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COOPERATING WITH THE  
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A FISHERIES SURVEY OF COLDWATER LAKE, ISABELLA COUNTY

by

Robert C. Ball

Introduction

Coldwater Lake, in Nottawa Township, (T.15 N; R.5W; Sec. 29, 30, 31) Isabella County, is situated about 10 miles northwest of Mt. Pleasant and two miles south of the village of Weidman. The lake is accessible by good graveled roads. Coldwater River flows through the lake and enters the Chippewa River about two miles below. This is part of the Tittabawassee drainage.

Acknowledgements

An Institute mapping party<sup>v</sup> prepared a map showing the shoreline, soundings, and bottom types in January, 1941. This map served as a basis for plotting the vegetation beds, and chemical and bottom sampling stations established by the biological survey party<sup>\*\*</sup> which was on the lake the first 2 days of August, 1941. Fish collections were made in the lake June 29 and 30, and July 1st, 1941.<sup>\*\*\*</sup>

Past and Present Use

As far as we have been able to determine, no industrial use has been made of this lake. The two unoccupied hotels and many unkept cottages are testimony of the lake having at one time been a much more popular recreation center than at present. This condition,

<sup>v</sup>The mapping party consisted of: G. Perry, leader; L. Newton and O. Jasmin, assistants.

<sup>\*\*</sup>Biological survey party included: J. Funk, leader; S. Lieveense and E. Roelofs, assistants.

<sup>\*\*\*</sup>Fish survey party included: W. Beckman, leader; L. Anderson, P. Galvin, and M. Pawlick, assistants.

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according to the local people, is due to the severe decline of the quality of the fishing in the lake. There is no assured access although more than half of the lake is owned by one individual who charges a dollar a year for "protection" to anyone putting a boat on the lake. There are two boat liveries and a small bathing beach on the lake in addition to twenty-one cottages and a resort.

Fishing pressure, at the present time is light both summer and winter. The winter fishing is mostly spearing for suckers.

Coldwater Lake is the largest lake in Isabella County and its proximity to Mt. Pleasant, a town of 8400 people, makes it of considerable potential importance.

### Physical Characteristics

#### Geological Origin

Coldwater Lake was formed in the pit of a terminal moraine about a mile long and half a mile wide. There is one small island in a bay on the west part of the lake. The basin is roughly rectangular in shape with only one small bay at the westernmost corner. The long axis lies in a northwest--southeast direction.

The maximum depth of 65 feet is found in a small depression in the southeastern end of the lake. The sides of the basin are fairly steep, and the immediate shore is partly wooded and partly swampy. The surrounding country is partially wooded and rolling. The soil is of poor quality and farming is marginal. The Coldwater River, which flows through the lake, arises in Littlefield Lake about seven miles to the north and, with its tributaries, drains about 70 square miles of land above Coldwater Lake.

#### Water Fluctuation

Scott (Inland Lakes of Michigan) indicates that at one time there was a dam in the outlet stream but there is none at present. The inlet stream, Coldwater River, is the main water source but is supplemented by several springs and small inlets along the shore of the lake. The river at the inlet is about 35 feet wide and 3 feet deep, and at the outlet 45 feet wide and 5 feet deep. There is no significant fluctuation of the water level in the lake.

#### Physical Characteristics in Relation to Fisheries

Coldwater Lake has a surface area of 294 acres and a maximum depth of 65 feet, with about 90 percent of the lake having a depth greater than 10 feet. The shoreline is but slightly irregular, having a shoreline development of 1.53. This means that the shoreline is about one and one half times as long as it would be on a perfectly

round lake of the same area. The bottom material in the shallow zone (less than 20 feet in depth) is composed of marl with an occasional patch of sand. Muck is the predominant bottom type in nearly all of the deeper areas of the lake, with patches of pulpy peat in the western bay and on the submerged "islands". The water was a light brown color and slightly turbid at the time of the survey, a secchi disc (a black and white plate) lowered into the lake disappeared at a depth of 5 feet. This reading is of significance in that it indicates a rather low light penetration for Michigan lakes and it is somewhat of a measure of the depth to which submerged aquatic plants can grow.

The low light penetration into the water, the absence of heavy vegetation beds, and the poor farming land surrounding the lake are all factors that indicate low fish production.

### Temperature and Chemical Characteristics

#### Temperature

Temperature and chemical data were obtained at the time of the first survey and since the results were not conclusive were supplemented by additional data on September 9, 1942. The temperature series (taken from top to bottom) on this latter date near the center of the lake showed a uniform temperature of 69°F. from the surface to a depth of 15 feet. From this latter depth to 30 feet the temperature dropped to 51°F., or a decline of 18°F.

This zone of rapid temperature change is known as the thermocline and, in effect, blankets off the water below, thus preventing circulation and replacement of the dissolved oxygen necessary to fish and most animals living in water. The water above the thermocline may reach a temperature of 80°F. during midsummer as shown by the temperature taken in August, 1941. The water temperature below the thermocline was 46°F. at the time of the survey.

