Original: Fish Division
cc: Education-Game
Mr. Robert Fortney 5-22-42
Manistee Forest - U. S. Forest Service 5-22-42
Mr. Perry

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

ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

May 14, 1942

REPORT NO. 781

A FISHERIES SURVEY OF NICHOLS, DIAMOND AND BLUE LAKES, NEWAYGO COUNTY

by

L. E. Perry

Introduction

Diamond Lake, Nichols Lake and Blue Lake are three small lakes in Newaygo County that have several characters in common and may conveniently be considered together in this report. Diamond Lake is in Lincoln Township (T. 14 N., R. 13 W., Sec. 12, 13, 14) about five miles northwest of White Cloud. Nichols Lake (T. 15, 16 N., R. 13 W., Sec. 5, 6, 31, 32) and Blue Lake (T. 16 N., R. 13 W., Sec. 31, 32) are some ten miles farther north in Lilley and Merrill Townships. None of the lakes has either inlet or outlet and thus are actually not connected to any drainage system; however, Nichols Lake and Blue Lake are in the drainage basin of the Pere Marquette River, and Diamond Lake in that of the White River.

Nichols Lake was mapped by the United States Forest Service; Diamond and Blue Lakes were mapped by the Institute for Fisheries Research. All three were given biological inventories in June, 1937.[1]

Fishing has been fairly good on these lakes in past years. They are popular with the sportsmen of the vicinity and have been fished to a

---

[1] The inventory party consisted of: Horace Telford, leader; Joseph Bailey and Landrum B. Shettles, assistants.

considerable extent. Nichols Lake has seen the greatest decline in recent years. Swimming and boating are other recreational interests, but they are of much less importance. Boats are available on all the lakes and are used principally by fishermen.

Diamond Lake has been rather well developed for summer cottages. Thirty-three are shown on the map. Nichols Lake has a few cottages and a dance hall. Blue Lake has no such developments.

Physical Characteristics

Diamond Lake, with a surface area of 171 acres, is the largest of the three. It is about one mile long and nearly one-half mile wide at the widest place. A constriction near the middle divides the lake into a large basin on the south (27 feet deep) and a small, shallow basin on the north (10 feet deep). Nichols Lake is only slightly smaller than Diamond Lake (160 acres) but it is somewhat deeper (maximum depth 57 feet). It is about three-fourths mile long and one-fourth mile wide for most of its length. On the southwest side is a large bay, narrowed at the center to form a nearly isolated basin about 15 feet deep. The deepest hole of the lake is in the northwest end of the main basin. Blue Lake is much smaller. It is about one-half mile long, has a surface area of 60 acres and a depth of 15 feet. It is nearly circular in shape.

These lakes were probably formed as pits in the outwash plain of the Port Huron morainic system. The wooded terrain surrounding Blue and Nichols Lakes is mostly sandy loam. Diamond Lake is in a semi-wooded area that is partially cultivated and pastured.

Springs and surface drainage provide the only source of water for these lakes. They have no surface connection with other bodies of water. They do, however, experience some fluctuation of surface level. This may be as great as four feet or more in Nichols Lake, but usually much less in the others.

A table giving certain of the physical features of each lake is presented below.

	Nichols Lake	Diamond Lake	Blue Lake
Area (acres)	160	171	60
Maximum depth (feet)	57	27	15
Shoreline development	1.64	1.77	1.27
Percentage of vegetated area	25	90	100
Bottom types			
Shallow	Sand, marl and pulpy peat.	Sand, pulpy peat.	Sand, pulpy peat.
Deep	Pulpy peat	Pulpy peat	...
Color of water	Colorless	Brown	Brown
Secchi disc (feet)	13.5	9	10

The irregularity of the shoreline of a lake is an index to its productivity. An irregular shore has many protected bays that harbor plants, fish food organisms and fish. A convenient way of expressing this irregularity is by comparing the length of the shoreline with that of a perfectly round lake of the same area. This ratio is given in the above table as "shoreline development". The shoreline development of Nichols Lake is 1.64. This means that the length of this shoreline is 1.64 times greater than it would be if the lake were round. In Diamond Lake this development is 1.77 and in Blue Lake, 1.27. These figures are of less importance in the latter two lakes because of their shallow depth and the abundance of vegetation in them.

