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FISHERIES SURVEY OF CRYSTAL, DUCK, LOON, AND MUD LAKES, MONTCALM COUNTY

by

John Funk

Crystal, Duck, Loon (Crystaloon) and Mud Lakes are located in Evergreen and Crystal Townships in the southeastern part of Montcalm County. Their specific locations are as follows:

Lake	Township	T.	R.	Sections
Crystal	Crystal	10 N.	5 W.	7, 8, 17, 18
Duck	Crystal	10 N.	5 W.	10, 11, 15
Loon	Evergreen, Crystal	10 N.	5, 6 W.	7, 12
Mud	Crystal	10 N.	5 W.	8, 9

The lakes all lie within an area of about ten square miles, in the Grand River drainage. They are approximately 8 miles southeast of Stanton and 7 miles northwest of Carson City.

Maps of the lakes showing shoreline, contours, and bottom types were prepared by an Institute party during the winter of 1940-41. In the following summer fish were collected and a regular biological inventory was made. The dates of the various investigations are given below.*

* Personnel of the various parties were as follows:
Mapping party: G. F. Perry, leader; Lyle Newton, Oscar Jasmin, assistants.
Fish party: W. C. Beckman, leader; Lee Anderson, Pat Galvin, and Donald Thomas, assistants.
Inventory party: John Funk, leader; Eugene Roelofs, and Stanley Lievense, assistants.

Lake	Mapped	Fish collected	Inventoried
Crystal	2/10/41	6/23-27/41	7/28-30/41
Duck	2/20/41	6/19-21/41	7/31/41
Loon	2/22/41	6/25-26/41	7/26-28/41
Mud	2/13/41	6/25-26/41	7/30/41

The cooperation of Dr. Carney in providing a camp site for the inventory party is hereby gratefully acknowledged.

Extensive industrial use of these lakes in the past seems improbable, however. At present, several oil wells are located on or near the margin of Duck Lake. All of these lakes are said to have furnished good fishing in the past but a general falling off in the catch in recent years is reported. Mud and Duck Lakes both winter kill quite frequently.

Accessibility and Development

The lakes are all readily accessible by good gravel roads. Crystal Lake is one of the best known resort lakes in this section of the state. There are over 200 cottages along its margin besides the Village of Crystal on the east shore. Facilities for swimming and boating are excellent, and hotels, resorts, and boat liveries are numerous. Loon and Duck Lakes have some resort development. Swimming is good in Loon while Duck is reported to provide fine duck hunting. The use of the three smaller lakes is, no doubt, greatly increased by their proximity to Crystal. These lakes as a group are certainly of considerable potential importance as public fishing waters.

Physical Characteristics

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

Lake	Area	Max. depth	Max. length	Max. width
Crystal	724 acres	70 ft.	1.48 mi.	1.02 mi.
Duck	306 acres	9 ft.	1.16 mi.	0.69 mi.
Loon	63 acres	53 ft.	0.47 mi.	0.28 mi.
Mud	127 acres	3 ft.	0.68 mi.	0.49 mi.

Geological Origin

Dr. I. D. Scott in his book, "Inland Lakes of Michigan", says of the geological origin of Crystal Lake, "The glacial formations have a north-south trend in this locality and the lake lies in an irregular morainic depression that originally consisted of several basins. This depression is situated on the edge of a sandy moraine which gives way to a till plain just east of the lake."

The four lakes illustrate in a striking way different stages in the "life history" of lakes. Theoretically, a lake originates as a water-filled depression in the earth. This depression gradually is filled in by silting, the accumulation of plant debris, etc. The lake becomes smaller and shallower, gradually evolving into a swamp or bog, and finally dry land. Crystal and Loon Lakes are deep and have extensive areas of open water, although each has a considerable deposit of peat on the bottom. They are middle-aged and still have a long life before them. Duck and Mud, on the other hand, have filled up until they are quite shallow. Plants can grow all over the bottom and the amount of open water has been materially reduced by the encroaching vegetation. The extensive plant growth will greatly speed up the filling process. The life of such lakes is generally quite short.

