Original: FishDivision
cc: Education-Game
Mr. Stanley Shust 1-30-42
Mr. Paul Eschmeyer

INSTITUTE FOR FISHERIES RESEARCH
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ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
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A FISHERIES SURVEY OF HOLLAND LAKE, LUCE COUNTY

by

Paul Eschmeyer

Introduction

Holland Lake is located in Sections 26 and 27 of T. 49 N., R. 11 W. of McMillan Township, Luce County, in the eastern portion of the Upper Peninsula of Michigan. The lake is situated about 27 miles north and slightly west of the City of Newberry, and 4½ miles southwest of the Village of Deer Park. The water is the most northerly of a rather compact group of about 20 small lakes, which include Camp Eight, Peanut, Pratt, Long and others. Muskallonge Lake is 3 miles north of Holland Lake. The latter water lies in the Two Hearted River drainage, although, being without an inlet or outlet, it has no connection with the stream.

Holland Lake is reached by following highway M-48 and County Road 407 north from Newberry for a distance of about 25 miles, to the point of intersection of Road 407 with the Two Hearted River. About 500 feet beyond (north of) the river, County Road 416 turns west from 407 toward West Fire Tower and Holland Lake. The lake lies about 2½ miles west of this point.

The shoreline, contour and bottom type map, as well as a biological and chemical inventory of Holland Lake, were made by Dr. A. S. Hazzard and the writer on August 8-10, 1941.

Holland Lake is quite far removed from population centers and has had no direct relationship to industry in the past. Although it has always been only lightly fished, some excellent catches of brook trout have been made in the past. Brook trout fishing, particularly in the early season, was considered good until about 1938, when it began declining steadily, becoming extremely poor by 1941. The decline in quality of fishing seems to bear a direct relationship to the unauthorized planting of some sunfish in about 1932. The sunfish had become well established by 1938, were stunted, and, together with the large numbers of minnows and suckers present, had all but crowded brook trout entirely out of the picture by 1941.

There are no cottages, hotels, resorts or boat liveries at Holland Lake. A Superior State Forest Camp Ground, located on the southeast shore, is much used during the summer months.

Under proper management, it can be expected that Holland Lake will furnish as good brook trout fishing in the future as it has in the past, and that it will resume its former status as one of the outstanding trout lakes of the area. The small size of the lake will continue to limit its production of trout in the future as it has in the past, however, and it cannot be expected to withstand continued heavy fishing pressure throughout the year.

Physical Characters of Holland Lake

The basin of Holland Lake is roughly circular in shape, and has an average diameter of about 450 feet, an area of 5.2 acres and a maximum

depth of 22 feet. The relationship between shoreline and area is such that the lake has a shoreline development of only 1.05. This means that the water has only 5 per cent (1.05 times) more shoreline than would have a perfectly circular lake of the same area. Ordinarily, the greater the shoreline development of a lake, the greater is its productivity, since added shoreward areas provide more food, shelter, and opportunity for reproduction (for many species) than does open water.

The basin of Holland Lake is of the "pot hole" type, and was probably formed by glacial action. The area surrounding the lake is moderately to densely wooded, rolling, and has chiefly sand soils. Relatively steep banks surround the lake on 3 sides.

Holland Lake has no inlet or outlet. Its drainage is restricted to the hills immediately adjacent to the lake. No significant fluctuation occurs in the lake, although an apparent lowering of the water table in the area within the past 10 years has caused a decrease in the water depth and about a 1-acre reduction in the size of the shoal area of the lake. About 25 per cent of the area of the lake may still be classified as shoal, however, and shoals range from 15 to 100 feet in width. The declivity from shoals to the depths is relatively gradual in most of the lake. The shoals have an almost exclusively sand bottom, while the deeper waters have a pulpy peat substratum, with some fibrous peat occurring in limited areas, mixed with the other bottom types.

The water in Holland Lake had a slightly greenish cast at the time of the survey, but was clearer than the average waters of the vicinity. A Secchi disk (white metal disk about 6 inches in diameter) when lowered into the water, disappeared from view at a depth of 13 feet. The

transparency is important in helping to determine the depth to which aquatic plants will grow in a given water. None of the higher aquatic plants is able to survive in the continued absence of light.