Vegetation covers practically the entire bottom of both Diamond and Blue Lakes, and in general these areas are highly productive. Only one small part of Diamond Lake, below 20 feet in the deepest depression,

is void of plants. Nichols Lake has less extensive plant beds (about 25 per cent of the area) because much of the lake is deeper than plants can tolerate. They were rarely found deeper than ten feet. This lake has, however, shallow areas that are also not inhabited by plants. These potentially productive areas are kept barren by the wind and waves. The extent of shallow water is fairly great all around the lake, except in the northwest end.

All three lakes have similar bottom types. Sand is found immediately adjacent to the shoreline and extends to a depth of about five feet in Nichols and Diamond Lakes, and to slightly less than this depth in Blue Lake. The bottom in the deeper areas of all three lakes is pulpy peat. In Nichols Lake there is a zone of marl between the sand and pulpy peat. This extends around most of the lake from a depth of a few feet to ten or fifteen feet. No marl is found in the isolated south bay nor in the northwest end of the main lake basin. No marl was reported for the other two lakes.

A fairly large area in the shallow water of the southeast end, and a smaller area in the north end, of Blue Lake were covered with wooden slabs and sawdust. A similar area was found in a bay on the east side of Diamond Lake. This gives evidence that these two lakes have been used in lumbering operations. Each was probably the sight of a sawmill.

The water of Nichols Lake is fairly transparent and colorless. A white disc, when lowered in the water to a depth of 13½ feet, disappeared. In Diamond Lake the disc was visible above 9 feet and in Blue Lake, 10 feet. The water in the latter lakes was brown in color, probably due to a greater abundance of dissolved or suspended organic matter--possibly sawdust.

Temperature and Chemical Conditions

Temperature readings and chemical analyses were made at various depths from the surface to the bottom during the biological survey in 1937. Again in 1939 (and also in 1940 in Diamond Lake) the United States Forest Service made further observations of a similar nature. The results of these findings are presented in the following tables:

Nichols Lake

Depth (feet)	Station 1 Temp. °F.	Station 1 Oxygen p.p.m.	Station 1 M. O. alkalinity p.p.m.	Station 1 pH	Station 2 Temp. °F.	Station 2 Oxygen p.p.m.	Station 2 M. O. alkalinity p.p.m.	Station 2 pH	Station 3 Temp. °F.	Station 3 Oxygen p.p.m.	Station 3 M. O. alkalinity p.p.m.	Station 3 pH
		6/18/37				6/19/37				6/21/37		
0	69	5.5	124	8.4	70	5.0	...	8.1	70	...	...	...
3	...	...	...	...	72	...	...	...	72	...	...	...
6	...	...	...	...	71	...	...	...	71	...	...	...
9	...	...	...	...	71	...	...	...	71	...	...	...
10	70	...	...	...	71	4.5	114	8.4	...	...	...	...
11	...	...	...	...	...	...	...	...	71-	...	...	...
12	...	...	...	...	...	...	...	...	70	4.5	122	8.5
15	67	...	...	...	...	...	...	...	...	...	...	...
18	66	...	...	...	...	...	...	...	...	...	...	...
20	61	...	...	...	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...
25	55	4.9	128	7.9	...	...	...	...	...	...	...	...
30	50	...	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...	...	...
48	...	...	...	...	...	...	...	...	...	...	...	...
56	47	1.6	137	6.6	...	...	...	...	...	...	...	...
		6/21/37										
35	51	2.2	133	7.6								

Station 3					Station 1				Station 2			
pH	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH
		6/21/37				8/22/39				8/22/39		
8.1	70	...	...	...	73.5	8.8	108.5	8.2	74	8.2	105.0	8.2
...	72	...	...	...	...	...	...	...	...	...	...	...
...	71	...	...	...	...	...	...	...	...	...	...	...
...	71	...	...	...	...	...	...	...	...	...	...	...
8.4	...	...	...	...	71.0	...	...	...	72	...	...	...
...	71-	...	...	...	...	...	...	...	...	...	...	...
...	70	4.5	122	8.5	...	...	...	...	...	...	...	...
...	...	...	...	...	71.0	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	71.0	7.8	108.0	8.2	71	8.0	112.0	8.2
...	...	...	...	...	71.0	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	63	...	...	...
...	...	...	...	...	...	...	...	...	54	6.0	135.0	7.8
...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	0.8	151.5	7.2
...	...	...	...	...	...	...	...	...	47	...	...	...
...	...	...	...	...	...	...	...	...	46	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...

