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FISHERIES SURVEY OF MUSKALLONGE AND PERCH LAKES, LUCE COUNTY

by

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Introduction

These two lakes occupy isolated basins in the northern part of Luce County, near Lake Superior. They are 30 miles north of Newberry and 15 miles east of Grand Marais; their specific locations are: Muskallonge Lake - T. 49 N., R. 10, 11 W., Sec. 1, 2, 11, 12, 6; Perch Lake - T. 49 N., R. 10 W., Sec. 18, 19, 20. They are both situated on County Road 407.

An outline map of Muskallonge Lake was prepared by Chief Foreman MacDonald of Camp Superior. The Institute for Fisheries Research mapped Perch Lake and completed the map of Muskallonge Lake in 1936. These maps show the outline, depth contours, distribution of vegetation and kinds of bottom. A biological survey was made of both lakes by the Institute* in 1936.

No records of past industrial use of the lakes are available. Reports indicate better fishing in years past--particularly for northern pike in Muskallonge and for brook trout in Perch Lake.

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* The party included: D. Miller, leader; W. F. Carbine, assistant.

chemical and biological inventories were made by the same party on Gerald Lake, August 24-26, 1937, and on Roland Lake on August 22-24 of the same year.

These lakes are not known to have been used for any industrial purposes in the past. Roland Lake has, for some years, been the site of Twin Lakes County Park, and its increasing development for recreational purposes, as well as that of the nearby Gerald Lake, has more or less paralleled increasing use of the park. At the time of the survey, there were 32 cottages on the shore of Roland Lake and 26 on the Gerald Lake shore. These numbers have increased somewhat since that time. There is a boat livery at each lake. The extensive sandy beaches found on both lakes are much used for swimming.

Little is known concerning the past history of the fishing in these lakes. They have for many years been fished principally for smallmouth bass and have provided fair to good fishing. Other species of fish were seldom taken in goodly numbers.

Roland and Gerald Lakes are at present among the more important fishing waters of the Upper Peninsula, and they will very probably continue to be much frequented by anglers and other recreationists in the future.

Physical Characters of Roland and Gerald Lakes

Roland and Gerald Lakes are fairly large lakes, relatively shallow in depth and irregular in shape. The former has an area of 292 acres while the latter has an acreage of 255. Each has a maximum depth of 41 feet. Roland Lake has a single major depression, located in the south-central portion of the lake. Gerald Lake is practically subdivided into 2 different lakes, separated by a narrow neck of water less than 5 feet in depth. The larger eastern bay of this lake has a maximum depth

of 41 feet, while the smaller western section (sometimes called Little Gerald Lake) reaches a depth of 26 feet. Roland Lake has a shoreline development of 1.78, while that of Gerald Lake is 2.03. This means that the lakes have 78 per cent (1.78 times) and 103 per cent (2.03 times) more shoreline, respectively, than perfectly circular lakes of the same areas. Ordinarily, lakes with extensive shorelines (which provide food, shelter and spawning facilities for many species of fish) are more productive than are lakes with low shoreline developments.

Roland and Gerald Lakes are very probably of glacial origin. However, nothing is known about their geological past.

The country surrounding these lakes, including all of their drainage area, is from moderately to densely wooded and has essentially sandy soils.

The water level in Roland and Gerald Lakes is controlled by a dam in the outlet of the latter, which backs up about a 2-foot head of water. The dam is not passable to fish. Fluctuations in the levels of Roland and Gerald Lakes are limited to about 2 feet, according to the report of the survey party. It is not known whether this fluctuation is due to the operation of the dam or occurs only during the spring runoff or during times of heavy precipitation.

Gerald Lake obtains its water supply from direct runoff and from 2 small, intermittent streams. Direct runoff and the outlet of Gerald Lake supply Roland Lake with its water. The drainages of the two lakes is limited to about 3 square miles.

About 20 per cent of the areas of both Roland and Gerald Lakes is sufficiently shallow to be potentially capable of producing aquatic plants. The shallow portions of the lake, extending down to depths of about 25 feet, have sandy soils. No gravel beds are known to be present in either

lake. The deeper waters in both lakes have a pulpy peat substratum. Small patches of fibrous peat cover the sand in a few places.

