Original: Fish Division
cc: Education-Game 12-4-41
Mr. Stanley Shust
Mr. Roelofs

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

November 26, 1941

REPORT NO. 699

A FISHERIES SURVEY REPORT OF ANN AND MARY LAKES, MENOMINEE COUNTY

by

E. W. Roelofs and F. E. Locke

These two small lakes lie nine miles northwest of Stephenson, three miles southwest of Swanson, and three miles east of the Wisconsin border. Their specific location is T. 35 N., R. 28 W., Sec. 3. County Road No. 356 passes between the two lakes; much of the east shore of Mary Lake is less than 200 feet from the road; the west end of Ann Lake is approximately 500 feet from the highway.

Both lakes are tributary to the Shakey River, which in turn is part of the Menominee River system. Little Shakey River flows through Ann Lake. Mary Lake has no normal inlet or outlet, although it is reported that during periods of high water it overflows into the Shakey River. In event of exceptionally high waters, the two lakes combine, flooding the highway between.

Maps of the lakes were prepared and a biological survey was made by the Institute for Fisheries Research* during the winter of 1939-1940 and the summer of 1940 respectively.

---

*The mapping party included: F. Ames, leader; E. Moody and W. Murphy, assistants.
The biological survey party consisted of Fred Locke, leader; I. J. Cantrall, B. P. Hunt and P. Galvin, assistants.

The Institute appreciates the cooperation of Mr. Clarence Lienna, Conservation Officer at Stephenson; they are also indebted to Mr. A. Wilson, who provided camping facilities as well as information regarding the history of the lake.

Fishing in both lakes is said to have been good in the past, particularly for northern pike and largemouth bass. Ann Lake also provided good catches of bluegills. Anglers report a decline in catches from both lakes in recent years.

No fish stocking was done in these lakes from 1934 to 1939 inclusive.

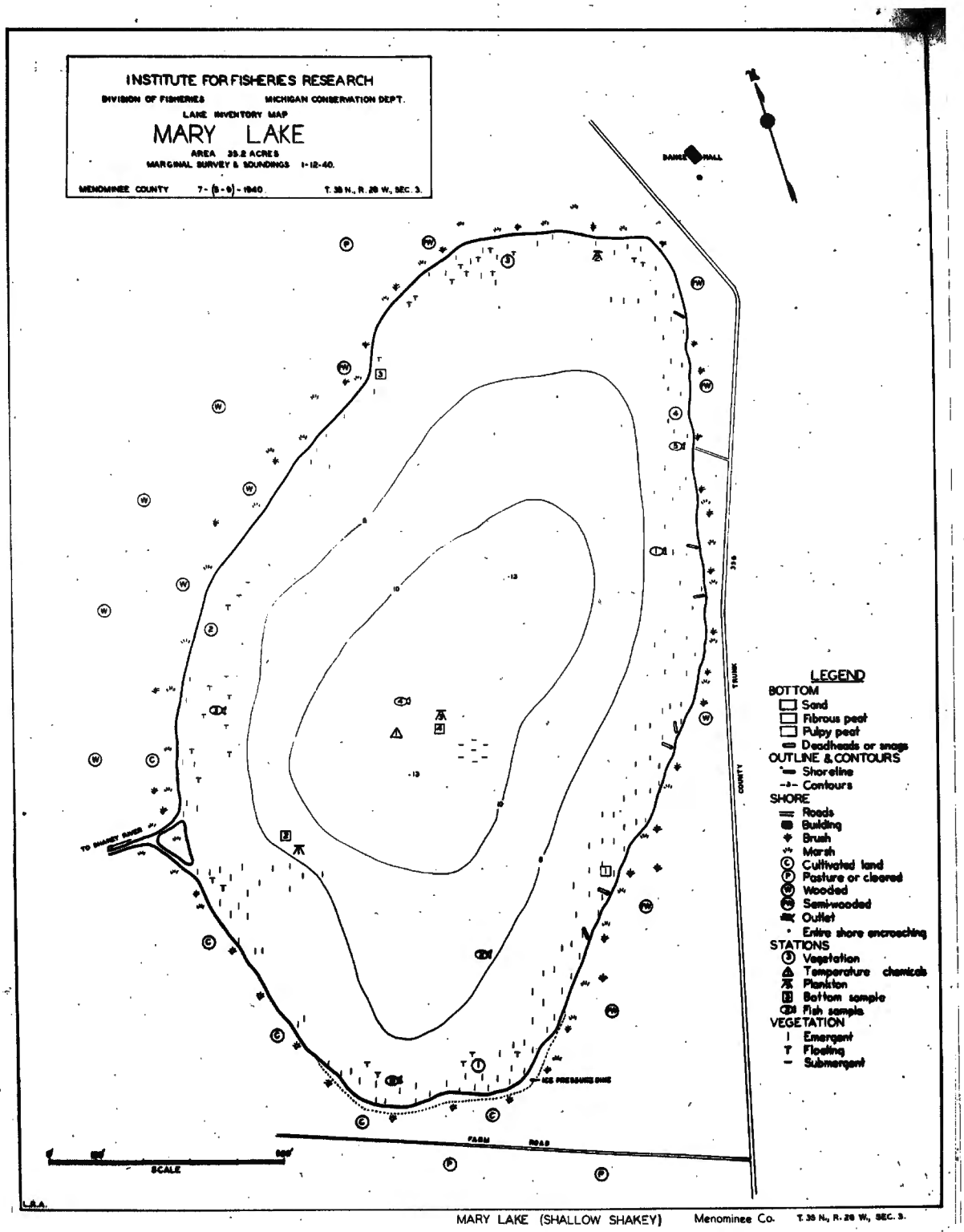
Mary Lake suffered a winter kill in 1934 or 1935, which presumably is partially responsible for the decline in fish catches. The kill was not complete and restocking was unnecessary.