Drainage and Tributaries

Crystal Lake has one small inlet stream and in turn drains into Mud Lake. The water supply of the other lakes is received chiefly from run-off and seepage. The entire drainage basin of the four lakes probably does not exceed 7 or 8 square miles in area. The soil is sandy and produces only fair crops. Much of the land is cleared.

As is shown in the accompanying sketch map, Loon Lake has no direct connection with the other three. The outlet of Crystal and Mud, however, joins that of Duck Lake and runs into Fish Creek. Fish Creek is tributary to the Maple River which in turn is a tributary of the Grand. Grand River flows into Lake Michigan at Grand Haven.

Water level fluctuations are ordinarily not great in any of the lakes. A dam has been installed in the outlet of Crystal for the purpose of maintaining a more uniform level in the summer. It is opened during the winter. At the time of the inventory the outlet was dry.

Physical characteristics of a more technical nature than those discussed above are given in the following table.

Lake	Shore develop-ment	Approx. per cent shoal	Secchi disc	Bottom types		Color of water
				Shoal	Depths	
Crystal	1.31	65	10	Sand and marl, rubble, marl.	Marl	Clear, colorless.
Duck	1.54	100	Bottom	Fibrous peat.	...	Brown
Loon	1.15	40	9	Marl and sand, marl and gravel, fibrous peat	Marl, pulpy peat	Clear, colorless.
Mud	1.51	100	Bottom	Fibrous peat, marl	...	Brown

Shore Development

The factor of shore development indicates the relationship between the area of the lake and the length of the shoreline. Crystal Lake, for instance, has a shoreline 1.3 times as long as a circular lake of the same area. The shore development gives some indication of the productivity of a lake. A high shore development suggests the presence of numerous protected bays and coves which are likely to be the most productive parts of the lake. The shore development of each of these lakes is rather low.

Shoal areas

The shoal of a lake is the area which is potentially able to produce plants. The per cent of shoal varies with the amount of deep water in the lake. The transparency of the water also limits the amount of shoal, since higher plants require a certain amount of light.

Transparency

Transparency is measured with the Secchi disc, a black and white disc 8 inches in diameter which is lowered into the water until it disappears from view. The waters of Crystal and Loon Lakes were of about average transparency for such lakes. The bottom soils are of types which may be quite productive if other conditions are favorable.

Temperature and Chemical Characteristics

Water temperatures are important to fisheries in two ways. First, every species of fish has a definite range of temperature toleration and an optimum within that range. Trout and other cold-water fish, for instance, generally require water below 75°F. while bass and bluegills do best in water which is warmer. Second, temperature directly affects the growth rate of the fish. Since fish are "cold blooded" animals, they are more active and feed more frequently when the water temperature is near the upper limits of their range of toleration.

The chemical characteristics of water which are considered of most importance in fisheries investigations are the amount of dissolved oxygen, the amount of dissolved solids (hardness), and the acidity or alkalinity (pH). Oxygen is necessary for most forms of life and 3 or 4 parts per million must be present for our game fish to survive. The amount of dissolved minerals present seems to bear a direct relationship to the amount of aquatic vegetation produced by a lake. Extremes of acidity or alkalinity may have a limiting effect on fish and other life in the water.

The table below gives the temperature and chemical characteristics of the lakes under consideration.

Lake	Station	Location	M.O.Alkalinity range	pH range		Surface	Thermocline Top	Thermocline Bottom	Bottom
Crystal	1	Deepest part of lake	124-162	7.2-8.3	Depth in ft.	...	15	40	60
					Temp. in °F.	82	72	44	42
					O_2 in p.p.m.	7.1	8.3	0.9	0.2
	2	Near central depression	128-154	7.4-8.4	Depth in ft.	...	...	...	51
					Temp. in °F.	80	...	...	62
					O_2 in p.p.m.	7.5	...	...	0.2
Duck	1	Deepest part of lake	64-67	7.9-8.0	Depth in ft.	...	...	...	6
					Temp. in °F.	81	...	...	78
					O_2 in p.p.m.	6.5	...	...	6.7
Loon	1	Deepest part of lake	124-188	7.3-8.6	Depth in ft.	...	20	35	52
					Temp. in °F.	81	70	54	51
					O_2 in p.p.m.	7.7	6.8	0.3	0.0
Mud	...	Northeastern part	173	8.1	Temp. in °F.	84	...	...	...
					O_2 in p.p.m.	6.8	...	...	...

