Aquatic biology of Swamp Creek, for the Crandon Project January-December 1983. 1984

Seegert, Greg; Lewis, Randall; Lauer, Gerald
Northbrook, Illinois: Ecological Analysts, Inc., 1984

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EA Final Report EXX31

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AQUATIC BIOLOGY OF SWAMP CREEK FOR THE CRANDON PROJECT JANUARY-DECEMBER 1983

Prepared for

Exxon Minerals Company
P.O. Box 813
Rhinelander, Wisconsin 54501

Prepared by

Ecological Analysts, Inc.
612 Anthony Trail
Northbrook, Illinois 60062

April 1984

Prepared by:
Greg Seegert
Project Manager

and

Randall Lewis
Aquatic Biologist

by:
Gerald Lauer, Ph.D.
Senior Vice-President

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1. INTRODUCTION

A one-year study of the aquatic biology, chemistry (water and sediment), and hydrology of Swamp Creek downstream from County Trunk Highway M was initiated by Ecological Analysts, Inc. (EA) in January 1983. The study was performed in the vicinity of the site proposed to receive the water discharge from the Crandon Project. Major components of the study included water and sediment chemistry, fish tissue analysis, particle size analysis, winter dissolved oxygen (DO) survey, summer diel (day/night) DO survey, current velocity, stream discharge, fisheries, and benthic macroinvertebrates. The frequency at which these components were examined is summarized below:

Task	Frequency During 1983
Regular water chemistry	Monthly; January through December
Intensive water chemistry	Quarterly; February, May, August, November
Tissue chemistry	Analysis of 15 fish collected during 1982-1983
Sediment chemistry	May
Particle size analysis	May
Winter DO survey	January through April
Summer diel DO survey	July through September
Current velocity	Monthly; March through December
Stream discharge	Monthly; February through December
Fisheries	April
Benthic macroinvertebrates	Quarterly; February, May, August November

The fisheries and macroinvertebrate data obtained during the studies are presented and discussed in this report. The chemistry and hydrology data are presented in a separate report (Ecological Analysts 1984).

The objective of the aquatic biology program was to describe the existing macroinvertebrate and fish communities in Swamp Creek. To accomplish this objective, a program was designed that included fish and macroinvertebrate sampling at stations above, near, and below the location proposed for the water discharge from the Crandon Project. The program was designed to be compatible with and complementary to previous aquatic studies on Swamp Creek (Section 2.5 of the EIR [Exxon Minerals Company 1982]; Wisconsin DNR 1974; Ecological Analysts 1983).

2. METHODS

2.1 FISH

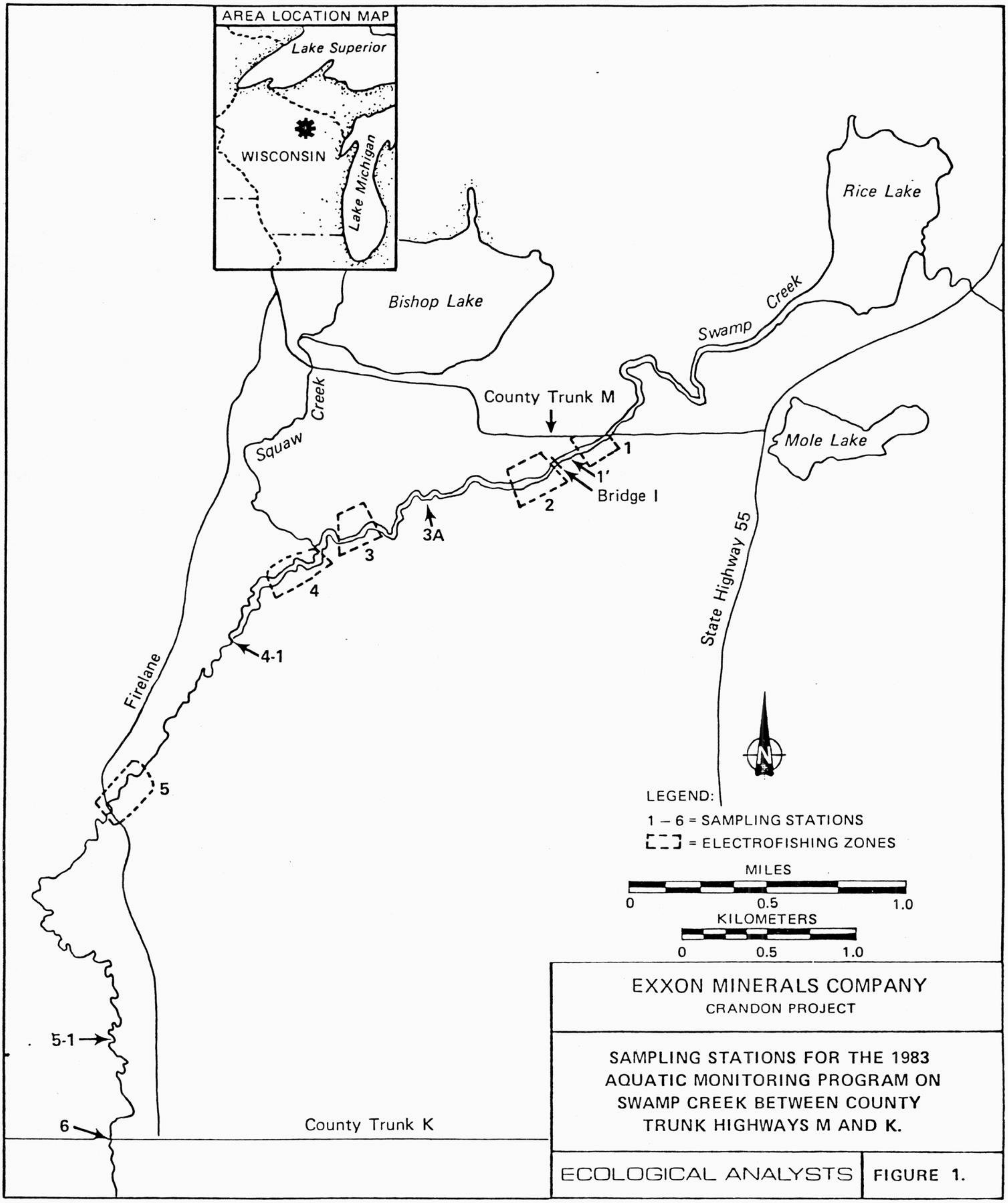
Fish were collected at five stations on Swamp Creek on 20 and 21 April 1983 (Figure 1). Based on a previous habitat inventory (Ecological Analysts 1983), each station was judged to be representative of the habitats observed in Swamp Creek. Physicochemical measurements taken in conjunction with each sampling effort are summarized in Appendix A. Station 1, situated upstream of the proposed water discharge location, was located at County Trunk Highway M and (for electrofishing) extended downstream 244 m (800 ft). Depths were generally 0.6-0.9 m (2-3 ft) and in-stream cover was limited primarily to overhanging branches. The substrate was a combination of sand and gravel near the upstream end of the 244-m segment grading quickly to sand, and eventually silt near the end of the segment. A detailed account of the habitat at Station 1 is presented in Ecological Analysts (1983).

Station 2, also situated upstream of the location proposed for the water discharge, was located at Bridge I between Sections 32 and 33, and (for electrofishing) extended downstream for 305 m (1000 ft). The damming effect of the bridge created a large, fast-flowing pool immediately below it. This pool was approximately 15 m (50 ft) wide and 21 m (70 ft) long. Except for a long, narrow island at the tail of the pool, the remainder of the segment was broad and shallow (0.3-0.6 m [1-2 ft]). Sand was the predominant substrate throughout the segment, except for a gravel area at the tail of the pool area.

Station 3, situated at the location proposed for the water discharge, began at staff gage 24 and extended downstream for 305 m (1000 ft). Depths generally ranged from 0.6 to 0.9 m (2-3 ft). This segment differed from Stations 1 and 2 in that it was more meandering, had more rooted aquatic plants (particularly <u>Elodea</u>), and had softer and finer substrates--a combination of silt and sand, with no gravel.

Station 4, situated approximately 750 m (2,500 ft) downstream of the location proposed for the water discharge, began immediately downstream of the mouth of Squaw Creek and extended downstream for 305 m (1,000 ft). Depths generally ranged from 0.6 to 1.2 m (2-4 ft). This segment was very similar in character to Station 3. Like Station 3, Station 4 had substrates that were a mixture of silt and sand, and contained numerous rooted aquatic plants.

Station 5 was situated at a bridge on a firelane approximately 4.9 km (3 mi) downstream of Country Trunk Highway M and approximately 2.4 km (1.5 mi) downstream of the proposed water discharge location. The electrofishing zone extended upstream from the bridge for 305 m (1,000 ft), whereas the macroinvertebrate collections were made immediately downstream of the bridge. In terms of substrate and macrophyte development, the electrofishing zone at Station 5 was similar to those at Stations 3 and 4. However, some morphometric differences were apparent. Swamp Creek at Station 5 was narrower (8-11 m [21-36 ft]) and deeper (0.9-1.5 m [3-5 ft]) than at any of the upstream stations and was more meandering.



EXXON MINERALS COMPANY
CRANDON PROJECT

SAMPLING STATIONS FOR THE 1983 AQUATIC MONITORING PROGRAM ON SWAMP CREEK BETWEEN COUNTY TRUNK HIGHWAYS M AND K.

ECOLOGICAL ANALYSTS | FIGURE 1.

2.1.1 Electrofishing

Electrofishing was conducted at Station 1 using a long-lead Coffelt Model VVP-2C electroshocker, and at Stations 3, 4, and 5 using a boat-mounted DC boom shocker (Smith-Root Type VI-A). No shocking was done at Station 2. Electrofishing was conducted using a three-person crew. With the long-lead shocker, one person shocked each shore, while the third person guided the boat containing the electrofisher. With the boom shocker, separate runs were made along each shore, with two people dipping and one person guiding the boat. The electrofishing runs were 305 m (1000 ft) long and made in an upstream direction.

All fish captured by electrofishing were identified to species and examined for incidence of parasites, disease, or physical abnormalities. Any specimens that could not be positively identified in the field were preserved and returned to the laboratory for confirmation. Minnows, darters, sculpins, and other small species were counted and batch weighed only. Gamefish (e.g., northern pike), panfish, and large species (e.g., white sucker) were weighed and measured individually. If more than 30 of these species were captured at a station, a random sample of 30 individuals was weighed and measured, with the remainder batch weighed. Taxonomic keys used in making these identifications included Hubbs and Lagler (1967), Becker and Johnston (1970), Pflieger (1975), and Smith (1979). A voucher collection of all species captured by electrofishing and seining was maintained. Fish in obvious breeding condition (e.g., minnows with tubercules, darters in breeding colors) were identified accordingly.

