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A FISHERIES SURVEY OF MIRROR LAKE, ONTONAGON COUNTY

by

Paul Eschmeyer

Introduction

Location and Accessibility

Mirror (Little Carp, Muriel) Lake is located in Section 2 of T. 50 N., R. 44 W., Little Carp Township, Ontonagon County, in the Upper Peninsula of Michigan. The lake is situated about 2½ miles south of the well known Lake of the Clouds, in the Porcupine Mountains, and is separated from the latter water by a narrow but steep divide. Mirror Lake lies near the headwaters of the Little Carp River.

The City of Ontonagon is about 25 miles east and slightly north of the lake. The water is one of the least accessible of Michigan's lakes, and cannot be closely approached by automobile. It lies in the heart of one of the few remaining undeveloped wilderness areas of Upper Michigan. The nearest access to the lake is a foot trail through the woods, about 4½ miles in length. The trail begins at the western extremity of highway M-107, 9 miles west of Silver City (or 22 miles west of Ontonagon), and terminates at the north-central shore of the lake. A second trail, about 9 miles in length and passable by horse and wagon with great difficulty, leads to the southeast end of the lake from the now abandoned Nonesuch Mine, which is situated east and slightly south of the lake.

Map and Survey

The map of Mirror Lake, which includes the shoreline, shore features, depth contours and bottom types, was supplied by the United States Forest Service, the physical survey having been made by the C.C.C., under the direction of members of the staff of the Ottawa National Forest, within the boundaries of which the lake lies.

A regular biological survey of Mirror Lake was made on August 29 and 30 by Dr. A. S. Hazzard and the writer at the request of Mr. Roy Johnston, District Supervisor of Fisheries Operations. Mr. Johnston made the arrangements for the transportation of the equipment by wagon and secured permission from Mr. John Hawley, of Ontonagon, for the use of his cabin on the lake shore, to serve as quarters for the party while the field work was being done. Mr. Johnston also accompanied the party and assisted in the survey.

History and Recreational Development of Mirror Lake

Mirror Lake, being located in a natural wilderness area, has undergone a minimum of recreational development. The area immediately surrounding the lake has never been of any particular industrial importance, since it has never been logged or otherwise developed. The history of past fishing in Mirror Lake is somewhat obscure. Apparently, however, fishing for brook trout has been good in the past, but has declined during recent years with an apparent continued increase in the chub population. The population of this species has apparently always been large, however, since Ruthven* mentioned the abundance of chubs in Little Carp Lake in 1906. The inside walls of the 2 cottages on the

*Ruthven, A. G., "The Cold-blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan", An Ecological Survey of Northern Michigan (prepared under the direction of Chas. C. Adams), State Board of Geological Survey, Lansing, Michigan, 1906.

north-central side of the lake contain many unfavorable inscriptions regarding the large numbers of chubs in the lake, the self-styled creel records showing a predominance of chubs over trout in a ratio of probably over 50 to 1. Several records of excellent fishing have appeared, however, in creel census records obtained in the past by the Department of Conservation. In May, 1928, 12 hours of fishing yielded 30 legal trout averaging 9 inches in length. Fifty trout of sub-legal size were taken during the same period. In June and July of 1929, 97 hours of fishing produced 204 legal trout with an average size of 9.7 inches, and 133 undersized trout. In May, 1931, 12 hours of fishing resulted in the taking of 40 legal trout with an average size of 12 inches. No mention was made of chubs in these earlier records, but by 1939, reference to large numbers of chubs appeared on almost all creel census returns, and the catch of brook trout per hour was much lower. During that year, 57½ hours of fishing yielded only 38 legal trout, averaging 8.3 inches in length. The records discussed are too small in number to permit sound conclusions, but they seem in general to indicate a decline in the quality of trout fishing in Mirror Lake.

There are no boat liveries, hotels, or resorts near Mirror Lake. The lake is fished lightly during the summer and not at all during the winter.

Mirror Lake might be of considerable importance as a public fishing water and would doubtless be much frequented if it were less inaccessible and if the quality of the fishing were brought back to its former levels. However, it seems highly desirable that it be retained in its present position as a lightly fished lake, inaccessible by road, near the center of one of the very few remaining wilderness areas of the state. Plans are at the present time under consideration by the state and national governments to insure the preservation of this wilderness area, and it seems possible that its present status will be maintained.

