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Abstract. The bottom fauna and related ecological factors were investigated in a bay of Lake West Okoboji, Iowa, during the summer of 1959. Two contiguous areas were compared: (1) a relatively small, shallow bay largely enclosed by land and partially separated by a narrow sand spit from (2) a larger, deeper bay opening into the major lake basin. Data include particle size analysis and organic content of substratum, and qualitative and quantitative distribution of more than 50 species of macroscopic bottom animals. Density and bio-mass of animals were calculated at 14 stations. Chironomids (Diptera) were the dominant group in the study area. Distribution of chironomid genera, as well as of other invertebrate groups, was found to be related to depth, vegetation, and substratum characteristics.

The distribution and density of the macroscopic, littoral, bottom animals and the related ecological factors were investigated at the Iowa Lakeside Laboratory on Millers Bay, Lake West Okoboji, during the summer of 1959. Limitations in both duration and scope of the project make this a reconnaissance rather than a definitive study, and its chief value may be to suggest avenues for further ecological and taxonomic work in this locality.

Very little work has been done at Lake Okoboji on bottom organisms. Mathers (1948) has reported on leeches and Shimek (1915, 1935), Bovbjerg and Ulmer (1960) on gastropods. Birge and Juday (1920), Bardach *et al.* (1951) investigated the bottom forms of the deeper waters; our work on the littoral zone complements these investigations. No attempt will be made to review the many studies on bottom faunae in other regions.

THE STUDY AREA

West Okoboji Lake, Dickinson County, Iowa, 43°21′ N. Latitude, 95° 11′ W. Longitude, is of Wisconsin drift origin. Its area is 1,535 hectares, maximum depth 40 meters, and length of shoreline 29.3 kilometers. Fifty per cent of the area is 10 meters or less in depth, unusual for such a deep lake (Birge and Juday 1920). A well-defined thermocline is nearly always established in the summer,

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preceded and followed by spring and fall turnovers, and there is a paucity of deep bottom forms (Bardach 1951). The present study was confined to the Millers Bay area (Figure 1), most of which is 10 meters or less in depth, and which is fairly representative of the shallower areas of the lake.

The specific site consisted of two transects, one extending across Little Millers Bay to a narrow sand spit, the other extending from this sand spit out into Millers Bay to a depth of 10 meters (Figure 1).

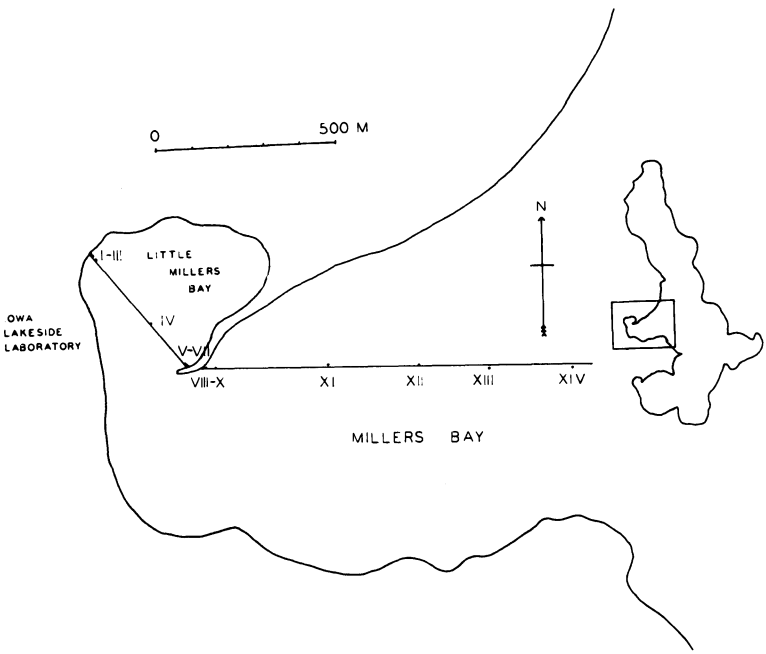


Figure 1. Millers Bay study area. West Okoboji Lake.

Little Millers Bay, enclosed by the sand spit, is very shallow, scarcely over one meter in greatest depth at the time of this study; the substratum is largely of mud and organic debris. The shore is predominantly of mud, but with sand and gravel along the sand spit shore; the bay is protected from the wave action characteristic of exposed shores. Large areas normally become choked with rooted vegetation during middle and late summer; lack of such conspicuous growth, along with the high turbidity of the water, were exceptional during the unusual low water period of 1959.

