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FISHERIES SURVEY OF CADILLAC AND MITCHELL LAKES, WEXFORD COUNTY

by

John Funk

Introduction

Two of the most popular fishing lakes in central Michigan are Cadillac and Mitchell Lakes in Wexford County. They are more specifically located as follows:

Lake	Township	Town	Range	Sections
Cadillac	Clam Lake	21 N.	9 W.	4, 5, 6, 7, 8, 9.
Mitchell	Selma and Cherry Grove	21, 22 N.	10 W.	1, 2, 3, 10, 11, 12, 25, 26, 34, 35, 36.

These lakes are drained by the Clam River which empties into the Muskegon, although most of Wexford County is in the drainage of the Manistee River. The City of Cadillac is located at the east end of Cadillac Lake.

A map of Mitchell Lake was prepared by the United States Forest Service. This was used as a basis for the location of vegetation beds and sampling stations when the lake was inventoried by an Institute party June 29-July 3, 1937. Cadillac Lake was mapped by the Institute March 25-28, 1941. Fish collections were made July 6-7, 1941, and the

inventory was completed August 7-8, 1941.*

Mitchell and Cadillac Lakes seem to have been used rather extensively in the past for industrial purposes. The remains of piling of numerous docks, etc., in the vicinity of the City of Cadillac are evidence of such use. A canal connecting the two lakes was constructed about 1870. Thus connected, the two lakes made a natural avenue of transportation for lumbering operations, etc. Both lakes have had in the past, and still have, a reputation for good fishing. Most of the angling is for perch and walleyes, although some large bluegills are caught, especially in Mitchell.

Resort development is heavy on both lakes. The City of Cadillac occupies the entire east shore of Cadillac Lake. The suburbs extend well along the north shore and, to a lesser extent, along the south. Most of the cottages on Mitchell are on the north and east margins. Lake Mitchell State Park, located on the narrow isthmus between the two lakes, is one of the most popular in the state. The lakes are easily accessible. U.S.-131 goes through the City of Cadillac, and M-55 and M-115 touch the margins of both lakes. In addition, good roads go entirely around the lakes. All of these factors contribute to make these lakes of great potential importance as public fishing waters.

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*Personnel of the various parties was as follows:

Mitchell-
Inventory party: Horace Telford, leader; Joseph Bailey and L. B. Shettles, assistants.

Cadillac-
Mapping party: Lee Anderson, leader; Richard Wilson, Royal Howe, James Moffett, and Robert Matthews, assistants.
Fish party: W. C. Beckman, leader; Lee Anderson, Pat Galvin, Micheal Pawlick, assistants.
Inventory party: John Funk, leader; Eugene Roelofs and Stanley Lievense, assistants.

Physical Characteristics

Some of the physical characteristics of the lakes are given below:

Lake	Area in acres	Maximum depth in feet	Maximum length in miles	Maximum width in miles	Orientation
Cadillac	1,150	28	2.5	0.8	ENE - WSW
Mitchell	2,580	22	2.6	2.5	WNW - ESE

The lakes are large with shallow, saucer-like basins. Cadillac is oblong and rather regular in outline. Mitchell is rather roughly oval. The greatest irregularity is a large bay (Big Cove) extending into the southwest shore.

Orientation refers to the direction of the long axis of the lake. If this coincides closely with the direction of the prevailing winds (general westerly in this region) considerable wave action may be expected on the exposed shores. The extent of the wave action depends chiefly upon the length of the long axis, i.e., the amount of sweep the wind has. Heavy wave action is quite destructive to plants and bottom organisms, especially on a shifting bottom material such as sand.

Considerable wave action is to be expected in the east end of Cadillac Lake since the wind has a sweep of 2.5 miles. Stone breakwaters have been built along much of the south and east shores to reduce the cutting. While the long axis of Mitchell runs almost north and south, the shorter axis is almost as long and runs directly east and west. A large part of the east shore of Mitchell, therefore, is wave-swept and not highly productive.

