13. BENTHOS

The invertebrate animals which inhabit the sediments of the lake bottom are called "benthos" (originating from the Greek word for bottom). They and the sediment which contains them, are usually sampled with a small hand-operated dredge (Fig. 13-1). Organisms are separated from the sediments by washing them in a screened bucket. The organisms (Fig. 13-2) are then identified, counted and weighed so that estimates of species diversity and standing crop can be made. Field collection of organisms is not unduly difficult, but the process of sorting them from detritus is very time consuming (often over an hour per sample). Identifying the organisms is very difficult and requires special training.

Benthos studies on Lake Winona have been sporadic and inadequate because of a lack of time, trained personnel and funds. The results of the studies are presented in Tables 13-1, 2, 3, 4. Even though the data are meager, some tentative conclusions can be drawn.

The sediments of Lake Winona are rich in organic matter and are potentially very productive of benthos. Because they are anaerobic, however, their benthos consists only of species which can tolerate anoxic conditions. The dominant benthos are several species of midge larvae and aquatic earthworms. Total standing crop biomass of benthos is less than 35 g/m^2 are common.

Furthermore, the anaerobic lake bottom provides a refuge for midge larvae and aquatic earthworms because oxygen-sensitive species of fish such as bluegills cannot penetrate the depths of the lake to feed. The midges are mainly vulnerable when they rise to the surface to emerge as adult insects, but this occurs principally during the night when sight-feeders like bluegills do not feed actively.

Until they attain a weight of about 1/10 lb, bluegills are able to feed upon zooplankton, but as they become larger their gill rakers are too far apart to retain such small organisms. Thus, they must depend upon larger organisms such as aquatic insects, but the benthos does not provide many. This lack of suitable food, exacerbated by crowding and other less obvious factors causes the bluegills to become stunted.

Figure 13-1. Ekman dredge used to collect benthos samples from Lake Winona. The screened washing bucket is used to separate organisms from the sediment.