The surface water of these lakes was warm enough to promote good growth of warm-water fish. Although the deeper water of Crystal and Loon Lakes was cold enough for trout, the greatly reduced oxygen supply would make it unsuitable for any kind of fish. Thermoclines were present in Loon Lake and in one small depression in Crystal at the time of the inventory.

A thermocline is a zone of rapid change in temperature ($\frac{1}{2}$°F. or more per foot). This zone divides the lake into (1) an upper layer of warm, circulating water, and (2) a lower layer of cold water which is shut off from all circulation by the thermocline. When this condition, known as thermal stratification, exists, it usually persists throughout the summer months. Since the lower layer is stagnant, decomposition of organic matter in the bottom deposit may reduce the supply of dissolved oxygen to such an extent that the lower strata of water become uninhabitable for fish and most other organisms. In Crystal Lake the true thermocline occupied only one small "pot-hole" depression near the south shore; however, the water in the main basin showed a considerable change in temperature between surface and bottom and the oxygen supply was reduced in the deeper water (3.9 p.p.m. at 30 feet).

The water of Crystal, Loon and Mud Lakes was moderately hard (M. O. Alkalinity 124-188 p.p.m.). This is about average for productive lakes in the Lower Peninsula. In Duck Lake the water was moderately soft (M. O. Alkalinity 64-67 p.p.m.). Productive lakes usually have somewhat harder water. All of the lakes were slightly to strongly alkaline (pH 7.2-8.6). This is near the average of productive waters.

No evidence of pollution was noted. A certain amount of domestic sewage might find its way into Crystal and Loon from the cottages on the shore. Even on Crystal, however, the amount would probably not be sufficient to have any harmful effect. There are several oil wells on the shores of Duck Lake--two right on the margin. These have been blamed for the winter kill and other difficulties on this lake. However, at the time of the survey, there was no evidence of salt water, oil, or other deleterious substances getting into the lake.

Biological Characteristics

Aquatic Plants

The relative abundance of the species of plants collected in the four lakes is given in the following table.

Species *	Crystal	Duck	Loon	Mud
Waterweed (Anacharis canadensis)	...	...	Rare	...
Water shield (Brasenia Schreberi)	...	Few	...	...
Swamp loosestrife (Decodon verticillatus)	Rare	Common	...	...
Square-stem spike rush (Eleocharis quadrangulata)	Rare	...	...	...
Spike rush (Eleocharis equisetoides)	...	Few	...	...
Water milfoil (Myriophyllum exalbescens)	...	...	...	...
Water milfoil (Myriophyllum sp.)	...	Rare	...	...
Bushy pondweed (Najas flexilis)	Rare	...	Abundant	...
Bushy pondweed (Najas marina)	Rare	Common	...	Rare
White water lily (Nymphaea odorata)	Rare	Common	...	Few
Yellow water lily (Nuphar advena)	...	...	Few	...
Yellow water lily (Nuphar variegatum)	Rare	Common	...	Few
Pickerel weed (Pontederia cordata)	Rare	Abundant	...	...
Large-leaf pondweed (Potamogeton amplifolius)	...	Common	Common	Rare
Pondweed (Potamogeton angustifolius)	Rare	Common	...	...
Pondweed (Potamogeton foliosus var. marcellus)	...	Few	...	...
Pondweed (Potamogeton Friesii)	Few	...	...	Rare
Pondweed (Potamogeton gramineus var. graminifolius)	...	...	Rare	...
Pondweed (Potamogeton gramineus var. graminifolius f. myriophyllus)	Rare	...	Rare	...
Floating-leaf pondweed (Potamogeton natans)	Rare	Few	...	Few
Sago pondweed (Potamogeton pectinatus)	Few	Rare	...	Few
Whitestem pondweed (Potamogeton praelongus)	Few	Rare	Common	...
Flat-stemmed pondweed (Potamogeton zosteriformis)	...	Rare	Few	...
Duck potato (Sagittaria latifolia)	...	Rare	...	...
Big bulrush (Scirpus acutus)	Abundant	Abundant	...	Very abundant
Three-square bulrush (Scirpus americanus)	Few	...	Common	Common
Great bulrush (Scirpus validus)	...	...	Few	...
Common cattail (Typha latifolia)	...	Rare	...	...
Bladderwort (Utricularia vulgaris var. americana)	Rare	...	...	Few
Wild celery (Vallisneria americana)	Rare	...	...	...
Wild rice (Zizania aquatica var. angustifolia)	...	Common	...	...
Musk grass (Chara sp.)	Abundant	Common	Common	Few

* Determinations by B. M. Robertson, U. of M. Department of Botany.