The geological origin of these basins is very interesting. Dr. Scott devotes a section of his book to the two lakes.✓ The following are excerpts:

✓ Scott, I. D. "Inland Lakes of Michigan".

"The location of the city of Cadillac is especially fortunate. It is built at the junction of a large morainic tract on the east and an extended outwash plain on the west. The surface of the outwash plain is extensively pitted, but few of the pits hold water. However, two large ones are located just west of Cadillac and form the basins of Little and Big Clam Lakes, or Cadillac and Mitchell Lakes, as they are now called." + + + + +

"In times past, a large lake of very irregular outline stood in this locality. The greatest variation from the present condition occurred in the Lake Mitchell basin which then included a great part of the swamp areas to the west. + + + The down cutting of the Clam River in the loose sands of the outwash lowered the level of this lake and formed two definite basins connected by an outlet, now abandoned."

+ + + + + +

"The lakes are fed to a large extent by ground water and the few entering streams flow from swamps, so that filling by sediment is not of importance. Vegetation has made little headway except in the protected bays, and this may be due to some extent to the sweeping effect of the ice jams near the shore from which the plants usually encroach. + + +"

The land to the east of the lakes has very irregular topography and is, as Dr. Scott mentions, morainic in character. The outwash plain to the west and north is lower and gently rolling. The "Thousand Acre Swamp" occupies several square miles to the west of Mitchell Lake. The land which is not swampy is sandy and of rather low fertility. Farming is not very profitable in this area. Much of the land is wooded.

The drainage basin of the lakes is quite small, approximately 35-40 square miles. Most of the water received is seepage and runoff. Mitchell Creek, the only important inlet of Mitchell Lake, enters Big Cove in the

southwestern part of the lake. The original outlet of Mitchell no longer functions except in periods of high water. The canal, which now serves as an outlet, is the principal inlet of Cadillac. This is 50 feet wide and 3-4 feet deep, with a slow current. The abandoned outlet of Mitchell brings some water into Cadillac. At its mouth it is 5-6 feet wide and a few inches deep. The current was very slow at the time of the survey.

The Clam River flows from the north side of Cadillac Lake near the east end. At the lake margin it is 30-50 feet wide, 2-3 feet deep, with no perceptible current at the time of the survey. A dam, about ½ mile downstream from the lake margin, obstructs the stream and will serve to maintain a constant lake level if properly operated. The dam has concrete wings and spillway with splash boards to hold back the water. With all the splash boards in place, the dam would maintain about a five-foot head of water. The structure includes a fish ladder, but its effectiveness is questionable. The dam probably serves as a barrier to all fish unable to jump over it.

The Clam River follows a somewhat circuitous course to enter the Muskegon River 20-25 miles southeast of Cadillac. The Muskegon flows in a southwesterly direction and enters Lake Michigan at Muskegon.

Other physical characteristics are given in the following table.

Lake	Shore development	Approximate per cent of shoal	Secchi disc (in feet)	Color of water	Bottom types	
					Shoal	Depths
Cadillac	1.55	80	5.5	Brown	Sand, fibrous peat, pulpy peat.	Pulpy peat
Mitchell	1.48	90	5-6	Brown	Sand, pulpy peat.	Pulpy peat

The most productive areas of a lake are usually along shore or in protected areas where the water is relatively shallow and plants can grow. All of the above factors are, to some extent, indices of the physical ability of the lake to produce.

The shore development is the relationship between the length of the shoreline of a lake and the circumference of a circle of equal area. These lakes with a shore development of approximately 1.5 have shorelines 1.5 times as long as perfectly round lakes of the same area. Such a shore development is rather small and indicates a rather regular shoreline with few protected areas.

The shoal of a lake is the area in which conditions of depth, etc., are suitable for plant growth. Since these lakes are mostly quite shallow, 80-90 per cent of the area should be able to produce vegetation. The depth to which plants can grow is limited to some extent by the amount of light which penetrates the water. The Secchi disc is a black and white disc 10 inches in diameter which is lowered into the water until it disappears. In these lakes it disappeared at a depth of 5-6 feet. This figure indicates roughly the depth of effective light penetration. However, at the time of the surveys of both lakes, large numbers of plankton organisms added greatly to the turbidity of the water. It is undoubtedly much more transparent during part of the growing season.