There are no resorts or cottages on either lake. One boat livery is operated on Ann Lake.

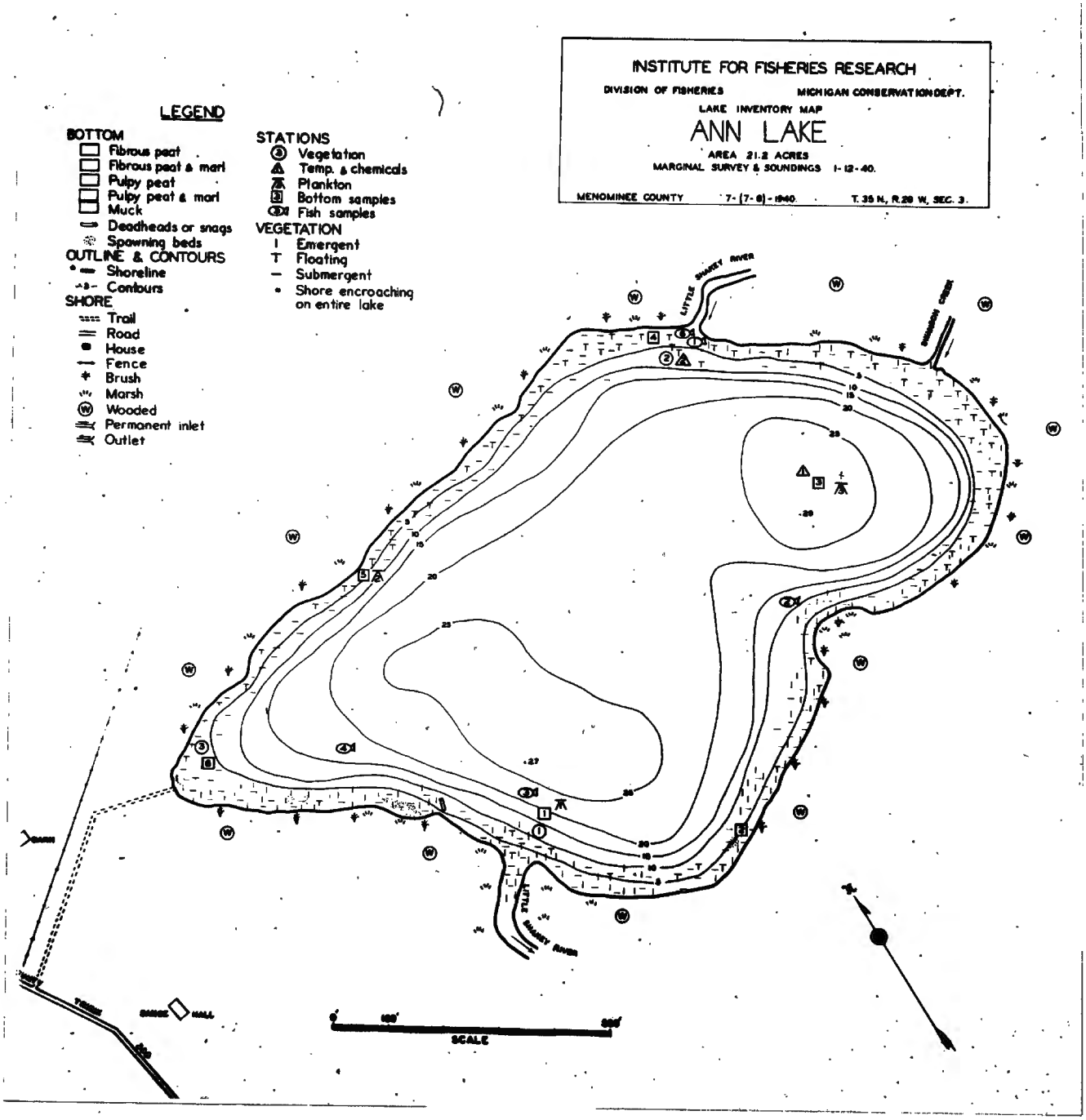
Both lakes are potential public fishing waters since they are easily accessible and there are no outstanding fishing lakes in the vicinity.

