reported seen spawning in the shallows of Black Bass Bay, but were not caught or observed during the survey.

Of the forage species, the bluntnose minnow is most abundant. It is likely that this species spawns under the large stones in shallow water. One bluntnose nest was observed on the underside of a piece of roofing paper. The mimic shiner, the common shiner, and the blacknose shiner are present in large numbers. The hornyhead chub, creek chub, and logperch are represented. The Johnny darter is common. In a small mucky bay near the south end of the lake, mudminnows and banded killifish were collected.

Parasites

The fish of Grand Lake are mostly free of common parasites. Table 5 gives the number of fish of each species checked for parasites and the number found infested. The fish were checked for yellow grub (Clinostomum marginatum), white-spot, black-spot (Neascus sp.), tapeworm (Proteocephalus ambloplitis and allied forms), and copepods. Severe infestations were found only in a few young northern pike 14 to 16 inches in length, which bore much black-spot, and 5 smallmouth bass in which the ovaries were heavily infested with tapeworms.

Stocking and natural propagation

An extensive program of stocking warm-water fish was carried on for Grand Lake in earlier years. The numbers stocked from 1933 through 1948 are listed in Table 4. The last large-scale planting was made in 1945. In 1948, a total of 240 rock bass, 10 northern pike, 41 perch, 42 pumpkinseeds, and 70 bullheads were transferred to Grand Lake from trap-netting operations carried on at Little Lake, Presque Isle County. The current state-wide policy of sharply curtailing the stocking of warm-water fish was begun in 1946 after it was found that natural reproduction provides an adequate stock of those warm-water species which are suited to a given body of water. It is of significance to note that whereas considerable numbers of bluegills (340,700) and largemouth bass (24,050) were planted in Grand Lake within the period of 1933 to 1945, the survey party collected no samples of either species. Fishermen who were interviewed could not remember ever seeing either a bluegill or a largemouth bass taken from the lake. A commercial fisherman, who operated on Grand Lake during two winters with trap nets under special permit for removal of suckers and noxious species, reported capturing one largemouth bass in 1944 and at least one bluegill in the winter of 1945-46.

Table 5.--Number of Grand Lake game fishes, 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	Copepods
Northern pike	60	24	0	0	0	0
Perch	120	28	0	4	0	0
Walleye	20	4	0	0	0	0
Smallmouth bass	7	1	0	0	5	0
Pumpkinseed	19	0	0	0	0	0
Rock bass	96	12	8	5	2	0
Cisco	12	0	0	0	0	0

Results of the fish collecting done during the survey indicate that reproduction under natural conditions is adequate for maintaining good numbers of the resident game species. Spawning facilities which are available have already been discussed under the heading of "Physical features in relation to fisheries." It seems possible that the current absence or extreme scarcity of bluegills and largemouth bass may be due to some unsuitable condition or conditions for spawning of these species.

Growth rate of game species

Scale samples collected from game fish during the survey were later examined microscopically to determine ages and growth rates. Also, the rate of growth of Grand Lake fish has been compared with State averages for the various species. This comparison shows that rock bass of Grand Lake were slightly above average in size and that perch as a group were somewhat below par, although the older perch revealed good growth. Most of the pumpkinseeds in the collection were three-year-olds, and these had developed at an above-average rate. The relatively small number of smallmouth bass samples indicated average growth. While comparable figures for evaluating the growth rates of the walleye, northern pike, and cisco of Michigan waters have not been drawn up, these species grew faster in Grand Lake than in several other lakes which have been studied. The size of Grand Lake walleyes with regard to age appeared to be especially good.

Growth data are listed in Table 6.

Table 6.--Growth rates of the fishes.[+]

Species	Age group[++]	Number of specimens	Average, total length, inches	State average, total length, inches
Rock bass	IV	12	6.9	6.2
	V	5	7.5	7.3
	VI	18	8.8	7.9
	VII	1	10.5	8.8
	VIII	2	10.6	910
Smallmouth bass	II	1	8.3	9.0
	III	2	12.9	11.2
	IV	4	13.5	13.3
	V	1	16.2	15.0
Pumpkinseed	II	1	3.3	4.1
	III	18	5.8	4.9
	V	1	8.2	6.2
Yellow perch	III	13	5.2	6.4
	IV	43	5.9	7.5
	V	26	7.7	8.5
	VI	22	9.0	9.5
	VII	12	10.9	10.4
	VIII	3	12.9	10.8
Walleye	III	6	13.0	...
	IV	4	15.9	...
	V	4	18.6	...
	VI	3	19.3	...
	VII	1	19.4	...
	VIII	2	22.3	...
Northern pike	I	16	15.9	...
	II	21	20.8	...
	III	13	24.7	...
	IV	8	27.3	...
	V	1	16.4	...
	VI	1	24.5	...
	VII	1	40.6	...
Cisco	II	3	6.8	...
	III	2	10.1	...
	V	2	13.6	...
	VI	3	14.2	...
	VII	2	14.2	...