Millers Bay, larger in size and opening into the major lake basin, has a maximum depth of at least 10 meters, with a substratum which varies linearly from cobbles to gravel, sand, and mud. Much of its shore line consists of boulders, cobbles, and pebbles intermixed with gravel. The water is much more disturbed by wave action than is that of Little Millers Bay but much less turbid. Rooted vegetation is sparse directly adjacent to shore and tends to be patchy to a depth of about three-fourths meter; it becomes more abundant and uniform in distribution out to three meters depth and at five meters again becomes sparse.

Physical and chemical conditions are not appreciably different in the two bays with regard to temperature, pH, and hardness of the water, but vary as to light penetration and O_2 levels. Summer water temperatures have been found to vary from 20° to 27° C. There is little temperature stratification in the study area except for high surface temperatures during warm days; bottom temperatures change little from shore to five meters depth. The water is hard, with 150 to 250 ppm. $CaCO_3$; pH is 8.5 to 9. Light penetration is much more variable in Little Millers Bay with its frequent high turbidity. Oxygen analyses of surface water at 6-hour intervals over a 72-hour period (August 11 to August 14, 1959) revealed a fluctuation in O_2 level in Little Millers Bay from a minimum of 3.3 to a maximum of 7.5 cc. per liter (60 per cent to 135 per cent saturated, respectively). That in Millers Bay varied only from 4.9 to 6.4 cc. per liter (84 per cent and 115 per cent saturated). (Paul E. Smith, personal communication.)

Fourteen stations were set up for sampling, seven in Little Millers Bay and seven in Millers Bay (Figure 1). Depth, substratum, and vegetation are briefly summarized for each station in Table 1.

Methods

Sampling was done by two methods. At the shallow stations, one meter or less in depth, a sheet metal "sampling cylinder" enclosing one-fourth square meter was placed on a representative spot at each station and pushed into the substratum to a depth of 10 centimeters. All vegetation above the substratum in the enclosed area was removed for identification. Then the substratum itself was carefully removed to a depth of 10 centimeters and placed in buckets for sorting; successively deeper layers were placed in separate buckets at some of the stations.

Deeper stations were sampled with an Ekman dredge enclosing an area of approximately one-twentieth square meter. Five dredge samples were taken at a particular station at one time, equivalent in area to one "cylinder" sample. Characteristically, good dredge samples are difficult to obtain on hard, gravel substrata and in plant-choked areas; therefore, samplings from stations XI and XII cannot be considered as reliable as those from the other stations.

Table 1

The Study Area

Station	Depth, M.	Substratum	Vegetation
LITTLE MILLERS BAY			
I	.00 to .01	Silt, organic detritus	Sparse, very small, *P. pectinatus* predominant
II	.10	Silt, organic detritus	Very sparse, small, mostly *P. pectinatus*
III	.40	Silt, organic detritus	none
IV	1.0	Silt, organic detritus	Patchy, tall, mostly *Ceratophyllum demersum*
V	.40	Sand, silt	none
VI	.10	Sand, gravel, some silt	Sparse, small
VII	.00 to .05	Sand, gravel	Sparse, small, includes *Chara*
MILLERS BAY			
VIII	.06 to .10	Cobbles, pebbles	Scattered, small; includes *Chara, P. pectinatus*
IX	.33 to .35	Sand, gravel	Patchy, sparse to dense, varied as to species
X	1.0	Sand, some silt	Dense, tall, numerous species; *Myriophyllum exalbescens* predominant
XI	3.0	Sand, silt, organic detritus	Dense, tall, mostly *Ceratophyllum demersum*
XII	5.0	Gravel, sand	No rooted plants; many algal colonies; mostly *Anacystis montana* f. *minor*
XIII	7.5	Sand, silt	No rooted plants; some algae
XIV	10.0	Silt	none

Samples were sorted using a stacking series of four screens: 8 mm., 5 mm., and 1.5 mm. mesh screens, then .8 mm. mesh bolting cloth. The samples were washed through the screens, and the animals hand sorted. Sediments passing through the bolting cloth were retained. Cobbles and larger pebbles were examined individually for attached animals. By these methods all animals caught on or above the .8 mm. mesh bolting cloth were detected and removed; they were preserved in 10 per cent formalin for identification and counting. Identifications were made, for the most part, using Pennak (1953). Wet weights for each species were determined at each station.

No attempt was made to include such facultative bottom animals as amphipods (*Hyalella azteca*), water boatmen (Corixidae), and water mites (Hydracarina), in the quantitative samples. These animals were, however, included in the species list (Table 3).