Temperature and Chemical Characteristics of Holland Lake

As a part of the survey conducted at Holland 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 nature of the dissolved gases and minerals in the water was obtained. Such data are very important in assisting to determine the degree of suitability of a lake for the various fish species. All fish require a certain range of temperature and dissolved oxygen in order to live and reproduce successfully. Within these ranges they 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 water.

Temperatures of the water in Holland Lake at 11 A.M. on August 10 were found to range from 73°F. at a depth of 3 feet to 66°F. at the bottom of the lake. The air temperature was 66°F. A thermocline (area of rapid change in temperature--e.g., at least 1°C. per meter of depth) was found in the lake, extending from a depth of 15 feet to the bottom of the lake. Temperature at the top of the thermocline was 71°F. The water temperatures were probably about as high during the mid-August survey as they usually become during an average summer. With a temperature at the bottom of the lake of 66°F., it is seen that the lake would be suitable for cold-water fish (with temperature tolerations ranging up to 70°F.) such as trout, if there was sufficient oxygen in the lower strata of water to support such species.

A chemical analysis of the water near the bottom of the lake, at a depth of 20 feet, revealed an oxygen content of 11.5 parts per million. Both temperatures and oxygen content are thus seen to be suitable for trout. This would be expected in view of the fact that a considerable number of trout have been caught in the lake during past years. Although it might have been assumed that temperature and oxygen content were suitable for trout since the lake has supported trout for a period of years, the tests were made to be certain that the decline in reported trout productivity was not due to changes in temperature or oxygen content caused by the drop in water level already discussed.

Some carbon dioxide was found dissolved in the water of Holland Lake, but it is insufficient in quantity to require consideration in the management of the fishery there.

Methyl Orange Alkalinity tests (for the total alkalinity due to dissolved minerals and certain buffer salts in the water) showed the water to be quite soft. A dissolved mineral and salt content ranging from 18 to 24 parts per million was found. Ordinarily a Methyl Orange Alkalinity of from 100 to 200 parts per million is found in the more productive lakes. However, waters otherwise suitable for trout are often not very productive of either fish-food or fish. Many trout lakes in the state which are producing well have soft water.

The pH (hydrogen ion concentration) of Holland Lake was found to range from 7.2 to 7.4, or slightly alkaline (7.0 is neutral). Lakes with a pH similar to that of Holland Lake are generally more productive than are acid lakes.

No pollution was found at Holland Lake. None would be expected in view of the lake's far removal from sources of domestic or industrial wastes.

Biological Characteristics of Holland Lake

Frequently the biological attributes of a given water offer more important clues to the proper management of that water than do the physical or chemical characters. To determine the biological nature of Holland Lake, a number of observations and collections were made. Representative specimens of the various kinds of vegetation in the lake were collected and identified, samples of plankton (microscopic free swimming and floating plants and animals) and bottom foods were obtained, and fish collections were made.

Casual observation of Holland Lake would lead one to believe that vegetation is extremely sparse in the lake. Only a few isolated plants are visible. It was learned during the course of the survey, however, that aquatic plants, chiefly a submergent pondweed (Potamogeton pusillus), are exceedingly dense at depths of from 10 to 17 feet, forming a rather wide strip at these depths around the entire basin. This area of vegetation makes the difference between what would be a very barren lake and a water with adequate vegetation to meet its normal requirements.

A record of the species of vegetation found during the survey, with an estimate of their abundance, is shown in Table I.

Table I
Vegetation Collected At Holland Lake*

Species	Abundance
Spike rush (Eleocharis sp.)	Sparse
Quillwort (Isoetes Braunii)	Sparse
**Large-leaf pondweed (Potamogeton amplifolius)	Sparse
Pondweed (Potamogeton pusillus)	Abundant
Musk grass (Nitella sp.)	Sparse

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

** It was noted that the large-leaf pondweed occurred as single plants or in small groups only within, or very close to, the brush shelters which had been placed in the lake by the C.C.C. The shelters were installed about 1935. Since this plant occurred only in relation to the shelters and were found at almost every one of them, it may be assumed that the shelters are responsible for the limited quantities of P. amplifolius present in Holland Lake.