The brown color of the water is to be expected since much of the water supply of the lakes is received from swamps. The bottom materials on the shoals are of types which are usually moderately productive.

Temperature and Chemical Characteristics

The temperature and chemical characteristics of a lake must be considered in formulating any policy of fisheries management. A knowledge of temperature conditions is necessary to determine whether

cold-water species (trout, etc.) or warm-water species (bass, perch, etc.) are best suited to the lake. Trout are considered to require temperatures generally below 70°F. while warm-water fish do best in water warmer than 70°F. Temperature also affects the growth rate of the fish, since each type grows best at temperatures near the top of its range of tolerance.

The chemical determinations which are considered to be of most importance from a fisheries standpoint are those of dissolved oxygen, carbon dioxide, dissolved minerals, and acidity or alkalinity. Dissolved oxygen is necessary for fish and most other forms of aquatic life. Most fish require at least 3 or 4 parts per million. Carbon dioxide in large concentrations is harmful to all forms of life, although dangerous amounts seldom occur in natural waters. Dissolved solids are utilized by aquatic plants and productive waters usually contain moderate amounts. A high degree of either acidity or alkalinity has a limiting effect on plants and animals.

Cadillac and Mitchell Lakes were remarkably similar in their thermal and chemical characteristics as is shown in the following table.

Temperature-Chemical Table

Lake	Location	Date	M. O. Alkalinity range	CO_2 range	pH range		Surface	Bottom
Cadillac	Station #1, culvert under M-115	8-7-41	64	...	...	Depth in ft.	...	...
						Temp. in °F.	77	...
						Oxygen in p.p.m.	7.9	...
	Station #2, outlet, Clam River	8-7-41	65	...	...	Depth in ft.	...	...
						Temp. in °F.	81	...
						Oxygen in p.p.m.	9.3	...
	Station #3, old inlet from L. Mitchell	8-7-41	64	...	...	Depth in ft.	...	...
						Temp. in °F.	84	...
						Oxygen in p.p.m.	10.3	...
	Station #4, canal from L. Mitchell	8-7-41	67	...	...	Depth in ft.	...	...
						Temp. in °F.	81	...
						Oxygen in p.p.m.	8.5	...
	Station #5, deepest part of lake	8-8-41	64-75	...	7.0-8.2	Depth in ft.	...	26
						Temp. in °F.	77	69
						Oxygen in p.p.m.	7.4	0.0
Mitchell	Station #1	6-29-37	60-67	2-3	7.7-7.8	Depth in ft.	...	11
						Temp. in °F.	69	71
						Oxygen in p.p.m.	6.5	6.3
	Station #2	6-29-37	61	2	7.7	Depth in ft.	...	10
						Temp. in °F.	70	70
						Oxygen in p.p.m.	...	6.7
	Station #3	6-30-37	67	2	7.8	Depth in ft.	...	10
						Temp. in °F.	68	68
						Oxygen in p.p.m.	...	8.6
	Station #4	6-30-37	66	2	7.9	Depth in ft.	...	14
						Temp. in °F.	68	68
						Oxygen in p.p.m.	...	7.2

The water is warm in both lakes. The slightly lower temperatures in Mitchell may be accounted for by the fact that the data from there were obtained earlier in the season. Undoubtedly these temperatures increase as the summer advances. The lakes are not thermally stratified, that is, there is little difference in temperature between the surface and bottom. These waters are certainly not suited to cold-water fishes, but temperatures are such as to promote good growth of warm-water species.

Dissolved oxygen was abundant in the upper waters of both lakes although it was absent in the deeper parts of Cadillac. However, since this deeper water is of very limited extent, the range of the fish is probably little restricted. The concentrations of carbon dioxide found to be present in Mitchell were too small to have any harmful effect.