Duck Lake was noteworthy for the great amount of vegetation it contained. Twenty species were collected, half of which were common or abundant. Eleven or twelve species, several of which were common or abundant, were found in the other lakes.

The productivity of lakes with a limited amount of shoal such as Crystal and Loon is likely to be in proportion to the amount of vegetation--the more plants in such a lake the better the lake for fishing. The situation may be quite different, however, in shallow lakes like Duck and Mud. Such lakes may be quite productive. The abundant vegetation encourages large quantities of fish food organisms and the photosynthetic activity of the plants may keep the water well supplied with oxygen in the summer. The critical time is likely to come in the winter. When the ice is covered with snow for long periods, plants die down. Respiration of the organisms and decomposition of organic matter in the bottom deposit may exhaust the supply of oxygen in the limited amount of water present. Under such conditions the fish suffocate. This has occurred at least twice (1936, 1940) in Duck Lake and may have occurred unnoticed in Mud Lake.

Fish Foods

Plankton (microscopic or nearly microscopic plants and animals which float free in the water) is important because it is the chief food of very young fish and of many larger fish food organisms. Bluegills and certain other game fish live largely on plankton at times. During the interval of the inventories plankton was abundant in Crystal Lake, moderately abundant in Loon and quite low in Duck. The very shallow water made it impossible to sample the plankton in Mud Lake. The known variation in plankton populations from week to week and from place to place makes a few samples of this nature only valuable in a general way.

Samples of insect larvae and other fish food organisms were collected from the aquatic vegetation and from the bottom at various depths in the four lakes. A summary of the results of this investigation is given in the table below.

Lake	Crystal			Duck	Loon			Mud	
	Shoal		Depths	Shoal	Shoal		Depths	Shoal	
Depth range (ft.)	$1\frac{1}{2}$-18	2-21	50-65	$\frac{1}{2}$-6	4-6	$1\frac{1}{2}$	50	1	1
Number of samples	4	7	2	5	3	1	1	2	1
Average area or weight	4 1/4 lb.	$\frac{1}{2}$ sq. ft.	$\frac{1}{2}$ sq. ft.	5 1/4 lb.	8 lb.	$\frac{1}{2}$ sq. ft.	$\frac{1}{2}$ sq. ft.	$7\frac{1}{2}$ lb.	$\frac{1}{2}$ sq. ft.
Bottom type	Marl	R., M., P.P., S.✓*	P.P., M.✓*	F.P.✓*	Marl	S., M., G.✓*	P.P.✓*	F.P.✓*	F.P.✓*
Organisms									
Flatworms (Turbellaria)	...	Rare	...	Rare	Rare	Rare	...	Rare	...
Aquatic earthworms (Oligochaeta)	...	Rare	...	...	Few	...	...	...	...
Leeches (Hirudinea)	Few	Rare	...	Few	Rare	...	...	Few	...
Snails (Gastropoda)	Abundant	Rare	...	Abundant	Few	Rare	...	Common	...
Clams (Pelecypoda)	Rare	Few	...	Rare	Rare	...	...	Rare	...
Scuds (Amphipoda)	Few	Few	...	Common	Few	...	...	Abundant	...
Water mites (Hydracarina)	Few-common	Rare	...	Few	Common	...	...	Common	Rare
Mayflies (Ephemeroptera)	Rare	Common	...	Few	Few	Common	...	Abundant	Rare
Dragonflies (Anisoptera)	Rare	Rare	...	Few	Few	Rare	...	Common	...
Damselflies (Zygoptera)	...	Rare	...	Few	Rare	Rare	...	Abundant	...
Fish flies (Neuroptera)	...	Rare	...	...	...	...	...	...	...
Caddisflies (Trichoptera)	Few-common	Few	...	Few	Few	...	...	Abundant	...
Beetles (Coleoptera)	Rare	Common	...	Few	Few	...	...	Rare	...
Phantom midges (Corethra)	...	...	Rare	...	...	...	Common	...	...
Midges (Chironomidae)	Common	Abundant	Few	Common	Abundant	Rare	Rare	Abundant	Rare
Other flies (Diptera)	...	...	...	Rare	...	...	...	...	...
True bugs (Hemiptera)	...	Rare	...	Rare	...	...	...	...	...
Crayfish (Decapoda)	Few	Rare	...	...	Rare	...	...	...	...