The two lake basins are quite different. Mary Lake is shallow and saucer-shaped, hence its local name of Shallow Shakey. There is no drop-off, but a gradual slope from all sides to the center. (See attached map.) Ann Lake (Deep Shakey Lake) is shaped more like a large soup bowl, with a sharp drop-off along nearly the entire margin. This drop-off goes down to about 20 feet, where the bottom levels off, except for two depressions of over 25 feet (see attached map).

The land surrounding these lakes is level to moderately rolling. Very little agricultural use is made of the land, most of it being wooded. This probably accounts for the fact that Ann Lake has no delta deposit at the mouth of Little Shakey River. Tree growths check erosion effectively in such a drainage.



MARY LAKE (SHALLOW SHAKEY) Menominee Co. T. 38 N., R. 28 W., SEC. 3.


INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES MICHIGAN CONSERVATION DEPT.
LAKE INVENTORY MAP
ANN LAKE
AREA 21.2 ACRES
MARGINAL SURVEY & SOUNDINGS 1-12-40.
MENOMINEE COUNTY 7-(7-8)-1940. T. 35 N., R. 29 W., SEC. 3.
LEGEND
BOTTOM
Fibrous peat
Fibrous peat & marl
Pulpy peat
Pulpy peat & marl
Muck
Deadheads or snags
Spawning beds
OUTLINE & CONTOURS
Shoreline
Contours
SHORE
Trail
Road
House
Fence
Brush
Marsh
Wooded
Permanent inlet
Outlet
STATIONS
Vegetation
Temp. & chemicals
Plankton
Bottom samples
Fish samples
VEGETATION
Emergent
Floating
Submergent
Shore encroaching on entire lake
LITTLE SHANTY RIVER
SHANTY CREEK
SCALE

In addition to Little Shakey River, Ann Lake has another inlet in Swanson Creek which rises from Swanson Lake - 3 miles northeast.

The watershed of Ann Lake is naturally much larger than that of Mary Lake. However, both lakes are subject to considerable fluctuation in water level, particularly in early spring with the melting of the snow. No control of the water level has been attempted.

Other physical characters are presented in the following table.

