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DIVISION OF FISHERIES
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A FISHERIES SURVEY OF LINNBECK LAKE, MENOMINEE COUNTY.

by

James W. Moffett and Fred E. Locke

Linnbeck Lake is a small body of water (4.5 acres) in Holmes township, (T36N., R 28W., Sec. 26), Menominee County. It is intermittently connected to the Little Shakey River drainage by a small creek which flows from its southwest side during exceptionally wet seasons. The village nearest to Linnbeck is Swanson, from which one travels over a poorly marked, unused tote road for about 1½ miles in a northwesterly direction to reach the lake. Banat, three miles north- and one-half mile east of Swanson is the nearest town of any size.

This lake was mapped by the Institute for Fisheries Research during the winter of 1939-40. The map thus obtained was used by the summer survey party*/ which gathered the data, embodied in this report, August 22-23, 1940.

Being quite inaccessible and remote from population centers, Linnbeck Lake has not had any role in the development of industry or townsites in the county. There are evidences around the lake which indicate that it was used as a skid road center during logging days. An old log road, now impassable, runs to the south shore of the lake. Reports dealing with the history of fishing on

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*/ The party personnel consisted of Fred E. Locke, Aquatic Biologist I, leader; Irving J. Cantrall and Burton P. Hunt, Fisheries Research Technicians A, and Pat Galvin, Fish Culturist C, assistants.

this lake are rather vague. Interviews with local sportsmen lead one to believe that only a few anglers use the lake each year. Northern pike and largemouth bass were the most sought after fish according to reports. There are no cottages, resorts or other signs of recreational development around the lake.

Physical Characters

The basin of Linnbeck Lake is rather deep. Abrupt slopes descend from the surrounding terraine to the lake level on three sides. The present lake level has been established for a long time since a mat of vegetation and considerable accumulations of peat extend from the abrupt slopes to the water's edge; in some places a distance of 50 - 75 feet. The surrounding country is composed of sand, gravel, and some scattered clay beds. The soil is very poor in nutrients. No cultivated tracts are near the lake. Most of the highland vegetation is second growth aspen and various coniferous trees. In the vicinity of the lake, cedar and spruce swamps are rather extensive. The general shape and contour of this lake can be seen in the accompanying map. It should be noted that the lake bottom continues the same general steep slope as previously described for the sides of the basin. The slope ends rather abruptly. The central portion of the lake levels off and becomes almost flat at the 20-foot contour.

Drainage to this lake is rather limited. Less than one-half square mile of surrounding territory contributes to its water supply. There are no inlets to Linnbeck. All of its water is derived from seepage and a small amount of surface run-off. The latter source is accompanied by some erosion which adds soil to the marginal mats further consolidating them. These mats filter run-off water so that the lake itself is never turbid. An intermittent outlet, mentioned previously, drains from the lake. At the time of the survey, the stream was flowing about one-half cubic foot per second due to heavy rains.

Considering the ten-foot contour as its lakeward limit, the shoal in Linnbeck Lake is 34% of the total area. The maximum depth is 25 feet. Bottom materials on the shoal are chiefly marl. Some fibrous peat borders the encroaching shore. In the depths, marl and fibrous peat are mixed except in the deepest portion where pulpy peat occurs.

The waters of Linnbeck are brown in color but relatively clear. A secchi disc (white disc used to measure transparency) disappears from view at a depth of nine feet. The color is probably derived from plant disintegration which releases certain stains from the broken down constituents.

The size and sheltered location of Linnbeck Lake are certainly favorable to its productivity. Wave action and winds have little effect on the waters. Consequently, plants can become established on all shores. Organic matter, necessary for plant and animal growth, remains on the shoals and is not swept off into the depths where chemical conditions of the water are likely to isolate it from further use by fish food organisms. The relative clarity of the water allows effective light penetration to depths of 18 - 20 feet, enabling plants to grow there. The small percentage of shoal, however, detracts from the total productivity. Usually, the shoals of a lake are the main areas of food production. Depths are generally much less productive. A combination of the effects of deep water, small size, and protection from wave action restricts heat distribution in this lake. Thermal conductivity of water is very low. Distribution of heat, acquired by surface waters of a lake from solar energy, to the lower strata is due mainly to wave and current action. If such action is minimized, most of the heat absorbed will remain in the surface layers and the deeper waters will retain their low temperatures. This phenomenon is illustrated by the vertical temperature readings presented in the next section. Should these cold-water layers contain fair amounts of dissolved oxygen, a lake in which they occur would support trout.