Water in both Roland and Gerald Lakes was light brown in color at the time of the survey. A Secchi disk (small, white disk about 6 inches in diameter), when lowered into the water, disappeared from view at an average depth of 9 feet in Gerald Lake and at a depth of $8\frac{1}{2}$ feet in Roland Lake. The degree of transparency of the water is an important factor in determining the depth to which aquatic plants will grow in a given lake. None of the higher aquatic plants are able to survive in the continued absence of light.

Temperature and Chemical Characters

As a part of the surveys conducted on Roland and Gerald Lakes, various temperature and chemical data concerning the lake water itself were collected. Temperature of the water at various depths was observed, the amount of dissolved oxygen and minerals in the water was determined, and other chemical data were obtained. Such information is frequently very important in determining the degree of suitability of a lake for the various fish species.

A summary of the temperature and chemical data obtained at Roland and Gerald Lakes during the surveys is shown in Table I.

Table I
Summary of Chemical and Temperature Conditions
in Roland and Gerald Lakes,
August, 1937

Lake	Roland	Gerald	
Station	1	1	2
Location	South-central portion of lake	Center of small bay	Center of large bay
Date	8/24/37	8/25/37	8/25/37
Air temperature, °F.	73	70	70
Surface temperature, °F.	70	71	72
Bottom temperature, °F.	53	58	54
Maximum depth, feet	40	21	40
Thermocline			
Location	20-30	16-21	20-30
Temperature, °F.			
Top of	67	67	67
Bottom of	54	58	55
Oxygen, p.p.m.			
Surface	6.9	7.2	7.2
Bottom	0.2	0.8	0.4
Methyl Orange Alkalinity			
Surface	11	13	13
Bottom	31	40	31
pH			
Surface	5.8	5.8	5.8
Bottom	5.6	5.8	5.6

Water temperatures in Roland Lake range from 53° to 70°F., and in Gerald Lake from 54° to 72°F. Both lakes have a thermocline (zone of rapid change of temperature, e.g., 1°C. or more per meter of depth).

Oxygen is adequate for all species of fish in the area above the thermocline, but is insufficient in amount to support fish life below the top few feet of this zone. A slight taste of hydrogen sulfide, a decomposition product, was observed in bottom samples taken from Roland Lake.

Methyl Orange Alkalinity tests, made to determine the amounts of certain minerals and salts dissolved in the water, showed Roland and Gerald Lakes to be quite soft. A dissolved mineral and salt content

of from 11 to 31 parts per million was found in Roland Lake, while in Gerald Lake the range was from 13 to 40. Moderately hard waters are ordinarily more productive of fish than are soft waters. A Methyl Orange Alkalinity of from 100 to 200 parts per million is generally considered necessary for high productivity.

The water of Roland and Gerald Lakes is moderately acid. The pH (hydrogen ion concentration) of Gerald Lake ranged from 5.3 to 5.8, and in Roland Lake the range was from 5.6 to 5.8 (7.0 is neutral). Moderately alkaline waters are ordinarily more productive than are waters with an acid reaction.

No pollution was found to be present in Roland and Gerald Lakes. There are no sources of industrial pollution in the vicinity, and the very small amounts of domestic wastes which probably reach the lakes are insufficient in amount to significantly affect the fisheries there.

Biological Characters

In determining the biological nature of Roland and Gerald Lakes, several types of data were collected. Representatives of the various species of vegetation in the lake were gathered and identified. Samples of plankton (microscopic free swimming and floating plant and animal life) were collected and the invertebrate bottom foods present in the lake were studied. Fish collections, including a sample of the various sizes and species present in the lakes, were made for studies of growth, condition, parasitism, etc. Spawning facilities for the various species were evaluated.

Roland and Gerald Lakes were found to support a fairly good growth of aquatic vegetation for acid, soft-water lakes. Gerald Lake has the most water plants, both in numbers and species, probably largely because

it has several well protected bays on the windward side of the lake. Although some of the more exposed areas of sandy beach have almost no vegetation, a thin strip of aquatic plants (essentially emergent forms) skirts most of the shoreline of both lakes. A summary of the species of vegetation found in the two lakes, with an estimate of their abundance, is shown in Table II.