Lake	Area (acres)	Maximum depth (feet)	Approximate per cent of shoal	Bottom types		Color of water	Secchi disc (feet)	Shoreline development
				Shoal	Depth			
Ann	21.2	29	20	Sand and fibrous peat	Muck and pulpy peat	Medium brown	5½	1.2
Mary	35.2	13	100	Sand, fibrous peat, pulpy peat	...	Colorless to light brown	7	1.1

Both of these lakes are in a rather advanced stage of development as indicated by the heavy deposit of organic material in the bottom and the bog mat formation about the margin. This tends to make a lake shallower and more round. The regularity of the shoreline is expressed by the shoreline development in the above table. This figure represents the ratio between the actual length of the shoreline and the length of the shoreline were the lake perfectly round and of the same area. In other words, the shorelines of these lakes are only slightly longer (Mary lake 1.1, Ann 1.2) than the circumference of a circle having the same area. This indicates a lack of protected bays and coves, which are often the most productive areas in a lake. Small, shallow lakes, however, are often productive irrespective of these features.

In addition to these physical characteristics of a lake, the temperature and chemical nature of the water are also very important in that they influence the kind and abundance of plants, fish, and fish foods. All

living forms in the lake can tolerate a range of conditions; some grow well under a very wide range while others are sensitive to slight changes in certain environmental factors. Moreover, each animal or plant has maximum, minimum, and optimum conditions under which its reactions vary accordingly. To illustrate, trout grow best in water having a temperature between 60° and 70°F.; they are killed if retained at a temperature of from 75° to 80° or above, while pan fish have their optimum temperature between 75° and 85°F. Fish also differ in their oxygen demands, e.g. trout require more than carp. With a knowledge of the requirements of fish and a study of the conditions in a lake, it is possible to reasonably determine what fish should thrive best.

Temperature and chemical information taken on Ann and Mary lakes are given on the following page.

Lake	Date	Surface					Thermocline* Top						Thermocline* Bottom						Bottom					
		Temp. (°F.)	O_2 p.p.m.	CO_2 p.p.m.	M.O. Alk. p.p.m.	pH	Depth (ft.)	Temp. (°F.)	O_2 p.p.m.	CO_2 p.p.m.	M.O. Alk. p.p.m.	pH	Depth (ft.)	Temp. (°F.)	O_2 p.p.m.	CO_2 p.p.m.	M.O. Alk. p.p.m.	pH	Depth (ft.)	Temp. (°F.)	O_2 p.p.m.	CO_2 p.p.m.	M.O. Alk. p.p.m.	pH
Ann	7/8/40	76.6	6.4	0.0	189	8.2	. . . Surface						15	50	3.5	1.0	165	7.6	25	46	4.2	2.5	174	7.9
Ann	8/26/40	61	6.5	2.0	198	7.9	12	56	5.4	2.0	198	7.9	18	49	0.55	12.0	172	7.2	27	47	0.1	14.0	186	7.4
Mary	7/9/40	77	8.6	0.0	..	..	. . . . . No thermocline												9	73	7.9	0.0	..	..

*The thermocline is a zone where the temperature changes rapidly (at the rate of 1.8°F. or more in 3 feet)

Ann Lake stratifies thermally, i.e. the lake can be divided into three depth zones on the basis of temperature. The atmosphere warms up the surface waters which then become lighter in weight than the colder waters beneath. This prevents mixing and by late summer there is a layer of warm water on top--above a layer of cold water on the bottom. In the region between the two, the temperature changes rapidly and this region is known as the thermocline.

Thermoclines almost always form in deep lakes and sometimes in shallow lakes, providing they are not subjected to heavy winds. Another cause for thermocline formation is the entrance of a cold stream into a lake. This cold water, being heavier than the lake water, flows down along the lake bottom, forming a thermocline between it and the warmer lake water above.

The position of the thermocline is important because the water below is not aerated and eventually loses the dissolved oxygen and becomes charged with carbon dioxide. These conditions are unsuitable for fish and for most fish foods. If the thermocline is near the surface, much of the lake may be unsuitable, while a thermocline near the bottom affects only a small portion of the water.