Diamond Lake

Depth (feet)	Station 1 Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Station 2 Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Station 3 Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH
		6/16/37				6/17/37				6/17/37		
0	70	6.5	58	7.9	70	...	...	...	70	...	...	
1	...	...	...	...	...	...	...	...	...	...	...	
2	...	...	...	...	...	...	...	...	...	...	...	
3	[illegible]	...	...	...	68	...	...	...	68	...	...	
4	...	...	...	...	...	...	...	...	...	...	...	
5	...	...	...	...	...	...	...	...	...	...	...	
6	70	...	...	...	...	...	...	...	...	...	...	
7	...	...	...	...	68	...	...	...	68	...	...	
8	...	...	...	...	...	...	...	...	...	...	...	
9	69	...	...	...	...	...	...	...	56	6.5	41	7.8
10	...	...	...	...	67	...	...	...	...	...	...	
11	...	...	...	...	...	...	...	...	...	...	...	
12	67	...	...	...	...	...	...	...	...	...	...	
13	...	...	...	...	...	...	...	...	...	...	...	
14	...	...	...	...	65	3.6	45	7.1	...	...	...	
15	65	3.9	35	7.0	...	...	...	...	...	...	...	
16	...	...	...	...	...	...	...	...	...	...	...	
17	...	...	...	...	...	...	...	...	...	...	...	
18	[illegible]	...	...	...	...	...	...	...	...	...	...	
19	...	...	...	...	...	...	...	...	...	...	...	
20	...	...	...	...	...	...	...	...	...	...	...	
21	61	...	...	...	...	...	...	...	...	...	...	
22	...	...	...	...	...	...	...	...	...	...	...	
23	...	...	...	...	...	...	...	...	...	...	...	
24	...	...	...	...	...	...	...	...	...	...	...	
25	...	...	...	...	...	...	...	...	...	...	...	
26	59	0.05	50	6.7	...	...	...	...	...	...	...	

Diamond Lake

	Station 3				Station 1				Station 2			
	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH	Temp. °F.	Oxygen p.p.m.	M. O. alkalinity p.p.m.	pH
	6/17/37				3/14/39				8/14/39			
	70	...	...	...	77	0.1	36.5	...	78	7.9	38.5	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	68	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	76	...	...	...	77	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	60	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	56	6.5	41	7.8	...	...	...	...	...	...	...	...
	...	...	...	...	75	...	...	...	75	7.0	38.5	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	74	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
.1	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	73	3.3	30.0	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	69	0.7	43.0	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	66	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...
				Depth (feet)		3/15/40					3/15/40	
				0	...	...	...	8.0	...	...	...	8.0
				10	...	...	...	8.0	...	...	...	8.0
				15	...	...	...	7.4	...	...	...	...
				20	...	...	...	6.8	...	...	...	...

Blue Lake

Depth (feet)	Station 1 Temp. °F.	Oxygen p.p.m.	M. O. Alkalinity p.p.m.	pH	Station 1 Temp. °F.	Oxygen p.p.m.	M. O. Alkalinity p.p.m.	pH
		6/22/37				8/23/39		
0	75	6.4	87	8.3	73	7.6	78.0	8.2
1	...	...	...	...	...	...	...	...
2	...	...	...	...	...	...	...	...
3	76	...	...	...	...	...	...	...
4	...	...	...	...	...	...	...	...
5	...	...	...	...	72	...	...	...
6	75	...	...	...	...	...	...	...
7	...	...	...	...	...	...	...	...
8	...	...	...	...	...	...	...	...
9	...	...	...	...	...	...	...	...
10	74	5.9	86	8.2	72	7.2	73.5	8.4
11	...	...	...	...	...	...	...	...
12	...	...	...	...	72	...	...	...

In Nichols Lake a marked difference in temperature is noted between surface and bottom waters. The surface was around 70°F. and the bottom 47°F. Between these two a definite pattern may be observed in the temperature readings. From the surface downward there is little change until a depth of 18 feet is reached. From there to 30 feet there is a rapid drop from 66° to 50°. Then follows little change to the bottom where a reading of 47° was found at 56 feet. From these data three layers may be distinguished in the lake, an upper layer of warm water which is separated from the bottom cold water by a middle layer of rapid change in temperature. This middle layer is called the thermocline and the entire situation is known as thermal stratification. Similar conditions exist in many Michigan lakes of this size and depth during the summer period.