Thermal and Chemical Features

The thermal and chemical characteristics of a body of water are the most important ecological factors in determining its productivity. Water is populated by cold-blooded animals whose activity, reproduction and growth are usually controlled by its temperature and chemical constitution. Cold waters retard these physiological processes while warm waters accelerate them. Naturally, there are maxima and minima within which the above statement is true. Extreme cold causes inactivity. Extreme heat results in death. Each species of organisms has an upper and lower toleration limit for each environmental factor, and this range often differs markedly from that of other species. Somewhere within each toleration range there is an optimum at which the species prospers. If the ranges and optima of game fishes are known and the attributes of a body of water are likewise known, the species best suited to that water can and should be encouraged. The chemical and thermal features of Linnbeck Lake, as found by the survey party are given in the following table.

Aug. 22, 1940 - 10:30AM - Air temp. 59°F.						Sept. 10, 1940-3:00PM-Air Temp. 52°F.				
Depth in Feet	Water Temp. °F.	Oxygen in p.p.m.*	CO_2 in p.p.m.	M.O. alk. in p.p.m.	pH	Water Temp. °F.	Oxygen in p.p.m.	CO_2 in p.p.m.	M.O. Alk.in p.p.m.	pH
0	65.8	8.4	0.0	168	8.4	62.0	8.8	Not	Not	8.2
3	65.8	...	...	...	...	62.0	8.8			8.2
6	65.8	...	...	...	...	62.0	8.8	taken	taken	8.2
9	57.6	...	...	...	...	58.0	6.6			7.6
12	52.0	6.6	1.0	199	7.9	55.0	5.4			7.6
15	48.9	...	...	...	...	52.0	4.2			7.6
18	47.4	3.0	9.0	211	7.6	50.0	3.0			7.5
22	Bottom									

* p.p.m. = Parts per million.

On both dates of sampling, the waters of this lake were thermally stratified. A thermocline (zone of rapid temperature change) was present between the depths of 6 and 15 feet on both occasions. Surface water temperatures appear to be low, but the air temperature was so low at each instance that it is almost certain they were the result of prolonged cool spells. Temperatures in the thermocline

remain consistently low and are well suited to the maintenance of trout. Oxygen concentrations were satisfactory at practically all depths. However, directly on or near the bottom the 3 parts per million of oxygen might not suffice especially since minor concentrations of carbon dioxide were found there. The occurrence of oxygen at all depths is probably due to the effect of physical conditions already described and to the photosynthetic activity of the carpet of musk grass which covers the lake bottom to depths of 18 feet. Depletion of a considerable oxygen supply by the disintegration of the peaty deposits in the lake must occur, but enough is produced by the musk grass to offset these demands. The water of Linnbeck Lake is hard and alkaline in reaction as methyl orange alkalinity (actually, the amounts of dissolved calcium, magnesium and other less prevalent salts in the water) and pH readings (factors expressing alkalinity or acidity, i.e., below 7.0 = acid) indicate. These attributes are more conducive to productivity than a direct reversal of conditions would be. Most animals and plants fare better under alkaline conditions.

Biological Features

Only six species of plants were collected from this lake by the survey party. Sedge, Carex lasciocarpa, bordered the entire lake shore in water from 0 to 1 foot in depth. Cladium, Cladium mariscoides, was found only rarely. It occurred in water 1 - 2 feet deep. White Water Lilies, Nymphaea odorata, and Yellow Water Lilies, Nuphar variegatum, were common around the shore and in the northwest bay. The yellow species was more abundant than the white one. Scattered patches of bladderwort, Utricularia vulgaris var. americanus, grew at depths of 1 - 2 feet. Musk grass, Chara sp., blanketed the entire bottom to depths of 18 feet. Plants are considered entirely adequate both for cover and food production.