The water of both lakes was moderately soft, that is, had moderate amounts of dissolved minerals (M. O. Alkalinity 60-75 p.p.m.). Productive warm-water lakes usually have somewhat harder water. However, the character of the bottom deposits and soil of the surrounding country is such as to produce less soluble minerals than might be expected in a region where the soils contained more lime, etc. Like most productive lakes, the water of these lakes was somewhat alkaline in reaction.

Biological Characteristics

Vegetation is very important to the fisheries of a lake. Plants support large numbers of organisms which are a readily available form of fish food. Fish also utilize the plants for cover and some species use them for spawning. The relative abundance of the different kinds of aquatic plants in Cadillac and Mitchell Lakes is given in the following table.

Plant Table

Species	Cadillac *	Mitchell **
Water marigold (Megalodonta Beckii)	...	Rare
Coontail (Ceratophyllum demersum)	...	Rare
Horsetail (Equisetum limosum)	...	Few
Blue flag (Iris versicolor)	...	Rare
Quillwort (Isoetes sp.)	...	Rare
Duckweed (Lemna sp.)	...	Rare
Water milfoil (Myriophyllum verticillatum)	...	Rare
Water milfoil (Myriophyllum spicatum)	...	Rare
Water milfoil (Myriophyllum tenellum)	...	Rare
Water milfoil (Myriophyllum sp.)	Abundant	...
White water lily (Nymphaea odorata)	...	Few
Yellow water lily (Nuphar advena)	...	Abundant
Yellow water lily (Nuphar variegatum)	Rare	...
Pickerel weed (Pontederia cordata)	...	Abundant
Large-leaf pondweed (Potamogeton amplifolius)	...	Few
Pondweed (Potamogeton angustifolius)	Few	...
Pondweed (Potamogeton gramineus var. graminifolius forma myriophyllus)	Common	...
Variable pondweed (Potamogeton gramineus)	...	Common
Floating-leaf pondweed (Potamogeton natans)	...	Common
Pondweed (Potamogeton perfoliatus)	...	Common
Whitestem pondweed (Potamogeton praelongus)	Abundant	Few
Clasping-leaf pondweed (Potamogeton Richardsonii)	Common	...
Pondweed (Potamogeton spirillus)	Rare	...
Pondweed (Potamogeton pusillus)	...	Rare
Robbins' pondweed (Potamogeton Robbinsii)	...	Few
Flat-stemmed pondweed (Potamogeton zosteriformis)	Rare	Rare
Stiff water crowfoot (Ranunculus longirostris)	...	Rare
Crowfoot (Ranunculus trichophyllous)	Common	...
Duck potato (Sagittaria sp.)	Few	...
Three-square (Scirpus americanus)	...	Abundant
Common cattail (Typha latifolia)	...	Common
Bladderwort (Utricularia vulgaris var. americana)	...	Few
Wild celery (Vallisneria americana)	Common	Few
Musk grass (Chara sp.)	...	Rare

* Determinations by B. M. Robertson

** Determinations by C. O. Grassl

Eleven species of plants were present in Cadillac and 26 in Mitchell. The greater variety in Mitchell is probably due to its having more protected bays and coves where plants have the best opportunity for growth. The list for Mitchell also contains several marginal or marsh plants which is to be expected from the nature of the shoreline. In both lakes the vegetation was about as abundant as could be expected in lakes of their type.

Plankton is composed of the plant and animal organisms, mostly of microscopic size, which are free floating in the water. These organisms are the main food of young fish, other fish food organisms and most forage fishes. They are also extensively used at times by some game fish, notably bluegills.

Plankton was quite abundant in both Cadillac and Mitchell at the time of the surveys. Great concentrations of a plankton algae of relatively large size were noted in the surface waters of both lakes. However, vertical hauls in the deeper water of Cadillac were found to be composed predominantly of animal organisms. Plankton populations are known to vary from week to week and from place to place in a lake so that anything but intensive studies are of only general value.