Plankton appeared to be fairly abundant in Holland Lake at the time of the survey, with Cladocerans being the dominant organisms. The one sample taken during the short survey period provides insufficient data from which to draw conclusions relative to the amount of plankton in the lake throughout the year. However, normally, the plankton is probably adequate to meet the needs of the sizes and species of fish requiring it for food.

Bottom foods were found to be quite sparse in Holland Lake. Samples taken showed no organisms present in the deeper waters, on the pulpy peat substratum, and only a very few midge larvae and dragonfly nymphs in the shallower waters. A few empty caddis cases were noted. The great abundance of pumpkinseeds in the lake may have been a factor in keeping the numbers of bottom organisms in the lake at a minimum. Considering the poundage and numbers of fish found in the lake at the time of poisoning and the generally favorable condition in the lake for fish, it would seem that Holland Lake should produce adequate food for a moderate number of trout.

The fish species present in Holland Lake, an estimate of their abundance at the time of the survey, and a record of artificial stocking during the 5 years preceding that time, are shown in Table II. Six of the species of fish listed did not appear on survey records, but were collected from the lake on a later date.

Table II

Fish Collected At Holland Lake, Their Estimated Abundance and Artificial Stocking

Species	Abundance	Stocking
GAME FISH		
Brook trout	Common	17,000
Pumpkinseeds	Extremely abundant	...
Yellow perch	Extremely rare	...
COARSE FISH		
Common sucker	Abundant	...
FORAGE FISH		
Black-nosed shiner	Abundant	...
Mimic shiner	Abundant	...
Blunt-nosed shiner	Abundant	...
Fat-headed minnow	Common	...
Golden shiner	Common	...
Red-bellied dace	Common	...
Fine-scaled dace (Pfrille)	Common	...
Pearl dace (Margariscus)	Rare	...
Log perch	Rare	...
Johnny darter	Rare	...
Mud minnow	Very common	...
Muddler	Common	...

Pumpkinseeds were more abundant than any other species. An unusually large number of suckers as well as forage fish of a variety of species were present. This very probably reflects the extensive use of minnows for bait by fishermen, and the emptying of the unused contents of minnow pails into the lake after fishing. This practice, together with the unauthorized stocking of sunfish previously mentioned, is probably largely accountable for the steady decline of trout fishing in Holland Lake.

The growth rate of pumpkinseed sunfish as judged by random samples of fish collected at the lake, is shown in Table III.

Table III
Growth Rate of Pumpkinseeds
in Holland Lake*

Number of Annuli	Number of Specimens	Average Length in inches
II	1	2 3/4
III	16	3 3/8
IV	31	4 1/8
V	8	4 3/8
VI	1	5 3/4
VII	1	5 1/2

* Growth rate determinations by W. C. Beckman

A pumpkinseed which grows at an average rate (in the State of Michigan) reaches legal size (6 inches) during the fourth summer of life. The largest fish captured in Holland Lake was in the 7th summer of life (with 6 annuli) and had not yet attained legal size. Fish of this species nearing the end of their fourth summer of life had barely attained one-half the length required to be legal. The data as presented in the table show very clearly the extreme degree of stunting which was occurring among Holland Lake pumpkinseeds at the time of the survey. Overpopulation due to lack of predation or low water temperatures, or both, may have been responsible.

All of the brook trout taken apparently dated back to the planting of 5,000 nine-month-old brook trout made in 1940, with the exception of 5 of the specimens collected at the lake which may have been stocked in 1939. No older trout were taken. Eighteen trout nearing the end of their second summer of life averaged 5 3/4 inches in length. Probably most of the fish were very near this size when originally planted. The trout taken during the survey were in fair condition, but those picked up at the time of poisoning (about a month later) were mostly thin and apparently starving.