Physical Characters of Mirror Lake

General Physical Characters

The basin of Mirror Lake is irregular in shape, has an area of 83 acres, and a shoreline which is 12,100 feet, or 2.29 miles in length. The major axis of the lake extends in an approximately east-west direction. The basin has two major depressions, the deepest of which is in the southeast portion of the lake and has a maximum depth of 40 feet. The other, in the west end of the lake, reaches a depth of 30 feet. The relation between shoreline and area of the lake indicates a shoreline development of 1.79, which means that the lake has a shoreline 1.79 times longer than a perfectly circular lake of the same area would have. Ordinarily, the greater the shoreline development of a given water (i.e., the greater the number of bays and coves) the greater is its productivity.

The declivity from the shore to the depths is quite gradual in much of Mirror Lake, although a few rather steep "drop-offs" are present. The shoals range in width from about 20 to 600 feet in the main body of the lake, while the narrow, shallow south bay may be considered almost entirely shoal. Shoal areas constitute about 20 per cent of the total area of the lake.

The bottom types in Mirror Lake include sand, gravel, pulpy peat, and some muck and silt. Sand, interspersed with small amounts of fine gravel, is found very close to the shoreline along much of its length, while the other soils are in general restricted to the deeper waters. Silt and muck soils encroach to the shoreline at some points, particularly in areas near some of the inlet streams.

The water of Mirror Lake is slightly brown in color, but is relatively transparent. A Secchi disk (white metal disk about 6 inches in diameter), when lowered into the water, disappears from view at a depth of 7 feet. This

represents about average transparency for waters of the vicinity. The degree of clearness of the water is one important factor which helps determine the depth to which aquatic vegetation will grow in a lake. Most aquatic plants require light to survive.

Geologic Origin of Mirror Lake*

The Porcupine Mountains, near the south boundary of which Mirror Lake lies, were present during pre-glacial times in somewhat different form, consisting chiefly of huge, erosion resisting, crystalline masses standing in relief as monadnock ridges above the peneplain which covers the western portion of the Upper Peninsula of Michigan. Glacial action scoured out the gaps, rounded off the hills, and filled the valleys with heavy deposits of drift, obscuring much of the former surface. The area today is thus covered, for the most part, with glacial material through which rock knobs project. It seems probable that, during this glacial action, the basin of Mirror Lake was formed.

Drainage of Mirror Lake

The drainage basin of Mirror Lake is restricted largely to the areas immediately adjacent to the lake. About 3 square miles is drained. This area is bounded by the Carp River tributaries on the north and the Little Iron River on the south. Most of the drainage basin has a sandy soil and is densely wooded. The basin has never been logged and magnificent stands of virgin white pine border some parts of the shoreline. Virgin hardwood timber areas cover other portions of the drainage. Rock outcrops are common.

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*Part of this discussion is based on Scott, I. D., Inland Lakes of Michigan (Lansing: Wynkoop, Hallenbeck, Crawford Co., 1921). This author does not specifically discuss the geological origin of Mirror Lake.

The water level in Mirror Lake does not fluctuate appreciably, and any fluctuation which occurs has no particular significance in the management of the fishery there.

Mirror Lake has 6 inlets, 5 of which are very small streams, or good sized individual springs. Two of these enter the extreme southeast end of the lake, and three enter the water along the north shore. They are all quite small except during time of heavy precipitation or during the spring break-up period. The principal inlet is the Little Carp River, which rises to the north and east of Mirror Lake and enters its northeast shore. It is a shallow stream, about 10 feet wide near the mouth.

The only outlet of Mirror Lake is likewise the Little Carp River, a stream about the size of the lake's chief inlet. It leaves the western extremity of the lake. The stream follows the south and west boundaries of the principal group of hills of the Porcupine Mountain Range, flowing through Lily Pond Lake (about one mile below Mirror Lake) and entering Lake Superior just west of the west boundary of Ontonagon County. No dam crosses the outlet between Lake Superior and Mirror Lake.