#### Oxygen

The chemical analyses made on September 9 showed a concentration of 7.8-9.0 parts per million of oxygen in the waters above the thermocline. The oxygen concentration dropped rapidly in the thermocline and showed a concentration of 0.0-0.2 parts per million at a depth of 30 feet. Below this point there was no oxygen. This means that all of the fish of the lake would have to live in the warmer waters above the thermocline during most of the summer. The productivity of the lake is greatly restricted by this oxygen deficiency.

#### Alkalinity and pH

The water is hard (methyl orange alkalinity 147-188 p.p.m.) and is

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Analyses made by L.E. Perry

alkaline from top to bottom (pH range 7.1-7.7). These factors are generally considered favorable to fish production.

### Pollution

No pollution was reported on Coldwater Lake.

### Temperature and Chemical Factors in Relation to the Fisheries

The temperature and chemical factors definitely establish this as a "Warm Water" lake. The high surface temperature and absence of oxygen at the lower levels eliminate any possibility of its being a trout lake.

### Biological Characteristics

#### Vegetation

There was a total of 16 species of higher aquatic plants collected in Coldwater Lake. A complete list appears in the following table.

#### Aquatic Plants Collected in Coldwater Lake

<u>Species</u>	<u>Abundance</u>
Coontail ( <u>Ceratophyllum demersum</u> )	Common
Musk grass ( <u>Chara sp.</u> )	Abundant
Lesser duckweed ( <u>Lemna minor</u> )	Sparse
Water milfoil ( <u>Myriophyllum sp.</u> )	Common
Bushy pondweed ( <u>Najas flexilis</u> )	Abundant
White water lily ( <u>Nymphaea odorata</u> )	Sparse
Pondweed ( <u>Potamogeton angustifolius</u> )	Abundant
Pondweed ( <u>Potamogeton Friesii</u> )	Common
Sago pondweed ( <u>Potamogeton pectinatus</u> )	Common
Clasping leaf pondweed ( <u>Potamogeton Richardsonii</u> )	Rare
Flat stemmed pondweed ( <u>Potamogeton zosteriformis</u> )	Sparse
Hardstem bulrush ( <u>Scirpus acutus</u> )	Sparse
Bur Reed ( <u>Sparganium eurycarpum</u> )	Sparse
Big duckweed ( <u>Spirodela polyrhiza</u> )	Sparse
Common cattail ( <u>Typha latifolia</u> )	Rare
Wild celery ( <u>Vallisneria americana</u> )	Common

Plants identified by Betty M. Robertson

Musk grass, bushy pondweed, and one other pondweed (Potamogeton angustifolius), were apparently the most abundant plants in the lake at the time of the survey. Musk grass was found in abundance in nearly all shallow areas of the lake.

Aquatic plants are highly important in the economy of the lake in that they furnish food, (directly or indirectly), shelter, and

spawning places for some fish. Plant abundance is generally associated with high fish productivity and plant scarcity with low fish productivity. Limited shallow areas, low light penetration, and unfavorable conditions for the growth of pondweeds as found in Coldwater Lake are factors that have a tendency to limit the fish food producing capacity of this lake and consequently the fish productivity.

#### Fish Foods

Bottom samples and plant collections indicate that fish food organisms are not very abundant in Coldwater Lake. The most common organisms were snails and fresh water shrimp. Larger forage is present in the form of forage fishes and the young of game fish. Plankton varies greatly in kind and quantity over short periods so that samples taken during a survey such as this do not have great significance. The plankton samples indicated that the amount of plankton in the lake at the time of the survey was small.

Low transparency, relative scarcity of plants, restricted shoal and the marl and sand bottom of the shoal areas are believed to be responsible for poor fish food production.

#### Fish Present

A total of 18 different species of fish was collected from Coldwater Lake at the time of the survey. Nine of these were game fish. Three species of coarse fish, six species of forage fish, and no obnoxious fish were collected.

A summary of the species found, along with their relative abundance and stocking, is given in the following table.

Fish Collected from Coldwater Lake

Species	Abundance	Stocking	Age (Mo.)
		1935-1940	
<b>GAME FISH</b>			
Northern pike	Common		
Walleye pike	Rare	460,000	Fry
Largemouth bass	Common	1,050	3
Smallmouth bass	Few		
Black crappie	Common		
Bluegill	Abundant	39,500	3-5
Perch	Abundant	7,500	7
Rock bass	Abundant		
Pumpkinseeds	Abundant		
<b>COARSE FISH</b>			
Common sucker	Common		
Longear sunfish	Common		
Green sunfish	Common		
<b>OBNOXIOUS FISH</b>			
	None taken		
<b>FORAGE FISH</b>			
Common shiner	Common		
Bluntnose minnow	Abundant		
Log perch	Common		
Iowa darter	Few		
Brook silversides	Rare		
Horny-headed chub	Few		

Creel Census

The creel census records taken on this lake by Conservation Officers indicate a marked drop in the fish catch in the past few years. There are far too few records, however, to give this much significance.