Invertebrate organisms which might be utilized as fish food were moderately abundant in both lakes. In Cadillac, scuds (Amphipoda), water mites (Hydrocarina), and midge larvae (Chironomidae) were common on the shoals. Snails (Gastropoda) were fairly common, and clams (Pelecypoda) were frequently observed. In the deeper water, larvae of the midge (Chironomidae) and phantom midge (Corethra) were common. Caddisflies (Trichoptera), damselflies and dragonflies (Odonata), mayflies (Ephemeroptera), and scuds were reported as being numerous in Mitchell. Clams and snails were common. Most of these organisms are frequently eaten by fish.

The relative abundance of the various species of fish in the lakes is given in the following table.**

Fish Table

Species	Cadillac Relative abundance	Cadillac Stocking 1934-40	Mitchell Relative abundance	Mitchell Stocking 1934-40
GAME FISH				
Northern pike (Esox lucius)	Rare	...	Rare	...
Perch (Perca flavescens)	Very abundant	95,000	Very abundant	103,000
Walleye (Stizostedion vitreum)	Common	1,690,000	Common	1,710,000
Smallmouth bass (Micropterus dolomieu)	Common	...	Common	...
Largemouth bass (Huro salmoides)	Rare	...	Few-common	...
Bluegill (Lepomis macrochirus)	Common	30,000	Abundant	30,000
Pumpkinseed (Lepomis gibbosus)	Common	...	Common	...
Rock bass (Ambloplites rupestris)	Common	...	Few-common	...
Black crappie (Pomoxis nigro-maculatus)	Few	...	Reported	...
Pumpkinseed x Bluegill	Rare	...	...	...
COARSE FISH				
Common sucker (Catostomus commersonnii)	Rare	...	Rare	...
Black bullhead (Ameiurus melas)	Rare	...	Rare	...
Brown bullhead (Ameiurus nebulosus)	Few	...	Rare	...
OBNOXIOUS FISH				
Dogfish (Amia calva)	Rare	...	Few	...
FORAGE FISH				
Mimic shiner (Notropis volucellus)	Abundant	...	Common	...
Straw-colored shiner (Notropis deliciosus)	...	...	Rare	...
Spot-tailed shiner (Notropis hudsonius)	...	...	Rare	...
*Rosy-faced shiner (Notropis rubellus)	Rare	...	...	...
Golden shiner (Notemigonus crysoleucas)	...	...	Common	...
Blunt-nosed minnow (Hyborhynchus notatus)	Abundant	...	Abundant	...
*Creek chub (Semotilus atromaculatus)	Rare	...	...	...
*Horny-headed chub (Nocomis biguttatus)	...	...	Rare	...
Mudminnow (Umbra limi)	Rare	...	Few	...
Menona killifish (Fundulus diaphanus)	Rare	...	Few	...
Log-perch (Percina caprodes)	Few	...	Rare	...
Johnny darter (Boleosoma nigrum)	Abundant	...	Abundant	...
Iowa darter (Poecilichthys exilis)	Few	...	Few	...
Lake emerald shiner (Notropis atherinoides)	...	850,000	...	750,000

* Stream forms, probably brought in as bait, or may have come in from tributaries.

** Data in this table are derived from several collections made by Institute personnel over a period of years. Dates, methods of collection, and collectors were as follows:

Cadillac Date	Method	Collector	Mitchell Date	Method	Collector
8/13/24	Seine?	Metzelaar	8/13/24	Seine?	Metzelaar
11/18/34	Seine	Cooper, Shetter, Leonard	6/29-7/3/37	Seine, gill net	Survey party-Telford
7/27/35	Seine	G. P. Cooper, E. L. Cooper	8/31/38	Seine	Carbine, Cooper
10/22/35	Seine	G. P. Cooper, E. L. Cooper	9/7/41	Seine	Beckman, Carbine
8/31/38	Seine	Carbine, Cooper			
7/6-7/41	Seine, gill net	Fish party-Beckman			

Although it is to be expected because of their close connection, it is interesting to note the similarity of the fish populations in the two lakes. It is probable that these results are about as truly representative of conditions in the lakes as it is possible in a study of this type.