This stratification prevents a thorough mixing of the top and bottom waters during the summer, thus tending to isolate the bottom water from the rest of the lake for certain periods of the year. In 1939, the temperature readings were made in August. The surface was slightly warmer and the thermocline was a little deeper; however, the difference was slight. As will be seen, this isolation may have an important effect on the fish life in the lake. Chemical analyses show that oxygen and other chemical compounds are affected by this stratification. For example, the content of dissolved oxygen is uniformly high in the surface layer of water, but in the bottom layer the oxygen may be depleted by organic decomposition, and, to some extent, by animal respiration. A replenishing of this oxygen from the surface does not usually occur until autumn. In many lakes the depletion of oxygen below the thermocline is so drastic that all fishes inhabiting these deeper waters either have to move or suffocate. It is not likely, however, that such a grave condition

ordinarily develops in Nichols Lake, although the oxygen supply does become low on the bottom late in the summer.

In Diamond Lake there is no distinct thermocline; however, the temperature drops gradually from near the surface to the bottom. The conditions observed in June, 1937, were similar to those of August, 1939, allowing for the fact that the lake becomes somewhat warmer as the summer season progresses.

Blue Lake is small and shallow, and the winds easily mix the water, thus maintaining more or less uniform temperature and chemical conditions from top to bottom throughout most of the year. A lake of this type is more easily affected by rapid atmospheric changes, yet it has no isolated zone where adverse conditions may develop such as the depletion of the oxygen supply during the summer. Analyses show oxygen to be ample.

All three lakes are alkaline (Nichols, pH 6.6-8.5; Diamond, pH 6.7-7.9; Blue, pH 8.2-8.4) and the water ranges in hardness from soft in Diamond Lake to moderately hard in Nichols Lake as determined by Methyl Orange Alkalinity tests. (Nichols, 105-137 p.p.m.; Diamond, 35-58 p.p.m.; Blue, 73-87 p.p.m.)

Biological Characteristics

Aquatic Plants

As already mentioned, submerged vegetation is very abundant in Diamond and Blue Lakes, extending over most of the bottom. Emergent plants are also found along the east shore of Diamond Lake. In Nichols Lake, vegetation occurs only in scattered areas--mostly in the southeast end. Few plant beds extend below the fifteen-foot contour. Emergent plants are common at one place in the northeast corner. Floating plants are present in a few protected areas. The following table gives the names of all the plants collected from the three lakes considered here.

Common name	Scientific name	Nichols Lake	Diamond Lake	Blue Lake
Waterweed	(Anacharis canadensis)	...	x	...
Swamp loosestrife	(Decodon verticillatus)	...	x	...
Spike rush	(Eleocharis palustris)	x	x	...
Spike rush	(Eleocharis calva)	...	x	...
Needle rush	(Eleocharis acicularis)	...	x	...
Water milfoil	(Myriophyllum exalbescens)	...	x	x
Yellow water lily	(Nuphar advena)	x	x	...
White water lily	(Nymphaea odorata)	...	x	...
Smartweed	(Polygonum amphibium)	...	x	...
Pickerel weed	(Pontederia cordata)	x	x	x
Large-leaf pondweed	(Potamogeton amplifolius)	...	x	...
Pondweed	(Potamogeton angustifolius)	x	...	x
Pondweed	(Potamogeton gramineus var. myriophyllus)	x	x	...
Floating-leaf pondweed	(Potamogeton natans)	x	...	...
Whitestem pondweed	(Potamogeton praelongus)	x	...	...
Pondweed	(Potamogeton pusillus)	...	x	...
Pondweed	(Potamogeton sp.)	...	...	x
Hardstem bulrush	(Scirpus acutus)	x	...	x
Three-square	(Scirpus americanus)	x	...	...
Bulrush	(Scirpus subterminalis)	x	x ?	...
Common cattail	(Typha latifolia)	x	x	...
Bushy pondweed	(Najas flexilis)	x	...	...
Moss	(Bryum sp.)	...	x	...
Musk grass	(Chara)	x	x	x

Fish Food Organisms

Fish food organisms in a lake may be found burrowing in the bottom, crawling on plants and floating freely in the water. The floating forms are more or less microscopic and have been given the collective name of "plankton". They are collected by pulling a small, fine-meshed silk net through the water. Plankton was found to be the most abundant in Diamond Lake. Water fleas were the dominant organisms. In the other two lakes microscopic plants predominated. Plankton is utilized as food by most young fish, some adults such as the cisco, and also by many of the larger fish food organisms.

