A QUALITATIVE STUDY OF THE INVERTEBRATE POPULATION OF PARK LAKE, CLINTON COUNTY, MICHIGAN

Thesis for the Degree of M. S.
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Albertus D. Bratt

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By

Albertus D. Bratt

AN ABSTRACT

Submitted to the College of Science and Arts
Michigan State University of Agriculture and
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MASTER OF SCIENCE

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Approved J. Wayne Porter

Albertus D. Bratt

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ABSTRACT

Park Lake, Clinton County, Michigan, is a shallow, eutrophic lake near the campus of Michigan State University. For this reason it was selected for a qualitative survey of the invertebrate population. This survey was made to determine the types of organisms present in this lake, to determine some of the physical and chemical conditions under which these organisms lived, and to provide field studies which can be used for comparison with other studies in future work.

The surface area of the lake is approximately 120 acres, and 20 feet is the maximum depth. Ninety-one percent of the surface area has a depth of less than ten feet. It is a temperate lake of the third order (Welch, 1952), eutrophic, and a hard water type with some marl precipitation. No natural inlets or outlets are present, although a dredged channel on the southwest side may provide an outlet during periods of high water. The basin is fibrous and pulpy peat. Much aquatic vegetation was present during the summer growing season.

Standard methods were used in the physical and chemical analyses. All chemical analyses were made during the early afternoon. Water temperature at the surface varied from 8.0 degrees C. to 28.0 degrees Centigrade. At the

four foot depth it varied from 9.5 degrees C. to 25.5 degrees C., and at the twelve foot depth it ranged from 7.5 degrees C. to 19.0 degrees Centigrade. The pH of the water varied from 6.9 to 9.0. Dissolved oxygen varied from 1.0 ppm. to 8.0 ppm. The values for free carbon dioxide varied from 10 ppm. to 65 ppm. Methyl Orange alkalinity varied from 70 ppm. to 137 ppm. No phenolphthalein alkalinity was observed.

Four collecting stations were set up. Since Park Lake is roughly triangular in shape, a station was set up on each point of the triangle and in the high water outlet. Specimens collected were assigned the nearest station number.

Specimens were collected with a Turtox Indestructible bottom net, an Ekman dredge, a plankton sieve funnel, a plankton net, and an insect sweeping net. Seventy percent alcohol and seven percent Formalin were used to preserve the specimens.

The specimens were identified to the lowest possible taxon, depending on the availability of taxonomic keys. Following each taxon is the station number where it was collected and the relative abundance.

Four Phyla, seven Classes, and 45 Families were represented. Of these, one group was keyed to Phylum, one to Order, six to Family, one to subfamily, 47 to genus, and 32 to species. A total of 88 taxons was collected and identified.

Station two had 61 taxons, followed by station one

with 50, station three with 48, and finally station four with 22.

The highest number of individuals were recorded at stations two, three, one, and four in the order listed.

REFERENCE CITED

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I. INTRODUCTION

Park Lake, Clinton County, Michigan, was selected for study because it is a shallow, rich lake, and is readily accessible from the campus of Michigan State University. The purpose of this study is threefold. First, a qualitative survey was made to determine the types of organisms present in this lake. A quantitative or food availability problem would be the logical follow-up of such a study. Second, the water chemistry was investigated to determine the range of conditions under which these organisms live, and last, the study provides field data which can be used for comparison of this lake to other aquatic habitats in future investigations.

The scope of this problem is limited to certain phyla of invertebrates. Several groups are considered only briefly owing to the lack of taxonomic literature and keys to the specimens. Consequently, their significance cannot be ascertained at this time.