Spawning facilities are very adequate in Holland Lake for pumpkinseed sunfish. In about 1935 the C.C.C. placed approximately 30 piles of gravel along the shore in water presumably from 1 to 2 feet in depth. At the time of the survey these were partly exposed, due to the drop in water level mentioned. In the absence of inlets or outlets, brook trout are unable to reproduce. No known improvements could be made at any reasonable cost at Holland Lake which might make it possible for the latter species to spawn successfully there.

Taken as a whole, the large population of undersized pumpkinseeds and the very limited population of thin, sub-legal brook trout present in Holland Lake represents about the poorest sort of a situation for a game fishery which it would be possible to conceive. Reference to past records of fishing in the lake give some indication of what should be possible to again achieve or surpass by proper management. A summary of creel census records taken in Holland Lake in recent years is shown in Table IV.

Table IV
Summary of Creel Census Records for
Holland Lake, 1934-39.

Year	Fisherman hours	Brook trout caught	Average size in inches	Brook trout per fisherman hour
1934	36	3	12.0	0.08
1935	64	102	9.4	1.6
1936	32	16	11.0	0.5
1938	46½	65	8.0	1.4
1939	19	92	9.0	4.8
1940	29	91	8.1	3.1

All of the records shown were taken very early in the year, during the first week of trout season. The best recorded catch was made on May 1, 1935, when two hours of fishing with a worm yielded 9 trout averaging 14 inches in length. Large numbers of undersized fish,

presumably pumpkinseeds, began appearing in the records in 1938 and thereafter. The records shown in the table are insufficient in number to give a good criterion of the general quality of the fishing, but merely show that the lake has in the past provided some good brook trout fishing on some occasions. The lake's reputation as a poor fishing water apparently got its beginning about 1938, as a result of excessive catches of undersized fish. In general, the total catch of trout is also said to have greatly declined in recent years.

Management Suggestions

As has been previously mentioned, Holland Lake, although suitable for trout, was, at the time of the survey, overrun with a stunted population of sunfish, a few brook trout (mostly undersized), suckers, and a large number of various species of forage fish. The lake was providing almost no fishing whatever, although in the past, before the sunfish became dominant, the lake furnished good brook trout fishing. It was readily apparent that if the pumpkinseeds and other competitive fish of no value could be removed and brook trout planted, the previous good fishing could again be expected. It was therefore recommended that the lake be poisoned to remove the entire present population of fish. All possible precautions should be taken to prevent fishing with minnows in the lake so that overpopulation with undesired species will not re-occur in the future. It was recommended that this lake be included in the list of those in which the use of live minnows would be prohibited. The legal bag limit should be reduced to 5 fish per man-day, so that the fishing may be extended beyond the first few days of the season, and so that more anglers may benefit by the plantings.

Since Holland Lake is at the present time a designated trout lake, no change in its classification is necessary.

Occasional snapping turtles have been reported from Holland Lake. A few painted turtles were seen at the time of the survey. Under the conditions present at the lake, neither these nor any other predators which might occur there would be likely to cause significant damage to the fishery. No control measures are recommended.

The pumpkinseeds in Holland Lake were found to be commonly infected with black spot and yellow grub parasites in the skin, musculature, and caudal fin. These parasites do not readily affect trout, and no control is practicable or necessary.

Cover in Holland Lake includes the considerable amounts of vegetation mentioned above, a number of logs and deadheads, and about 15 or 18 brush shelters placed in the lake by the C.C.C. The cover is adequate, and no additions or improvements are recommended.

No regulation of the water level is possible at Holland Lake, and spawning facilities cannot be provided for trout in the lake. Repeated stocking will be required to sustain the trout population.

Suggested Management Procedures Already Completed

The fish population in Holland Lake was poisoned on September 10 and removed. After it was determined by tests with live fish in cages that the toxicity of the lake water had become dissipated, there were planted, on October 20, 200 legal brook trout weighing one pound each, and 2,000 fingerling brook trout weighing 4 pounds per hundred. A detailed analysis of the nature of the fish population and the production of fish in Holland Lake is being made the subject of another report now being prepared by Mr. Louis Krumholz, of the Institute Staff.

INSTITUTE FOR FISHERIES RESEARCH

By Paul Eschmeyer

Report approved by: A. S. Hazzard

Report typed by: R. Bauch