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STUDIES ON CERTAIN LAKES OF KEWEENAW COUNTY

During the summer of 1938 the Institute for Fisheries Research* extended its regular inventory to five of the thirty inland lakes situated in Keweenaw County, Michigan. The waters studied included Gration, Medora, Fanny Hooe, Manganese and Bailey lakes. These constitute the most important accessible lakes of the county with the possible exception of Lac La Belle and are in general representative of the lakes in the peninsula.

Not more than 2000 years ago most of the Keweenaw lakes were very probably connected with the Great Lakes, whose level at that time was 35 feet higher than the present level of Lake Superior. As the old lake (referred to as Lake Nipissing) receded, the basins scooped out by glaciers many thousands of years before were left full of water. Some of the higher ones were undoubtedly left isolated at even an earlier time, probably 5000 - 10,000 years ago.

The lakes of Keweenaw County have rather small and shallow basins. Their areas, percentage of shoal (depth less than 20 feet), and maximum depths are given in the following table.

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* Survey party consisted of Dr. George M. Moore, leader; William Beckman, Stanley Baker and Floyd Ames, assistants.

Lake	Area in acres	Percentage of shoal	Maximum depth in feet
Gratiot	1,438	30	78
Medora	695	55	30
Fanny Hooe	231	30	48
Bailey	204	100	9
Manganese	52	60	27

On the whole, the lakes of this area are not very productive of aquatic life. This is partially due to the fact that their bottoms are rocky and their drainages short. Feeder streams flow only short distances through sterile soils and contribute very little to the fertility of the lake bottoms. Aquatic plants are either sparse or absent because of poor soil conditions on the shoals. This is especially true in Medora, where the shoal consists largely of bedrock. In Gratiot, Fanny Hooe and Manganese gravel and sand are the predominant bottom constituents in the shallow areas. Bailey Lake is in a class by itself with regard to bottom conditions because of its shallowness (maximum depth 9 feet). Its bottom is covered by a fiarly thick layer of pulpy peat (dead plant remains). The bottoms in the deeper portions of the other lakes are covered by a thin layer of peaty soil with the exception of Gratiot, which has deposits of muck and silt.

The waters of these lakes are considerably colder than those of lakes the same size in lower Michigan. There are no great summer extremes. It is doubtful if the maximum summer temperatures at the surface ever exceed 75° F., while the deeper water remains cold the year around. The growing season for the organisms that inhabit these waters is also much shorter than in lakes farther south which results in retarding the growth of both fish and fish-food organisms.

Surface temperatures taken during July and August ranged from 69-73°F. The botton temperatures of the deeper lakes varied between 48°F. in Gratiot to 62°F. in Medora. All of the lakes with the exception of Bailey, developed thermoclines. (A thermocline is a zone of water in which the termperature changes very rapidly). The effect of thermocline formation is often of great importance to the well being of fish because this zone or band of water acts as a blanket and prevents the mixing of the upper and lower waters. It tends therefore to keep the water cold below. In this respect it is often of value in maintaining suitable temperatures for cold water fish such as trout or cisco. Sometimes by this same blanketing effect, this layer of water prevents transfer of dissolved oxygen from the surface to the bottom waters and as a result all of the available oxygen in the deeper portions of the lakes may be used up. This condition usually comes about when there is abundant organic matter on the bottom (organic matter uses oxygen in the process of decay and may completely exhaust the supply). Fish going to the lower waters because its temperature is more desirable must either move up to the warmer waters or die from suffocation.

In the Keweenaw lakes studied, the formation of thermocline was not detrimental to the fish because the small amount of organic matter in these lakes does not reduce the oxygen in the lower waters to a critical point. The only oxygen-free waters detected were found as very restricted zones in the bottom of Gratiot and Manganese lakes. From the point of view of temperature conditions, the Keweenaw lakes, with the exception of the pond lakes such as Bailey, are more suited to cold water species that to warm water ones.