II. LAKE MORPHOMETRY AND FEATURES

Park Lake is located in the southeast corner of Clinton County, Michigan, (T. 5 N., R. 1 W., Sec. 28, 29.) and is glacial in origin. The Michigan Institute for Fisheries Research surveyed the lake in 1938 and prepared a hydrographic map at that time. The area given in this survey was 185 acres and 25 feet as the maximum depth. Fifty-eight percent of the surface area of the lake had a depth of less than five feet, 33 percent between five and ten feet deep, and only nine percent of the total area was over ten feet in depth. These figures were calculated from the 1938 map with a Dietzgen Polar Planimeter (Welch, 1948). Since 1938, the area has decreased to approximately 120 acres and the maximum depth has been reduced to 20 feet. It was considered beyond the scope of this study to bring the lake survey map up to date.

According to the lake classification of Forel and Whipple (Welch, 1952) Park Lake is a temperate lake of the third order. However, a temporary thermocline may be formed when wind and wave action is limited. It is eutrophic (Welch, 1952) and is a hard water type with some marl precipitation. No natural inlets or outlets are present, although a dredged channel on the southwest side may provide drainage during periods of high water.

Floating, submerged, and emergent vegetation were very prevalent during the growing season.

Fibrous and pulpy peat cover a large percentage of the bottom. A Chamaedaphne sp. bog extends along the south and west shores of the lake. Some pollution was present due to effluent from chemical toilets and other domestic sources. The Health Department closed the lake to bathing several times in recent years because of this pollution.

III. PHYSICAL AND CHEMICAL FEATURES

A. Temperature

A Taylor maximum-minimum thermometer was used to record temperatures. This device is accurate to the nearest 0.5 degree F. when used in shallow water and when complications of the usual temperature gradient, such as inversions, are not present. The thermometer was left at the required depth for a period of five minutes to insure an accurate reading. The readings taken were converted to the Centigrade scale and are tabulated below in Table 1 according to depth and date.

TABLE 1

COMPARISON OF WATER TEMPERATURES

Surface		4 Feet		12 Feet	
Date	Degrees C.	Date	Degrees C.	Date	Degrees C.
July 9	17.0	July 9	16.5		
July 18	19.0	July 18	20.0	July 18	17.0
July 28	28.0	July 28	25.5	July 28	19.0
Aug. 16	24.5	Aug. 16	24.5	Aug. 16	19.0
Sept. 28	9.5	Sept. 28	9.5	Sept. 28	7.5
Nov. 16	8.0				

These values do not suggest that a thermocline is present. The inversion present on July 18 was probably caused by atmospheric conditions and limited wind action.

B. Hydrogen-ion Concentration

These values were determined with a Hellige Pocket Comparator Set and a Beckman line operated pH meter. The colorimetric readings were checked against the meter readings in the laboratory to determine accuracy. The readings are recorded below in Table 2 according to date and depth.

TABLE 2

COMPARISON OF THE pH

Surface		4 Feet		12 Feet	
Date	pH	Date	pH	Date	pH
July 9	8.8	July 9	9.0		
July 18	7.8	July 18	7.7	July 18	7.5
		July 18 weed bed	8.8		
July 28	8.8	July 28	8.8	July 28	7.6
Aug. 16	6.9	Aug. 16	8.0	Aug. 16	7.3
		Aug. 16 weed bed	8.8		
Sept. 28	8.7	Sept. 28	8.8	Sept. 28	7.6
Nov. 16	7.3				

The values indicate that the water is quite basic. Welch (1948) states that irregular fluctuations in the pH are common. Rainfall and photosynthesis are important factors. A marked difference in the pH occurs between samples taken in the open water area and in a weed bed. Figure 1 shows this difference at the four foot depth.