✓* R. = Rubble
G. = Gravel
S. = Sand
P.P. = Pulpy peat
F.P. = Fibrous peat
M. = Marl

Food organisms were fairly abundant in the shallower water of Crystal Lake. Snails and midge larvae were most numerous on the vegetation and mayfly nymphs, beetle larvae and midge larvae in the bottom soil. Very little life was found in the deeper water. Vegetation was so abundant in Duck Lake that no other type of substratum was sampled. Snails, scuds and midge larvae were the predominant kinds of organism found. In Loon Lake food organisms were fairly abundant on the vegetation (water mites and midge larvae predominated), less abundant in the bottom soil in shallow water (mayflies dominant), and rather few in the deep water. The vegetation in Mud Lake supported a large and varied population of food organisms. Snails, scuds, water mites, dragonfly and damselfly nymphs, caddisfly larvae, and midge larvae were all quite numerous. Life was rare in the bottom soil, however.

Fish Collections

Fish were collected in the four lakes and estimates of the relative abundance of the various species in the population were made. The following table summarizes the results. Stocking records for 1934-40 are included.

Species	Crystal	Duck	Loon	Mud
GAME FISH				
Northern pike (Esox lucius)	Rare	Common	...	Rare
Perch (Perca flavescens)	Abundant	Common	Common	Rare
Smallmouth bass (Micropterus dolomieu)	Rare	...	...	...
Largemouth bass (Huro salmoides)	Common	Few	Common	Common
Warmouth bass (Chaenobryttus gulosus)	...	Rare	...	...
Bluegill (Lepomis macrochirus)	Abundant	Abundant	Abundant	Abundant
Long-eared sunfish (Lepomis megalotis)	Rare	...	...	...
Pumpkinseed (Lepomis gibbosus)	Common	Abundant	Common	Common
Rock bass (Ambloplites rupestris)	Few	Rare	...	Few
Black crappie (Pomoxis nigro-maculatus)	...	Rare	...	...
Hybrid Pumpkinseed x Bluegill	...	...	...	Rare
COARSE FISH				
Common sucker (Catostomus commersonnii)	Rare	Few	...	...
Lake chub sucker (Erimyzon sucetta)	...	...	...	Rare
Mullet (Moxostoma sp.)	...	Rare	...	...
Brown bullhead (Ameiurus nebulosus)	...	Common	...	Rare
Yellow bullhead (Ameiurus natalis)	Rare	Rare	...	Rare
OBNOXIOUS FISH				
Long-nosed gar (Lepisosteus osseus)	Rare	...	...	...
Dogfish (Amia calva)	...	Rare	...	Rare
FORAGE FISH				
Black-nosed shiner (Notropis heterolepis)	Abundant	Abundant	...	Abundant
Black-chinned shiner (Notropis heterodon)	Common	Few	Few	Common
Mimic shiner (Notropis volucellus)	Rare	...	...	...
Straw-colored shiner (Notropis deliciosus)	...	...	Rare	...
Common shiner (Notropis cornutus)	...	Common	Rare	...
Golden shiner (Notemigonus crysoleucas)	Rare	...	...	Rare
Blunt-nosed minnow (Hyborhynchus notatus)	Common	Few	Common	Rare
Tadpole madtom (Schilbeodes gyrinus)	...	...	...	Few
Mudminnow (Umbra limi)	...	Rare	...	...
Menona killifish (Fundulus diaphanus)	Common	Rare	Rare	Few
Johnny darter (Boleosoma nigrum)	Rare	...	...	...
Iowa darter (Poecilichthys exilis)	...	Rare	...	Common
Silversides (Labidesthes sicculus)	Rare	...	...	...
Stocking 1934-40				
Smallmouth bass	3,367	...	...	...
Largemouth bass	5,203	3,550	840	...
Walleye (Stizostedion vitreum)	3,160,000	...	...	...
Perch	50,775	7,000	5,000	...
Bluegills	24,060	11,772	9,900	3,000
Sunfish	156	...	...	...
Bullheads	...	300	...	...