Table II
Species of Vegetation Collected At
Roland and Gerald Lakes.

Species	Abundance	
	Roland Lake	Gerald Lake
Bulrush (Scirpus acutus)	Abundant	Abundant
Bulrush (Scirpus subterminalis)	...	Common
Yellow water lily (Nuphar advena)	Very common	Abundant
White water lily (Nymphaea odorata)	Very common	Common
Coontail (Ceratophyllum demersum)	Common	Sparse
Bushy pondweed (Najas flexilis)	Sparse	...
Water shield (Brasenia Schreberi)	Common	Sparse
Bur reed (Sparganium sp.)	Common	Common
Bladderwort (Utricularia intermedia)	...	Sparse
Bladderwort (Utricularia vulgaris var. americana)	Sparse	Sparse
Cattail (Typha latifolia)	Sparse	Sparse
Wapato (Sagittaria latifolia)	...	Sparse
Sedge (Carex sp.)	...	Sparse
Creeping spike rush (Eleocharis palustris)	...	Sparse
Horsetail (Equisetum limosum)	...	Sparse
Water milfoil (Myriophyllum Farwellii)	...	Sparse
Leafy pondweed (Potamogeton epihydrus)	Sparse	Sparse
Variable pondweed (Potamogeton gramineus)	...	Sparse
Floating-leaf pondweed (Potamogeton natans)	...	Sparse
Pondweed (Potamogeton pusillus)	Sparse	Sparse
Stonewort (Chara)	...	Sparse
Stonewort (Nitella)	...	Sparse

Plankton was found to be very abundant in the smaller bay of Gerald Lake, and fairly abundant in its larger bay, as well as in Roland Lake. However, records based upon collections made during a single short survey period provide insufficient data upon which to base an estimate of general plankton abundance throughout the year.

Invertebrate bottom foods in Roland and Gerald Lakes are relatively scarce, judging from several samples taken by the survey party. Two 1/4 square foot samples in Gerald Lake yielded 9 phantom midge larvae, 14 other midge larvae, and one aquatic earthworm. A similar sample taken in Roland Lake yielded 9 aquatic earthworms, 3 phantom midge and 3 other midge larvae. The vegetation in the lakes probably shelters a large number of other aquatic organisms. No samples were taken by the survey party in the shallow areas of either lake. Crayfish are common in both lakes and add to the available food supply.

A list of the species of fish collected by the survey party, with an estimate of their abundance at the time of the survey and a record of artificial stocking for the 4-year period immediately preceding the survey are shown in Table III.

The fish of Roland and Gerald Lakes have approximately the same species composition, except that the rock bass is not known to occur in Roland Lake and the sturgeon sucker was not collected in Gerald Lake. Largemouth bass, perch, suckers and mudminnows appeared from the survey records to be more numerous in Roland Lake than in Gerald Lake, while in the case of bluegills the reverse appeared to be true.

Table III
List of Fishes Collected in Roland and Gerald Lakes;
Their Abundance and Artificial Stocking

Species	Roland Lake		Gerald Lake	
	Abundance	Stocking	Abundance	Stocking
GAME FISH				
Smallmouth bass	Very common	1,500	Very common	1,500
Largemouth bass	Common	5,900	Occasional	5,700
Pumpkinseed sunfish	Common	...	Common	...
Bluegills	Occasional	38,000	Common	39,000
Black crappies	Occasional	...	Occasional	...
Rockbass	...	...	Common	...
Perch	Very common	16,400	Occasional	9,600
FORAGE FISH				
Mudminnow	Common	...	Rare	...
COARSE FISH				
Sucker	Abundant	...	Common	...
Sturgeon sucker	Rare	...	...	...
Yellow bullhead	Occasional	...	Occasional	...
Brown bullhead	Common	...	Rare	...

The populations of both lakes are seen to be composed almost entirely of centrarchid species, with smallmouth bass being probably the dominant species in both lakes. This is further illustrated by creel census records which were taken by Conservation officers from 1928 to 1936. The records are insufficient to give an accurate idea of the quality of the fishing during the period which they partly cover, but some indication is given regarding the species which occurred in anglers' catches in the past. A summary of the records taken to date is shown in Table IV. Largemouth bass appeared in anglers' catches more often in Roland Lake than did smallmouth bass. This is not believed to be the general rule, however.