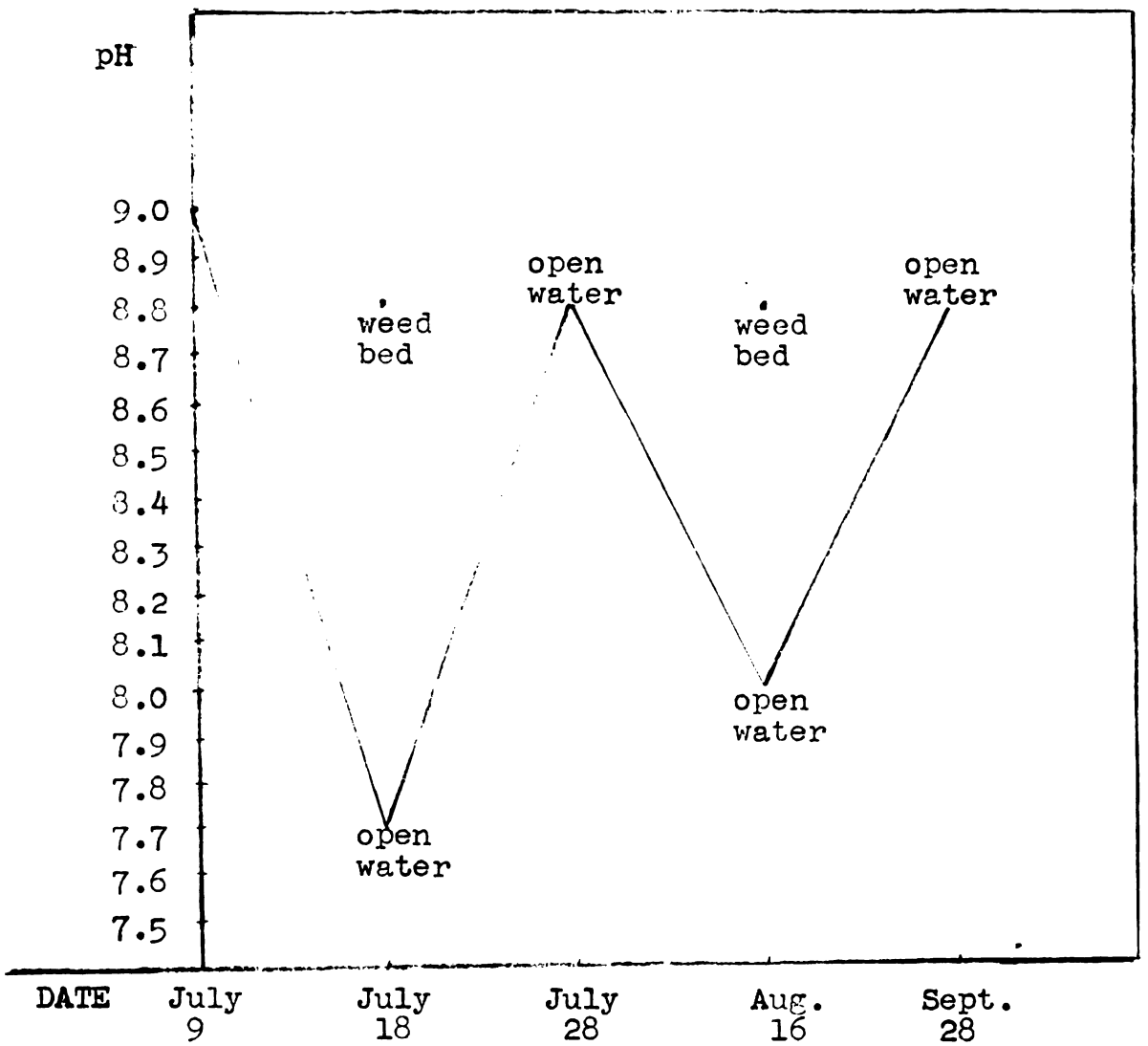


Fig. 1. pH at the four foot depth.
Comparison of open water and weed bed samples.

C. Dissolved Oxygen

Dissolved oxygen determinations were by the Rapid, Unmodified Winkler Method (Ellis, Westfall, and Ellis, 1948). The results are given below in Table 3.