2.1.2 Seining

Seining was conducted at each of the five locations. A 9-m (30-ft) long by 1.8-m (6-ft) deep bag seine with 0.63-mm (0.25-in.) mesh was used at Station 1, while a 15-m (50-ft) long by 1.8-m (6 ft) deep straight seine with 0.63-mm (0.25-in.) mesh was used at Stations 2 through 5. Upstream and downstream seining was conducted depending on depth and current speed. "Kick" seining was conducted at Station 2 near several large snags and in the riffle at the tail of the pool. Kick seining, which is effective for darters, sculpins, and other bottom-dwelling species, consisted of positioning the seine downstream of the area to be sampled and driving the fish (or having them be swept) into the seine by overturning rocks, logs, and other debris and generally creating as much disturbance in the water as possible.

The number of seine hauls per station was not fixed, but instead varied according to the number of habitats available and the diversity of the resident fish community. Seining continued at each location until all available habitats were sampled, and no new species were captured. The number of seine hauls ranged from 5 to 8. Because large numbers of small fish are frequently collected by seining, only adult game fish, panfish, and white suckers were weighed and measured individually. Young-of-the-year and juvenile game fish, panfish, and white suckers were generally measured individually, but weighed in aggregate. Smaller species (e.g., minnows, darters, sculpins) were counted and batch weighed only. All individuals collected by seining were identified to species and visually inspected for breeding condition, deformities, and parasites.

2.1.3 Data Analysis

Fish captured by electrofishing were held until the sampling had been completed at each station. However, the fish captured by seining, unless preserved, typically were processed after each seine haul. Thus, the seining results may include a small percentage of recaptures. The number of recaptures is probably low because each seine haul at a given station was usually taken at a different location within the 305-m (1,000-ft) study segment. Also, most fish collected by seining were not released, but were preserved for later identification.

Summary tables were prepared based on the results of each sample collected. Based on these summary tables, each species was classified according to the following classification scheme:

- Abundant - Collected in almost every sample, frequently in large numbers (>25) from each sample
- Common - Collected in many samples, occasionally in large numbers
- Uncommon - Collected in only a few samples, never in large numbers
- Rare - Represented during the study by only one or two specimens.

Because these terms can be applied to different categories (e.g., the entire study, electrofishing only, Station 1 only), more than one classification may be appropriate for the same species. For example, a species might be common at one station, uncommon at another, and rare at the remaining stations.

Length-frequency distributions were determined for white sucker, black bullhead, yellow perch, and rock bass, the four sport species collected frequently enough to warrant such analysis. Because of its larger size, white sucker data were placed in 50-mm (1.97-in.) divisions from 0 to 499 mm (19.65 in.). The other species were placed into 20-mm (0.79-in.) divisions ranging from 0 to 299 mm (11.77 in.).

Condition (K) factors were calculated for these same four species using the equation described by Carlander (1969):

$$K(TL) = \frac{W \times 105}{L3}$$

where:

K (TL) = coefficient of condition where total length is used
W = weight in grams
L = total length in millimeters

and 10^5 is a factor to bring the value of K near unity. K-factors were not calculated for young-of-the-year specimens.

2.2 BENTHIC MACROINVERTEBRATES

2.2.1 Field Procedures

Benthic macroinvertebrates were sampled in Swamp Creek at Stations 4 and 5 in February, May, August, and November 1983. In addition, macroinvertebrate samples for qualitative analysis and biotic index determinations (Hilsenhoff 1977, 1982) were collected from Station 3A (Shallock's Bridge) in May, August, and November 1983. Drifting macroinvertebrates were collected at Stations 1 and 3 in August and November. These stations were selected to provide baseline information for the lower reach of Swamp Creek. A variety of habitats was examined at each station to ensure that the entire range of species was collected and to allow a description of overall macroinvertebrate community structure within this reach of Swamp Creek. During the initial field samplings, the major habitats within each of the three collection areas were identified, marked, and their precise position recorded in field notes. Habitats containing predominantly sand and silt substrates were identified at Stations 4 and 5. In addition, gravel substrates were identified at Station 5. Two replicate Ponar grab samples (area sampled = 231 cm^2) were collected from each substrate type at Stations 4 and 5 during each sampling.

To ensure complete representation by all taxa present at each station, organisms associated with all available habitats (e.g., aquatic vegetation [nearshore and midstream], low and high current velocity areas, underwater structures [branches and logs]) were sampled by qualitative hand-picking, dip netting, and kick-sampling. In addition, the fauna in the substrates were qualitatively sampled by kick-sampling along a transect across each station in Swamp Creek. To maintain comparability between stations, qualitative sampling consisted of 30 man-minutes of collection effort at each station. The approximate amount of time spent sampling each habitat type was recorded.

To calculate biotic index values, separate macroinvertebrate samples were collected at each station by kick-sampling in those areas where the current was most rapid. Each station was sampled for approximately 5 minutes until at least 100 arthropods were collected.

Drift samples were collected at Stations 1 and 3 using a 0.5-m (1.6 ft) diameter conical plankton net with 0-mesh (571-µm) aperture. The net was held stationary in a horizontal position and water was allowed to flow through it for 15 minutes. Sampling was initiated immediately after sunset and two 15-minute samples were collected. The current velocity was recorded at the mouth of the net to provide a means of quantifying the volume of water sampled.

Detailed field notes were maintained for each replicate sample. Notations included a description of each habitat's (location) precise position within the stream reach, depth, current velocity, temperature, dissolved oxygen, and a visual characterization of the substrate. Substrates were characterized in accordance with U.S. Environmental Protection Agency procedures (U.S. EPA 1973) with each sediment component estimated in 10 percent increments. The results of these physicochemical measurements are presented in Appendix A.

Samples were screened in the field on a U.S. Standard No. 30 mesh sieve (595-μm aperture), and the residue and organisms retained were transferred to appropriately labeled jars containing a solution of 10 percent formalin containing rose-bengal dye. Sample Control Sheets were originated at the time of collection and accompanied samples to the laboratory for processing.

2.2.2 Laboratory and Data Analysis

In the laboratory, samples were inventoried and Sample Control Sheets were noted for receipt. Prior to analysis, each sample was rinsed on a U.S. No. 60 mesh sieve to remove the preservative. The sample material was then sorted, a small portion at a time, under a dissection microscope at 10X magnification. All organisms, except oligochaetes and chironomids, were identified and enumerated during this initial sorting procedure. Oligochaetes and chironomids were placed on glass slides in a nonresinous mounting medium for examination under a compound binocular microscope at 40-1000X magnifications. To avoid possible overcounts, only head-ends of fragmented organisms were enumerated.

When large amounts of detrital material were collected, samples were split using the methods specified by the U.S. EPA (1973).

All macroinvertebrates were identified to the lowest taxonomic level practicable (usually genus or species) using appropriate comprehensive taxonomic keys and literature. The taxonomy of Oligochaeta followed that of Brinkhurst and Jamieson (1971), Hiltunen and Klemm (1980), and Stimpson et al. (1982). Identification of Lumbriculidae and Naididae was based on external characteristics. Some Tubificidae were identified by the characteristic shape and configuration of the somatic chaetae at all life stages while others were identifiable only when the specimen was sexually mature enough to display reproductive organs. Immature specimens that could not be specifically identified were divided into two groups: those with capilliform chaetae and those without capilliform chaetae.

Amphipoda taxonomy followed that of Bousfield (1958) and Holsinger (1976). Identification of Hirudinea specimens was based on Klemm (1982), and Gastropoda were determined according to the description of Burch (1982). Sphaeriidae were identified according to Burch (1973). In general, the aquatic insects were identified utilizing the keys by Hilsenhoff (1981, 1982); however, additional literature was consulted in the identification of the various aquatic insect groups. Ephemeroptera and Trichoptera taxonomy followed that of Burks (1953) and Wiggins (1977), respectively. The nomenclature suggested by Hamilton et al. (1969) was used for Chironomidae. A voucher collection of all macroinvertebrate taxa was compiled and maintained.

2.3 QUALITY ASSURANCE AND QUALITY CONTROL

All samples were collected and analyzed utilizing procedures outlined in Ecological Analysts' Macroinvertebrate Group Procedures Manual and/or Fisheries Procedures Manual. Chain-of-Custody sheets were prepared for all samples delivered to the laboratory for processing. All data were recorded on field and laboratory bench sheets developed for the project. During the macroinvertebrate analysis, quality control checks were conducted and results recorded at each stage of analysis including sieving, sorting, mounting, identification, and data tabulation. These checks were recorded on Sample Processing Sheets which were prepared for each sample. Scales and measuring boards used to weigh and measure fish were calibrated in accordance with methods in the Fisheries Procedure Manual. Quality assurance checks, as described in the Fisheries Procedures Manual, were conducted by the project manager. When necessary, taxonomically difficult specimens were sent to recognized experts for confirmation.

3. RESULTS

3.1 FISH

A total of 745 fish representing 18 species was collected at the five stations (Table 1). The common and scientific names for each of the species captured are presented in Table 2. No threatened or endangered species, as defined by the Federal Endangered Species Act of 1973 (and updated in the Federal Register: 47(251):58454-58460) and the Wisconsin Endangered Species Act (Wisconsin DNR 1982), were captured. Taxonomically, the catch was dominated by cyprinids (minnows), with seven species being represented. Percids (perches) and centrarchids (sunfishes) were the only other families represented by more than one species. They were represented by three and two species, respectively. Five sport species were captured: yellow perch (67 individuals), rock bass (46), black bullhead (21), northern pike (3), and pumkinseed (1). These sport species were typically represented by specimens too small to be sought by anglers. Only 18 yellow perch, 6 black bullhead, 2 northern pike, and 1 rock bass could be characterized as "keepers." The numbers of species and individuals were comparable among Stations 1, 2, and 5. Similarly, the numbers of species and individuals were comparable at Stations 3 and 4. However, the number of species and individuals collected at Stations 3 and 4 were noticeably higher than at Stations 1, 2, or 5 (Table 1). Common shiner was the dominant species accounting for 58 percent of the total catch (numerically); it would be considered abundant. Hornyhead chub was the only other species accounting for more than 10 percent of the catch. Yellow perch, rock bass, and hornyhead chub were abundant at Stations 3 and 4 and generally common elsewhere. Bluntnose minnow, blacknose shiner, white sucker, black bullhead, Iowa darter, and Johnny darter were uncommon to common depending on station. The remaining seven species were rare to uncommon. A detailed discussion of the results for each station is presented below.

3.1.1 Station 1

Seining produced 35 individuals and only three species at Station 1 (Table 3). Common shiners dominated (86 percent) the seine catch. The 30 common shiners and the one blacknose shiner were all young-of-the-year (YOY) fish. Electrofishing yielded only 14 individuals, but these were distributed among six species (Table 4). None of these six species had been collected seining. The northern pike that was captured was an adult, "ripe and running" female. None of the fish collected at Station 1 by either method had any external parasites or physical deformities.

Station 1 is quite shallow and free of macrophytes for most of its length which makes qualitative visual observations possible. The low numbers of fish caught by seining and electrofishing were supported by the observations of the field investigators who saw very few fish. This contrasts with the large number of fish that have been observed and collected at this station at other times of the year (Ecological Analysts 1983).