Growth Rate of Game Species

The following table gives a summary of the growth rate data secured for the game fishes of Coldwater Lake. (See table on next page.)

The series of scales collected for age determinations of the game fishes is not large enough to give conclusive information on the growth rate of each species. We do believe, however, that these data show, in a general way, the growth of each species represented.

The predaceous game species of the lake; the largemouth and smallmouth bass, the black crappies, and the northern pike, are all growing equal to or better than the tentative state average. Most of the other game species of the lake, those that depend largely upon the small animals living on the plants and the bottom of the lake, show a decided tendency toward slow growth, in most cases they are a full year behind what is considered average for the state. The perch show the slowest growth of any species in the lake.

Growth Rate of Game Fish from Coldwater Lake

Species	Age group	No. of individuals	Average total length (inches)	Average weight (ounces)
Northern pike	V	3	25.9	61.0
Largemouth bass	I	5	4.9	1.0
	II	1	8.4	5.6
Smallmouth bass	I	1	5.0	1.0
	II	1	8.6	5.2
Walleye pike	IV	2	22.4	64.0
Black crappie	V	2	12.3	15.0
	VI	1	13.6	27.0
	VII	1	13.8	23.0
Perch	I	1	2.8	.1
	II	22	4.1	.3
	III	32	5.2	1.2
	IV	3	6.6	1.5
	V	4	7.3	2.6
	VI	1	8.6	3.7
Bluegill	I	0		
	II	11	3.4	.3
	III	17	5.1	1.4
	IV	8	5.8	2.2
Rock bass	II	4	2.8	.2
	III	9	3.5	.4
	IV	11	4.9	1.4
	V	7	6.1	3.0
	VI	6	6.8	3.7
	VII	1	7.5	5.4
	VIII	1	8.6	6.9
Pumpkinseed	I	1	2.0	.1
	II	15	3.4	.5
	III	17	4.6	1.2
	IV	14	5.2	1.9
	V	8	6.0	2.8
	VI	1	7.4	5.0

✓ Age determinations by W. C. Beckman

Natural Propagation

There are adequate spawning facilities for all of the game fish. This is evidenced by the large numbers of small fish taken in the survey. Conditions are not exceptionally good for smallmouth bass (only one small area on the east side of the lake is gravel shoal), but this species is free to use the stream above and below. The largemouth bass should find conditions very favorable for natural reproduction. The already apparent crowded population of bluegills and sunfish leaves no doubt as to their successful natural propagation. Perch likewise must find conditions very favorable.

Our knowledge of the spawning requirements of walleye is limited, but it would appear that either in the lake or in the river there should be some suitable spawning grounds for walleye if a breeding stock could once be established.

### Management Proposals

#### Designation of the Lake

Coldwater Lake is in the "all other lakes" classification and the findings of the survey show no reason for change.

#### Stocking

The stocking of all pan fish should be discontinued as any successful plantings would aggravate an already overcrowded and stunted condition.

Pike and bass should be encouraged as a means of controlling the overpopulation of the pan fishes.

Since Coldwater Lake once produced satisfactory fishing and since no marked change in the lake or in the fish population has occurred, it is reasonable to assume that it is passing through a cycle of poor fishing, and that the next few years should show a marked improvement. Such cycles of alternating good and poor fishing seem to be characteristic of most inland lakes. The causes are not thoroughly understood, and as yet no methods have been developed to maintain continuous production. This is one of the important fisheries problems requiring more research.

#### Predators and Parasites

No predators were found in the lake.

Black spot, bass tapeworm, and intestinal tapeworms were found in the fish of the lake. No record was made of these parasites being found in the reproductive organs of the bass. None of these parasites are capable of attacking man. No control is practicable or necessary.

#### Shelter

There is adequate shelter in the already existing weed beds and no improvements are recommended.

#### Water Level Regulation

There is no need for water level regulation on the lake.

#### Improvement of Spawning Facilities

There is no way known to increase the northern pike population



in a lake such as Coldwater except by raising the level and flooding adjacent marshes. The presence of a number of cottages close to the present shore line probably makes this impracticable. Pike cannot be propagated successfully because of cannibalism.

Walleyed pike have apparently become established as a result of fry plantings (100,000 in 1935 and 360,000 in 1936). Although reported to be scarce in the lake two specimens were taken by the fish collecting party. Both were in the fifth year of life which, if the scale readings are reliable, means that they resulted from natural spawning possibly of the walleyes planted as fry in 1935. If conditions in this lake are suitable for walleyes, they should increase in the next few years and may aid in the reduction of pan fish. No further plantings of walleyes should be made for a period of three years to determine if these fish will increase naturally since it has been proved that a breeding stock is now present.

No further planting of bass should be made since both largemouth and smallmouth bass are present and are reproducing successfully.

INSTITUTE FOR FISHERIES RESEARCH

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