All of the lakes supported an abundant population of fish, apparently well suited to the habitats each provided. Bluegills were abundant in all of the waters. Pumpkinseed and perch were also quite common. The larger game fish were represented by largemouth bass and northern pike, the former being common in Crystal, Loon and Mud, and the latter in Duck. Coarse and obnoxious fish were relatively rare. All of the lakes except Loon had heavy populations of forage fish. In Loon Lake minnows were only moderately abundant.

Game Fish Growth Rate

The growth rate of the game species was studied. The following table gives the average total length of each age class for each lake and species.

Species	Age* group	Crystal: Number of specimens	Crystal: Average total length	Duck: Number of specimens	Duck: Average total length	Loon: Number of specimens	Loon: Average total length	Mud: Number of specimens	Mud: Average total length
Northern pike	I	...	...	1	12.4	...	...	...	...
	II	...	...	18	18.9	...	...	3	18.1
	III	...	...	4	21.1	...	...	1	20.9
	IV	2	28.6	1	27.6	...	...	...	...
	V	1	23.9	1	22.8	...	...	...	...
Perch	I	4	4.5	1	3.6	...	...	...	...
	II	34	6.4	7	5.3	...	...	2	5.5
	III	28	6.8	8	6.5	18	6.9	1	8.9
	IV	3	8.2	5	7.2	5	8.7	...	...
	V	2	10.8	4	7.8	3	10.7	...	...
	VI	5	10.9	3	9.7	1	10.2	...	...
	VII	3	11.2	2	10.6	...	...	...	...
	VIII	5	10.7	...	...	...	...	...	...
Smallmouth bass	III	2	11.5	...	...	...	...	...	...
	IV	2	11.2	...	...	...	...	...	...
Largemouth bass	I	4	3.6	...	...	...	...	1	4.0
	II	10	6.9	1	7.6	9	7.0	2	7.9
	III	10	8.5	10	11.8	5	10.2	12	10.6
	IV	3	10.9	4	12.6	2	12.8	1	13.2
	V	4	12.2	...	...	...	...	...	...
	VI	...	...	...	...	1	13.0	1	14.1
Warmouth bass	III	...	...	1	6.3	...	...	...	...
	V	...	...	1	6.7	...	...	...	...
	VI	...	...	1	8.2	...	...	...	...
Rock bass	II	...	...	...	...	...	...	2	5.0
	III	2	4.8	5	6.9	...	...	6	7.3
	IV	6	5.4	...	...	...	...	...	...
	V	2	8.4	...	...	...	...	...	...
	VII	1	8.1	...	...	...	...	...	...
	VIII	1	7.9	...	...	...	...	...	...
Bluegill	I	...	...	...	...	...	...	1	2.2
	II	...	...	2	5.0	9	2.8	1	3.6
	III	10	4.0	21	6.1	42	5.7	10	5.8
	IV	34	5.7	19	7.5	9	6.8	11	7.2
	V	1	8.2	2	7.8	1	7.7	9	8.1
	VI	...	...	...	...	4	9.0	9	8.6
Long-eared sunfish	III	2	4.4	...	...	...	...	...	...
Pumpkinseed	I	2	2.2	3	2.4	...	...	1	2.5
	II	1	2.5	1	3.9	...	...	...	...
	III	9	5.2	22	5.9	4	6.7	3	6.1
	IV	16	6.3	13	6.8	7	6.6	3	6.9
	V	6	6.7	11	7.3	3	7.0	3	8.1
	VI	3	7.1	...	...	...	...	2	8.5
	VII	...	...	...	...	...	...	1	8.8
Pumpkinseed x Bluegill	VI	...	...	...	...	...	...	1	9.1
	VII	...	...	...	...	...	...	1	9.1
Black crappie	III	...	...	2	8.7	...	...	...	...
	IV	...	...	2	8.9	...	...	...	...
	VI	...	...	1	13.0	...	...	...	...