In Ann Lake the thermocline began at the surface in July but continued warming of the surface waters shifted the top of the thermocline to a depth of 12 feet by the latter part of August, at which time oxygen at the bottom decreased to 0.1 part per million--not enough to support fish life. However, at that time temperature and oxygen conditions in the surface waters and in the thermocline were suitable for trout.

Mary Lake has no thermocline; hence there is adequate oxygen at all depths during the summer although the temperature is then too high for trout.

Winter presents a different picture since under the ice there is no opportunity for aeration. During prolonged winters the oxygen supply may be depleted, by its use in decomposition of dead vegetation and by the organisms present, to such an extent that fish become endangered or die in extreme cases. The result is a winter-kill, such as occurred in 1934-1935.

Except for the possibility of winter-kill in Mary Lake, thermal and chemical conditions favor good growth of fish and fish foods.

Vegetation in the two lakes is markedly different. Ann Lake has an abundance of submerged vegetation with only one species emergent, while the opposite is true of Mary Lake. A complete list* of plants showing their abundance in each lake follows.

Common name	Scientific name	Ann Lake	Mary Lake
Coontail	Ceratophyllum demersum	Common	...
Musk grass	Chara sp.	Abundant	...
Horsetail	Equisetum fluviatile	...	Few
Yellow water lily	Nuphar variegatum	Common	Common
White water lily	Nymphaea odorata	...	Common
Water milfoil	Myriophyllum sp.	Common	...
Large-leaf pondweed	Potamogeton amplifolius	Common	...
Floating-leaf ponweed	Potamogeton natans	Few	...
Sago pondweed	Potamogeton pectinatus	Few	...
Flat-stem pondweed	Potamogeton zosteriformis	Common	...
Hard-stem bulrush	Scirpus acutus	...	Abundant
Soft-stem bulrush	Scirpus validus	Abundant	...
Cattail	Typha latifolia	Common	Few
Bladderwort	Utricularia vulgaris var. americana	Common	...

The vegetation in Ann Lake provides adequate food and cover for both young and adult fish but the emergent vegetation in Mary Lake probably does not provide much in the way of food. The scarcity of submerged vegetation in Mary Lake undoubtedly limits the capacity of the lake for food production.

* Plants identified by Miss Betty Robertson, University of Michigan.

Plankton (microscopic plants and animals) was more abundant in Mary Lake than in Ann Lake at the time of the survey.

Phytoplankton (plants) predominate in Mary Lake and zooplankton (animals) is more abundant in Ann Lake. The small plankton crop in Ann Lake may be due to a slight current in the lake resulting from the two inlet streams. Most lake plankton is destroyed by water currents.

Bottom foods are abundant in Ann Lake. Snails, fresh-water shrimp, and midge larvae form the bulk of the shoal supply. Phantom midge larvae are plentiful in deeper waters. In addition, the vegetation supports a good supply of food.

Mary Lake is almost devoid of bottom foods. This, coupled with the lack of submerged weed beds, may result in very slow growth of the fish or stunting. However, winter-kills have kept and may continue to keep down the fish population to a point where the food supply is adequate.

The kind and relative abundance of fish in the two lakes are recorded in the following table.

Fish	Ann Lake	Mary Lake
GAME FISH		
Bluegill	Abundant	Reported
Rock bass	Common	...
Perch	Common	Abundant
Great northern pike	Common	...
Black crappie	Common	...
Pumpkinseed	Rare	...
Largemouth bass	Rare	...
FORAGE FISH		
Blunt-nosed minnow	Rare	...
Golden shiner	Rare	...
Johnny darter	Rare	...
Common shiner	Rare	...
COARSE FISH		
Common sucker	Rare	...
Bullhead	Common	...
OBNOXIOUS FISH		
Dogfish	Reported	...

The absence of other species of fish in Mary Lake is attributed to winter-kill. Pike and largemouth bass were caught previous to the winter-kill, but only perch have been taken since. Bluegills are reported to have survived, although none were taken by the survey party.