The insects and other invertebrates that live on plants and in the bottom mud are the most important direct source of food for game fish. This foodsupply is very abundant in well-vegetated lakes such as Diamond

and Blue Lakes. In the small number of bottom samples taken for food determinations, midge larvae were the most abundant organisms found. Food sampling of this type seldom gives a fair picture of the kinds and abundance of organisms present.

Fish

Collections of fish were made with nets to determine the species present, their relative abundance, and their growth rate. A list of the species and their abundance is given in the table below.

Species	Nichols Lake Abundance	Nichols Lake Stocking 1933-40	Diamond Lake Abundance	Diamond Lake Stocking 1933-40	Blue Lake Abundance	Blue Lake Stocking 1933-40
GAME FISH						
Northern pike	Reported	...	...	...	Common	...
Yellow perch	Common	...	Few	...	Few	...
Walleye	Few	955,000 fry	...	...	Reported	...
Largemouth bass	Few	3,000 (1 mo.) 400 (yrlg.)	Common	4,500 (1 mo.) 23,000 (4 mo.) 1,000 (5 mo.) 500 (1-5 in.) 100 (adults)	Common	...
Smallmouth bass	Reported	1,500 (4 mo.) 1,000 (5 mo.)	...	...	Reported	...
Brook trout	✓	1,875 (3 in.) 600 (4 in.)	...	...	...	...
Rainbow trout	✓	13,600 (2 in.)	...	...	...	...
Green sunfish	Few	...	Few	...	Few	...
Bluegill	Abundant	7,000 (4 mo.) 18,800 (5 mo.)	Very abundant	19,500 (3 mo.) 15,000 (4 mo.) 22,800 (5 mo.) 20,000 (6 mo.)	Abundant	3,000 (5 mo.)
Long-eared sunfish	...	...	Common	...	...	...
Pumpkinseed	Few	...	Common	...	Reported	...
Rock bass	Few	...	...	...	...	...
Cisco	Few	...	...	...	...	...
FORAGE FISH						
Black-nosed shiner	Few	...	...	...	✓✓	...
Straw-colored shiner	Few	...	✓✓	...	...	...
Common shiner	Few	...	...	...	...	...
Golden shiner	Few	...	...	...	Few	...
Blunt-nosed minnow	Common	...	Common	...	Common	...
Mudminnow	...	...	Few	...	...	...
Iowa darter	✓✓	...	...	...	✓✓	...
Least darter	✓✓	...	...	...	...	...
Menona killifish	Few	...	...	...	Few	...
COARSE FISH						
Common sucker	Common	...	✓✓	...	Few	...
Brown bullhead	...	...	...	...	Few	...
Yellow bullhead	Few	...	✓✓	...	...	...
Black bullhead	Few	...	...	...	...	...

✓ Planted since inventory was made.

✓✓ Collected by T. H. Langlois in 1926.

The bluegill is most common in all three lakes. It is extremely abundant in Diamond Lake where also the largemouth bass, long-eared sunfish, pumpkinseed, perch and green sunfish are common. Blue Lake has a similar population. The bluegill is most abundant, the largemouth bass is common and there are a few perch, also the northern pike is rapidly becoming more important and seems to be reducing the yellow perch. Smallmouth bass, walleye and pumpkinseed have been reported to be in this lake.

Nichols Lake is similar in having an abundance of bluegills, but different in other respects. It has enough cold water to encourage the planting of some trout and smallmouth bass. Plantings of brook trout and rainbow trout were made in 1939 and 1940 and possibly survived to good advantage; however, no detailed check has been made of the success of these plantings. Smallmouth bass have been planted and caught by fishermen. Other fish in the lake include perch, walleye, largemouth bass, green sunfish, pumpkinseed, rock bass, and cisco.

The blunt-nosed minnow was the most common of the 10 forage fish found in these lakes. Several other species were fairly common at the time of the surveys. Nichols Lake, with the greatest variety of habitats, had the largest list of species. Coarse fish in the form of the common sucker and bullheads were collected or reported from all three lakes. The sucker was considered fairly common in Nichols Lake.