Table IV
A Summary of Creel Census Records Taken at
Roland Lake and Gerald Lake, 1928 to 1936*

Year	Hours fished	Legal fish caught	Catch per hour	Smallmouth bass		Largemouth bass		Bluegill		Pumpkinseed		Rockbass		Crappie		Perch	
				No.	Average size	No.	Average size	No.	Average size	No.	Average size	No.	Average size	No.	Average size	No.	Average size
ROLAND LAKE																	
1928	26.00	7	0.27	4	13.0	3	13.0	...	...	...	...	...	...	...	...	...	...
1929	2.75	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1930	38.50	19	0.50	...	...	1	13.0	...	...	...	...	...	...	...	...	18	8.1
1932	17.00	11	0.65	6	17.7	5	15.4	...	...	...	...	...	...	...	...	...	...
1933	14.00	6	0.43	...	...	6	10.8	...	...	...	...	...	...	...	...	...	...
1935	14.00	6	0.43	...	...	6	12.0	...	...	...	...	...	...	...	...	...	...
1936	4.00	2	0.50	...	...	2	11.0	...	...	...	...	...	...	...	...	...	...
Totals	116.25	51	0.44	10	15.8	23	12.5	...	...	...	...	...	...	...	...	18	8.1
GERALD LAKE																	
1928	74.50	38	0.51	8	13.3	19	15.1	2	8.5	...	...	9	8.0	...	...	...	...
1929	89.75	115	1.37	35	14.8	1	15.0	6	7.4	23	7.3	45	8.0	...	...	5	7.8
1930	28.00	21	0.77	...	...	...	...	...	...	...	...	13	8.7	...	...	8	8.4
1932	40.50	57	1.40	2	15.0	1	10.4	3	7.0	...	...	2	8.0	...	...	49	6.7
1933	13.00	7	0.53	...	...	5	12.4	...	...	...	...	...	...	2	6.5	...	...
1934	9.00	4	0.44	...	...	4	12.0	...	...	...	...	...	...	...	...	...	...
1936	4.00	3	0.75	...	...	3	11.3	...	...	...	...	...	...	...	...	...	...
Totals	258.75	245	0.95	45	14.5	33	13.8	11	7.5	23	7.3	69	8.1	2	6.5	62	7.1

* Summaries made by Helen Staebler.

It is interesting to note from seining records of the survey party that young-of-the-year were collected of all game species occurring in each lake. This gives evidence that all the species present reproduce naturally in the lakes.

A study of the growth rate of game fish occurring in Roland and Gerald Lakes was made. A summary of the findings is shown in Table V. Since the fish were collected in late August, they were almost a full growing season older than is shown by the number of annuli, as listed in the table. The number of specimens upon which each average is based is also shown. Most of the age groups are too poorly represented to give good averages. However, when considered in combination with adjacent age groups, some indication is given of the growth of the various species in the lake.

Table V
Growth Rate of Game Fish of Roland and Gerald Lakes*

	Roland Lake			Gerald Lake		
Annuli	Number individuals	Average total length (inches)	Average weight (ounces)	Number individuals	Average total length (inches)	Average weight (ounces)
Smallmouth bass						
II	...	...	...	1	11 1/8	12.2
III	1	11 7/8	14.8	1	12	13.6
IV	1	15 3/4	31.2	2	12 1/2	15.0
V	1	19	52.0	...	...	...
VI	1	17 1/2	34.9	...	...	...
VII	...	...	...	1	15 1/4	25.0
Common sunfish						
IV	...	...	...	1	7 3/4	6.7
V	1	7 7/8	5.8	...	...	...
Bluegill						
III	...	...	...	3	7 5/8	4.9
Perch						
II	2	5 1/8	0.7	...	...	...
III	6	6 1/4	1.4	...	...	...
IV	5	7 1/2	2.4	...	...	...
V	3	8 3/8	3.5	...	...	...
Rockbass						
IV	...	...	...	1	8 1/8	6.0
V	...	...	...	2	8 5/8	6.8
VI	...	...	...	1	9 5/8	11.2
VII	...	...	...	2	9 3/4	10.1

* Age determinations by W. C. Beckman.