The plankton (microscopic plants and animals living free in the water) production in Linnbeck was only average. Samples taken averaged 4.0 cc per cubic

liter. The plant components were most abundant. Bottom fauna was quite abundant. Phantom midge larvae, midge larvae, snails and fresh-water shrimps swarmed in the Chara that carpets the lake bottom. Free-living flatworms, finger-nail clams, water mites, dragon fly nymphs and various other dipterous larvae were lesser components of this association. Few organisms were found below the 18 foot contour. Midge larvae were the most prevalent forms. The fish food supply is adequate.

Two species of game fish were reported by the survey party, northern pike and bluegills. No coarse nor obnoxious fishes were caught. Forage species consisted of golden shiners, black-nose shiners, blunt-nosed minnows, and fine-scaled dace. When the lake was poisoned, (this poisoning will be described later) pumpkinseed sunfish (all small), yellow perch, largemouth bass, rock bass, and northern pike, in order of their occurrence, constituted the game fish population. Yellow bullheads were the only coarse fish taken. Of the forage fish, the following species were present. They are listed in order of their abundance.

Stickleback
Black-nose shiner
Blunt-nose minnow
Madtom
Mudminnow
Black-chin shiner
Golden shiner
Menona killifish
Iowa darter
Common shiner
Northern dace

According to Conservation Department records, no fish were stocked in this lake during the years 1934 - 1940 inclusive.

Growth rate data are available on but two of the northern pike taken by the survey party. One of these fish was in its fourth summer, weighed 1 pound, 6½ ounces and was 19-1/4 inches long. The other was in its fifth summer, 18-3/4 inches long and weighed 1 pound, 6½ ounces. A more complete study of the fish of Linnbeck Lake will appear in a subsequent report dealing with the results of poisoning and a statistical analysis of the population.

Management Suggestions

Shortly after the survey was made on this lake, a preliminary study of the data collected revealed that the lake was suited to trout. Since there are few trout waters in Menominee County, it was decided to remove the fish population present in Linnbeck and to replace it with trout. It is very unlikely that trout plantings (even though legal-sized) could have survived in the presence of pike and bass. Linnbeck Lake was poisoned September 11, 1940, by a party in charge of Mr. John Greenbank. Previous to the poisoning a brush filter was was placed in the outlet of the lake to prohibit immigration of undesirable species from the river below and to retain the trout population once it became established. The designation of this lake was changed from the "all others" group to "trout lake" status by action of the Conservation Commission, October 10, 1940.

Linnbeck Lake will have to be stocked with trout each year or at less frequent intervals depending on the fishing pressure. It is doubtful whether natural spawning which might be made possible in the outlet of this lake would be successful because of fluctuation in level and high temperatures of the lake surface waters.

Maintenance of the brush filter dam or construction of a more permanent dam to prevent upstream migrations of undesirable species is imperative. The operation of a creel census or, at least, periodic checking of fishermen on this lake is necessary to determine, in a measure, the fishing pressure and relative success of trout stocking.

Further management suggestions should follow observations on the success of the present program.

INSTITUTE FOR FISHERIES RESEARCH

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Report typed by: M. Hoffman

INSTITUTE FOR FISHERIES RESEARCH

DIVISION OF FISHERIES — MICHIGAN CONSERVATION DEPT.