Age Determinations

The game fish collected were weighed and measured and their ages determined from growth lines on the scales. The results are presented below. These data do not necessarily show the average growth of the species of fish in the lake, but they do show the trend in growth rates and are valuable to this extent.

Species	Age*	Nichols Lake: Total length, inches	Nichols Lake: Weight lbs.	Nichols Lake: Weight oz.	Diamond Lake: Total length, inches	Diamond Lake: Weight lbs.	Diamond Lake: Weight oz.	Blue Lake: Total length, inches	Blue Lake: Weight lbs.	Blue Lake: Weight oz.
Northern pike	I	...	...	...	...	...	...	(2)** 17.4	1	1.3
	II	...	...	...	...	...	...	(1) 18.9	...	...
	IV	...	...	...	...	...	...	(1) 24.7	...	...
	VII	...	...	...	...	...	...	(1) 38.9	10	...
Perch	II	...	...	...	(1)** 6.2	...	1.6	...	...	...
	VIII	...	...	...	(1) 8.2	...	3.5	...	...	...
Largemouth bass	I	...	...	...	(3) 5.3	...	1.0	...	...	...
	II	...	...	...	(5) 7.6	...	2.9	...	...	...
	III	...	...	...	(2) 9.9	...	6.1	...	...	...
	IV	(1)** 12.9	...	15.0	(2) 10.5	...	7.6	(2) 11.2	...	10.3
	VI	...	...	...	(1) 15.6	...	8.5	...	...	...
Bluegill	III	(8) 6.2	...	2.5	...	...	...	...	...	...
	IV	(6) 5.5	...	1.8	...	...	...	...	...	...
	V	...	...	...	(3) 6.0	...	1.9	...	...	...
	VI	...	...	...	(4) 6.1	...	2.0	...	...	...
	VII	...	...	...	(2) 6.5	...	2.2	...	...	...
	VIII	...	...	...	(1) 6.1	...	1.8	...	...	...
Pumpkinseed	III	...	...	...	(2) 4.9	...	1.6	...	...	...
	IV	...	...	...	(3) 6.0	...	2.4	...	...	...
	V	(1) 7.6	...	5.9	(2) 6.3	...	2.6	...	...	...
	VII	...	...	...	(1) 6.5	...	2.8	...	...	...
Rock bass	III	(1) 7.0	...	3.5	...	...	...	...	...	...

*Age determinations by W. C. Beckman.

**Parentheses denote number of individuals.

The growth of the fish in Nichols Lake seems to be about equal to the state averages as reported by W. C. Beckman. The largemouth bass probably reach their legal size of ten inches during the third summer of life. The bluegill and pumpkinseed (common sunfish) reach the legal size of six inches during their fourth summer and the rock bass during their fifth summer. Only one rock bass was collected. It was in its fourth summer and was seven inches long; however, this one specimen is not sufficient to permit definite recognition of a faster than average growth rate.

In Diamond Lake the growth of the perch, pumpkinseed and largemouth bass is average, the perch reaching a legal length of six inches during the third summer, the pumpkinseed during the fourth or fifth summer and the bass reaching ten inches during the third or fourth summer. The growth of the bluegill is slow in this lake. It reaches six inches during its fifth or sixth summer. Ordinarily an average Michigan bluegill would attain this size during its fourth summer. This slower growth is undoubtedly due to an overcrowded population of this species. This condition can in no way be improved by further plantings of bluegills.

The northern pike in Blue Lake show exceptionally fine growth. Usually pike reach a legal length of fourteen inches during their second summer. In Blue Lake two individuals reached an average of 17½ inches early in the season of the second summer (June 22). The growth of the largemouth bass in this lake is about equal to the state average.

The abundance of bluegills in these lakes has provided good fishing and makes up the principal part of the catches, according to general creel census reports. Next in importance in the catch for Diamond Lake is largemouth bass; in Blue Lake, largemouth bass and northern pike; and in Nichols Lake, small- and largemouth bass and northern pike.