Temperature and Chemical Characters of Mirror Lake

Significance of Temperature and Chemical Data

As a part of the survey conducted at Mirror Lake, various physical and chemical data concerning the lake water itself were collected. Temperature of the water at various depths was observed, and pertinent information concerning the dissolved gases and minerals in the water was obtained. Such data are very important in assisting to determine the degree of adaptability of a lake to the various fish species. All fish have certain ranges of temperature and dissolved gas content (specific for each gas) which they will tolerate, and within these ranges are optima. Not only the ranges,

but particularly the optima, vary among the different fish species, as well as among food organisms and other organic life in the waters.

Temperature of the Water

The analysis made at Mirror Lake on August 29 showed a surface temperature of 62.8°F. The air temperature at the time of the observation (11 A.M.) was 64.8°F. Bottom temperature, at a depth of 33 feet, was 42°. A thermocline (area of rapid change in temperature, e.g. at least one degree centigrade per meter of depth) was found to be present, extending from a depth of 12 to 24 feet, with a temperature at the top of this stratum of 61.9° and a 24-foot reading of 43.5°. The presence of a thermocline in a lake indicates a division of the lake into 3 different horizontal strata during the summer months. The uppermost of these is the epilimnion, which is a warm, circulating surface layer of water above the thermocline (described above). The hypolimnion is a layer of cold, non-circulating water below the thermocline. If oxygen is adequate in the hypolimnion or thermocline, a lake will ordinarily support cold-water species, such as trout. If a given lake has no thermocline, or if the thermocline or hypolimnion has less than 4 parts per million of oxygen, the lower strata of water are either not suitable for fish or are generally too warm for cold-water species. Such a lake can ordinarily be managed only for warm-water species. Although the surface temperatures taken at Mirror Lake at the time of the survey (about 63°F.) were well below the toleration limit of brook trout (about 70°F.), there may be some periods during some summers when waters above the thermocline are too warm to support trout.

Oxygen

Mirror Lake was found to have adequate oxygen in the upper portions of the thermocline to support trout. This condition would be expected in view of the fact that brook trout have been caught in the lake for some years,

as has been previously mentioned. It would be possible, however, in the case of a lake such as Mirror Lake, for the trout to spend the summer in certain zones very close to spring-fed inlet streams. Such inflowing water would be of sufficiently cool temperature and may be saturated with oxygen.

An oxygen content of 0.1 part per million was found at the bottom of the lake. At a depth of 21 feet, near the bottom of the thermocline, only 2.4 parts per million were found. Near the top of the thermocline, however, at a depth of 15 feet, 6.8 parts per million were found, which is ample for trout. The area above this depth would logically be expected to have about as much or more of the dissolved gas.

Other Chemical Characters

Only very small amounts of carbon dioxide were found in Mirror Lake. This gas is not present in sufficient amounts to require consideration in the management of the fishery there.

Methyl Orange Alkalinity tests (designed to determine the amounts of certain mineral and buffer salts in the water) showed the water in Mirror Lake to be very soft. A Methyl Orange Alkalinity of 21 parts per million was found at both the surface and the bottom of the lake. Ordinarily waters with a considerably higher Methyl Orange Alkalinity (from about 100 to 200 parts per million) are more productive than are soft waters such as Mirror Lake. However, many Michigan Lakes with an equally low Methyl Orange Alkalinity produce good growth in trout. As a matter of fact, many, if not most, of the trout lakes have soft water, and they are characterized by being low in their general productivity.

The pH (hydrogen ion concentration) of the water in Mirror Lake ranges from 6.0 to 6.8, or from quite acid to slightly acid (7.0 is the neutral point). Ordinarily, lakes which are slightly alkaline are more productive

than are neutral or acid waters. This appears to be most easily observed when applied to warm-water fishes, however, and many of the State's good trout lakes have hydrogen ion concentrations similar to that of Mirror Lake.

No pollution was found to exist in Mirror Lake. This would be expected in view of its far removal from sources of domestic or industrial wastes.

Biological Characters of Mirror Lake

Vegetation

A record of the vegetation found by the survey party, and an estimate of its abundance, is shown in Table I. The entire lake has a narrow fringe of vegetation near the shoreline, and, especially on the shallower shoals, rather large areas are covered with aquatic plants. Adequate vegetation seems to be present to meet the needs of the lake and its fauna.