TABLE 3

COMPARISON OF THE DISSOLVED OXYGEN

Surface		4 Feet		12 Feet	
Date	ppm.	Date	ppm.	Date	ppm.
July 9	4.8	July 9	4.5		
July 18	3.9	July 18	4.2	July 18	1.5
		July 18 weed bed	4.8		
July 28	6.5	July 28	5.0	July 28	1.6
Aug. 16	4.5	Aug. 16	5.0	Aug. 16	1.0
		Aug. 16 weed bed	4.9		
Sept. 28	6.4	Sept. 28	6.3	Sept. 28	5.9
Nov. 16	8.0				

The values indicate that a sufficient supply of oxygen was present during the sampling period to supply the organisms at the surface and at the four foot depth. The amount of oxygen at the 12 foot depth is not adequate for all types of organisms.

D. Free Carbon Dioxide

Determination of the free carbon dioxide was by N/44 sodium hydroxide with phenolphthalein as the indicator (Ellis, Westfall, and Ellis, 1948). The results are tabulated below in Table 4.

TABLE 4

COMPARISON OF THE FREE CARBON DIOXIDE

Surface		4 Feet		12 Feet	
Date	ppm.	Date	ppm.	Date	ppm.
July 9	45	July 9	35		
July 18	34	July 18	32	July 18	45
		July 18 weed bed	10		
July 28	15	July 28	20	July 28	40
Aug. 16	17	Aug. 16	45	Aug. 16	65
		Aug. 16 weed bed	15		
Sept. 28	13	Sept. 28	16	Sept. 28	15
Nov. 16	15				

The results show rather high values for free carbon dioxide. Carbon dioxide is constantly being given off as a product of decomposition, as a result of air absorption, and by respiration. The samples taken in the weed bed show a marked decrease in the amount of free carbon dioxide apparently due to photosynthetic action of the plants during daylight hours.

E. Alkalinity

Determination of alkalinity was by titration with sulphuric acid, with Methyl Orange and phenolphthalein being the indicators, described by Ellis, Westfall, and Ellis (1948). At no time was phenolphthalein alkalinity observed. The Methyl Orange alkalinity ran fairly high. The results are tabulated below in Table 5.

TABLE 5

COMPARISON OF THE ALKALINITY

Surface		4 Feet		12 Feet	
Date	ppm.	Date	ppm.	Date	ppm.
July 9	113	July 9	120		
July 18	115	July 18	135	July 18	112
		July 18 weed bed	98		
July 28	110	July 28	110	July 28	115
Aug. 16	105	Aug. 16	105	Aug. 16	135
		Aug. 16 weed bed	70		
Sept. 28	130	Sept. 28	131	Sept. 28	133
Nov. 16	137				

These figures indicate that only bicarbonate hardness is present (Ellis, Westfall, and Ellis, 1948). These findings are in keeping with the observations by Welch (1952) that when free carbon dioxide is present, it combines with the monocarbonates to form bicarbonate hardness.

IV. COLLECTING STATIONS

A preliminary survey was made in the fall of 1955 to determine the location of the collecting stations. Four sites were found to be suitable and stations were set up in these areas. Specimens collected in the intervening areas were assigned the number of the nearest station. Consequently, all material collected had an assigned station number. The collecting period extended from December, 1955, to November, 1956.

Park Lake is roughly triangular in shape (see map). Station one was located on the northeast point of the lake. Heavy stands of Scirpus sp. and much wave swept debris characterized the shoreline of this area and dense masses of Potamogeton sp. existed in the offshore area. Benthic organisms were sampled at depths ranging from two inches to three feet.

Station two was located on the west contour of the lake. Vegetation was similar to station one, but the north shore was wave-swept, and it had a predominately sandy bottom with little debris. The northwest shore of this station consisted of a Typha sp. marsh with much muck and debris. A channel was dredged at the tip of the contour to serve as a boat dock.