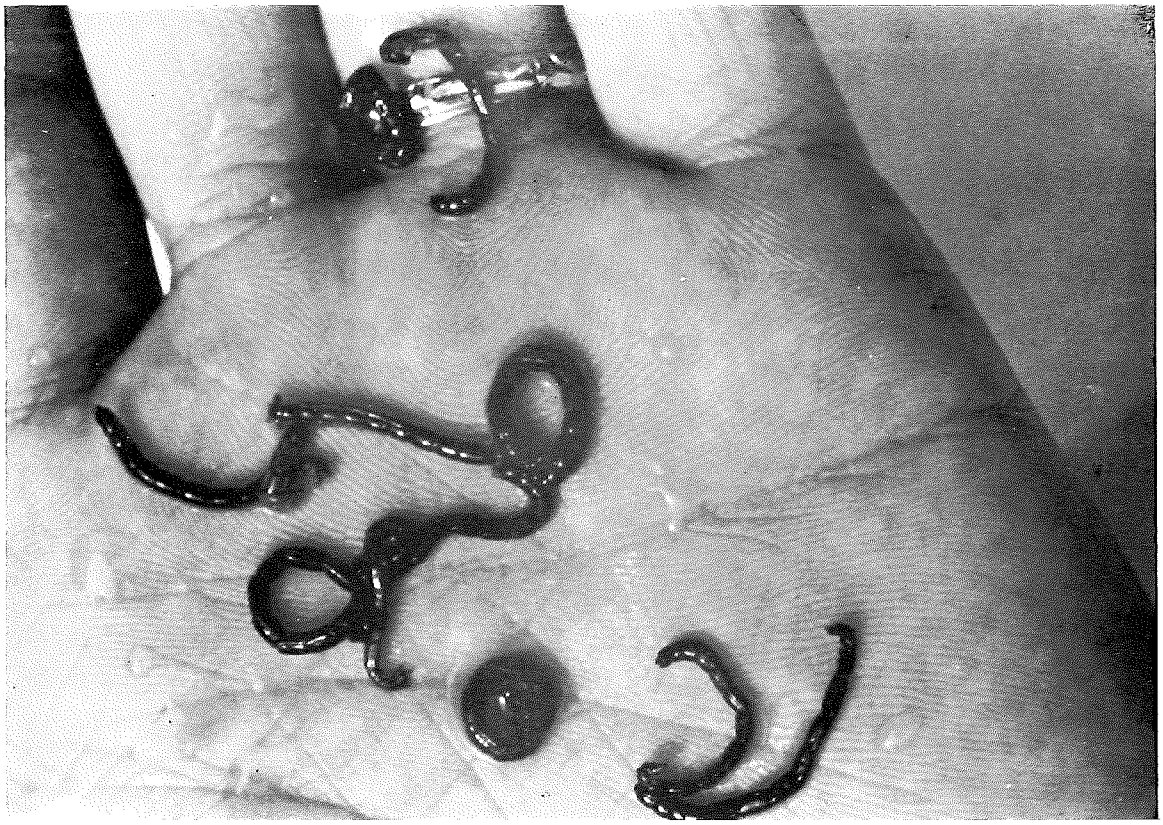

Figure 13-2. Chironomid midge larvae collected by dredging in Lake Winona. Midge larvae can tolerate anoxic conditions and are the dominant benthos in the lake.

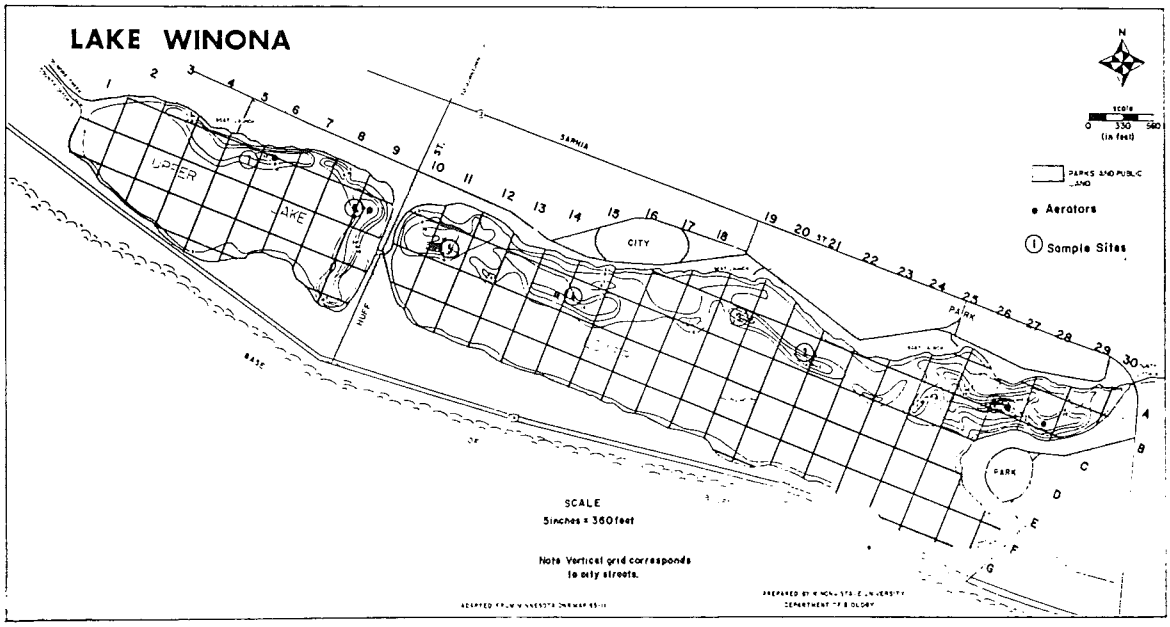

Figure 13-3. Guide to benthos sampling sites.

Table 13-1

LAKE WINONA BENTHOS, BEFORE RECLAMATION

July 31 - August 1, 1972

Each site represents one sample taken with an Ekman dredge and collected in a U.S. Standard Sieve No. 40 (.0165 in. mesh). A quantity of clam and snail shell fragments was found in every Ekman dredge sample taken. See accompanying map for locations of dredging sites.