Particle size analysis of the samples was done after sorting. Relative volumes of cobbles, pebbles, and granules were determined by water displacement of the particles in each size category. Sand was analyzed by sifting small but representative dry samples through a U. S. Standard Sieve series and weighing each size category. Silt and organic detritus content were determined volumetrically. Percentage volumes were calculated from direct measurements wherever possible, otherwise by extrapolation. Per cent of organic matter was estimated by placing representative dry samples from each station in a muffle furnace at 600° C. for several hours and determining ash weight.

Samples from all stations were limited to a total area of one-fourth square meter except for station XII, at which an area of one-half square meter was sampled. The quantitative data on the bottom fauna were converted to numbers of animals and wet weight per square meter to enhance their comparative value.

Analysis of Substratum

Particle size analysis of the substratum (Figure 2) shows a high concentration of silt and organic detritus at stations I through IV in Little Millers Bay, and of silt at station XIV (10 meters depth) in Millers Bay; a high percentage of organic matter (17 per cent to 31 per cent) was also present at these stations (Figure 3). The substratum of all other stations was rather low in organic content (5 per cent to 10 per cent), and the texture varied from coarse gravel to fine sand. The stations adjacent to the sand spit have the coarsest texture, with a large proportion of cobbles and pebbles and very little silt; the rather high proportion of pebbles and granules of station XII (5 meters depth) is also notable. Otherwise there is a definite progression from cobbles to gravel to sand to silt with increasing depth outward in Millers Bay.

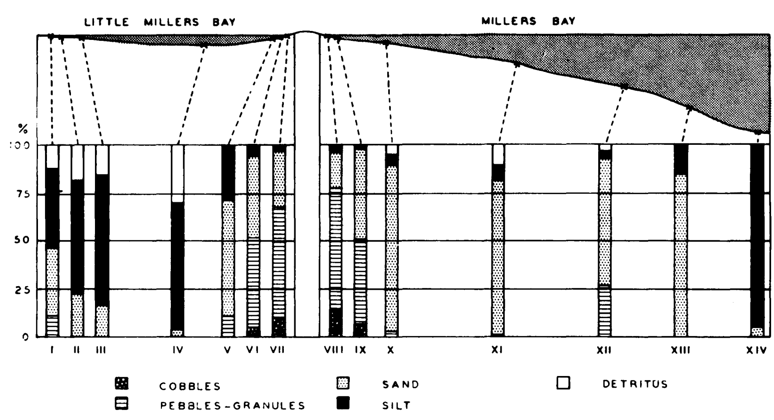


Figure 2. Particle size analysis of substratum: comparative volumes.

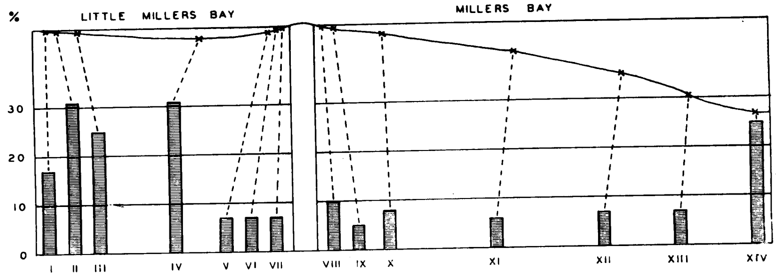


Figure 3. Organic content of substratum in per cent.

Bottom Fauna

Summary data on total numbers and bio-mass of animals per square meter show wide fluctuations from station to station (Figure 4). At most of the stations, the Chironomidae (Diptera) were the predominant group of animals (shaded portion of bars, Figure 4). These were mostly larvae, but included variable numbers of pupae. Predominating among the chironomids were a very few genera, particularly *Pseudochironomus* in the shallow water adjacent to the sand spit, and *Tendipes* in the silt substratum (stations II, III, and IV) of Little Millers Bay and in the comparable but deeper stations (XIII and XIV) of Millers Bay (Figure 5). At three stations, two on the muddy shores of Little Millers Bay and one in the deep waters of Millers Bay, oligochaetes, mostly *Limnodrilus* (Tubificidae), exceeded all other groups in numbers and at least equaled them in bio-mass; nearly all animals from station I were *Limnodrilus* (Table 2).