Table I
Vegetation Present in Mirror Lake,
With an Estimate of its Abundance*

Species	Abundance
Water marigold (Megalodonta Beckii)	Sparse
Water shield (Brasenia Schreberi)	Abundant
Needle rush (Eleocharis acicularis)	Sparse
Rush (Eleocharis sp.)	Common
Horsetail (Equisetum fluviatile)	Sparse
Water milfoil (Myriophyllum sp.)	Sparse
Bushy pondweed (Najas flexilis)	Sparse
White water lily (Nymphaea odorata)	Common
Yellow water lily (Nuphar variegatum)	Common
Leafy pondweed (Potamogeton epihydrus)	Sparse
Variable pondweed (Potamogeton gramineus var. graminifolius f. myriophyllus)	Sparse
Floating-leaf pondweed (Potamogeton natans)	Sparse
Pondweed (Potamogeton panormitanus var. minor)	Sparse
Dwarf wapato (Sagittaria teres)	Sparse
Duck potato (Sagittaria sp.)	Sparse
Bur reed (Sparganium sp.)	Sparse
Musk grass (Nitella sp.)	Common

*Identifications made by B. M. Robertson, Department of Botany, University of Michigan.

Fish Foods

Plankton (microscopic free-floating plants and animals) is of average abundance in Mirror Lake. The dominant type was animal plankton at the time of the survey, and crustaceans were the prevalent types of organisms. Phantom midge larvae (Corethra) also appeared in the plankton sample collected.

Midge larvae were the dominant bottom foods in the deeper portions of Mirror Lake. These and numbers of dragonfly nymphs were present on the shoals. By and large, the bottom foods in the lake are quantitatively and qualitatively sparse. For the existing population of trout and chubs, however, the quantity of food is apparently adequate. Although no stomachs of chubs were examined in the field, the examination of a number of brook trout stomachs revealed that at this time of year this species feeds more on forage fish than on the insects available in the lake. Sticklebacks appear to be the most readily available or most desired trout food, since 7 out of 18 stomachs examined contained this forage fish. Chubs were found in 3 stomachs, and unidentified fish remains in 5. Insects or insect remains formed all or a part of the stomach contents of 6 fish.

Fish Present in Mirror Lake

Fish present in Mirror Lake, as indicated by collecting done during the survey, included only a single game species--brook trout. Trout are fairly abundant in the lake and range from 6½ to 12 inches in length. Among the trout collected were two specimens which may represent an as yet undescribed sub-species.

Common suckers were the only coarse fish taken in the lake. Those collected ranged from 1 1/4 to 18 inches in length, and were caught commonly.

Forage species found in the lake include creek chubs (very abundant), fat-headed minnows (common) and black-nosed dace (common). Although none

were taken in the seining, field analysis of the stomach contents of a number of brook trout, as described above, revealed that sticklebacks (very probably the rather rare 9-spined form) are relatively abundant in the lake.

The population of fish in Mirror Lake is somewhat unusual, due to the fact that creek chubs and black-nosed dace ordinarily restrict themselves to stream habitats, particularly to rather warm and moderately sluggish trout streams.

Growth Rate of Brook Trout in Mirror Lake

The growth of brook trout in Mirror Lake seems to be somewhat below average for lakes of the Upper Peninsula of Michigan. Growth of trout in lakes usually is consistently better than in streams, when the lakes are at all suitable for the species. In Mirror Lake the growth of trout up to 3 summers old is probably about average for streams of the Upper Peninsula. Fish near the end of their third summer of growth reach an average length of 7 3/4 inches and an average weight of 2.9 ounces. Four-summer-old trout have an average length of 9 1/4 inches and a weight of 5.1 ounces. Although the 3-summer-old fish have about average growth, the 4-summer-old fish appear to be slightly stunted, judging by the scant available data on the growth of brook trout in Michigan.* Fish nearing the end of their fourth year should be about an inch longer than are those which were collected from Mirror Lake, judging by averages which have been obtained for stream fish. Lake fish would be expected to grow even faster than those living in streams. The relatively slow growth of trout in Mirror Lake may be traceable to the competition for food and space offered by the unusually large population of chubs.