TABLE 1 SUMMARY OF FISHES COLLECTED 20 AND 21 APRIL 1983 IN SWAMP CREEK

SPECIES	Station 1		Station 2		Station 3		Station 4		Station 5		All Stations	
	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.	No.	% Comp.
Creek chub	-	-	-	-	1	<1	1	<1	-	-	2	<1
Bluntnose minnow	2	4	3	3	11	4	-	-	1	2	17	3
Hornyhead chub	2	4	-	-	45	16	27	10	7	15	81	11
Golden shiner	-	-	1	1	2	1	2	1	1	2	6	1
Blackchin shiner	-	-	-	-	1	<1	2	1	-	-	3	<1
Blacknose shiner	1	2	3	3	11	4	1	<1	-	-	16	2
Common shiner	30	61	81	89	126	45	181	65	15	32	433	58
White sucker	1	2	-	-	4	1	1	<1	7	15	13	2
Northern pike	1	2	-	-	-	-	1	<1	1	2	3	<1
Central mudminnow	-	-	-	-	2	1	-	-	-	-	2	<1
Brook stickleback	-	-	-	-	1	<1	-	-	-	-	1	<1
Black bullhead	6	12	-	-	7	3	6	2	2	4	21	3
Rock bass	-	-	-	-	29	10	14	5	3	6	46	6
Pumpkinseed	-	-	-	-	1	<1	-	-	-	-	1	<1
Iowa darter	-	-	-	-	3	1	8	3	-	-	11	1
Johnny darter	4	8	3	3	4	1	8	3	-	-	19	3
Yellow perch	2	4	-	-	28	10	27	10	10	21	67	9
Mottled sculpin	-	-	-	-	2	1	1	<1	-	-	3	<1
Total Species	9		5		17		14		9		18	
Total Number	49		91		278		280		47		745	

*Includes seining data only.

TABLE 2 LIST OF FISH SPECIES CAPTURED FROM SWAMP CREEK, 20-21 APRIL 1983

Common Name	Scientific Name
Creek chub	*Semotilus atromaculatus*
Hornyhead chub	*Nocomis biguttatus*
Bluntnose minnow	*Pimephales notatus*
Golden shiner	*Notemigonus crysoleucas*
Common shiner	*Notropis cornutus*
Blacknose shiner	*Notropis heterolepis*
Blackchin shiner	*Notropis heterodon*
White sucker	*Catostomus commersoni*
Central mudminnow	*Umbra limi*
Northern pike	*Esox lucius*
Brook stickleback	*Culaea inconstans*
Black bullhead	*Ictalurus melas*
Yellow perch	*Perca flavescens*
Iowa darter	*Etheostoma exile*
Johhny darter	*Etheostoma nigrum*
Rock bass	*Ambloplites rupestris*
Pumpkinseed	*Lepomis gibbosus*
Mottled sculpin	*Cottus bairdi*

TABLE 3 SUMMARY OF FISH COLLECTED BY SEINING AT STATION 1 IN SWAMP CREEK, 20 APRIL 1983 (data shown include number collected, percent composition, total length, and weight)

Species	No.	% Comp.	Total Length (mm) Avg	Weight (g) Avg
Blacknose shiner	1	3	24	<1
Common shiner	30	86	-(*)	<1
Johnny darter	4	11	50	1
Total Number	35			
Total Species	3			

(*) Data not applicable or not available.

TABLE 4 SUMMARY OF FISH COLLECTED BY ELECTROFISHING AT STATION 1 IN SWAMP CREEK 21 APRIL 1983 (data shown include number collected, percent composition, catch-per-effort [CPE], total length, and weight)

				Total Length (mm)		Weight (g)	
Species	No.	% Comp.	CPE[a]	Avg	Range	Avg	Range
Hornyhead chub	2	14	0.01	-[b]	58-65	-	-
Bluntnose minnow	2	14	0.01	65	-	-	-
Northern pike	1	7	<0.01	525	-	900	-
White sucker	1	7	<0.01	434	-	980	-
Black bullhead	6	43	0.02	175	113-205	75	15-110
Yellow perch	2	14	0.01	216	-	136	-
Total Number	14						
Total Species	6						
CPE			0.05				

(a) CPE defined as number of fish per meter of stream.
(b) Data not applicable or not available.

3.1.2 Station 2

Seining, which was the only method used at Station 2, yielded 91 individuals and five species (Table 5). As at Station 1, common shiners dominated (89 percent) the catch. None of the four other species were represented by more than three individuals. No diseased or malformed fish were collected. No fish were observed or captured in the large pool immediately below the bridge at Station 2. This contrasts with the situation in June 1982 when hundreds of minnows were collected from the pool and thousands more were observed (Ecological Analysts 1983).

3.1.3 Station 3

The fish community at this station was more diverse and abundant than at Stations 1 and 2. The two sampling methods combined produced a total of 278 individuals representing 17 species (Table 1). Six species (creek chub, blackchin shiner, central mudminnow, brook stickleback, rock bass, and pumpkinseed) collected at Station 3 had not been collected at either Stations 1 or 2.

Seining yielded 81 individuals representing 10 species (Table 6). Common shiner (33 individuals), rock bass (15), yellow perch (13), and hornyhead chub (10) dominated the seine catch, collectively accounting for 88 percent of the numerical catch. All but three of the rock bass were Age I fish, less than 37 mm. No parasitized or malformed fish were collected.

Electrofishing yielded 197 individuals representing 16 species (Table 7). The resultant CPE (0.65, Table 7) was much higher than had been found at Station 1 (0.05, Table 4). Except for blackchin shiner, all the species collected by seining were also collected by electrofishing. In addition, electrofishing yielded seven species (creek chub, white sucker, central mudminnow, brook stickleback, black bullhead, pumpkinseed, and mottled sculpin) not collected seining. Brook stickleback was the most unusual of these additional species, as it has not been reported previously from Swamp Creek (Becker 1966; Wisconsin DNR 1974; Ecological Analysts 1983). The electrofishing catch was dominated by common shiner (93 individuals), hornyhead chub (35), yellow perch (15), and rock bass (14). Collectively, these species accounted for 80 percent of the total electrofishing catch. The remaining 12 species were represented by 1-8 individuals each. None of the yellow perch or rock bass collected by electrofishing were large enough to be considered "keepers" by fishermen. All the yellow perch and most of the rock bass appeared to be Age I fish (Table 7).

A major portion (21 percent) of the fish collected electrofishing had black spot, a common parasitic infection. The number of infected individuals by species included: hornyhead chub (35), yellow perch (4), and bluntnose minnow (3). One common shiner was collected that had a deformed spine. Sex or breeding condition could not be determined for most of the fish, however, both of the mottled sculpins that were captured were ripe females.

TABLE 5 SUMMARY OF FISH COLLECTED BY SEINING AT STATION 2 IN SWAMP CREEK, 20 APRIL 1983 (data shown include number collected, percent composition, total length, and weight)

Species	No.	% Comp.	Total Length (mm) Avg	Weight (g) Avg
Golden shiner	1	1	54	1
Bluntnose minnow	3	3	-(*)	<1
Common shiner	81	89	-	1.3
Blacknose shiner	3	3	-	<1
Johnny darter	3	3	-	2.3
Total Number	91			
Total Species	5			

(*) Data not applicable or not available.

TABLE 6 SUMMARY OF FISH COLLECTED BY SEINING AT STATION 3 IN SWAMP CREEK, 20 APRIL 1983 (data shown include number collected, percent composition, total length, and weight)

Species	No.	% Comp.	Total Length (mm) Avg	Total Length (mm) Range	Weight (g) Avg	Weight (g) Range
Bluntnose minnow	3	4	- (*)	-	1.7	-
Golden shiner	1	1	62	-	1	-
Hornyhead chub	10	12	-	-	1.7	-
Common shiner	33	41	-	-	2.8	-
Blackchin shiner	1	1	48	-	<1	-
Blacknose shiner	3	4	-	-	<1	-
Yellow perch	13	16	68	59-74	3.2	-
Iowa darter	1	1	54	-	1	-
Johnny darter	1	1	34	-	<1	-
Rock bass	15	19	40	20-109	3	<1-24
Total Number	81					
Total Species	10					

(*) Data not applicable or not available.

TABLE 7 SUMMARY OF FISH COLLECTED BY ELECTROFISHING AT STATION 3 IN SWAMP CREEK, 21 APRIL 1983 (data shown include number collected, percent composition, catch-per-effort [CPE], total length, and weight)

Species	No.	% Comp.	CPE[a]	Total Length (mm) Avg	Total Length (mm) Range	Weight (g) Avg	Weight (g) Range
Hornyhead chub	35	18	0.11	-[b]	-	4.6	-
Creek chub	1	<1	<0.01	78	-	4	-
Bluntnose minnow	8	4	0.03	-	-	2.5	-
Golden shiner	1	<1	<0.01	82	-	4	-
Common shiner	93	47	0.30	-	-	4.5	-
Blacknose shiner	8	4	0.03	-	-	1	-
White sucker	4	2	0.01	159	127-178	44.5	23-64
Central mudminnow	2	1	0.01	15.5	-	15.5	10-21
Brook stickleback	1	<1	<0.01	54	-	1	-
Black bullhead	7	4	0.02	118	104-130	24.4	16-32
Johnny darter	3	2	0.01	-	-	3.7	-
Rock bass	14	7	0.05	44	25-92	3.1	<1-14
Pumpkinseed	1	<1	<0.01	89	-	12	-
Mottled sculpin	2	1	0.01	-	-	14.5	-
Iowa darter	2	1	0.01	-	-	1	-
Yellow perch	15	8	0.05	64	51-75	2.9	-
Total Number	197						
Total Species	16						
CPE			0.65				

(a) CPE defined as number of fish per meter of stream.

(b) Data not applicable or not available.

3.1.4 Station 4

In terms of both abundance and diversity (i.e., species richness), the catch at Station 4 was very similar to that at Station 3. Station 4 yielded a total of 280 fish representing 14 species (Table 1). Northern pike was the only species captured at Station 4 that was not captured at Station 3.

Seining yielded 81 individuals and 7 species (Table 8)--totals very similar to those at Station 3 (Table 6). The catch was dominated (68 percent) by common shiner with no other species contributing more than 12 percent to the total (Table 8). All the rock bass were Age I fish. No fish with parasites or deformities were noted.

The number of species caught electrofishing at Stations 3 and 4 was similar (16 at Station 3 versus 14 at Station 4), and the CPE values were identical, 0.65 (Tables 7 and 9). The three species (common shiner, hornyhead chub, and yellow perch) most numerous at Station 3 were also the three most common species in the electrofishing catch at Station 4, where they accounted for 87 percent of the total catch. No other species was represented by more than seven individuals (4 percent).

Of the 24 yellow perch collected, nine were adults (>126 mm) of which three were "ripe and running" males. Twenty-six (13 percent) of the 199 fish collected electrofishing had black spot.

3.1.5 Station 5

The catch at Station 5 was lower than at Stations 3 and 4, but comparable to that at Stations 1 and 2 (Table 1). Only three species were caught by seining at Station 5--10 yellow perch, 2 common shiners, and 1 northern pike (Table 10). All the yellow perch were adults (>142 mm) and half were "ripe and running" males. The area that could effectively be seined was reduced at this station because of its greater depth. However, the degree to which this contributed to the poor seine catch is unknown. No parasitized or deformed fish were observed.