Station three was located on the south contour of the

lake. The east shore and the offshore area of this contour were sampled intensively. Vegetation was sparse. Much filamentous algae and debris were present. The bottom was gravel over muck. The water depth along this shore did not exceed two feet. Old docks and pilings provided sources of fruitful collecting. The south tip of the lake was also sampled. Here the bottom was muck with Typha sp. being the predominant vegetation type.

Station four was at the high water outlet of the lake. This site was the dredged channel, approximately 400 feet in length, where the depth of the water varied from six inches to five feet. The extreme end of this channel provided rich collecting of benthic organisms due to the presence of wind blown debris and tangled masses of vegetation.

V. COLLECTING APPARATUS

An Indestructible Turtox bottom net was used to collect in the shallow water. The net, with the flat edge flush, was drawn over the bottom area to be sampled and proved to be quite efficient for collecting most of the benthic organisms present. Areas too deep for net collecting were sampled with a standard Ekman dredge with a jaw area of 36 square inches. The materials collected were then transferred to a sieve pan with 576 meshes to the square inch for washing. This residue was placed in a white porcelain pan, the organisms sorted, and subsequently preserved in a mixture of 70 percent alcohol and glycerin.

Plankton was collected in two ways; through the ice cover by pouring the water through a plankton funnel sieve and by towing behind a boat, or casting off-shore a standard plankton net with #20 silk bolting cloth. A seven percent Formalin solution was used as a preservative.

The smaller forms were collected in the surface waters by the use of the plankton net while a standard insect sweeping net sufficed for the larger forms.

Collected specimens were placed in numbered containers and the station, depth, and time of day entered in the field notes.

Water samples were taken with a 1200 ml. Kemmerer

sampler. The Kemmerer sampler, the Ekman dredge, and the Taylor thermometer were operated from the boat by means of a plastic Kordite clothesline which was marked off in feet and fathoms for depth determination.

VI. RESULTS

Owing to the lack of taxonomic keys to some species, the degree of classification has been necessarily limited in some groups. In groups where keys were available, species determination were made. Most determinations follow the nomenclature as used by Pennak (1953).

In the following classification of each group, the number of the station or stations where the collection was made is given. Following each number is a Roman numeral indicating the abundance of the organisms at the station where they were collected. Roman numeral I indicates one to ten individuals, II denotes ten to twenty individuals, III indicates twenty to thirty individuals, and IV refers to numbers in excess of thirty individuals.

PHYLUM Nematomorpha; 2:I.

PHYLUM Annelida

Class Oligochaeta

Family Tubificidae; 2:IV.

Class Hirudinea

Family Erpobdellidae; 1:II, 2:II, 3:II.

Family Glossiphoniidae; 1:I, 2:I, 3:I.

PHYLUM Arthropoda

Class Crustacea

Order Cladocera

Bosmina spp.; 2:IV.

Order Eucopepoda

Cyclops spp.; 2:IV.

Diaptomus spp.; 1:IV, 2:IV, 3:IV.

Order Isopoda

Asellus sp.; 4:I.

Order Amphipoda

Hyalella azteca Saussere; 1:IV, 2:IV, 3:IV, 4:IV.

Crangonyx sp.; 2:I, 3:I.

Order Decapoda

Procambarus sp.; 1:I. 3:I.

Class Arachnoidea

Order Hydracarina; 1:IV, 2:IV, 3:IV.

Order Araneida

Family Micryphantidae; 1:I.

Family Pisauridae

Dolomedes sp.; 1:I, 2:I.

Family Tetragnathidae

Tetragnatha sp.; 1:I, 2:I.

Class Insecta

Order Collembola

Family Isotomidae

Isotoma sp.; 3:I.

Isotomurus palustris Müller; 2:IV, 3:IV.

Family Poduridae

Podura aquatica L.; 1:II.

Order Ephemeroptera

Family Baetidae

Ameletus sp.; 1:I.

Callibaetis sp.; 1:II, 2:II.