Aside from chironomids and oligochaetes, attention should be given to other groups of animals (Table 2). Flatworms (*Dugesia tigrina*) were restricted to sheltered crevices associated with the wave-washed cobbles and pebbles of station VIII, immediately

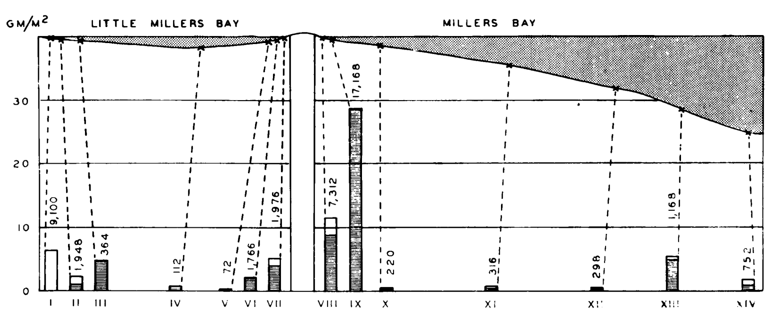


Figure 4. Quantitative data on macroscopic bottom animals; total wet weight in gm./square meter, and total numbers of animals/square meter.

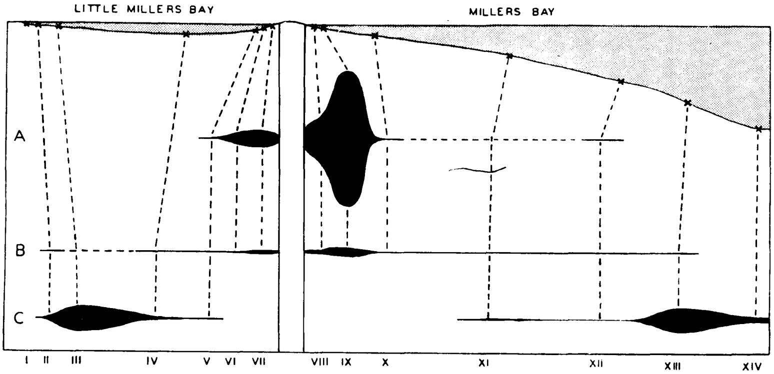


Figure 5. Comparative bio-mass of three genera of chironomids: A = *Pseudochironomus*, B = *Cryptochironomus*, C = Tendipes sp. (See Table 4 B for same data in tabular form.)

adjacent to the sand spit, but were abundant there. Snails, mostly *Physa sayii*, were also found in fair numbers here, attached to cobbles and pebbles and apparently feeding on the encrusted algae and other "Aufwuchs" of these stones; at other stations they were either absent or fewer in numbers. The leeches had a more general distribution, particularly in Millers Bay, but had the greatest number of species adjacent to the sand spit (Figure 6). *Helobdella stagnalis* was the most abundant and widely distributed. Larvae and nymphs of various orders of insects other than the Diptera were mostly few in number and sporadic in distribution; it is quite probable that members of some of these groups would be much more numerous at other times in the season.

Vertical stratification of bottom sediments and of animals was decidedly present, particularly at stations of less than one-half meter depth. The most striking example was the vertical stratification of

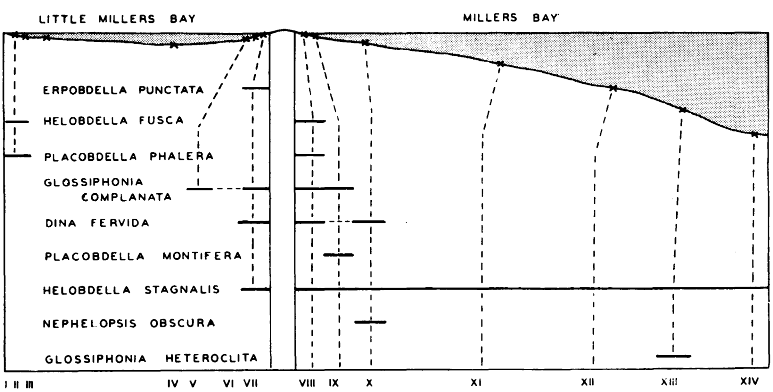


Figure 6. Distribution of leeches by species.

Pseudochironomus at station IX; 98 per cent of the more than 16,000 animals recovered were from the upper three or four centimeters of the sediments (removed to a total depth of 10 centimeters). The larger and more robust but much less numerous *Cryptochironomus* (368 animals) showed much less stratification at this station; 62 per cent of the animals were confined to the same upper stratum. At station II, 91 per cent of the *Limnodrilus* recovered were in the top five centimeters or less of the sample. *Tendipes* at station II were more numerous below five centimeters depth. Flatworms (station VIII) were restricted to the surface layer of cobbles and pebbles; snails and leeches were largely confined to this layer.