Electrofishing at Station 5 yielded 34 specimens distributed among 7 species (Table 11). These totals are comparable to those reported at Station 1, but are much lower than those reported at Stations 3 or 4. The composition of the catch at Station 5 was similar to that at the other stations except white suckers made up a greater percentage of the catch (21 percent). One of the common shiners had a large cyst or tumor, but no other physical deformities were noted.

3.2 BENTHIC MACROINVERTEBRATES

A total of 178 macroinvertebrate taxa was found in all the collections from Swamp Creek in 1983 (Table 12). The dipteran family Chironomidae (midges) and the oligochaete family Naididae (aquatic worms) were the most diverse groups with 58 and 15 taxa, respectively. These families were also the most diverse groups in previous samplings in this reach of Swamp Creek (Ecological Analysts 1983). One hundred and twenty-two benthic macroinvertebrate taxa were collected in the Ponar grab samples.

TABLE 8 SUMMARY OF FISH COLLECTED BY SEINING AT STATION 4 IN SWAMP CREEK, 20 APRIL 1983 (data shown include number collected, percent composition, total length, and weight)

Species	No.	% Comp.	Total Length (mm) Avg	Total Length (mm) Range	Weight (g) Avg	Weight (g) Range
Golden shiner	1	1	-(*)	-	1	-
Hornyhead chub	4	5	-	-	1.3	-
Common shiner	55	68	-	-	3.5	-
Yellow perch	3	4	53	50-60	1.3	1-2
Iowa darter	7	9	-	-	1.5	-
Johnny darter	1	1	-	-	1.5	-
Rock bass	10	12	-	-	<1	-
Total Number	81					
Total Species	7					

(*) Data not applicable or not available.

TABLE 9 SUMMARY OF FISH COLLECTED BY ELECTROFISHING AT STATION 4 IN SWAMP CREEK, 21 APRIL 1983 (data shown include number collected, percent composition, catch-per-effort [CPE], total length, and weight)

				Total Length (mm)		Weight (g)	
Species	No.	% Comp.	CPE[a]	Avg	Range	Avg	Range
Blacknose shiner	1	<1	<0.01	60	-[b]	1	-
Creek chub	1	<1	<0.01	105	-	11	-
Golden shiner	1	<1	<0.01	-	-	4	-
Hornyhead chub	23	12	0.08	-	-	10.5	-
Blackchin shiner	2	1	0.01	51	50-51	<1	-
Common shiner	126	63	0.41	-	-	4.5	-
White sucker	1	<1	<0.01	176	-	55	-
Northern pike	1	<1	<0.01	250	-	92	-
Black bullhead	6	3	0.02	117	97-134	21	12-32
Yellow perch	24	12	0.08	103	53-215	24	1-115
Iowa darter	1	<1	<0.01	48	-	<1	-
Johnny darter	7	4	0.02	-	-	2.6	-
Rock bass	4	2	0.01	36	32-40	<1	-
Mottled sculpin	1	<1	<0.01	98	-	15	-
Total Number	199						
Total Species	14						
CPE			0.65				

(a) CPE defined as number of fish per meter of stream.
(b) Data not applicable or not available.

TABLE 10 SUMMARY OF FISH COLLECTED BY SEINING AT STATION 5 IN SWAMP CREEK, 20 APRIL 1983 (data shown include number collected, percent composition, total length, and weight)

			Total Length (mm)		Weight (g)	
Species	No.	% Comp.	Avg	Range	Avg	Range
Yellow perch	10	77	158	131-197	47	25-97
Common shiner	2	15	89	80-98	7	6-8
Northern pike	1	8	535	-(*)	-	-
Total Number	13					
Total Species	3					

(*) Data not applicable or not available.

TABLE 11 SUMMARY OF FISH COLLECTED BY ELECTROFISHING AT STATION 5 IN SWAMP CREEK, 21 APRIL 1983 (data shown include number collected, percent composition, catch-per-effort [CPE], total length, and weight)

				Total Length (mm)		Weight (g)	
Species	No.	% Comp.	CPE[a]	Avg	Range	Avg	Range
Hornyhead chub	7	21	0.02	-[b]	-	17	-
Golden shiner	1	3	<0.01	61	-	1	-
Common shiner	13	38	0.04	-	-	9.2	-
Bluntnose minnow	1	3	<0.01	88	-	5	-
White sucker	7	21	0.02	194	120-247	81	16-155
Black bullhead	2	6	0.01	127	111-143	-	-
Rock bass	3	9	0.01	138	117-155	51	31-71
Total Number	34						
Total Species	7						
CPE			0.11				

(a) CPE defined as number of fish per meter of stream.
(b) Data not applicable or not available.

TABLE 12 MACROINVERTEBRATES PRESENT IN QUANTITATIVE, QUALITATIVE, AND DRIFT COLLECTIONS FROM SWAMP CREEK, 1983

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Platyhelminthes			
Turbellaria			
Planariidae			
Dugesia sp. Girard	X(*)	X	X
Cnidaria			
Hydridae			
Hydra sp. (Linnaeus)	X	X	X
Nemertea			
Unidentified Nemertea	X	-	-
Nematoda			
Unidentified Nematoda	X	X	-
Annelida			
Oligochaeta			
Enchytraeidae	-	X	-
Naididae			
Arcteonais lomondi (Martin)	X	X	-
Dero digitata (Muller)	X	X	X
Nais behningi (Michaelsen)	X	-	-
N. communis Piguet	X	X	-
N. pardalis Piguet	X	-	-
N. variabilis Piguet	X	X	X
Piguetiella michiganensis Hiltunen	X	-	-
Pristina longiseta leidyi Smith	X	X	-
P. l. longiseta Ehrenberg	X	-	-

(*) Indicates taxon was collected by this sampling method.

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Slavina appendiculata D'Ukekem	X	X	X
Specaria josinae (Vejdovsky)	X	-	X
Stylaria fossularis Leidy	X	X	X
S. lacustris (Linnaeus)	-	-	X
Uncinais uncinata (Orsted)	X	-	-
Vejdovskyella comata (Vejdovsky)	X	-	-
Tubificidae			
Aulodrilus limnobius Bretscher	X	-	-
A. pigueti Kowalewski	X	-	-
Ilyodrilus templetoni (Southern)	X	X	-
Isochaetides freyi (Brinkhurst)	X	-	-
Limnodrilus hoffmeisteri Claparede	X	X	-
L. hoffmeisteri varient	X	-	-
L. udekemianus Claparede	X	X	-
Lumbriculidae			
Unidentified Lumbriculidae	X	X	-
Hirudinea			
Glossiphoniidae			
Helobdella stagnalis (Linnaeus)	X	-	-
H. triserialis (Blanchard)	-	X	-
Placobdella ornata (Verrill)	X	X	-
Theromyzon sp. Philippi	-	X	-
Erpobdellidae			
Erpobdella punctata (Leidy)	X	X	-
Arthropoda			
Crustacea			
Isopoda			
Asellidae			
Asellus racovitzai racovitzai Williams	X	X	-

TABLE 12 (Cont.)

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Amphipoda			
Gammaridae			
Gammarus pseudolimnaeus Bausfield	X	X	-
Talitridae			
Hyalella azteca (Saussure)	X	X	X
Decapoda			
Astacidae			
Orconectes propinquus (Girard)	-	X	-
Orconectes virilis (Hagen)	-	X	-
Arachnida			
Hydracarina	X	X	X
Insecta			
Ephemeroptera			
Ephemeridae			
Hexagenia limbata (Serville)	X	X	-
Baetiscidae			
Baetisca obesa (Say)	X	X	X
Caenidae			
Brachycercus sp. Curtis	X	-	-
Caenis sp. Stephens	X	X	X
Heptageniidae			
Arthroplea bipunctata (McDunnough)	-	X	-
Stenacron interpunctatum (Say)	X	X	-
Stenonema vicarium (Walker)	-	X	-
Baetidae			
Baetis amplus (Traver)	-	X	-
B. pygmaeus (Hagen)	X	X	X
Callibaetis sp. Eaton	X	X	X
Leptophlebiidae			
Leptophlebia sp. Westwood	X	X	X

TABLE 12 (Cont.)

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Odonata			
Coenagrionidae			
Enallagma sp. Charpentier	-	X	X
Calopterygidae			
Calopteryx sp. Leach	X	X	-
Aeshnidae			
Aeshna umbrosa Walker	-	X	-
Anax junius Drury	-	X	-
Basiaeschna janata Say	X	X	-
Libellulidae			
Plathemis lydia (Drury)	-	X	-
Corduliidae			
Dorocordulia libera Selys	-	X	-
Epitheca sp.	-	X	-
Gomphidae			
Gomphus lividus Selys	X	X	-
Ophiogomphus sp. Selys	-	X	-
Plecoptera			
Perlidae			
Immature Perlidae	-	X	-
Hemiptera			
Belostomatidae			
Belostoma flumineum Say	X	X	-
Corixidae	-	X	X
Notonectidae			
Notonecta sp. Linne	-	X	-
Nepidae			
Ranatra fusca Palisot de Beauvois	-	X	-
Megaloptera			
Corydalidae			
Chauliodes sp. Latreille	-	X	-

TABLE 12 (Cont.)

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Sialidae			
Sialis sp. Latreille	X	-	-
Trichoptera			
Polycentropodidae			
Neureclipsis sp. McLachlan	X	X	-
Polycentropus sp. Curtis	X	X	X
Hydropsychidae			
Cheumatopsyche sp. Wallengren	X	X	X
Hydropsyche betteni Ross	-	X	-
Philopotamidae			
Chimarra obscura (Walker)	-	X	-
Hydroptilidae			
Hydroptila sp. Dalman	-	X	X
H. waubesiana Betten	X	X	-
Oxyethira sp. Eaton	X	X	X
Leptoceridae			
Mystacides sepulchralis (Walker)	X	X	-
Oecetis sp. McLachlan	X	X	X
Triaenodes sp. McLachlan	X	X	X
Brachycentridae			
Brachycentrus numerosus (Say)	X	X	-
Limnephilidae			
Nemotaulius hostilis (Hagen)	X	X	-
Platycentropus sp. Ulmer	X	X	X
Pycnopsyche sp. Banks	X	X	-
Phryganeidae			
Agrypnia vestita (Walker)	X	X	-
Phryganea sp. Linnaeus	-	-	X
Ptilostomis sp. Kolenati	X	X	-
Molannidae			
Molanna tryphena Betten	X	X	-