*Age determinations by W. C. Beckman.

Although in some cases the number of specimens was not large enough to give conclusive evidence, it is believed that, in general, conditions in the lakes are well represented. Too few pike were taken from Crystal and Mud Lakes to give evidence of the growth rate of the entire population, but those studied were growing very well. The fine series of pike from Duck Lake gave indication of about average growth for the state. The perch in Crystal and Loon were making average or better growth as were the few taken from Mud. In Duck, the perch were about one year behind the average for the state. Largemouth bass were growing at near average rate in Duck, Loon, and Mud, but were about a year behind in Crystal. Bluegills were doing better than average in Duck, about average in Loon and Mud, and were about a year behind in Crystal. The growth rate of pumpkinseeds was average or better for the state in all four lakes. The few specimens of other species taken cannot be trusted to be representative of the populations.

Spawning Facilities

Spawning facilities for bass, bluegills, and perch were abundant in Crystal and Loon Lakes. Marshy areas such as are usually utilized by pike were limited. Facilities for pike were abundant in Duck and Mud, however. There was little area in Duck and Mud which meets the traditional requirements of Centrarchids, although beds (apparently bluegill) were observed in the soft bottom in both lakes. Weedy areas suitable for perch were abundant in both.

Management Suggestions

At present all of these lakes are in the "all other lakes" classification. The results of the survey indicate that Crystal, Loon, and Mud Lakes should retain that designation. It is suggested that the designation of Duck Lake be changed to that of "pike lake". There are several reasons why this seems advisable. Pike are numerous in the lake, they are growing well, and have ideal spawning facilities. The life of the lake as fishing water is definitely limited so that the few remaining good years should be utilized to the fullest extent. Due to the probability of future winter kills, it would be best to keep the population down as much as possible to avoid wasteful losses. There are few pike lakes in this vicinity. Opening this lake to the early season fishing would provide sport for a large number of fishermen at a season when it would not otherwise be available.

Stocking of all species should be discontinued in all the lakes. Spawning facilities are adequate and natural propagation should therefore be able to maintain the population against any expected fishing pressure. ~~Loon Lake illustrates very well the ability of a lake to provide good fishing without artificial stocking if suitable spawning areas are present. Although our records show that no plantings have been made in the last ten years, the fish population compares favorably with that of similar lakes.~~ Walleyes have been planted in Crystal Lake in large numbers but there are no records of any having been caught. Further planting would undoubtedly also be useless. The slow growth of the bluegills in Crystal probably indicates that these fish are overcrowded already. Further stocking would only aggravate the situation. Stocking of Centrarchids in Duck Lake would be automatically stopped if its designation is changed to that of pike lake. However, if it should again suffer a complete winter kill, restocking with moderate numbers of all the species now present might be advisable.

Some predators of various kinds were noticed on the lake. However, it is probable that their numbers are not sufficient to materially damage the fishing. No control measures are suggested. The fish taken contained some parasites. These in no way impair the food qualities of the fish since none of them will attack man. Control of fish parasites is very difficult and no measures are suggested. The dense beds of aquatic vegetation probably provide adequate cover for the fish. No structures are suggested.

The past practice in controlling the dam in the outlet of Crystal Lake seems to have been satisfactory. It is probably necessary to allow the water to flow into Mud Lake during the period of ice cover to avoid winter kill there. The danger of winter kill in Duck Lake could, no doubt, be greatly decreased if the inlet stream which was diverted by a W.P.A. drainage project could be allowed once more to flow into the lake. However, the relative value of the two projects must be considered.

Spawning facilities, as was indicated above, are probably adequate and no improvement attempts are suggested.