The number of species of macroscopic bottom animals (Figure 7) decreased with depth on both sides of the sand spit, and similarly on the opposite shore of Little Millers Bay. Plants increased in variety with depth in Millers Bay to a maximum (12 species) at one meter depth; they were absent at depths of five meters or more.

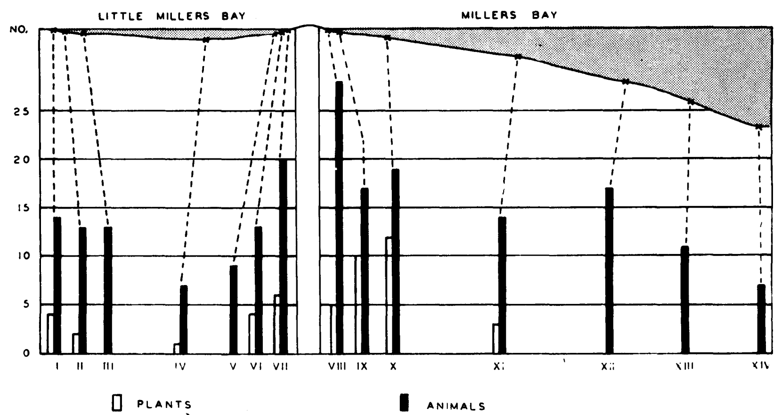
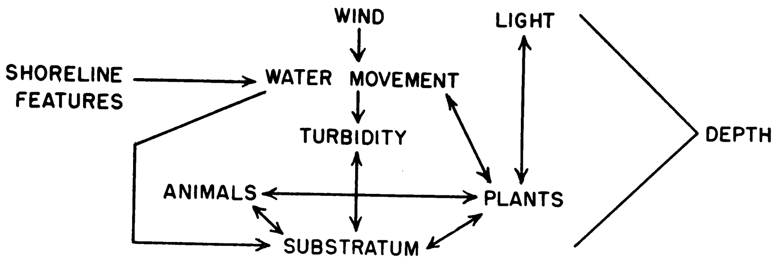


Figure 7. Numbers of species of vascular plants (plus *Chara*) and macroscopic bottom animals.

Discussion

The most obvious primary differences between Millers Bay and Little Millers Bay are physiographic; extent, depth, shoreline, and substratum. Related to these are wave action, turbidity, and light penetration. Slight chemical differences in the water of the two bays are thought to be of little ecological importance. Substratum temperature is variable in very shallow, quiet water, reaching high levels on particularly warm, quiet days. The physical and chemical variables in turn influence qualitative and quantitative features of the bottom biota. The interactions of some of these factors are suggested in the following diagram:



Qualitative comparisons (Figure 7 and Table 3) suggest that Millers Bay has a richer biota than does Little Millers Bay. It should be noted, however, that this was an atypical year for Little Millers Bay. A reduced variety and quantity of vegetation was thought to be related to high turbidity and poor light penetration. Thirteen species of plants (vascular plants and *Chara*) were recorded from Millers Bay, and only seven species from Little Millers Bay. All species from the latter were also found in the larger bay. Similarly, 47 species of bottom animals were recorded from Millers Bay compared with 33 species from Little Millers Bay. The greater variety of habitats and microhabitats in Millers Bay, related to its larger extent and greater depth, would explain these qualitative differences. Reduced water movements, rich substratum and adequate light penetration interact most favorably at about one meter depth in Millers Bay for the growth of the greatest variety of plants (12 species). Bottom animals, on the other hand, were most varied (28 species) in the coarse rubble immediately adjacent to the sand spit in Millers Bay. The variety of favorable microhabitats is apparently greater here than elsewhere, accounting for the more varied bottom fauna.

Distribution data on the leeches (Figure 6) are suggestive in relating biotic to ecological factors. A preference by many leech species for a shallow substratum of cobbles and gravel rather than for silt is indicated by the restriction of most species to the sand spit shore area. The wide distribution of *Helobdella stagnalis* suggests a much wider ecological valence for this species than for any of the others. Five species of leeches were collected from both bays; one species, *Erpobdella punctata*, was found only in Little Millers Bay, and three species only in Millers Bay. These data illustrate the overlapping character, probably typical, of the fauna of the two bays, and the tendency toward a more varied fauna in Millers Bay. More extensive sampling would confirm both the similarities and the differences of the two bays as to leech distribution. The same would apply to any of the other animal groups.