The following table presents material obtained from the random creel census conducted by conservation officers. The number of fishermen contacted, the number of hours they fished, the number of each species of game fish caught and the catch per hour of each species are given for each year. The 1940 state average catch per hour is given for purposes of comparison.

Creel Census Table

Year	Number of fishermen	Number of hours	Smallmouth bass: Number of fish	Smallmouth bass: Catch per hour	Largemouth bass: Number of fish	Largemouth bass: Catch per hour	Bluegill: Number of fish	Bluegill: Catch per hour	Pumpkinseed: Number of fish	Pumpkinseed: Catch per hour	Rock bass: Number of fish	Rock bass: Catch per hour	Black crappie: Number of fish	Black crappie: Catch per hour	Perch: Number of fish	Perch: Catch per hour	Walleye: Number of fish	Walleye: Catch per hour	Northern pike: Number of fish	Northern pike: Catch per hour
							CADILLAC													
1928	2?	5	...	...	...	...	...	...	...	...	...	...	...	...	6	1.2	...	...	2	0.4
1930	11	29	1	...	...	...	...	...	...	...	...	...	...	...	...	...	9	...	6	...
1931	1?	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...
1932	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1934	18	45	...	...	...	...	...	...	...	...	...	...	...	...	5	...	...	...	2	...
1935	17	45	...	...	...	...	...	...	...	...	...	...	...	...	66	...	9	...	1	...
1936	219	640	...	...	...	...	...	...	1	0.002	...	...	...	...	369	0.58	5	0.008	...	...
1937	262	612	6	0.01	...	...	13	0.02	12	0.02	4	0.006	...	...	631	1.03	...	...	1	0.002
1938	145	332	2	0.006	...	...	...	...	7	0.02	23	0.07	...	...	146	0.44	30	0.09	4	0.01
1939	484	977	15	0.02	3	Tr.	24	0.02	24	0.02	35	0.04	6	0.01	575	0.59	43	0.04	3	Tr.
1940	358	1,187	10	0.008	...	...	14	0.01	4	0.003	34	0.03	8	0.007	814	0.69	52	0.04	2	0.002
							MITCHELL													
1928	17?	67	...	...	...	...	...	...	...	...	...	...	...	...	6	0.09	4	0.06	11	0.16
1929	2?	13?	- No Fish -																	
1930	16?	32?	...	...	1	...	...	...	...	...	...	...	...	...	1	...	11	...	1	...
1931	9?	28	...	...	...	...	...	...	...	...	...	...	...	...	12	0.43	...	...	...	...
1932	29?	109?	...	...	1	...	...	...	1	...	...	...	...	...	68	...	30	...	2	...
1934	17?	50?	...	...	...	...	12	...	...	...	1	...	...	...	9	...	2	...	4	...
1935	3	8	- No Fish -																	
1936	51	194	...	...	...	...	4	0.02	...	...	1	0.005	...	...	31	0.16	18	0.09	4	0.02
1937	378	1,010	1	Tr.	...	...	142	0.14	44	0.04	4	0.004	...	...	491	0.49	35	0.03	18	0.02
1938	230	532	...	...	1	0.002	47	0.09	20	0.04	6	0.01	...	...	43	0.09	71	0.13	41	0.08
1939	439	928	2	Tr.	...	...	218	0.23	69	0.07	19	0.02	...	...	318	0.34	67	0.07	17	0.02
1940	353	822	3	0.004	...	...	253	0.31	41	0.05	11	0.01	3	0.004	294	0.36	68	0.08	15	0.02
State Average 1940				0.02		0.02		0.27		0.05		0.07		0.04		0.24		0.02		0.03

In the earlier years not enough takes are recorded to give representative results, but for the last four or five years the results are probably near average for fishing conditions on the lakes. Perch were, by far, the most important game fish. Fishing for them was somewhat better in Cadillac, but in both lakes the catch per hour was usually far above the average for the state. Both lakes furnished better than average fishing for walleyes, with Mitchell furnishing somewhat the better of the two. Mitchell also provided good fishing for bluegills, although the catch per hour was usually below the state average. The catch per hour of pumpkinseeds and northern pike was usually near average in Mitchell but was considerably lower in Cadillac.