Spawning facilities in these lakes are probably sufficient for the populations of fish that are present. The sand and gravel bottoms in the shallow areas provide good spawning beds for the smallmouth bass in Nichols Lake, and also may be used by trout, although there is no evidence of this. There are abundant spawning grounds in all the lakes for bluegill, pumpkinseed sunfish, and largemouth bass. The perch must certainly find adequate spawning grounds in the extensive weed beds. The abundance of pike in Blue Lake is evidence of their ability to maintain themselves there, since no artificial introductions have been made. Vegetation provides good cover to protect the young fish in all the lakes.

Management Suggestions

These three lakes are in the group of "all other lakes", that is, they are neither trout nor pike lakes. The information secured in our investigations give no good reason why this classification should be changed.

Nichols Lake

Nichols Lake has sufficient cold water and oxygen for trout, and the smallmouth bass should be encouraged as a companion species. Inquiries were made to the local officers concerning the results of trout plantings. The following replies were received:

Paris, Michigan
April 10, 1942

Dr. A. S. Hazzard, Director
Institute for Fisheries Research
University Museums. Annex
Ann Arbor, Michigan

Dear Al:

In regard to results from trout plantings on Nichols Lake, Lake County.*

I have had very good reports not only from the resort proprietors on the lake but also from anglers who have fished Nichols Lake for trout.

My best information is that these plantings, especially the legal fish plants have been very productive and we plan to plant the lake this spring to legal rainbow trout.

Very truly yours,

PARIS STATE FISH HATCHERY

R. G. Fortney,
District Supervisor

RGF:ag

* This should be Newaygo County. - I.F.R.

White Cloud, Michigan
April 13, 1942

Mr. A. S. Hazzard
Institute of Fisheries Research
Lansing, Michigan

Dear Sir:

We have had reports of an occasional rainbow trout being taken in Nichols Lake here in Newaygo during the summer of 1941 but none of brook trout. I will pay especial attention to this matter this summer and let you know the result.

Yours truly,

Alger Cline
Conservation Officer
White Cloud, Michigan

W
COOPERATION - Manistee
Institute for Fisheries Research

Baldwin, Michigan
April 18, 1942

Mr. A. S. Hazzard, Director,
Institute for Fisheries Research,
Ann Arbor, Michigan

Dear Sir:

Reference is made to your letter of April 6 to Robert Fortney, Paris, Michigan, a copy of which was received by our Muskegon office.

For your information we regret to inform you that we do not have any definite information regarding the taking of rainbow trout from Nichols Lake in Newaygo County, except reports from those who speared cisco from this lake.

In a round about way we have heard that during the cisco season several rainbow trout of good size were seen, but insofar as we know, none were caught.

We regret that we can not be of more definite help in this matter.

Sincerely yours,

E. S. Iversen
District Ranger

FRL
xcc-Musk.

By F. R. Longwood, Acting

Apparently results were secured from rainbow plantings but not from those of brook trout. Even better results might be had from planting legal-sized rainbow trout as suggested by Mr. Fortney, but we believe that, in the future, such plantings should be made in the fall just before the ice forms. It is believed that this lake could handle about 5,000 rainbows each year.

Plantings of other species than trout should be discontinued.

Diamond Lake

The population of bluegills has reached large proportions, even to the extent of preventing normal growth. Further stocking of this species should be discontinued.

The reported "dying-off" of bluegills, perch and bullheads in Diamond Lake has not been definitely explained. An examination of bluegills has been made and reported elsewhere (Report No. 425). Fungus growth was noticed on many specimens; however, fungus is usually present as a secondary infection of any injured or weakened fish. The "dying-off" may have been due to oxygen depletion but this is not certain. The presence of larval stages of the bass tapeworm (Proteocephalus) in the liver of bluegills was also mentioned in the same report. No practical method of controlling this parasite is known at present. It is not believed to be a serious menace in this lake.

Blue Lake

Blue Lake has maintained a substantial population of northern pike, perch and bluegills for some time without restocking. On this premise, no stocking of any kind is recommended.

Predatory animals such as herons, jays, loons and turtles were observed on these lakes, but we are almost certain that these predators

do little damage and, on the other hand, they may be beneficial in helping to remove sick or diseased fish or by holding in check populations which might otherwise become stunted.

The extensive plant beds provide necessary cover for both young and adult fish and no recommendations are made for improvement of cover and spawning facilities.

INSTITUTE FOR FISHERIES RESEARCH

By L. E. Perry

Report approved by: A. S. Hazzard

Report typed by: R. Bauch