Quantitative comparisons (Figures 4 and 5, Tables 2 and 4) show wide fluctuations between stations in both numbers and bio-mass of animals. A very few species make up a large proportion of the total number and bio-mass of animals; in the distribution of these species, substratum appears to be of particular ecological importance. The characteristic mud bottom inhabitants, whether the depth is a few centimeters or ten meters, are of the genera *Limnodrilus* (Oligochaeta, Tubificidae) and *Tendipes* (a large red bloodworm, Chironomidae). *Pseudochironomus* (Chironomidae) is characteristic of the sand and gravel substratum of the shallow areas adjacent to both sides of the sand spit; it is responsible particularly for the much higher numbers and bio-mass of animals at one-third meter depth in Millers Bay than elsewhere in the study area. According to Hauber's (1947) description, this is probably *P. fulviventris* (Johannsen). Whether *Limnodrilus* and *Tendipes* are represented by different species at different depths was not determined; this is a problem for future investigation.

While the data presented here are intriguing, they dictate further investigation, particularly quantitative and annual studies. There is opportunity here for careful taxonomic and life history studies of the chironomids in particular. Similar handling of other aquatic insects, mollusks, leeches, and plants could result in the basis of a picture of productivity in lake embayments. A meaningful comparison could then be made with open water productivity such as presented by Weber (1958). It is hoped that this initial, restricted study will provide a helpful background and stimulus for such work.

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Table 2
Quantitative Data on Major Animal Groups

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Depth, Meters	.01	.10	.40	1.0	.40	.10	.05	.10	.35	1.0	3.0	5.0	7.5	10.0
Date collected	8/4	8/13	8/1	7/25	7/29	7/22	7/29	7/23	7/27	7/30	8/10	8/3,8	8/12	8/3
A. Number Animals/Sq. Meter														
Flatworms (*Dugesia tigrina*)	......	......	......	......	......	......	......	856	......	......	......	......	......	......
Oligochaetes	8960	1840	8	8	......	104	72	20	72	4	4	70	420	704
Leeches	8	......	......	......	4	......	84	28	8	12	184	50	16	4
Insects														
Ephemeroptera	......	8	......	8	......	12	......	......	......	4	......	4	......	4
Odonata (Zygoptera)	......	......	......	......	......	......	12	......	......	......	......	......	......	......
Trichoptera	......	......	......	4	......	4	8	8	......	4	......	10	......	......
Coleoptera	......	......	......	......	......	......	4	8	40	44	......	......	4	......
Diptera (mostly Chironomidae)	124	100	356	92	68	1646	1796	6340	17040	148	112	164	728	40
Gastropods	8	......	......	......	......	......	......	52	8	4	16	......	......	......
TOTALS	9100	1948	364	112	72	1766	1976	7312	17168	220	316	298	1168	752
B. Wet Weight of Animals, Grams/Sq. Meter														
Flatworms (*Dugesia tigrina*)	......	......	......	......	......	......	......	1.88	......	......	......	......	......	......
Oligochaetes	6.27	1.30	0.01	0.001	......	0.01	0.06	0.03	0.10	0.01	0.000	0.16	0.52	0.96
Leeches	0.08	......	......	......	0.04	......	0.86	0.16	0.02	0.17	0.20	0.05	0.03	0.004
Insects														
Ephemeroptera	......	0.02	......	0.02	......	0.02	......	......	......	0.07	......	0.01	......	0.02
Odonata (Zygoptera)	......	......	......	......	......	......	0.32	......	......	......	......	......	......	......
Trichoptera	......	......	......	0.02	......	0.02	0.04	0.04	......	0.02	......	0.04	......	......
Coleoptera	......	......	......	......	......	......	0.01	0.01	0.04	0.04	......	......	0.001	......
Diptera (mostly Chironomidae)	0.10	1.07	4.84	0.80	0.30	2.31	4.06	8.87	28.60	0.29	0.52	0.31	5.04	0.96
Gastropods	0.12	......	......	......	......	......	......	0.65	0.06	0.05	0.18	......	......	......
TOTALS	6.57	2.39	4.85	0.84	0.34	2.36	5.35	11.64	28.82	0.65	0.90	0.57	5.59	1.94