Chemical studies of these lakes show the water to be moderately soft, The average pH ranged from 7.1 in Gratiot to 7.8 in Bailey. This means

that the water is just barely alkaline. The total or methyl orange alkalinity ranged from 24 ppm. in Gratiot to 52 ppm. in Bailey. This is a comparatively low alkalinity when compared with lakes in limestone regions. It is definitely known that hard water lakes are more productive as a rule than soft water ones. The presence of a desirable quantity of alkaline substances in the water encourages a more luxuriant growth of useful vegetation, which in turn is necessary for good populations of fish and fish food organisms.

The food conditions in a body of water depend upon many physical and chemical factors, some of which have been mentioned. The physical conditions in these lakes have already been described as very suitable for a large production of fish. There is plenty shallow water for the production of food, but these shallow areas are without the proper nutrient conditions to encourage aquatic vegetation and its associated food organisms. The water is too soft to be very productive of the things fish need.

A rough measurement of the food organisms in these waters indicate only fair conditions. The four major categories used as a basis for food conditions are aquatic plants, plankton (very small organisms floating in the water), invertebrate organisms such as aquatic insects and shrimp and forage fishes. The following table shows the relative abundance of each for the lakes studied.

Name of lake	Vegetation	Plankton	Aquatic insects & other invertebrates	Forage fish
Medora	Very scarce. Little submerged	Moderate. Mostly algae	Midges and mayflies. Scarce	None
Gratiot	Very scarce. Little submerged	Moderate	Midges and mayflies. Scarce	Common
Fanny Hooe	Moderately abundant. Localized submerged	Moderate	Caddis, stoneflies, midges and crayfish. Abundant	Few
Manganese	Abundant. Submerged and floating	Moderate	Midges and mayflies common. Stoneflies, caddis and Crayfish abundant	Abundant
Bailey	Very abundant. Submerged and floating	Abundant.	Midges, mayflies, shrimp, leaches abundant	Abundant

As can be seen, Medora Lake is the least productive of the food elements needed, and Bailey Lake is the most satisfactory in this respect. This does not mean, however, that Bailey Lake is best suited for all species of fish, but simply that this lake or pond produces more food per surface acre than the other lakes. Medora and Gratiot are poor in the required food items, while Fanny Hooe and Manganese are moderately rich when compared with the lakes of the region but only fair when compared with the more productive lakes of the state.

The different kinds of fish found in each lake at the time of the survey are listed below.

Name of Lake	Game Fish	Forage Fish	Coarse Fish
Medora	Bluegills Perch Walleye (young of year) Smallmouth bass Whitefish	None taken	Common sucker
Gratiot	Small number of bass Rock bass Perch Northern pike	Johnny darter Iowa darter Muddler Blunt-nosed minnow Log perch Stickleback	Common sucker
Fanny Hooe	Perch Rock bass Brook trout Smallmouth bass Largemouth bass	Black nose shiner Johnny darter Log perch Muddler	Common sucker
Manganese	Brook trout Smallmouth bass Largemouth bass Bluegill	Lake chub Fine-scaled dace Red-bellied dace Johnny darter Iowa darter Stickleback Brassy minnow	None found
Bailey	Northern pike Perch	Black nose shiner Spot tail shiner Golden shiner Johnny darter Muddler	None taken

No obnoxious fish were found in these lakes and the only coarse fish taken was the common sucker.

The futility of stocking warm water species in certain of these lakes is obvious when the planting records are examined.

Fish Planted in the Keweenaw Lakes between 1934-1938

Name of Lake	Year	Pike Perch		Black bass (largemouthed)		Perch	Bluegills	Brook Trout	Lake trout
		Fry	Adults	Fingerling	Adult	Fingerling	Fingerling	Fingerling	Fingerlin
Medora	1934	...	...	2,500	...	3,400	15,000	...	...
	1935	...	...	900	...	4,000	10,000	...	...
	1936	...	...	900	...	5,000	20,000	...	4,000
	1937	...	...	800	...	4,500	25,000	...	...
	1938	...	...	500	...	...	20,000	...	7,500
Gratiot	1934	...	...	1,200	...	...	...	...	...
	1935	375,000	...	500	...	4,000	10,000	...	...
	1936	350,000	...	500	...	...	20,000	...	6,000
	1937	225,000	...	1,000	...	...	25,000	...	...
	1938	500,000	...	500	...	...	25,000	...	7,500
Fanny Hooe	1934	...	...	1,200	...	10,600	10,000	...	...
	1935	...	...	900	...	4,000	9,000	....	...
	1936	...	...	1,000	...	3,000	20,000	...	...
	1937	...	...	800	...	4,500	25,000	...	...
	1938	...	...	500	...	...	20,000	...	...
Manganese	1934	...	...	...	...	...	...	...	...
	1935	...	...	400	...	...	5,000	800	...
	1936	...	...	200	...	...	5,000	...	...
	1937	...	...	...	...	...	...	...	...
	1938	...	...	...	...	...	...	300	...
Bailey	1934	250,000	...	...	...	...	...	...	...
	1935	250,000	...	...	...	2,000	...	...	...
	1936	125,000	...	...	...	3,000	...	...	...
	1937	75,000	...	...	...	...	...	...	...
	1938	375,000	...	...	...	...	...	...	...