Subfamily Baetinae; 2:III, 3:III, 4:II.

Family Caenidae

Caenis sp.; 1:III, 2:II, 3:III.

Family Ephemerillidae

Ephemerella sp.; 1:I, 2:II, 3:II.

Family Heptageniidae

Stenonema tripunctatum Banks; 2:IV, 3:IV.

Family Leptophlebiidae

Paraleptophlebia sp.; 2:II.

Order Odonata

Family Aeschnidae

Anax junius Drury; 1:III, 2:II, 3:II.

Boyeria vinosa Say; 4:I.

Family Coenagrionidae

Chromagrion conditum Hagen; 3:I, 4:I.

Ischnura posita Hagen; 1:IV, 2:IV, 3:IV, 4:IV.

Ischnura verticalis Say; 1:IV, 2:IV, 3:IV.

Family Gomphidae

Gomphus sp.; 1:II, 2:II, 3:II, 4:II.

Family Lestidae

Lestes sp.; 1:I, 2:I, 3:I, 4:I.

Family Libellulidae

Celithemis sp.; 2:III, 3:III.

Epicordulia princeps Hagen; 1:I, 2:I, 3:I.

Erythemis sp.; 1:III, 2:II, 3:III, 4:I.

Leucorrhinia sp.; 1:III, 2:III, 3:III, 4:II.

Libellula sp.; 1:IV, 2:IV, 3:IV, 4:IV.

Pachydiplax longipennis Burmeister; 1:I, 2:I.

Plathemis lydia Drury; 1:I.

Sympetrum sp.; 2:II, 3:I.

Tetragoneuria sp.; 1:I, 2:I, 3:I, 4:I.

Tramea carolina L.; 1:II, 2:II.

Order Hemiptera

Family Belostomatidae

Belostoma flumineum Say; 1:IV, 3:IV, 4:IV.

Lethocerus americana Leidy; 2:I.

Family Corixidae

Arctocorixa sp.; 1:IV, 2:IV, 3:IV.

Family Gerridae

Gerris buenoi Kirkaldy; 1:II.

Metrobates hesperius Uhler; 4:III.

Family Mesoveliidae

Mesovelia mulsanti White; 2:IV.

Family Naucoridae

Pelocoris femoratus P.B.; 1:III, 2:III, 3:IV.

Family Nepidae

Nepa apiculata Uhler; 2:I, 3:I, 4:I.

Ranatra fusca P.B.; 1:II, 2:II, 3:II.

Family Notonectidae

Notonecta irrorata Uhler; 1:I, 4:I.

Notonecta lunata Hungerford; 1:I, 2:I, 3:II.

Notonecta undulata Say; 2:I.

Family Pleidae

Plea striola Feiber; 1:I.

Order Trichoptera

Family Leptoceridae

Leptocella albida Walker; 1:III, 2:III, 3:III.

Oecetis sp.; 1:I.

Family Molannidae

Molanna sp.; 2:IV, 3:IV.

Family Phryganeidae

Agrypnia vestita Walker; 2:I, 3:I.

Family Psychomyiidae

Polycentropus sp.; 3:I, 4:I.

Order Coleoptera

Family Dytiscidae

Copelatus sp.; 1:I, 2:I, 3:I.

Bidessus sp.; 3:III.

Laccophilus sp.; 3:I.

Hydrovatus sp.; 4:I.

Dytiscus sp.; 4:I.

Family Gyrinidae

Dineutus sp.; 1:I.

Gyrinus sp.; 2:I, 3:I.

Family Chrysomelidae

Donacia sp.; 2:III.

Family Hydrophilidae

Enochrus sp.; 1:I.

Tropisternus sp.; 1:II.

Family Haliplidae

Haliplus sp.; 2:III, 3:III, 4:III.

Pelodytes sp.; 2:II, 3:II, 4:II.

Order Diptera

Family Ceratopogonidae; 2:I.