Table 3

Species List

A. Macroscopic Plants	Station Depth, M.	I .01	II .1	III .4	IV 1.	V .4	VI .1	VII .05	VIII .1	IX .35	X 1.	XI 3.	XII 5.	XIII 7.5	XIV 10.
Zannichelliaceae															
Zannichellia palustris		X	X	......	......	......	X	X	......	X	......	......	......	......	......
Potamogetonaceae															
Potamogeton pectinatus		X	X	......	......	......	X	X	X	X	X	X	......	......	......
P. friesii		......	......	......	......	......	......	......	......	X	X	......	......	......	......
P. praelongus		......	......	......	......	......	......	......	......	X	X	......	......	......	......
P. richardsonii		......	......	......	......	......	......	X	X	X	X	......	......	......	......
Najadaceae															
Najas flexilis		X	......	......	......	......	X	X	X	X	X	......	......	......	......
Hydrocharitaceae															
Vallisneria americana		......	......	......	......	......	......	......	......	X	X	......	......	......	......
Pontederiaceae															
Heteranthera dubia		X	......	......	......	......	X	X	X	X	X	......	......	......	......
Ceratophyllaceae															
Ceratophyllum demersum		......	......	......	X	......	......	......	......	......	X	X	......	......	......
Ranunculaceae															
Ranunculus longirostris		......	......	......	......	......	......	......	......	......	X	......	......	......	......
Haloragaceae															
Myriophyllum exalbescens		......	......	......	......	......	......	......	......	X	X	X	......	......	......
Compositae															
Megalodonta beckii		......	......	......	......	......	......	......	......	......	X	......	......	......	......
Characeae (Algae)															
Chara fragilis		......	......	......	......	......	......	X	X	X	X	......	......	......	......
TOTAL PLANT SPECIES		4	2	0	1	0	4	6	5	10	12	3	0	0	0

Table 3 (Continued)

B. Macroscopic Animals	Station Depth, M.	I .01	II .1	III .4	IV 1.	V .4	VI .1	VII .05	VIII .1	IX .35	X 1.	XI 3.	XII 5.	XIII 7.5	XIV 10.
Turbellaria															
Dugesia tigrina		......	......	......	......	......	......	X	X	......	......	......	......	......	......
Bryozoa (unidentified)		......	......	......	......	......	......	......	X	......	......	......	......	......	......
Annelida															
Oligochaeta															
Tubificidae															
Limnodrilus sp.		X	X	X	......	......	X	X	X	X	......	......	X	X	X
Tubifex sp.		X	X	X	......	......	......	......	......	......	......	......	X	X	......
Peloscolex sp.		......	......	......	......	......	......	......	......	......	......	......	X	......	......
Enchytraeidae															
(unidentified)		......	......	......	......	......	......	......	......	......	......	......	X	......	......
Lumbriculidae															
Lumbriculus inconstans		......	......	......	......	......	......	X	X	X	X	......	......	......	......
Naididae															
(unidentified sp.)		......	......	......	X	......	X	X	......	......	......	......	......	......	......
Stylaria proboscidea		......	......	......	......	......	......	......	......	......	......	X	......	......	......
Hirudinea															
Erpobdella punctata		......	......	......	......	......	......	X	......	......	......	......	......	......	......
Helobdella stagnalis		......	......	......	......	......	......	X	X	X	X	X	X	X	X
Helobdella fusca		X	......	......	......	......	......	......	X	......	......	......	......	......	......
Glossiphonia complanata		......	......	......	......	X	......	X	X	X	......	......	......	......	......
Glossiphonia heteroclita		......	......	......	......	......	......	......	......	......	......	......	......	X	......
Placobdella montifera		......	......	......	......	......	......	......	......	X	......	......	......	......	......
Placobdella phalera		X	......	......	......	......	......	......	X	......	......	......	......	......	......
Nephelopsis obscura		......	......	......	......	......	......	......	......	......	X	......	......	......	......
Dina fervida		......	......	......	......	......	......	X	X	......	X	......	......	......	......

Table 3 (Continued)