It will be noted that the relative abundance of the various species of fish as listed in the fish table does not correspond with the frequency with which they appear in the fisherman's catch. This difference is particularly noticeable in the case of the two species of black bass and, to a lesser extent, in the bluegills, pumpkinseed and rock bass. The explanation probably lies in the fact that most of the fish collections were made by seining so that the small fish in the population are given full weight. The fisherman, on the other hand, takes only fish of legal size, so that in the creel census material only the large fish in the population are considered. It seems to be evident that bass, etc., are reproducing successfully in the lakes, as a good number of young bass, especially smallmouth, were collected by the survey parties. However, their numbers apparently are reduced by predation or some other cause so that few reach legal size.

Scale samples from representatives of all the game species were examined to determine the age of the fish. When ages are compared with

the average total lengths for each age group, as in the following table, an idea of the growth rate can be obtained. The size for each species in each age group and the state average for this group (if available) are given.

Growth Rate Table

Species	Growing seasons completed*	Cadillac		Mitchell		Tentative** state average total length in inches
		Number of specimens	Total length in inches	Number of specimens	Total length in inches	
Northern pike	I	3	13.9	1	14.6	...
	II	...	...	1	19.2	...
Perch	I	16	3.5	...	...	4.7
	II	30	6.3	1	4.9	6.2
	III	17	7.7	11	7.0	7.1
	IV	4	9.6	10	9.1	7.8
	V	7	10.5	5	9.6	9.4
	VI	7	10.8	4	10.6	10.2
	VII	9	11.3	...	...	10.4
	VIII	6	11.7	...	...	11.3
	IX	1	11.5	...	...	11.8
	X	1	13.2	...	...	...
Walleye	I	3	7.6	...	...	...
	II	4	10.7	...	...	...
	III	15	13.5	3	13.1	...
	IV	2	14.2	1	13.7	...
	V	1	14.9	1	17.0	...
Smallmouth bass	I	1	4.8	...	...	6.0
	II	1	7.2	...	...	8.8
	IV	1	12.5	...	...	13.3
Bluegill	I	2	2.1	...	...	3.0
	III	...	...	4	6.6	5.6
	V	1	5.0	2	8.8	7.4
Pumpkinseed	I	8	2.2	...	...	2.7
	III	...	...	2	6.3	5.8
	VI	...	...	1	8.3	7.1
	VII	...	...	1	8.4	7.8
Rock bass	I	3	2.2	...	...	3.2
	III	1	6.0	1	7.2	4.9
	IV	1	8.7	...	...	5.6
Pumpkinseed x Bluegill	IV	1	7.6	...	...	...

*Age determinations by W. C. Beckman.

**Institute Report No. 741, Growth Rate of Some Michigan Fishes.

The few northern pike taken were growing at a rate very near the state average. The series of perch from both lakes are large enough to be representative. They show that the perch here are growing at a somewhat better than average rate. The growth rate of the walleyes seems to be near average. All of the other species are represented by too few specimens to furnish conclusive evidence, but most of them seem to be growing at near the average rate. The rock bass studied were growing considerably faster than the average for the state.

Spawning facilities for most of the species present seem to be abundant in both lakes. Solid sand bottom, found to be used by bluegills, sunfish, rock bass, etc., is abundant on the shoal all around the lakes. There are numerous patches of gravel, especially in Mitchell Lake, which should be ideal for smallmouth bass. Weedy areas with soft bottom, utilized by largemouth bass, are also abundant. The perch should also find adequate facilities in the abundant vegetation. Facilities for northern pike are somewhat limited, although there are some marshy areas adjacent to both lakes which might be suitable.