Site No.	Depth in Ft.	Type of Substrate	Fauna	Approximate No/m^2
F-28	3	sand, no detritus	no fauna	
E-27	10	mud, organic detritus no H_2S odor.	1 chironomid	44
E-24	12	mudded silt, detritus slight odor of H_2S	4 chironomids	176
E-23	10	mud, very fine organic detritus, no H_2S odor	2 chironomids	88
C-23	11	silt and some detritus no H_2S odor	5 chironomids	220
A-30	4	silt and some organic detritus	2 chironomids	88
B-28	18	silt with fine organic detritus, H_2S odor	no fauna	0
B-27	37	very little detritus, silt and very strong H_2S odor	no fauna	0
C-21	11	mud and coarse detritus, no H_2S odor	4 chironomids	176
C-19	15	mud, coarse detritus, H_2S odor	3 chironomids	132
C-18	20	silt, detritus, strong no H_2S odor	3 chironomids	132
D-15	22	silt, fine detritus, H_2S odor	1 chironomid	44
D-12	18	mud, fine organic detritus, H_2S odor	3 chironomids	132
E-10	rock sample	rock and gravel	planaria, caddis fly, larvae, bryzoans	?
D-1	5	sand, no detritus	no fauna	0
D-1	5	mud and sand, no detritus	no fauna	0
D-1	6	mud, coarse detritus	no fauna	0
D-3	11	mud, detritus, H_2S odor	1 gastropod	44
F-2	2.5	no mud or sand, only a small amount of detritus	no fauna	0
C-3	13	mud and sand, detritus,	1 chironomid	44
F-4	10	no mud or sand, only a thick layer of coarse organic detritus, H_2S odor	no fauna	0
D-5	23	silt, fine detritus, strong H_2S odor	1 chironomid	44
F-6	6	mud, much coarse detritus	5 chironomids	220
C-7	15	silt, fine detritus, H_2S odor	2 chironomids	88
G-9	4	no mud, much fine detritus	no fauna	0
C-9	27	mud, fine detritus, H_2S odor	1 chironomid	44
C-8	18	mud, fine detritus, H_2S odor	no fauna	0
F-15	shore sample	sand	1 Haemopis sp. and 1 Erpobdella punctata	44 44

Table 13-2

LAKE WINONA BENTHOS, AFTER RECLAMATION

Each site represents one sample collected with a Ponar dredge and sifted through a U.S. Standard Sieve No. 40 (.0165 in. mesh).

Site No.	Depth (ft.)	Fauna	Number	weight(g)	approximate No. per m^2	approximate weight/g/m^2
		June 26, 1974				
B-27	30.0	Chironomus sp.	1	.0011	18	.02
C-22	21.0	Chironomus sp.	1	.0137	18	.25
D-9	24.0	Chironomus sp.	27	.0484	486	.88
		Procladius sp.	2	.0068	36	.11
		Chaoborus sp.	1	.0067	18	.12
		Chaoborus albipes	1	.0081	18	.15
		June 28, 1974				
B-27	30.0	Polypedilum sp.	1	.0041	18	.08
		Chaoborus sp.	1	.0070	18	.14
		Branchiobdellidae	1	.0031	18	.06
		Chironomus sp.	1	.0141	18	.26
		Procladius sp.	1	.0056	18	.10
C-22	21.0	Chironomus sp.	10	.0889	180	1.61
C-20	17.0	Palpomyia sp.	1	.0092	18	
		Pentaneura sp.	1	.0085	18	
		Chironomus sp.	57	.3381	1,046	6.13
C-17	24.0	Procladius sp.	1	.0018	18	.03
		Amnicola sp.	1	.0036	18	.07
		Lumbriculus inconstans	2	.0016	36	.03
		Chironomus sp.	245	1.7952	2,410	32.53
		August 2, 1974				
B-27	30.0	Chironomus sp.	19	.2542	342	4.44
D-9	24.0	Chironomus sp.	109	1.1338	1,962	20.54
		Palpomyia sp.	1	.0005	18	.01
D-6	16.0	Chironomus sp.	106	1.8147	1,908	32.88
		Palpomyia sp.	1	.0006	18	.01

Determination of Percent Oxidizable Material in Lake Winona Sediments, Winter 1974-75.