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Coleoptera			
Elmidae			
Ancyronyx variegata (Germar)	-	X	-
Dubiraphia sp. Sanderson	X	X	-
D. vittata (Melsheimer)	-	X	-
Macronychus glabratus Muller	-	X	-
Stenelmis sp. Dufour	X	X	-
S. crenata (Say)	-	X	-
Gyrinidae			
Dineutus sp. MacLeay	-	X	-
Gyrinus sp. Muller	-	X	-
Dytiscidae			
Unidentified Dytiscidae	-	X	-
Ilybius sp. Erichson	-	-	X
Laccophilus sp. Leach	-	X	-
Haliplidae			
Haliplus sp. Latreille	-	X	-
Diptera			
Chironomidae			
Chironominae			
Cladotanytarsus sp. Kieffer	X	X	X
Cryptochironomus sp. Kieffer	X	X	-
Cryptotendipes sp. Lenz	X	X	-
Dicrotendipes sp. Kieffer	X	X	X
Endochironomus sp. Kieffer	X	-	-
Lauterborniella sp. Bause	X	X	-
Micropsectra curvicornis Tshernovskii	X	X	X
Micropsectra sp. Kieffer	X	X	X
Microtendipes sp. Kieffer	X	X	-
Nilothauma bayiyi (Rempel)	X	-	-
Paralauterborniella sp. Lenz	X	X	-
Paratanytarsus sp. Kieffer	X	X	X

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Paratendipes sp. Kieffer	X	-	-
Phaenopsectra sp. Kieffer	X	X	-
Polypedilum convictum type (Walker)	X	X	X
P. fallax group Kieffer	X	X	-
P. scalaenum type (Schrank)	X	X	-
P. simulans type	X	X	-
Rheotanytarsus sp. (Bause)	X	X	X
Stempellina sp. Bause	X	X	-
Stenochironomus sp. Kieffer	-	X	-
Stictochironomus sp. Kieffer	X	X	X
Tanytarsus sp. van der Wulp	X	X	X
Tribelos sp. Townes	X	X	-
Zavrelia sp. Kieffer	X	X	-
Tanypodinae			
Ablabesmyia sp. Johannsen	X	X	X
Clinotanypus sp. Kieffer	X	X	-
Coelotanypus sp. Kieffer	X	-	-
Labrundinia sp. Fittkau	-	-	X
Larsia sp. Fittkau	X	-	-
Natarsia sp. Fittkau	X	-	-
Pentaneura sp. Philippi	-	X	X
Procladius sp. Skuse	X	X	X
Thienemannimyia series Fittkau	X	X	X
Orthocladiinae			
Brillia sp. Kieffer	-	X	-
Corynoneura sp. Winnertz	X	-	-
Cricotopus bicinctus group Meigen	X	X	X
C. cylindraceus group Sensu Hirvenoja	X	X	X
C. intersectus group Sensu Hirvenoja	-	X	-
C. sylvestris group Sensu Hirvenoja	X	-	-
C. tibialis group Sensu Hirvenoja	-	-	X
C. tremulus group Sensu Hirvenoja	-	X	-

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
C. trifascia group Sensu Hirvenoja	X	-	-
Diplocadius sp. Kieffer	X	X	X
Epoicocladius sp. Kieffer	X	-	-
Eukiefferiella sp. Thienemann	-	X	-
E. discoloripes group	-	X	-
Heterotrissocladius sp. Spark	X	-	-
Hydrobaenus sp. Fries	X	X	-
Nanocladius sp. Kieffer	X	X	X
Orthocladius sp. van der Wulp	X	X	X
Parakiefferiella sp. (Thienemann)	X	X	X
Parametriocnemus sp. Goetghebuer	X	X	-
Psectrocladius sp. (Kieffer)	-	X	X
Rheocricotopus sp. (Thien. α Harn.)	-	X	-
Synorthocladius sp. Thienemann	X	X	X
Thienemanniella sp. Kieffer	X	X	X
Orthocladiinae acutilabis	X	-	-
Ceratopogonidae	X	X	X
Simuliidae			
Prosimulium sp. Rouband	-	X	-
Simulium sp. Laetrille	X	X	X
S. tuberosum (Lundstrom)	-	X	-
Tabanidae			
Chrysops sp. Meigen	X	X	-
Dixidae			
Dixa sp. Meigen	-	X	-
Empididae	-	X	-
Tipulidae			
Unidentified Tipulidae	X	-	-
Dicranota sp. Zetterstedt	-	X	-
Tipula sp. Linnaeus	-	X	-

Taxa	Quantitative (Ponar)	Qualitative (Hand Collections)	Drift Collections
Lepidoptera			
Pyralidae			
Paraponyx sp. Hubner	X	X	X
Mollusca			
Gastropoda			
Hydrobiidae			
Unidentified Hydrobiidae	X	X	X
Viviparidae			
Campeloma sp. Rafinesque	X	X	-
Lymnaeidae			
Lymnaea sp. Lamarck	-	X	-
Physidae			
Physa sp. Draparnaud	X	X	-
Planorbidae			
Gyraulus sp. J. du Charpentier	X	X	-
Helisoma sp. Swainson	-	X	-
Ancylidae			
Ferrissia sp. Walker	X	X	-
Pelecypoda			
Sphaeriidae			
Pisidium sp. Pfeiffer	X	X	-
Sphaerium striatinum (Lamarck)	X	X	-
Unionidae			
Anodonta grandis Say	-	X	-
Lampsilis siliquoidea (Barnes)	-	X	-
Subtotal taxa	122	145	54
Total taxa (all methods)		178	

The qualitative and drift collections in 1983 yielded 56 taxa in addition to those present in the Ponar samples. These additional taxa were primarily in the insect orders Odonata (dragonflies), Coleoptera (beetles), and Diptera (true flies and midges). No macroinvertebrate species that are listed in the Federal Endangered Species Act or the Wisconsin Endangered Species Act were collected from Swamp Creek.

3.2.1 February 1983

The dominant organisms collected quantitatively from Swamp Creek in February were amphipods (*Hyalella azteca*) and midge-fly larvae (Chironomidae) (Table 13). Other taxa that were occasionally abundant included aquatic oligochaetes (Tubificidae), mayflies (*Leptophlebia* sp.), biting midges (Ceratopogonidae), and snails (Hydrobiidae). At each station, the silt substrate yielded the highest densities among the three substrates sampled.

Station 4

The amphipod *Hyalella azteca* and chironomid midges (especially *Micropsectra* sp.) were abundant in both substrate types at Station 4 (Table 14). In addition, hydrobiid snails (in the silt substrate) and the mayfly *Leptophlebia* sp. (in both substrate types) were also commonly collected. The silt substrate yielded greater total density than the sand substrate; however, the sand substrate contained more taxa. The higher density in the silt substrate resulted from the large population (12,145 individuals/m^2) of *Hyalella azteca*. The greater number of taxa in the sand substrate was a result of the more diverse chironomid assemblage in this substrate.

Station 5

Chironomid midges dominated the benthic communities (44-70 percent of the total benthos) at Station 5 in February and were especially numerous (12,233 individuals/m^2) in the silt substrate (Table 13). The most commonly collected midges included *Micropsectra* sp., *Polypedilum scalaenum* type, *Procladius* sp. (especially in the sand and silt substrates), and *Parakiefferiella* sp. (in the gravel habitat) (Table 15). Other commonly collected taxa at Station 5 included tubificid oligochaetes (primarily immature individuals) and biting midges (Ceratopogonidae).

Total benthos and total taxa were highest in the silt substrate at Station 5 and lowest in the sand substrate. The density and diversity of organisms in the gravel habitat community were intermediate between the silt and sand communities (Table 13).

3.2.2 May 1983

The dominant organisms in the quantitative and qualitative collections from Swamp Creek in May included tubificid oligochaetes, the amphipod *Hyalella azteca*, the mayfly *Baetis* sp., the caddisfly *Cheumatopsyche* sp., and chironomid midges (Tables 16 and 17). The quantitative samples indicated that, in general, community composition in February and May 1983 was similar; however, total benthos and total taxa declined slightly

TABLE 13 MEAN DENSITY AND PERCENT OCCURRENCE OF THE DOMINANT(*) BENTHIC MACROINVERTEBRATES COLLECTED WITH A PONAR GRAB SAMPLER FROM SWAMP CREEK, 17 FEBRUARY 1983

	Station 4				Station 5					
	Sand		Silt		Sand		Silt		Gravel	
Taxa	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%
Annelida										
Oligochaeta										
Tubificidae	888	7.0	368	1.6	455	21.2	2,338	12.4	260	5.3
Crustacea										
Amphipoda										
Hyalella azteca	3,919	31.0	12,146	53.4	--	--	1,256	6.6	65	1.3
Insecta										
Ephemeroptera										
Leptophlebia sp.	1,645	13.0	2,295	10.1	--	--	606	3.2	22	0.4
Diptera										
Chironomidae	3,183	25.2	3,356	14.7	953	44.4	12,233	54.6	3,421	69.6
Ceratopogonidae	130	1.0	43	0.2	282	13.1	476	2.5	195	4.0
Mollusca										
Gastropoda										
Hydrobiidae	325	2.6	3,356	14.7	108	5.1	65	0.4	65	1.3
Total Benthos	12,645		22,755		2,144		18,924		4,916	
Total Taxa	60		39		19		58		47	

(*) Taxa or groups that compose $\geq$5% of the total benthos at any substrate type.

TABLE 14 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 4 IN SWAMP CREEK, 17 FEBRUARY 1983

	Substrate							
	Sand				Silt			
	Replicate		Mean	Percent	Replicate		Mean	Percent
Taxa	A	B	No./M^2	Occurrence	A	B	No./M^2	Occurrence
Cnidaria								
Hydridae								
Hydra sp.	-	1	21.7	0.2	-	-		
Nematoda								
Unidentified Nematoda	4	2	129.9	1.0	7	12	411.4	1.8
Annelida								
Oligochaeta								
Naididae								
Arcteonais lomondi	1	8	194.9	1.5	-	-		
Nais sp.	-	-			2	-	43.3	0.2
N. variabilis	-	1	21.7	0.2	-	-		
Piguetiella michiganensis	-	1	21.7	0.2	-	-		
Pristina longiseta	-	1	21.7	0.2	-	-		
Slavina appendiculata	1	1	43.3	0.3	3	-	65.0	0.3
Stylaria fossularis	-	-			2	-	43.3	0.2
Vejdovskyella comata	-	1	21.7	0.2	-	2	43.3	0.2
Tubificidae								
Aulodrilus pigueti	-	-			1	-	21.7	0.1
Ilyodrilus templetoni	3	5	173.2	1.4	-	-		
Limnodrilus udekemianus	-	-			3	-	65.0	0.3
Immature w/capilliform chaetae	12	6	389.7	3.1	6	4	216.5	1.0
Immature w/o capilliform chaetae	7	8	324.8	2.6	1	2	65.0	0.3
Arthropoda								
Crustacea								
Amphipoda								
Gammarus pseudolimnaeus	10	-	216.5	1.7	1	-	21.7	0.1
Hyalella azteca	39	142	3,918.7	31.0	489	72	12,145.7	53.4
Arachnida								
Hydracarina	-	5	108.3	0.9	1	2	65.0	0.3
Insecta								
Ephemeroptera								
Ephemeridae								
Hexagenia sp.	1	1	43.3	0.3	-	-		
Baetidae								
Baetis sp.	14	6	433.0	3.4	1	-	21.7	0.1
Callibaetis sp.	-	1	21.7	0.2	-	-		
Leptophlebiidae								
Leptophlebia sp.	29	47	1,645.4	13.0	50	56	2,294.9	10.1
Odonata								
Gomphidae								
Gomphus sp.	6	6	259.8	2.1	-	-		
Calopterygidae								
Calopteryx sp.	-	1	21.7	0.2	1	-	21.7	0.1
Megaloptera								
Sialidae								
Sialis sp.	1	-	21.7	0.2	-	-		
Trichoptera								
Polycentropodidae								
Polycentropus sp.	1	-	21.7	0.2	-	-		
Hydropsychidae								
Cheumatopsyche sp.	3	-	65.0	0.5	1	-	21.7	0.1
Hydroptilidae								
Oxyethira sp.	16	2	389.7	3.1	9	-	194.9	0.9
Oxyethira sp. pupa	-	-			1	2	65.0	0.3
Leptoceridae								
Triaenodes sp.	1	2	65.0	0.5	-	-		
Limnephilidae								
Nemotaulius hostilis	-	1	21.7	0.2	-	-		
Platycentropus sp.	-	-			1	-	21.7	0.1
Pycnopsyche sp.	1	-	21.7	0.2	-	-		
Phryganeidae								
Agrypnia vestita	1	-	21.7	0.2	-	-		
Ptilostomis sp.	-	1	21.7	0.2	-	-		
Coleoptera								
Elmidae								
Dubiraphia sp.	2	3	108.3	0.9	2	-	43.3	0.2