Family Tabanidae

Chrysops sp.; 2:I.

Family Tendipedidae

Calopsectra sp.; 1:III.

Clinotanypus sp.; 1:II, 2:II.

Harnischia sp.; 2:II.

Pentaneura sp.; 1:I, 3:I.

Procladius sp.; 2:III, 3:III.

Tendipes sp.; 2:II, 3:II.

Family Tipulidae; 1:I.

PHYLUM Mollusca

Class Gastropoda

Family Lymnaeidae

Lymnea palustris Müller; 1:I.

Family Physidae

Physa sayii Tappan; 1:IV, 3:IV.

Family Planorbidae

Helisoma trivolis Say; 1:IV, 2:IV, 3:IV.

Family Viviparidae

Campeloma rufum Haldeman; 1:III, 2:III, 3:II.

Viviparus sp.; 2:I.

Class Pelecypoda

Family Sphaeriidae

Sphaerium sp.; 1:IV, 2:IV, 3:IV.

Family Unionidae

Anodonta grandis Say; 2:I, 3:I.

VII. SUMMARY

Park Lake, Clinton County, Michigan, was selected for a qualitative study of the invertebrate population. The collecting period extended from December, 1955, to November, 1956. Water analyses were made from July, 1956, to November, 1956.

Park Lake is shallow, eutrophic, glacial in origin, and a temperate lake of the third order. The surface area is approximately 120 acres in extent and approaches twenty feet as its maximum depth. No natural inlets or outlets are present. The basin is covered by fibrous and pulpy peat with submerged, floating, and emergent vegetation very prevalent during the growing season. Selected chemical analyses were made at the surface, the four foot depth, and at the twelve foot depth. The analyses were made in the early afternoon.

No thermocline was present when the water analyses were made. The surface temperature varied from 8.0 degrees C. to 28.0 degrees C., at the four foot depth it ranged from 9.5 degrees C. to 25.5 degrees C., and at the twelve foot depth it varied from 7.5 degrees C. to 19.0 degrees Centigrade.

The pH of the water varied from 6.9 to 9.0. These values indicate that the water was quite basic with a considerable fluctuation in the pH.

Values for dissolved oxygen varied from 1.0 ppm. to 8.0 ppm. and from 10 ppm. to 65 ppm. for free carbon dioxide.

Methyl Orange alkalinity ranged from 70 ppm. to 137 ppm. No phenolphthalein alkalinity was observed, thereby indicating that only bicarbonate hardness was present.

Four sites were selected as collecting areas. Park Lake is roughly triangular in outline. Stations were set up on each point of the lake and in the high water outlet. Specimens collected were assigned the nearest station number. Various habitats sampled were sandy, wave-swept shores, marshes, mud flats, and debris choked channels.