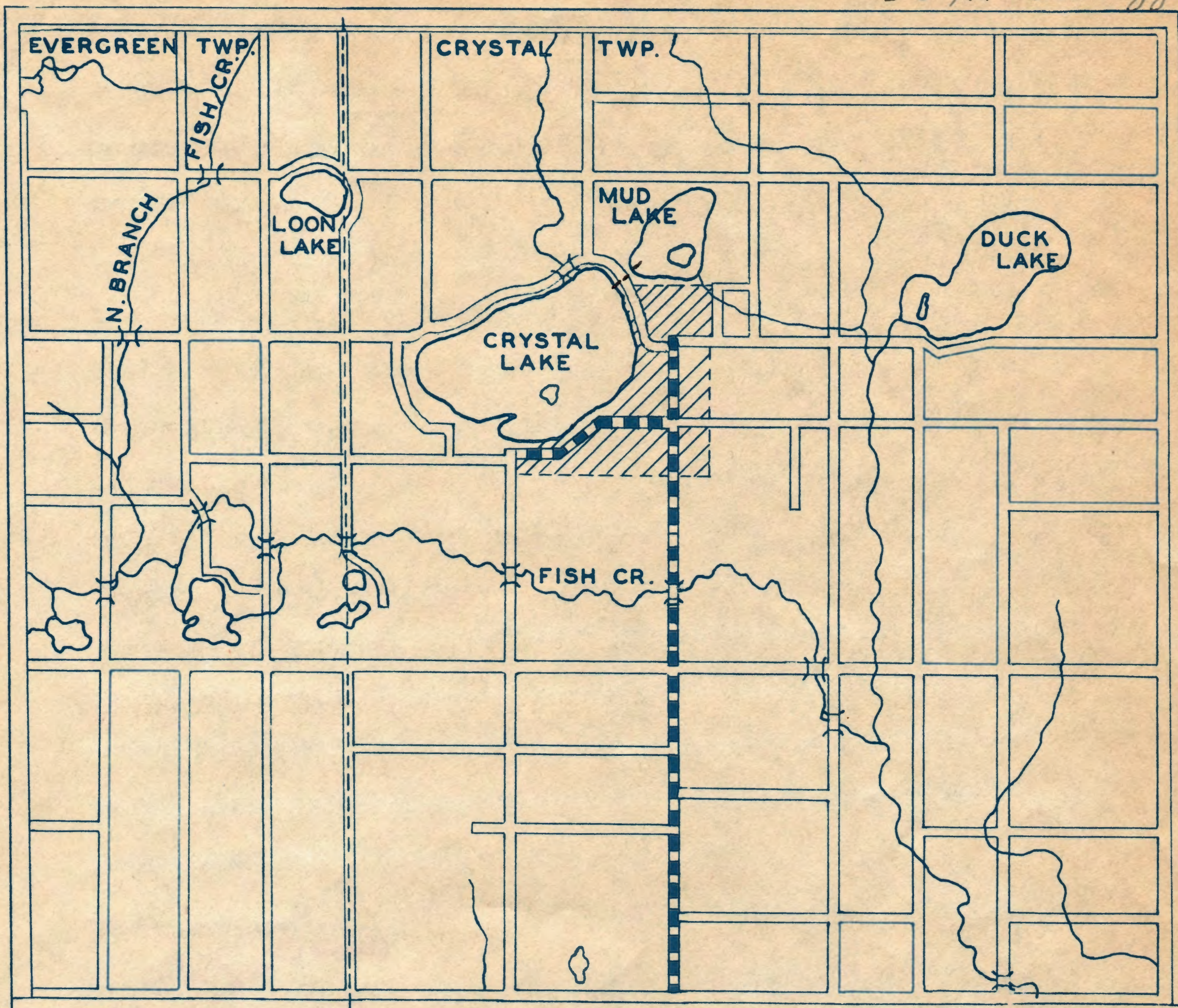
INSTITUTE FOR FISHERIES RESEARCH

By John Funk

Report approved by: A. S. Hazzard

Report typed by: R. Bauch

"this map should show an intermittent channel connecting Crystal and Mud Lakes"
5-6-42 Dr. Hazzard



CRYSTAL, DUCK, LOON, & MUD LAKES
EVERGREEN & CRYSTAL TWPS.
MONTCALM COUNTY

0 1 2 3

SCALE IN MILES