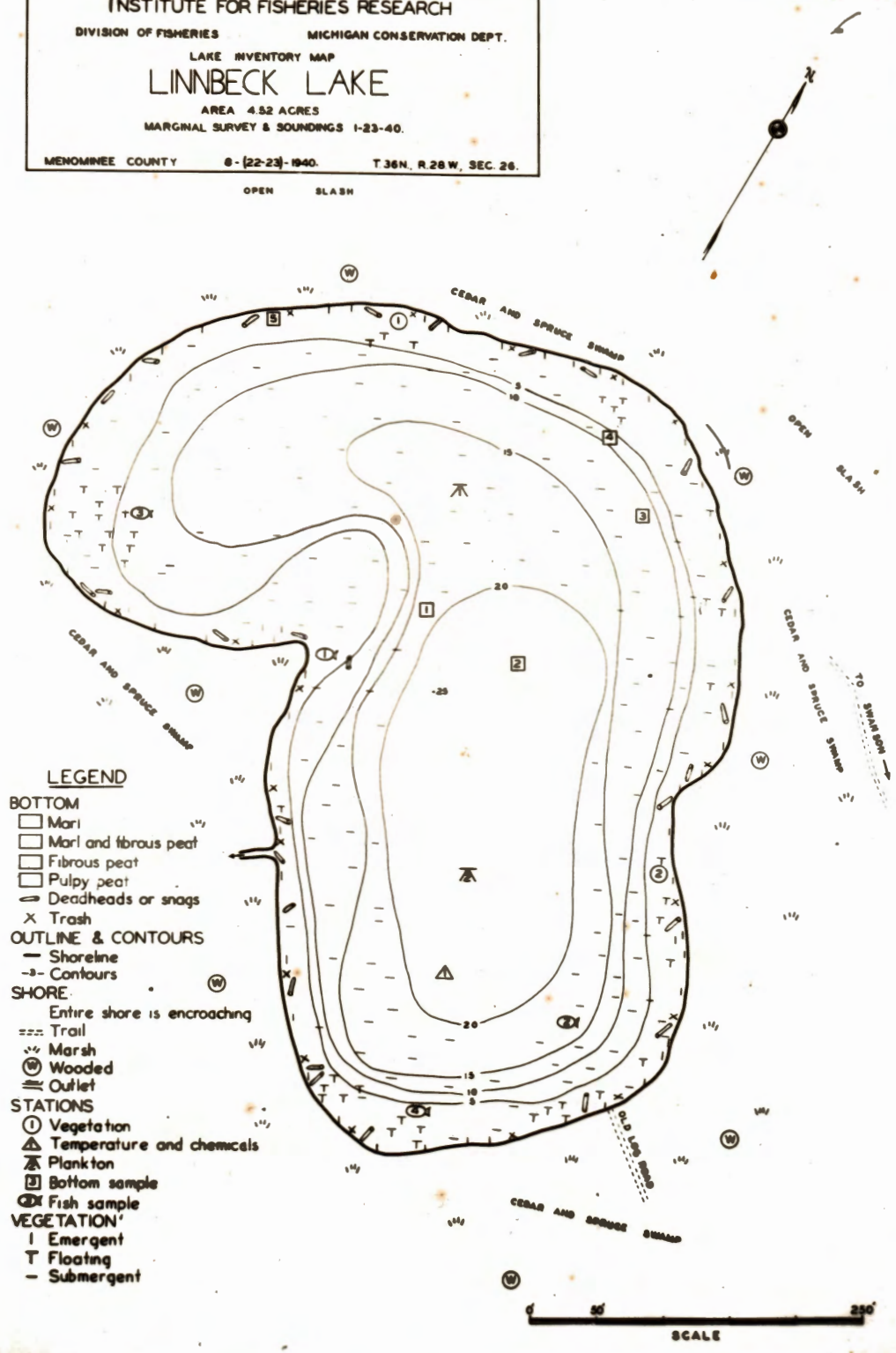
LAKE INVENTORY MAP

LINNBECK LAKE

AREA 4.52 ACRES

MARGINAL SURVEY & SOUNDINGS 1-23-40.

MENOMINEE COUNTY — 8-(22-23)-1940. — T.36N., R.28W., SEC. 26.



LEGEND

BOTTOM
- Marl
- Marl and fibrous peat
- Fibrous peat
- Pulpy peat
- Deadheads or snags
- X Trash

OUTLINE & CONTOURS
- Shoreline
- Contours

SHORE
- Entire shore is encroaching
- Trail
- Marsh
- (W) Wooded
- Outlet

STATIONS
- (1) Vegetation
- Temperature and chemicals
- Plankton
- [3] Bottom sample
- Fish sample

VEGETATION
- I Emergent
- T Floating
- – Submergent

LINNBECK LAKE Menominee Co. T. 36 N., R. 28 W., SEC. 26.