Site No.	Weight of Dry Sample	Weight of Ashed Sample	Weight Loss	% Oxidizable Material
B-26	17.1527 g.	17.0412 g.	.1115 g.	.65
B-26	3.4529 g.	2.7168 g.	.7361 g.	21.32
C-26	3.2256 g.	2.4228 g.	.7058 g.	24.89
C-26	2.7963 g.	2.0905 g.	.7058 g.	25.24
D-26	3.3217 g.	2.7591 g.	.5626 g.	16.94
C-14	18.0614 g.	17.9545 g.	.1069 g.	.59
D-14	2.3705 g.	1.7495 g.	.6210 g.	26.20
E-14	1.5142 g.	*		
F-14	2.6831 g.	2.0853 g.	.5978 g.	22.28
D-6	4.2338 g.	3.4977 g.	.7361 g.	17.39
D-6	3.3414 g.	2.6389 g.	.7025 g.	21.02
E-6	2.3957 g.	1.8370 g.	.5587 g.	23.32
F-7	2.1382 g.	1.9176 g.	.2206 g.	10.32

* Sample Lost

Table 13-3

Organisms Collected in Ponar Dredge Samples, Winter 1974-75.

Site No.	Depth in Ft.	Fauna: Chironomidae (#-wet wt.)	Fauna: Heleidae (#-wet wt.)	Fauna: Oligochaeta (#-wet wt.)
B-26	10	1-.0104 g.	3-.0028 g.	
B-26	18	20-1.0300 g.	2-.0040 g.	
C-26	33	66-1.9313 g.		
C-26	20	5-.0513 g.	2-.0047 g.	
D-26	8	11-.2422 g.	5-.0060 g.	
C-14	6	44-.3410 g.	2-.0058 g.	5-.0045 g.
D-14	21.5	9-.1143 g.	3-.0088 g.	1-.0002 g.
E-14	7	6-.1665 g.		
F-14	6.5	4-.0032 g.	1-.0007 g.	
D-6	19.5	3-.0613 g.	12-.0239 g.	18-.0571 g.
D-6	8	40-1.1740 g.	3-.0100 g.	65-.1217 g.
E-6	8	13-.3853 g.	23-.0932 g.	4-.0012 g.
F-7	4.5	4-.0213 g.	7-.0029 g.	1-.0003 g.

Estimated Benthos Standing Crop in Lake Winona, Winter 1974-75.

Organism	Average Mass Per Sample 0-15 Ft. Depth Range	Average / $Ft.^2$ 0-15 Ft.	Average Mass Per Sample 15-30 Ft. Depth Range	Average /$Ft.^2$ 15-30 Ft.
Chironomidae	.2929 g.	1.1716 g.	.6436 g.	2.5744 g.
Heleidae	.0152 g.	.0508 g.	.0083 g.	.0332 g.
Oligochaeta	.0159 g.	.0636 g.	.0114 g.	.0456 g.

Standing Crop Biomass

N.W. Basin 0-15 Ft.	Chironomidae	- 4,006,239 g. or 8942 lb.
	Heleidae	- 173,708 g. or 388 lb.
	Oligochaeta	- 217,477 g. or 485 lb.
15-30 Ft.	Chironomidae	- 1,151,735 g. or 2570 lb.
	Heleidae	- 14,853 g. or 33 lb.
	Oligochaeta	- 20,400 g. or 46 lb.
S.E. Basin 0-15 Ft.	Chironomidae	- 9,747,665 g. or 21,445 lb.
	Heleidae	- 422,654 g. or 930 lb.
	Oligochaeta	- 529.149 g. or 1164 lb.
15-30 Ft.	Chironomidae	- 4,373,494 g. or 9622 lb.
	Heleidae	- 56,401 g. or 124 lb.
	Oligochaeta	- 77,467 g. or 170 lb.
Total for both basins	Chironomidae	- 19,279,133 g. or 42,579 lb.
	Heleidae	- 667,616 g. or 1,475 lb.
	Oligochaeta	- 844,493 g. or 1,865 lb.
	Total of all	- 20,791,242 g. or 45,919 lb.