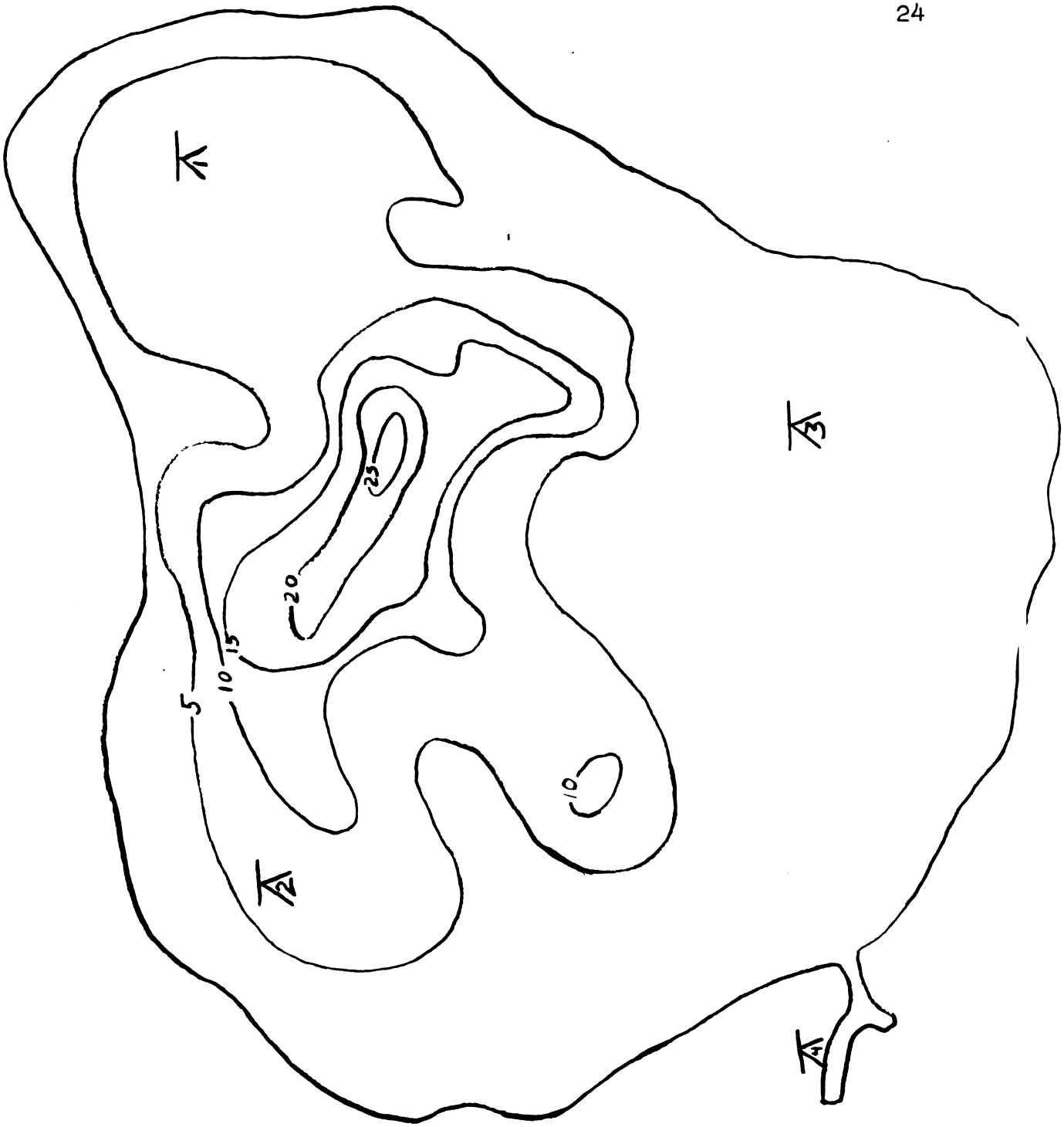
Specimens were collected by a Turtox Indestructible bottom net, as Ekman dredge, a plankton sieve funnel, a plankton net, and an insect sweeping net. Seventy percent alcohol and seven percent Formalin were used to preserve the specimens.

The specimens were identified to the lowest possible taxon, depending on the availability of taxonomic keys. Following the classification of each group is the station number and the relative abundance. In this manner the distribution and abundance of each taxon was determined.

Four Phyla, seven Classes, 45 Families, 47 genera, and 32 species were represented. Of these, one group was keyed to Phylum, one group to Order, six groups to Family, one to subfamily, 47 to genus, and 32 identified to species. This gives a total of 88 taxons represented in this lake.

Station two had the highest number of taxons with 61 while stations one, three, and four recorded 50, 48, and 22 taxons, respectively.

Station two also had the highest number of individuals, and, in order of abundance, was followed by stations three, one, and four.



PARK LAKE
Clinton County, Michigan
Area 120 Acres

Modified from map by
Institute for Fisheries
Research
Michigan Cons. Dept.
8/16/38

Figure 3

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