Ann Lake maintains a good fish population. Forage fish are not abundant. Scattered reports of brook trout in the lake have been received. Swanson River is known to have brook trout, and it is probable that they find their way into the lake.

Growth rate studies were made from fish samples taken from these lakes. The object was to determine how fast the various species of fish were growing so that management policies might be formulated accordingly. The results of these studies are given in the following table.

		Ann Lake		Mary Lake	
Fish	Age Group*	Number of Specimens	Average length (in.)	Number of Specimens	Average length (in.)
Perch	0	...	...	2	1.6
	I	4	2.9	3	3.8
	II	...	...	15	5.9
	III	...	...	5	9.3
Bluegill	V	5	6.1	...	...
	VI	3	5.8	...	...
	VII	6	6.5	...	...
	VIII	3	7.3	...	...
Rock bass	I	2	1.6	...	...
	V	1	5.4	...	...
	VI	2	7.4	...	...
	VII	1	8.2	...	...
	VIII	1	9.3	...	...
Pumpkinseed	IV	1	4.6	...	...
	VI	1	5.7	...	...
Largemouth bass	VI	1	15.6	...	...
Black crappie	V	2	9.2	...	...
Great northern pike	0	1	3.2	...	...
	IV	1	19.5	...	...
	V	1	20.0	...	...

* Age determinations made by W. C. Beckman.

Most species in Ann Lake show an unusually slow growth rate. The perch in Mary Lake are growing fairly fast. The rate of growth in these lakes is not what would be expected from the food supply, which was discussed previously. Ann Lake has an abundant food supply, while food in Mary Lake is very limited. The difference in growth may be the result of temperature and population.

Ann Lake contains rather cold water for pan fish. Temperatures in the latter part of August 1940 were: surface - 61°F., 12 feet - 56°F., 18 feet - 49°F., 27 feet - 47°F. Pan fish grow best in water above 75°F. other conditions being favorable.

In addition to cold temperatures, it is believed that overpopulation may be partially responsible for slow growth. While food is abundant, fish may be too crowded, with the same result as is obtained when agricultural crops, for instance, are planted too close together; they never grow to a large size, regardless of the fertility of the soil.

The growth of perch in Mary Lake is apparently faster than in Ann Lake. The lack of small invertebrate fish food organisms has little direct relation to the growth of perch since they are, except for the young, largely fish eaters. Inasmuch as they are the only species known to exist in the lake, there is little demand for insects and other invertebrates.

Management Suggestions

Both lakes are designated pike lakes. Continuation in this classification is recommended.

Mary Lake contains a perch population with no forage fish. Bluegills have been reported but, if present, small numbers must exist as none were taken or observed by the survey. All other species were removed by winter-kill. No stocking has occurred in recent years and none is recommended for the present, for two reasons; first, the lake is subject to winter-kill,

and second, the lake affords an opportunity to observe what happens to a perch population when no other fish are present in quantities. The perch are growing reasonably fast at present, and if this continues, the lake should remain unchanged. If stunting occurs, forage fish may be introduced or northern pike may be restocked, or both. Spawning facilities for perch must be adequate because the lake has maintained a good perch population for years.

As pointed out in the discussion, Ann Lake has adequate food, cover, and spawning facilities for all of the species present. Slow growth is attributed to low water temperature and perhaps overcrowding of fish.

There is little that can be done in the way of management of such lakes. The lake is suitable for trout but it seems almost impossible for trout to become established because of the large pike population. Removal of pike is impractical, if not impossible, since Little Shakey River flows through the lake. Trout have access to the lake from Swanson's Creek and Little Shakey River; the latter is frequently stocked with legal trout. But trout are not taken from the lake and it is probably safe to assume that plantings of trout in the lake would only serve as food for the pike. Legal fish, if planted, might show a small percentage of survival but permanent establishment in the lake is not likely.

Parasites and predators require no regulation in either lake.

Water levels fluctuate following the spring thawing season, but regulation is impractical.

INSTITUTE FOR FISHERIES RESEARCH

By E. W. Roelofs and F. E. Locke

Report approved by: A. S. Hazzard
Report typed by: V. Andres