According to the State averages determined by Dr. W. C. Beckman, the smallmouth bass reaches legal size (10 inches) during the 3rd summer of life, the common sunfish and bluegill (6 inches) during their 4th, the perch (6 inches) during its 3rd, and the rockbass (6 inches) during its 5th. Inspection of Table V shows that all species in Roland and Gerald Lakes, except the perch, are growing at an average or better than average rate. Further comparison with tables of state averages shows that all of the species shown in the table, except perch, have very near average or above average weight in comparison to their lengths. In other words, most of the fish in Roland and Gerald Lakes are growing well and are in good condition. All age groups of perch are stunted in growth, being not only short in length for their age, but also light in weight for their length.

In view of the presence of young-of-the-year of all game species in Roland Lake and Gerald Lake before the usual fall stocking had occurred, there can be little doubt of the successful natural propagation of all species present. No gravel was found in either lake by the survey party, but apparently both smallmouth bass and rockbass are reproducing successfully.

Management Suggestions

Roland and Gerald Lakes are at the present time in the "all others" classification. The survey data show this to be the proper designation, and no change is recommended.

Since, as has been noted above, all the game species in Roland and Gerald Lakes (except perch in Roland Lake) are growing well and are in average or better condition, and are furnishing fairly good fishing, any special management seems unnecessary. However, in view of the fact that

all the game species appear to be reproducing well at the lakes, it does not appear probable that a future stocking program is necessary. Once centrarchid species become established in a lake, it is the exception rather than the rule when natural reproduction is inadequate to insure continued maintenance of their numbers. In view of the apparent adequacy of spawning facilities in the lake for all the species which it is desirable to perpetuate, it is suggested that all stocking be discontinued in the lakes for a period of 3 years. During this period the district fisheries biologist should check the lakes each summer to determine the extent and adequacy of natural reproduction of the various species. If it is seen to be insufficient, artificial stocking should be resumed. Under no circumstances should perch ever again be stocked in either lake.

In view of the very significant departure from the past stocking policy which the above recommendation prescribes, some unfavorable comment from those interested in Roland and Gerald Lakes may possibly be forthcoming. It should be pointed out here that any fluctuation in the quality of the fishing during the next three years will not be a reflection of the change in stocking policy, since at least three years are required for a given year's production of young to reach legal size. If adequate observations are made in the interim, a decrease in the numbers of young would become evident before any significant damage to the fishing itself had occurred.

One bittern and several kingfishers were seen by the survey party, and some evidence of the presence of great blue herons in the vicinity was observed. No significant damage is done by these or any other birds or mammals which might occur at the lakes, in their capacity as predators.

However, water birds are final hosts of two of the parasites (black spot and yellow grub) which occur at the lake, and in this capacity they do affect the fisheries. Although there are no records from Roland Lake, it was found that 3 types of fish parasites occur at Gerald Lake (very probably these also occur in the fish of Roland Lake). Black spots (Neascus) were found in small numbers in the skin and fins of rock bass, and the skin of common sunfish, bluegills and smallmouth bass. A few yellow grubs (Clinostomum) were found in the musculature of the latter species. The larval bass tapeworm (Proteocephalus) was found in abundance in the gonads, intestine, liver, and peritoneal cavity of older specimens of smallmouth bass. Younger fish of this species were less severely affected. The parasitism in Roland and Gerald Lakes is insufficiently heavy to substantially reduce the quality of the fish for eating (none of the parasites found are harmful to man), and the organisms have no apparent effect upon the growth and development of the fish themselves (the bass tapeworm may, in cases of heavy infection, attack the gonads and prevent reproduction of its host. Apparently this occurs only rarely at Roland and Gerald Lakes). In view of the small extent of the damage being caused, and the fact that control of the parasites under natural conditions is both difficult and impracticable, no control measures are here recommended.

Cover present in Roland and Gerald Lakes appears to be adequate to meet the needs of the fish population there, and no improvements seem necessary. Spawning facilities are also believed to be adequate, as has been discussed earlier in this report.

INSTITUTE FOR FISHERIES RESEARCH

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