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*Shetter, David S., "Trout Stream Population Study on Hunt Creek, September, 1940", Institute for Fisheries Research Report No. 682 (manuscript).

Natural Propagation

All the trout in Mirror Lake are wild fish, no artificial stocking having been undertaken during at least the past 7 years, and very probably not before then. (The Institute also has no record of any trout stocking in the lake's tributaries or outlet.) Spawning facilities are excellent for brook trout (and, unfortunately, equally ideal for chubs). The inlet streams form good spawning habitats, and no doubt all the trout in the lake enter the inlets to spawn. Chubs and black-nosed dace spawn in habitat similar to that used by brook trout. Both require streams for spawning. Mirror Lake is one of the relatively few Michigan lakes in which natural reproduction of brook trout occurs. It seems very probable that, if chubs were removed from the lake, a good-sized population of brook trout could be built up and would sustain itself entirely without artificial stocking.

Management Suggestions

Designation of Lake

Mirror Lake is now designated as a trout lake and there is no reason for changing this classification.

Stocking

No stocking should be done in Mirror Lake. Planting of hatchery fish would not improve the fishing, as the lake is now, without doubt, producing as many trout as possible under existing conditions. It seems improbable that the size of the trout population in Mirror Lake will ever be restricted by inadequacy of natural spawning facilities.

Predators and Parasites

Only one kingfisher was seen at the time of the survey, and it is highly improbable that any advantage could be gained by the control of predators which may occur at the lake.

Parasites are rare in the brook trout of Mirror Lake. About half of the trout examined had very scattered "black spot" parasites in the skin. Only 3 to 6 such parasites occurred on any individual. A few trout are apparently infected with the common yellow grub. One of the larger trout examined had a single yellow grub in the body musculature. No others were seen. Cysts were found in the kidneys of a few fish. In general, the parasites in Mirror Lake are much too sparse to impair in any way the quality of the fish or fishing, and no control measures are necessary. None of the parasites present are in any way harmful to man.

Cover

The cover in Mirror Lake is made up of the vegetation in the lake, a few deadheads and windfalls, and occasional large boulders and rocks. Dense growths of alders overhanging some of the banks offer additional fish shelter. The cover in the lake appears to be adequate and no improvements are recommended.

Water Level and Spawning Facilities

No advantage could be gained by bringing about a change in the present, long established, stable water levels at Mirror Lake.

As has been mentioned earlier, the inlet streams furnish excellent spawning habitat for brook trout, and no improvements are necessary.

Control of the Fish Population

The key to better trout fishing in Mirror Lake lies almost completely in control of the numbers of chubs in the lake. This species apparently offers intense competition to the trout for food, shelter and space. Also, just as trout eat small chubs, the latter are likewise known to consume small trout. The lake habitat appears to be equally suitable for both species, but the greater reproductive potential of the chubs has apparently swung the balance in their favor during the course of the past 8 or 10 years. Good trout fishing cannot be expected until this balance has been reversed.

The problem of controlling the chub population does not offer itself to easy solution. Introduction of a highly pisciverous (fish-eating) species of fish to control the chubs would not constitute an answer to the problem, since such species would logically be expected to reduce the numbers of the fish which it is desired to encourage, namely brook trout, just as readily as it would control the chubs. Removal of the entire population by poisoning, with subsequent stocking with trout would not only destroy the present, apparently quite sizable native trout population, but would also be a costly venture, the success of which would be relatively uncertain when considered over the span of a number of years. It cannot be said with certainty that the chubs from inlet streams would not completely restock the lake before trout had had a chance to become firmly reestablished. Furthermore, the very light fishing on this relatively inaccessible lake would not justify the expenditure involved. The inlet and outlet streams are almost entirely inaccessible at some points, and the poisoning of the entire Little Carp River drainage would be very costly and probably would not result in the eradication of the chubs from the area for any appreciable length of time.

In discussing the possibilities of the use of poison in controlling the chub population, note should be taken of the fact that a partial poisoning of the lake might accomplish the results here desired. Sufficient poison might be placed in the lake to produce a lethal effect in that portion of the water above the thermocline. Several uncertainties attend the suggestion of such a method, however. Even though a thermocline is known to form in the lake, it has not yet been established that the temperature in the epilimnion rises sufficiently high even in midsummer to cause the trout to seek the refuge of the cooler thermocline. It is likewise not known what percentage of trout in the lake would remain fairly near the surface, in

the cool-water areas present just off the mouth of each inlet stream. Again, it cannot be said with certainty that a large percentage of the chub population would not be mingled with the trout, in the thermocline, thus making such a partial poisoning relatively ineffectual.