[+] Age determinations by J. E. Williams.

[++] Number of annuli or completed growing seasons.

Management Proposals for Grand Lake

Regulations

Grand Lake has been open to year-round fishing for such species as the law allows since January 1, 1946. These regulations should be continued.

Stocking

Further stocking of warm-water fishes is not recommended since the present stock of fish is thought sufficient to populate the lake to its capacity.

Predators and parasites

Few predators were observed in the lake. There were a few turtles and loons. Gar and bowfin (dogfish) do not warrant any special control measures. The occasional spearing parties sanctioned by the Conservation Officer help control these fish, and also furnish good sport.

While the survey party received several reports of lamprey-marked fish, some of which were traced and checked, the invasion of the sea lamprey into Grand Lake is questionable. Of the larger fish taken in gill nets, not one of the 60 northern pike nor any of the other species bore evidence of lamprey attack.

The common parasites (black-spot, white-spot, yellow grub, and tapeworm) were found in some of the fish of Grand Lake. Only in some young northern pike were there severe infestations of black-spot. In female smallmouth bass the ovaries were frequently infested with tapeworm. However, these fish did not appear sterile as a result of the condition.

Cover

Brush shelters have been installed in Grand Lake by local sportsmen with the cooperation of the Department of Conservation. Two hundred ladder-type structures were introduced in the winters of 1948-49 and 1949-50.

These shelters are used by fishermen to a considerable extent, and good catches are taken around them. They are easy to find by fishermen who are strangers to the lake because of the emergent pole markers. Vegetation was found growing sparsely around some of the structures, and it seems possible that it may become more extensive and more dense in future years.

Because of the apparent success of the shelters and the general scarcity of natural cover, it is recommended that their installation be continued--at depths not to exceed 12 feet. Since Grand Lake is such a large body of water, 200 shelters barely make an impression. This lake could well have from 1,000 to 2,000 of such structures, grouped like those already installed. It is evident that considerable care was given to the placement of the shelters, and those people responsible should be congratulated for not just dumping them haphazardly into the lake.

Other cover includes rocks, logs, slab lumber, and deadheads. The largest collection of such material occurs in the southwest part of Metzelaar Bay where several acres of the lake bottom is profusely covered with slabs and water-logged timbers. Except in this bay and Black Bass Bay at the north end of the lake, little cover is available other than rocks, brush shelters, and generally scanty stands of vegetation.

Regulation of water level

Since 1942, the United States Geological Survey has recorded the water level fluctuations of Grand Lake. These figures indicate that the highest level is attained during April and May. During these months from 1942 through 1949, average level of the lake was 594.49 feet above sea level. Following a steady decline throughout the summer months the level remains fairly constant during October and November at an average for the two months of 593.25 feet above sea level, giving a mean fluctuation of 1.24 feet.

The Presque Isle County Board of Supervisors has requested that the water level of Grand Lake be maintained at the average for July. The average for July from 1942 to 1949 was 593.94 feet above sea level. This requested level would be one-half foot higher than the average for September, when the water is lowest, and one-third foot higher than the next lowest month, which is August. Further, the figures show that the level requested would be 0.55 foot below the high of April and May, and 0.69 foot higher than the average level for October and November.

At the time of the survey during July of 1950, a temporary dam, about 20 feet long and composed of rocks, gravel, and sand, lay across the outlet from Grand Lake. The dam maintained a head of water of approximately 6 inches. The distance from the top of this structure to the surface of the stream below it was about 2 feet. Were this impediment to flowage removed, the lake level would drop considerably.

Evidence that other dams have been located here consisted of broken wooden and concrete structures which were not functional in the summer of 1950. The survey party members were informed that a dam existed here in the past but that it was blown out by certain cottage owners who did not want a high water level.

The effectiveness of the present dam is evidently maintained by some interested local individuals who occasionally shovel sand into the rocks forming the mainstay of the structure. Evidence of this labor was observed by the survey party.

From a fishery viewpoint, no harm can be seen in building a permanent dam in the outlet to maintain the water level at a height found most satisfactory to those concerned. Such a dam, holding the water at the level requested by the County Board of Supervisors, should not hamper fish production.

Further investigations

Permanent summer residents around Grand Lake claim that the quality of northern pike fishing is declining. It is reported that one of the important pike spawning areas is Lotus Lake, which is now connected by an 18-inch culvert with Grand Lake. In the past this connection was an open stream which flowed under a wooden bridge. The length of the culvert was at first shorter, but was lengthened as the road between the two lakes was widened. It seems that the present culvert should be adequate to permit the migration of pike. Moreover, netting results indicated that a fairly good sized population of the species is present. However, it is suggested that someone during the spawning season should evaluate the desire of Grand Lake pike to reach Lotus Lake and also the adequacy of the passageway. Then if alteration of the inter-lake connection appears advisable, definite recommendations can be made.

INSTITUTE FOR FISHERIES RESEARCH

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