It seems likely that walleyes may be spawning in the lakes. At present our knowledge of the conditions which they require is rather limited. The following observation on bottom types is quoted from Mr. Paul Eschmeyer's report on the spawning of walleyes in Lake Gogebic.*

"This area, like most of the east shore of Lake Gogebic, has a gradual declivity from the shore to the depths and a bottom type of rubble. Between the rounded boulders is found coarse gravel, underlain with finer gravel

* Institute Report No. 695, "Notes on the natural reproduction of the walleyed pike in Lake Gogebic", by Paul Eschmeyer, Regional Biologist, District No. I.

and sand. The entire shore is exposed to the prevailing wind, and the rubble is kept washed very clean by almost constant wave action. Spawning was usually observed to take place in shallow water in an area partly enclosed and protected by boulders, logs, etc."

While areas of the type described above are not numerous in Cadillac and Mitchell Lakes, some sections may coincide rather closely. It is not known whether this is the only type of bottom utilized by walleyes. Further observations may reveal that other types are also used. It would be of great importance from the standpoint of fish management to know if walleyes are spawning in these lakes.

Management Suggestions

At present the lakes are designated as pike lakes and the results of the surveys indicate that this designation should be continued.

Since the lakes are designated pike lakes, no more bluegills, bass, etc., can be planted. Although these species are desirable, this is as it should be since it is certain there is abundant natural reproduction in both lakes. That the adult population is restricted is probably due to predation rather than inadequate natural propagation. A few thousand hatchery fingerlings would probably only add a little to the food supply of the large perch and walleyes.

Natural propagation seems certain also to be adequate to maintain the perch population. It is therefore suggested that plantings be discontinued. As was mentioned above, it is possible that walleyes are reproducing in the lake. If this is so, to continue stocking is certainly uneconomical. It will be impossible to determine if successful spawning is taking place if fry are planted every year. It is therefore suggested that no walleyes be planted in Cadillac and Mitchell Lakes during 1942 and 1943. In 1943 (and subsequently) careful attempts should be made to

ascertain the presence in the lakes of walleyes of those years, proving whether or not reproduction is taking place. If it is found that the walleyes are reproducing, plantings should be permanently discontinued. If natural reproduction is not taking place, stocking should be continued at about the present rate if it is desired to continue this species.

The experimental planting of "Great Lakes shiners" (lake emerald shiner, Notropis atherinoides) made in the lakes in 1935 and 1936 appears to have been unsuccessful in establishing the species.* Apparently these lakes do not furnish suitable conditions for this very desirable forage fish. However, the abundance of young perch and the presence of other desirable forage minnows probably make the establishment of the Great Lakes shiner unnecessary.

Recognized fish predators on the lakes seem to be limited to a few herons, kingfishers, turtles, and dogfish. None are numerous and, since there is doubt as to the amount of harm these animals do to a fish population, no control measures are suggested. Fish parasites were not abundant although the smaller perch were infested with black spot and some of the bass had bass tapeworm. These parasites are harmless to man and in many cases seem to cause the fish little inconvenience. No successful methods of control are known.

Cover in the lakes consists chiefly of the dense beds of vegetation and numerous deadheads, docks, piling, etc. No special structures are suggested.

Reports are received from time to time of fluctuations in the water level of Cadillac and Mitchell Lakes because splash boards have been

* Institute report no. 715 - A sixth examination of Michigan lakes in which plantings of Great Lakes emerald shiner (Notropis atherinoides) have been made", by W. F. Carbine.

removed from the dam for one reason or another. In lakes like these with a very gradual slope, large areas of productive shoal may be stranded by a drop in water level of only a few inches. To achieve maximum production, the level of a lake must be maintained as constant as possible. Action should be taken locally to determine a level most satisfactory to the interests of all parties and then every effort should be put forth to maintain that level.

Spawning facilities are adequate for all species present except possibly for northern pike. Since this species is not abundant in the lake, it seems possible that they need some encouragement. Our present knowledge of the spawning requirements of the pike indicates that weedy, marsh areas are most utilized. If the water level of the lakes could be maintained at a height which would ensure a few inches of water in the marshy portions in the early spring, the pike would no doubt benefit greatly.

INSTITUTE FOR FISHERIES RESEARCH

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