Taxa	Sand: Replicate A	Sand: Replicate B	Sand: Mean No./M^2	Sand: Percent Occurrence	Silt: Replicate A	Silt: Replicate B	Silt: Mean No./M^2	Silt: Percent Occurrence
Diptera								
Chironomidae								
Chironominae								
Cladotanytarsus sp.	1	-	21.7	0.2	-	-		
Cryptochironomus sp.	3	-	65.0	0.5	-	-		
Dicrotendipes sp.	1	-	21.7	0.2	-	-		
Endochironomus sp.	1	1	43.3	0.3	-	-		
Lauterborniella sp.	1	-	21.7	0.2	-	-		
Micropsectra curvicornis	-	-	-		1	-	21.7	0.1
Micropsectra sp.	15	33	1,039.2	8.2	73	12	1,840.3	8.1
Microtendipes sp.	-	-			8	4	259.8	1.1
Paralauterborniella sp.	2	-	43.3	0.3	-	-		
Paratanytarsus sp.	3	-	65.0	0.5	-	-		
Polypedilum scalaenum type	-	2	43.3	0.3	-	-		
P. simulans type	1	1	43.3	0.3	1	-	21.7	0.1
Rheotanytarsus sp.	-	1	21.7	0.2	2	-	43.3	0.2
Stictochironomus sp.	8	6	303.1	2.4	-	-		
Tanytarsus sp.	2	1	65.0	0.3	4	-	86.6	0.4
Tribelos sp.	-	1	21.7	0.2	6	14	433.0	1.9
Tanypodinae								
Ablabesmyia sp.	1	2	65.0	0.5	1	-	21.7	0.1
Clinotanypus sp.	3	3	129.9	1.0	6	8	303.1	1.3
Larsia sp.	1	1	43.3	0.3	-	-		
Procladius sp.	19	13	692.8	5.5	2	-	43.3	0.2
Thienemannimyia series	1	4	108.3	0.9	1	-	21.7	0.1
Orthocladiinae								
Cricotopus cylindraceus group	-	-			1	-	21.7	0.1
Corynoneura sp.	2	1	65.0	0.5	1	-	21.7	0.1
Heterotrissocladius sp.	4	-	86.6	0.7	3	-	65.0	0.3
Hydrobaenus sp.	1	-	21.7	0.2	-	-		
Nanocladius sp.	1	-	21.7	0.2	-	-		
Orthocladius sp.	2	1	65.0	0.5	5	-	108.3	0.5
Parakiefferiella sp.	-	-			2	-	43.3	0.2
Synorthocladius sp.	3	-	65.0	0.5	-	-		
Ceratopogonidae	3	3	129.9	1.0	-	2	43.3	0.2
Mollusca								
Gastropoda								
Hydrobiidae								
Unidentified Hydrobiidae	7	8	324.8	2.6	129	26	3,355.8	14.7
Viviparidae								
Campeloma sp.	3	3	129.9	1.0	2	-	43.3	0.2
Ancylidae								
Ferrissia sp.	2	-	43.3	0.3	-	-		
Pelecypoda								
Sphaeriidae								
Sphaerium striatinum	-	2	43.3	0.3	-	-		
Immature Sphaeriidae	-	-			3	-	65.0	0.3
Total Benthos			12,645.4				22,755.4	
Total Taxa			60				39	

TABLE 15 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 5 IN SWAMP CREEK, 17 FEBRUARY 1983

	Substrate											
	Sand				Silt				Gravel			
	Replicate		Mean No./M^2	Percent Occurrence	Replicate		Mean No./M^2	Percent Occurrence	Replicate		Mean No./M^2	Percent Occurrence
Taxa	A	B			A	B			A	B		
Platyhelminthes												
Planariidae												
Dugesia sp.	-	-			-	-			-	1	21.7	0.4
Nematoda												
Unidentified Nematoda	1	3	86.6	4.0	1	4	108.3	0.6	-	1	21.7	0.4
Annelida												
Oligochaeta												
Naididae												
Arcteonais lomondi	-	-			1	2	65.0	0.4	-	-		
Dero digitata	-	-			1	-	21.7	0.1	1	-	21.7	0.4
Nais sp.	-	-			1	-	21.7	0.1	-	-		
N. variabilis	-	-			1	4	108.3	0.6	1	-	21.7	0.4
Piguetiella michiganensis	-	-			-	2	43.3	0.3	-	-		
Slavina appendiculata	-	-			1	8	194.9	1.0	-	-		
Vejdovskyella comata	-	-			2	-	43.3	0.3	-	-		
Tubificidae												
Ilyodrilus templetoni	-	-			2	2	86.6	0.5	1	1	43.3	0.9
Limnodrilus hoffmeisteri	2	2	86.6	4.0	1	6	151.6	0.8	-	1	21.7	0.4
L. udekemianus	-	-			3	2	108.3	0.6	-	-		
Immature w/capilliform chaetae	-	-			19	10	627.9	3.3	1	5	129.9	2.6
Immature w/o capilliform chaetae	7	10	368.1	17.2	13	50	1,364.0	7.2	2	1	65.0	1.3
Lumbriculidae												
Unidentified Lumbriculidae	-	1	21.7	1.0	-	-			-	-		
Hirudinea												
Erpobdellidae												
Erpobdella punctata	1	-	21.7	1.0	-	-			-	-		
Arthropoda												
Crustacea												
Amphipoda												
Gammarus pseudolimnaeus	-	-			1	2	65.0	0.4	-	-		
Hyalella azteca	-	-			34	44	1,255.7	6.6	2	1	65.0	1.3
Arachnida												
Hydracarina	-	-			1	-	21.7	0.1	7	1	173.2	3.5
Insecta												
Ephemeroptera												
Ephemeridae												
Hexagenia sp.	-	-			1	2	65.0	0.4	-	1	21.7	0.4
Caenidae												
Caenis sp.	-	-			-	2	43.3	0.3	-	-		
Baetiscidae												
Baetisca obesa	-	-			-	-			8	1	194.9	4.0
Baetidae												
Baetis sp.	-	-			1	-	21.7	0.1	-	1	21.7	0.4
Leptophlebiidae												
Leptophlebia sp.	-	-			22	6	606.2	3.2	-	1	21.7	0.4
Odonata												
Aeshnidae												
Basiaeschna janata	-	-			1	2	65.0	0.4	-	-		
Gomphidae												
Immature Gomphidae	-	-			-	2	43.3	0.2	-	-		
Megaloptera												
Sialidae												
Sialis sp.	-	-			1	-	21.7	0.1	-	-		
Trichoptera												
Hydropsychidae												
Cheumatopsyche sp.	-	-			4	-	86.6	0.6	1	-	21.7	0.4
Hydroptilidae												
Oxyethira sp.	1	-	21.7	1.0	1	-	21.7	0.1	-	1	21.7	0.4
Leptoceridae												
Mystacides sepulchralis	-	-			-	-			2	-	43.3	0.9
Oecetis sp.	-	-			-	-			1	-	21.7	0.4
Triaenodes sp.	-	-			3	-	65.0	0.4	-	-		
Phryganeidae												
Ptilostomis sp.	-	-			-	2	43.3	0.2	-	-		
Coleoptera												
Elmidae												
Dubiraphia sp.	-	3	65.0	3.0	2	20	476.3	2.5	-	1	21.7	0.4
Stenelmis sp.	-	-			-	-			-	1	21.7	0.4

Taxa	Sand Replicate A	Sand Replicate B	Sand Mean No./M^2	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./M^2	Silt Percent Occurrence	Gravel Replicate A	Gravel Replicate B	Gravel Mean No./M^2	Gravel Percent Occurrence
Diptera												
Chironomidae												
Chironominae												
Cladotanytarsus sp.	1	1	43.3	2.0	-	4	86.6	0.6	-	-		
Cryptochironomus sp.	-	2	43.3	2.0	-	6	129.9	0.7	2	2	86.6	1.8
Dicrotendipes sp.	-	-			-	2	43.3	0.2	-	-		
Micropsectra curvicornis	-	-			-	-			-	1	21.7	0.4
Micropsectra sp.	4	1	108.3	5.1	118	108	4,892.9	25.9	19	15	736.1	15.0
Microtendipes sp.	2	1	65.0	3.0	9	4	281.5	1.5	-	1	21.7	0.4
Paralauterborniella sp.	-	-			3	6	194.9	1.0	3	4	151.6	3.1
Paratendipes sp.	-	-			-	2	43.3	0.2	-	1	21.7	0.4
Paratanytarsus sp.	-	-			-	-			1	1	43.3	0.9
Polypedilum scalaenum type	7	4	238.2	11.1	32	104	2,944.4	15.6	3	8	238.2	4.8
P. simulans type	-	-			3	2	108.3	0.6	1	-	21.7	0.4
Rheotanytarsus sp.	-	-			1	-	21.7	0.1	-	1	21.7	0.4
Stictochironomus sp.	3	4	151.6	7.1	23	34	1,234.1	6.5	5	1	129.9	2.6
Tanytarsus sp.	-	-			-	2	43.3	0.2	1	1	43.3	0.9
Tribelos sp.	1	-	21.7	1.0	2	6	173.2	0.9	1	4	108.3	2.2
Zavrelia sp.	-	-			-	-			-	1	21.7	0.4
Tanypodinae												
Ablabesmyia sp.	-	-			9	4	281.5	1.6	-	1	21.7	0.4
Clinotanypus sp.	-	-			2	-	43.3	0.2	-	-		
Larsia sp.	-	-			-	2	43.3	0.2	1	10	238.2	4.8
Procladius sp.	3	10	281.5	13.1	20	18	822.7	4.3	-	2	43.3	0.9
Thienemannimyia series	-	-			9	8	368.1	1.9	4	7	238.2	4.8
Orthocladiinae												
Cricotopus sylvestris group	-	-			1	-	21.7	0.1	-	-		
Heterotrissocladius sp.	-	-			1	8	194.9	1.0	13	1	303.1	6.2
Hydrobaenus sp.	-	-			-	4	86.6	0.6	-	-		
Orthocladius sp.	-	-			-	2	43.3	0.2	-	-		
Parakiefferiella sp.	-	-			1	2	65.0	0.4	21	11	692.8	14.1
Parametriocnemus sp.	-	-			1	-	21.7	0.1	5	5	216.5	4.4
Orthocladiinae *acutilabis*	-	-			-	2	43.3	0.2	-	-		
Ceratopogonidae	-	13	281.5	13.1	2	20	476.3	2.5	5	4	194.9	4.0
Simuliidae												
Simulium sp.	-	3	65.0	3.0	-	-			-	-		
Tabanidae												
Chrysops sp.	-	-			-	-			-	1	21.7	0.4
Mollusca												
Gastropoda												
Hydrobiidae												
Unidentified Hydrobiidae	3	2	108.3	5.1	3	-	65.0	0.4	2	1	65.0	1.3
Viviparidae												
Campeloma sp.	-	-			1	8	194.9	1.0	2	5	151.6	3.1
Ancylidae												
Ferrissia sp.	-	-			1	2	65.0	0.4	-	1	21.7	0.4
Pelecypoda												
Sphaeriidae												
Immature Sphaeriidae	-	3	65.0	3.0	-	2	43.3	0.2	1	1	43.3	0.9
Total Benthos			2,144.1				18,923.7				4,916.2	
Total Taxa			19				58				47	