B. Macroscopic Animals (cont.)	Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
	Depth, M.	.01	.1	.4	1.	.4	.1	.05	.1	.35	1.	3.	5.	7.5	10.
Mollusca															
Pelecypoda (*juvenile)															
Lampsilis siliquoides		......	......	......	......	X*	......	......	......	X	X	......	......	......	......
Gastropoda															
Physa sayii		......	......	......	......	......	......	......	X	X	X	X	......	......	......
Physa gyrina		X	X	X	......	......	......	......	X	X	X	......	......	......	......
Gyraulus parvus		X	X	X	......	......	......	......	X	X	X	......	......	......	......
Menetus exacuous		X	X	X	......	......	......	......	X	X	X	......	......	......	......
Amnicola limosa		......	......	......	......	......	......	......	......	......	......	X	......	......	......
Lymnaea obrussa		X	......	......	......	......	......	......	......	......	......	......	......	......	......
Crustacea															
Hyalella azteca		X	X	X	X	X	X	X	X	......	......	......	......	......	......
Orconectes virilis		......	......	......	......	......	......	......	X	X	......	......	......	......	......
Arachnoidea, Hydracarina															
(unidentified: at least 3 spp.)		X	......	......	X	......	X	X	X	X	X	X (3 spp.)	X (2 spp.)	X (2 spp.)	X
Insecta															
Trichoptera															
Hydropsyche sp		......	......	......	......	......	......	......	X	......	......	......	......	......	......
Helicopsyche sp		......	......	......	......	......	......	......	......	X	......	......	......	......	......
Psychomyia sp		......	......	......	......	......	X	......	X	......	......	......	X	......	......
Oecetis sp		......	......	......	......	......	......	......	......	......	X	......	X	......	......
(unidentified sp., Leptoceridae)		......	......	......	......	......	......	X	......	......	......	......	......	......	......
Ephemeroptera															
Caenis sp		......	X	......	......	......	X	......	X	X	X	......	X	......	......
Stenonema sp		......	......	......	......	......	......	......	X	......	......	......	......	......	......
(unidentified sp.)		......	......	......	......	......	......	......	......	......	X	......	......	......	X
Odonata, Zygoptera															
Enallagma sp. (?)		......	......	......	......	......	......	X	......	......	......	......	......	......	......

Table 3 (Continued)

B. Macroscopic Animals (cont.)	Station Depth, M.	I .01	II .1	III .4	IV 1.	V .4	VI .1	VII .05	VIII .1	IX .35	X 1.	XI 3.	XII 5.	XIII 7.5	XIV 10.
Insecta (cont.)															
Hemiptera, Corixidae															
(unidentified sp.)		X	X	X	......	X	X	X	......	......	......	......	......	......	......
Coleoptera, Haliplidae															
Haliplus sp. (?)		......	......	......	......	......	......	X	X	X	X	......	......	X	......
Diptera															
Chironomidae															
Pentaneura sp.		......	......	X	......	X	X	......	......	......	......	X	......	......	......
Tanypus sp.		......	......	......	......	......	......	......	......	......	......	X	......	......	......
Procladius (*Anatopynia*?) sp.		......	......	......	......	......	......	......	......	......	X	X	X	X	X
Cardiocladius sp.		......	......	......	......	......	......	......	X	......	......	......	......	......	......
Cryptochironomus sp.		......	X	X	X	X	X	X	X	X	X	X	X	X	......
Pseudochironomus sp.		X	......	X	......	X	X	X	X	X	X	......	X	......	......
Phaenopsectra (*Polypedilum*?) sp.		......	......	......	......	......	X	X	X	......	X	X	X	......	......
Tendipes, 2 spp.		......	X	X	X	X	......	X	......	......	......	X	X	X	X
Harnischia sp.		X	X	X	X	X	X	X	X	......	X	X	X	......	......
Calopsectra sp.		......	X	......	......	......	X	......	......	......	......	......	X	......	......
Ceratopogonidae															
(unidentified sp.)		X	X	X	X	......	......	X	X	......	......	......	......	X	X
Ephydridae															
Hydrellia sp. (?)		......	......	......	......	......	......	......	X	......	......	......	......	......	......
TOTAL ANIMAL SPECIES		14	13	13	7	9	13	20	28	17	19	14	17	11	7

Table 4

Quantitative Comparisons of Three Genera of Chironomids

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
A. Numbers of Larvae and Pupae/Sq. Meter														
Pseudochironomus	......	......	......	......	20	868	1544	6096	16432	48	......	34	......	......
Cryptochironomus	......	24	......	24	24	340	192	136	368	40	4	14	12	......
Tendipes sp.	......	40	320	16	16	......	......	......	......	......	48	36	472	20
B. Wet Weight of Larvae and Pupae, Gm./Sq. Meter														
Pseudochironomus	......	......	......	......	0.05	1.70	3.56	8.30	27.00	0.07	......	0.05	......	......
Cryptochironomus	......	0.06	......	0.10	0.12	0.39	0.63	0.40	1.60	0.12	0.005	0.03	0.02	......
Tendipes sp.	......	1.00	4.80	0.60	0.12	......	......	......	......	......	0.40	0.11	4.50	0.92