For example, in spite of the fact that 119,000 bluegill fingerlings were stocked in Gratiot and Fanny Hooe lakes between 1934 and 1937, none were taken by fishermen in 1938. Only small numbers were taken from Medora and very few from Manganese. Growth rate studies show that bluegills probably do not reach legal length in these lakes until their third or fourth years. Smallmouth bass do not reach legal size until their fourth year in Medora and Fanny Hooe, but strangely enough reached legal length in their second year in Manganese Lake. It is common knowledge, however, that this seemingly fine growth in Manganese represents the typical condition

following the "first stocking" of cold lakes. The first plants usually do well because of the accumulated foods not hitherto used by the fish present. When this food is reduced and the next generation or two of young fish begin to compete, the size and growth rate decreases very rapidly. It is not guessing to suspect that the growth rate and condition of bass in Manganese Lake will change greatly within the next 2 or 3 years and this change will be definitely for the worse.

Perch reach legal length in Gratiot and Fanny Hoee during their third year of life and during their second year at Bailey Lake.

While we do not have a great deal of information as a basis for our conclusions regarding the desirability of these lakes for certain species, we are of the opinion that certain practices help to get the greatest value out of these waters.

The following are suggestions for stocking and improvement of the lakes studied which seem logical at this time:

1. Avoid stocking cold and warm water species together in lakes.

2. Bailey Lake and others of the shallow pond type should be restricted to perch and pike. No stocking should be necessary in these lakes.

3. Manganese Lake should be restricted entirely to brook trout at present. If the bass stocked there reach and maintain a catchable size, it may be desirable to consider this as a bass lake and to discontinue trout stocking.

The desirability of constructing a dam at the outlet of Manganese Lake has been considered, and it seems logical that such a dam would not be detrimental and may be beneficial to the lake. However, it should be remembered that an increase in the size of the lake would also greatly increase the cost of removing the fish population if at some future time this was considered necessary to restore the lake for trout. We suggest

therefore that if a dam is constructed, some provision be made for drawing the water down to the lowest possible level. The lake could then be lowered to a point where all the fish could be removed if necessary.

Beaver dams should be kept out of all inlet streams of trout lakes (such as Manganese and Fanny Hooe), making these areas available for trout spawning.

4. Gratiot Lake is obviously doing well as a pike-bass lake and should be left that way until future changes show this combination to be undesirable.

This lake would probably be improved by the installation of a considerable number of brush shelters as described in "The Improvement of Lakes for Fishing," since the cover is rather poor.

5. Medora Lake should be used to encourage the fine whitefish now present there. A size and number limit needs to be established. Lake trout should be stocked but not as fry or small fingerlings. We suspect that plants of 6-10 inch lake trout and brook trout would be the most desirable and that planting of bluegills, bass and perch should be discontinued.

If this lake is to be used for whitefish and trout, then lake improvement devices are of questionable necessity.

6. Fanny Hooe Lake might well be used for whitefish and trout. Adult whitefish from Medora Lake can very probably be captured for stocking purposes.

Brook or rainbow trout or a combination of the two should do well in this lake. The former was fairly abundant during the 1938 season even though no stocking with brook trout had been done in this lake during the

previous four years.

Beaver dams should be removed from all inlet creeks, which are of value as trout spawning ground.

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