In consideration of poisoning or partial poisoning, it must be remembered that Mirror Lake is located in a beautiful, scenic wilderness area, and that it has never been stocked or in any way tampered with by man (insofar as can be determined from Department of Conservation records). A plan of eradication of the fish population by application of a commercial poison has little to offer that is not repulsive to the esthetic sense.

An alternative to the removal of the chub population, or a large part of it, as has been considered above, would be to control it by preventing its reproduction. If chubs absolutely require streams to spawn, some means of keeping the chubs out of the streams should cause the elimination of the population after the life spans of the present population of fishes have been spent. However, creek chubs, if entrance into streams is prevented, are known to be able to spawn in the lake itself, just beyond the mouths of inlet streams, where a current of water passes over a gravel bottom. Since these conditions are present outside the mouths of several inlet streams, the prevention of spawning of the chubs would be a difficult task, since mere blocking of their passage up streams would be an insufficient control measure.

A workable means of removing the chubs from Mirror Lake would be to place a weir in each of the inlet streams, and the outlet, during the spawning season of the chubs, and to destroy the chubs after their capture in these weirs. It would be necessary to operate such weirs from about April 25 to June 15. Trout spawning would not be interfered with, since brook trout spawn in the fall. Weirs would require daily attention during the period of

their operation. It would be expected that a single season of operation would very materially reduce the adult chub population in the lake, in addition to preventing natural reproduction of the species. The volume of the catch of chubs would probably help determine a future course of action. One-summer-old chubs would not be expected in the weirs, since they would probably not spawn. The use of the weirs during 2 successive seasons, however, should sufficiently reduce the chub population to give the trout the "balance of power" for an indeterminate number of years. The operation might have to be repeated in the future, since chubs would probably re-enter the lake from tributary streams. Since these streams are quite shallow, however, with few deep holes, it is quite possible that considerable numbers of the stream-inhabiting chubs, in the face of severe northern Michigan winters, might retreat to the lake during the cold months of the year. Such fish would also, of course, be captured in the weirs.

It could probably be arranged for the weir operator to use one of the two cabins on the shore of the lake for living quarters.

It is recommended that the operation of weirs in the inlet and outlet streams of Mirror Lake be undertaken during the spring of 1942 or 1943, as described above.

Further Investigations

Little literature is available concerning the inter-relation of trout and chubs, particularly under lake conditions. It would be highly desirable for the operator of the weirs to keep a careful daily record of numbers of chubs removed from the lake, and to take a good random sample of lengths and weights of the fish so that the weight of fish removed can be accurately estimated. Since no disadvantage would be likely to accrue from the presence of suckers in the lake, fish of this species should be allowed to continue upstream after being removed from the weirs.

During the course of the biological survey of Mirror Lake, there were found along the southeast shore the partially disintegrated remains of a fish which, although it could not be identified, could be recognized as being different from any species collected in the lake by the survey party. The fish had some characters of a smelt or cisco. Such a record for the lake would be extremely interesting, and the presence of either species might make desirable a change in the method of management of the lake. Further fish collections should be made to attempt to capture fresh specimens of the fish.

Further collections of trout should be made at Mirror Lake with a view in mind of obtaining enough individuals of the supposed new sub-species of trout in the lake to permit its description and an entry of the findings into taxonomic literature.

Sticklebacks were collected at Mirror Lake only from fish stomachs, and these were all pretty well disintegrated. Collection of fresh specimens should be further attempted to verify the belief that the form present is the relatively rare nine-spined stickleback (Pungitius pungitius).

At least one form of vegetation present in Mirror Lake was seen but not collected during the brief period of the survey. Collections of this plant should be made. Also, several more bottom samples should be taken to complete and round out the survey data on the lake.

It is expected that at least some of the above investigations could be undertaken by the operator of the weir during his stay at the lake.

INSTITUTE FOR FISHERIES RESEARCH

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