TABLE 16 MEAN DENSITY AND PERCENT OCCURRENCE OF THE DOMINANT(*) BENTHIC MACROINVERTEBRATES COLLECTED WITH A PONAR GRAB SAMPLER FROM SWAMP CREEK, 10 MAY 1983

	Station 4				Station 5					
	Sand		Silt		Sand		Silt		Gravel	
Taxa	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%
Nematoda	455	10.7	130	0.6	--	--	--	--	130	9.8
Annelida										
Oligochaeta										
Naididae	--	--	108	0.5	--	--	--	--	108	8.2
Tubificidae	412	9.7	1,386	6.8	1,039	28.2	5,261	30.7	43	3.3
Crustacea										
Amphipoda										
Hyalella azteca	1,126	26.5	8,379	41.4	22	0.6	2,966	17.3	--	--
Insecta										
Coleoptera										
Elmidae	22	0.5	498	2.5	22	0.6	974	5.7	43	3.3
Diptera										
Chironomidae	628	14.8	5,348	26.4	2,100	57.1	6,149	35.9	780	59.0
Ceratopogonidae	303	7.1	1,429	7.1	282	7.6	217	1.3	22	1.6
Mollusca										
Gastropoda										
Hydrobiidae	498	11.7	1,212	6.0	65	1.8	130	0.8	43	3.3
Pelecypoda										
Sphaeriidae	411	9.7	217	1.1	43	1.2	65	0.4	--	--
Total Benthos	4,244		20,245		3,681		17,126		1,321	
Total Taxa	25		54		20		43		16	

(*) Taxa or groups that compose $\geq$5% of the total benthos at any substrate type.

TABLE 17 COMPOSITION AND RELATIVE ABUNDANCE(*) OF AQUATIC MACROINVERTEBRATES COLLECTED BY QUALITATIVE TECHNIQUES FROM SWAMP CREEK, 10 MAY 1983

Taxa	Station 3A	Station 4	Station 5
Platyhelminthes			
Planariidae			
Dugesia sp.	C	C	-
Nematoda			
Unidentified Nematoda	0	-	-
Annelida			
Oligochaeta			
Naididae			
Nais communis	-	-	0
Slavina appendiculata	-	0	-
Tubificidae			
Ilyodrilus templetoni	0	-	-
Limnodrilus hoffmeisteri	C	0	0
Limnodrilus udekemianus	0	0	-
Immature w/o capilliform chaetae	C	0	0
Lumbriculidae			
Unidentified Lumbriculidae	C	-	0
Arthropoda			
Crustacea			
Isopoda			
Asellidae			
Asellus r. racovitzai	0	0	-
Amphipoda			
Gammaridae			
Gammarus pseudolimnaeus	A	C	C
Talitridae			
Hyalella azteca	V	V	A
Arachnida			
Hydracarina	-	0	0

(*) 0 = Occasional, 1-4 organisms
C = Common, 5-24 organisms
A = Abundant, 25-99 organisms
V = Very abundant, 100+ organisms
\- = Not collected

Taxa	Station 3A	Station 4	Station 5
Insecta			
Ephemeroptera			
Ephemeridae			
Hexagenia limbata	-	-	O
Baetiscidae			
Baetisca obesa	-	-	O
Caenidae			
Caenis sp.	O	O	-
Heptageniidae			
Arthroplea bipunctata	-	C	A
Stenonema vicarium	C	O	C
Baetidae			
Baetis sp.	A	V	V
Callibaetis sp.	-	O	-
Leptophlebiidae			
Leptophlebia sp.	-	C	A
Odonata			
Aeshnidae			
Basiaeschna janata	O	O	O
Gomphidae			
Gomphus lividus	O	-	O
Coenagrionidae			
Enallagma sp.	-	O	-
Calopterygidae			
Calopteryx sp.	C	C	O
Megaloptera			
Corydalidae			
Chauliodes sp.	-	O	-
Trichoptera			
Hydropsychidae			
Cheumatopsyche sp.	A	C	A
Cheumatopsyche sp. pupa	O	-	-
Hydroptilidae			
Oxyethira sp.	C	A	C
Branchycentridae			
Brachycentrus sp. pupa	-	-	O
Leptoceridae			
Oecetis sp.	O	-	O
Triaenodes sp.	-	C	-
Limnephilidae			
Platycentropus sp.	O	O	O
Pycnopsyche sp.	A	C	C
Immature Limnephilidae	C	C	A
Coleoptera			
Gyrinidae			
Gyrinus sp. adult	-	-	O
Dytiscidae			
Laccophilus sp.	-	-	O

Taxa	Station 3A	Station 4	Station 5
Elmidae			
Dubiraphia sp.	A	0	0
Diptera			
Chironomidae			
Chironominae			
Cladotanytarsus sp.	0	-	-
Cryptochironomus sp.	C	-	-
Micropsectra curvicornis	0	C	0
Microtendipes sp.	C	-	C
Microtendipes sp. pupa	0	-	-
Paratanytarsus sp.	-	-	A
Paratanytarsus sp. pupa	-	-	0
Paralauterborniella sp.	0	-	-
Paratendipes sp.	C	C	-
Polypedilum sp. pupa	0	-	0
Polypedilum convictum type	C	0	C
P. simulans type	-	0	0
P. scalaenum type	0	-	-
Rheotanytarsus sp.	-	C	C
Stenochironomus sp.	C	-	-
Stictochironomus sp.	C	0	-
Tanytarsus sp.	C	C	C
Tribelos sp.	-	C	0
Zavrelia sp.	-	C	-
Tanypodinae			
Ablabesmyia sp.	-	0	-
Clinotanypus sp.	0	0	-
Procladius sp.	0	0	0
Procladius sp. pupa	-	-	0
Thienemannimyia series	0	C	C
Thienemannimyia series pupa	-	-	0
Orthocladiinae			
Cricotopus sp. pupa	-	-	0
C. bicinctus group	0	0	0
C. cylindraceus group	-	-	C
C. intersectus group	-	-	0
Eukiefferiella sp.	-	-	0
Psectrocladius sp.	0	-	0
Parametriocnemus sp.	-	-	0
Rheocricotopus sp.	-	-	C
Rheocricotopus sp. pupa	-	-	0
Ceratopogonidae	C	C	-
Empididae	-	-	0
Simuliidae			
Simulium tuberosum	0	0	C
Simulium sp. pupa	-	-	C
Dixidae			
Dixa sp.	0	-	-

Taxa	Station 3A	Station 4	Station 5
Mollusca			
Gastropoda			
Hydrobiidae			
Unidertified Hydrobiidae	V	C	0
Viviparidae			
Campeloma sp.	0	0	0
Lymnaeidae			
Lymnaea sp.	0	0	A
Physidae			
Physa sp.	C	0	-
Planorbidae			
Gyraulus sp.	C	0	0
Heliscma sp.	C	-	-
Pelecypoda			
Sphaeriidae			
Pisidium sp.	-	0	-
Sphaerium striatinum	0	-	-
Immature Sphaeriidae	A	-	-
Unionidae			
Anodorta grandis	0	-	-
Lampsilis siliquoidea	0	-	-
Subtotal taxa	53	48	52
Total taxa (all stations)		82	

at most habitats from February to May. Eighty-two taxa were collected in the May qualitative samples. The number of total taxa was similar (range of 48-53) at all stations. In May the biotic index values varied from a low of 2.61 at Station 4 to a high of 3.35 at Station 5 (Table 18).

Station 3A (Shallock's Bridge)

Qualitative and Hilsenhoff biotic index samplings were conducted at Station 3A in May 1983. Qualitative sampling (30 minutes of effort) of the various substrates and underwater structures yielded 53 macroinvertebrate taxa in May (Table 17). The amphipod Hyalella azteca and hydrobiid snails were very abundant at Station 3A. Abundant taxa included the amphipod Gammarus psuedolimnaeus, the mayfly Baetis sp., the caddisflies Cheumatopsyche sp. and Pycnopsyche sp., the riffle beetle Dubiraphia sp., and immature fingernail clams (Sphaeriidae). Midges (17 taxa) and snails (6 taxa) were the most diverse groups collected from Station 3A.

The biotic index sample at Station 3A was collected from a fast-flowing, rocky habitat. The biotic index value calculated from this sample collected at Station 3A in May was 3.24 (Table 18). Hyalella azteca (tolerance value = 4) heavily dominated the sample and strongly influenced the biotic index value for this station.

Station 4

The Ponar samples from the sand and silt substrates at Station 4 were dominated by the amphipod Hyalella azteca (Table 16). Chironomid midges, especially in the silt substrate were the second most commonly collected organisms. The midges Clinotanypus sp. (1,299/m^2) and Polypedilum simulans type (1,212/m^2) were the dominant midges in the silt substrate (Table 19). Other commonly collected taxa at Station 4 in May included hydrobiid snails, Nematoda (in the sand substrate), tubificid oligochaetes, and biting midges (Ceratopogonidae). Both diversity (total taxa) and total benthos were greater in the silt substrate than in the sand substrate in May.

Forty-eight macroinvertebrate taxa were collected by qualitative sampling at Station 4 (Table 17), with Hyalella azteca, the mayfly Baetis sp., and the micro-caddisfly Oxyethira sp. being the most abundant organisms. Diversity was highest among the midges (14 taxa) and mayflies (6 taxa).

The Hilsenhoff biotic index sample at Station 4 was collected from a tangle of submerged branches in a fast-water area. The value calculated for this sample was 2.61 (Table 18). This arthropod collection was dominated by the mayfly Baetis pygmaeus (tolerance value = 2), with Hyallela azteca, Cheumatopsyche sp., and the blackfly Simulium tuberosum also commonly collected.