Table 13-4

LAKE WINONA BENTHOS, AFTER RECLAMATION

Each site represents one sample collected with an Ekman dredge sifted through a standard sieve No. 40 (.0165 in. mesh). For Taxa Code, see table at end of Benthos section.

April 23, 28, 1977

Site No.	Depth(ft.)	Taxa Code	Fauna	Approximate No. per m^2	Bottom type
B-27	35	I,A,1,a	Chironomus chironomus	4218	sapropel
			Procladius sp.	44	
		II,B,2	Tubificidae	44	
		III,C,3,c	Diplogaster chironomus	44	
C-26	19	I,A,1,a	Chironomus	1820	sapropel
			Procladius	844	
		III,C,3,c	Diplogaster	44	
C-21	21	I,A,1,a	Chironomus chironomus	1687	sapropel
			Procladius	577	
		III,C,3,c	Diplogaster	622	
		II,B,2	Tubificidae	44	
C-21	15	I,A,1,a	Chironomus chironomus	1199	sapropel
			Procladius	888	
		I,A,4	Ephemeroptera	44	
		II,B,2	Tubificidae	44	
D-4	18	I,A,1,a	Chironomus chironomus	3196	copropel
			Procladius	177.6	
		I,A,1,b	Palpomyia tibialis	311	
		I,A,4	Ephemeroptera	44	
		IV,D,d	Musculium	89	
D-4	15	I,A,1,a	Chironomus chironomus	1287	sapropel
			Procladius	400	
		I,A,1,b	Palpomyia tibialis	89	
		II,b	Oligochaeta	133	
		IV,D,d	Musculium	89	
B-27	11	I,A,1,a	Chironomus chironomus	1820	copropel
			Procladius	133	
		I,A,1,b	Palypomyia tibialis	310	
		II,B,2	Tubificidae	399	
E-26	8	I,A,1,a	Chironomus chironomus	2664	copropel
			Procladius	266	
E-21	8	I,A,1,a	Chironomus chironomus	1154	copropel
		I,A,1,b	Palypomyia tibialis	44	
		II,B,2	Tubificidae	133	
D-3	8	I,A,1,a	Chironomus chironomus	2397	sapropel
			Procladius	133	
		I,A,4	Ephemeroptera	44	
		I,A,1,b	Palypomyia tibialis	89	
		IV,D,d	Musculium	176	
E-1	6	I,A,1,a	Chironomus chironomus	44	copropel
			Procladius	177	
		I,A,1,b	Palypomyia tibialis	577	
		I,A,4	Ephemeroptera	44	

BENTHOS COLLECTED APRIL 24, 1985

Limnology class, site 25B, water depth 22 ft, organic-rich bottom, two Ponar dredge and two Ekman dredge samples, total sample area 270 in^2 (0.174 m^2), yield 159 chironomid midges (914.3/m^2) and several tubificid worms, blotted weight of chironomids = 4.8 g (27.6 g/m^2).

Phylogenetic Outline of Taxa Code for the Benthos Studies of Lake Winona.

Code Symbol	Taxa
I	Phylum Arthropoda
A	Class Insecta
1	Order Diptera
a	Family Chironomidae
b	Family Heleidae
4	Order Ephemeroptera
II	Phylum Annelida
B	Class Oligochaeta
2	Order Tubificidae
III	Phylum Nematoda
C	Class Phasmidia
3	Order Rhabditida
c	Family Diplogasteridae
IV	Phylum Mollusca
D	Class Pelecypoda
d	Family Sphaeriidae