Station 5

Midges dominated the benthos (36-59 percent of the total) in all three substrates at Station 5 in May (Table 16). Cladotanytarsus sp. (only in the sand substrate), Procladius sp. (in the silt and sand substrates),

TABLE 18 HILSENHOFF BIOTIC INDICES OF MACROINVERTEBRATE COLLECTIONS FROM SWAMP CREEK, 10 MAY 1983

Taxa	Tolerance Value	Station 3A	Station 4	Station 5
Crustacea				
Gammarus pseudolimnaeus	2	11(*)	4	4
Hyalella azteca	4	50	21	39
Ephemeroptera				
Stenacron interpunctatum	3	-	1	-
Stenonema vicarium	1	-	1	1
Leptophlebia sp.	2	-	9	-
Baetis pygmaeus	2	5	30	2
Hexagenia limbata	3	-	-	1
Caenis sp.	3	1	-	-
Odonata				
Calopteryx sp.	2	-	1	-
Trichoptera				
Cheumatopsyche sp.	3	13	11	-
Mystacides sepulchralis	2	-	-	1
Oecetis sp.	2	2	-	-
Triaenodes sp.	2	-	3	-
Neureclipsis sp.	4	-	-	1
Pycnopsyche sp.	2	-	4	4
Coleoptera				
Dubiraphia ap.	3	8	1	3
Dubiraphia vittata	3	1	-	1
Stenelmis sp.	3	5	-	-
Stenelmis crenata	3	1	-	-
Diptera				
Chrysops sp.	3	1	-	-
Cladotanytarsus sp.	3	3	1	1
Micropsectra sp.	3	4	6	2
Microtendipes sp.	3	4	1	4
Paratanytarsus sp.	3	1	-	1
Phaenopsectra (*Tribelos*) sp.	4	-	-	1
Polypedilum sp.	3	4	-	6
Rheotanytarsus sp.	3	-	5	-
Stempellina sp.	2	-	-	1
Stenochironomus sp.	2	-	1	-
Stictochironomus sp.	3	1	-	3
Tanytarsus sp.	3	2	-	1
Procladius sp.	3	1	-	-
Thienemannimyia series	3	1	1	2
Brillia sp.	3	-	1	-
Cricotopus sp.	4	1	1	1

Taxa	Tolerance Value	Station		
		3A	4	5
Orthocladius sp.	3	1	-	-
Simulium tuberosum	2	-	13	-
Lepidoptera				
Paraponyx sp.	1	2	-	-
Total Number of Taxa		23	20	21
Total Number of Individuals		123	116	80
Biotic Index Value		3.24	2.61	3.35

TABLE 19 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 4 IN SWAMP CREEK, 10 MAY 1983

	Substrate							
	Sand				Silt			
	Replicate		Mean No./M²	Percent Occurrence	Replicate		Mean No./M²	Percent Occurrence
Taxa	A	B			A	B		
Platyhelminthes								
Planariidae								
Dugesia sp.	-	1	21.7	0.5	2	2	86.6	0.4
Nematoda								
Unidentified Nematoda	14	7	454.7	10.7	-	6	129.9	0.6
Annelida								
Oligochaeta								
Naididae								
Arcteonais lomondi	-	-			-	1	21.7	0.1
Slavina appendiculata	-	-			3	-	65.0	0.3
Specaria josinae	-	-			-	1	21.7	0.1
Tubificidae								
Aulodrilus limnobius	-	-			1	-	21.7	0.1
A. pigueti	-	-			-	1	21.7	0.1
Ilyodrilus templetoni	-	2	43.3	1.0	17	8	541.3	2.7
Limnodrilus hoffmeisteri	-	1	21.7	0.5	2	-	43.3	0.2
L. udekemianus	2	3	108.3	2.6	6	6	259.8	1.3
Immature w/ cap. chaetae	2	-	43.3	1.0	5	3	173.2	0.9
Immature w/o cap. chaetae	4	5	194.9	4.6	8	7	324.8	1.6
Lumbriculidae	-	-			1	-	21.7	0.1
Arthropoda								
Crustacea								
Amphipoda								
Gammarus pseudolimnaeus	-	-			-	1	21.7	0.1
Hyalella azteca	8	44	1,125.8	26.5	190	197	8,378.6	41.4
Arachnida								
Hydracarina	6	-	129.9	3.1	5	25	649.5	3.2
Insecta								
Collembola	-	-			-	1	21.7	0.1
Ephemeroptera								
Ephemeridae								
Hexagenia limbata	-	-			-	3	65.0	0.3
Caenidae								
Caenis sp.	-	-			-	3	65.0	0.3
Baetidae								
Baetis sp.	-	-			-	1	21.7	0.1
Leptophlebiidae								
Leptophlebia sp.	-	-			1	-	21.7	0.1
Odonata								
Gomphidae								
Gomphus exilis	-	1	21.7	0.5	1	1	43.3	0.2
Megaloptera								
Sialidae								
Sialis sp.	-	1	21.7	0.5	-	-		
Trichoptera								
Polycentropodidae								
Polycentropus sp.	-	-			1	-	21.7	0.1
Leptoceridae								
Oecetis sp.	-	-			-	1	21.7	0.1
Triaenodes sp.	-	-			2	1	65.0	0.3
Limnephilidae								
Nemotaulius hostilis	-	-			-	1	21.7	0.1
Pycnopsyche sp.	-	-			-	1	21.7	0.1
Coleoptera								
Elmidae								
Dubiraphia sp.	-	1	21.7	0.5	13	10	498.0	2.5
Diptera								
Chironomidae								
Chironominae								
Cladotanytarsus sp.	2	-	43.3	1.0	-	-		
Cryptochironomus sp.	-	-			3	1	86.6	0.4
Dicrotendipes sp.	-	-			-	1	21.7	0.1
Dicrotendipes sp. pupa	-	-			-	1	21.7	0.1
Lauterborniella sp.	-	-			1	-	21.7	0.1
Micropsectra sp.	-	-			-	1	21.7	0.1
Microtendipes sp.	-	-			12	10	476.3	2.4
Microtendipes sp. pupa	-	-			-	2	43.3	0.2
Paralauterborniella sp.	-	-			1	13	303.1	1.5
Paratanytarsus sp.	-	-			1	1	43.3	0.2
Phaenopsectra sp.	-	1	21.7	0.5	-	-		
Polypedilum scalaenum type	4	-	86.6	2.0	-	-		
P. simulans type	-	1	21.7	0.5	25	31	1,212.4	6.0
Polypedilum sp. pupa	6	-	129.9	3.1	-	-		
Rheotanytarsus sp.	2	-	43.3	1.0	-	-		
Stictochironomus sp.	-	6	129.9	3.1	1	-	21.7	0.1
Tanytarsus sp.	-	-			2	4	129.9	0.6
Tribelos sp.	2	5	151.6	3.6	10	10	433.0	2.1
Zavrelia sp.	-	-			2	13	324.8	1.6
Tanypodinae								
Ablabesmyia sp.	-	-			-	2	43.3	0.2

Taxa	Sand Replicate A	Sand Replicate B	Sand Mean No./M^2	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./M^2	Silt Percent Occurrence
Clinotanypus sp.	-	-			34	26	1,299.0	6.4
Coelotanypus sp.	-	-			1	-	21.7	0.1
Procladius sp.	-	-			9	9	389.7	1.9
Thienemannimyia series	-	-			7	9	346.4	1.7
Orthocladiinae								
Epoicocladius sp.	-	-			-	2	43.3	0.2
Orthocladius sp. pupa	-	-			-	1	21.7	0.1
Parakiefferiella sp.	-	-			-	1	21.7	0.1
Ceratopogonidae	8	6	303.1	7.1	35	31	1,428.9	7.1
Mollusca								
Gastropoda								
Hydrobiidae								
Unidentified Hydrobiidae	-	23	498.0	11.7	38	18	1,212.4	6.0
Viviparidae								
Campeloma sp.	-	6	129.9	3.1	10	5	324.8	1.6
Physidae								
Physa sp.	-	-			-	1	21.7	0.1
Planorbidae								
Gyraulus sp.	-	3	65.0	1.5	-	1	21.7	0.1
Pelecypoda								
Sphaeriidae								
Pisidium sp.	-	7	151.6	3.6	1	1	43.3	0.2
Sphaerium striatinum	-	2	43.3	1.0	-	1	21.7	0.1
Immature Sphaeriidae	-	10	216.5	5.1	1	6	151.6	0.7
Total Benthos			4,244.1				20,244.5	
Total Taxa			25				54	

and Corynoneura sp. (only in the gravel substrate) were the dominant chironomid taxa at Station 5 (Table 20). Tubificid oligochaetes (in the sand and silt substrates) and Hyalella azteca (in the silt habitat) were also abundant at Station 5 in May. The tubificid assemblage was dominated by immatures without capilliform chaetae (probably either Isochaetides freyi or Limnodrilus spp.) in the sand substrate and Limnodrilus hoffmeisteri in the silt substrate. As was found in February, the silt substrate yielded the greatest density and diversity of organisms at Station 5.

Qualitative collections from Station 5 in May yielded 52 macroinvertebrate taxa (Table 17). The mayflies Baetis sp., Arthroplea bipunctata, and Leptophlebia sp.; the amphipod Hyallela azteca; the caddisflies Cheumatopsyche sp. and immature Limnephilidae; the midge Paratanytarsus sp.; and the snail Lymnaea sp. were all abundant or very abundant in the May qualitative sample. It should be noted that Arthroplea bipunctata was not collected in any recent samplings of Swamp Creek (Section 2.5 of the EIR [Exxon Minerals Company 1982]; Ecological Analysts 1983). In Wisconsin, Arthroplea bipunctata nymphs are generally found in vernal ponds near large streams, developing rapidly and emerging in late May (Hilsenhoff 1981). Thus, the absence of this mayfly species in previous collections from Swamp Creek was not unexpected. The most diverse macroinvertebrate groups in the May qualitative collections at Station 5 were the midges (19 taxa), mayflies (6 taxa), and caddisflies (6 taxa).

The biotic index value for Station 5 was 3.35 in May (Table 18). The sample was collected from a fast-flowing, sandy area of Station 5 where Hyalella azteca (tolerance value = 4) was dominant.

3.2.3 August 1983

The planaria Dugesia sp., tubificid oligochaetes, the amphipod Hyalella azteca, the mayfly Baetis pygmaeus, and chironomid midges were the dominant macroinvertebrates in the Ponar and qualitative samples from Swamp Creek in August (Tables 21 and 22, respectively). The wide variations in total benthos and total taxa noted among the various substrates in the May quantitative samples were not evident in August. Total taxa collected in the qualitative samples increased from 82 in May to 103 in August. As in May, all stations had similar numbers of total taxa (range 55-65) in August. The biotic index values in August ranged from 2.16 at Station 5 to 3.73 at Station 3A (Table 23).

Station 3A

The qualitative sample from Station 3A yielded 65 macroinvertebrate taxa in August (Table 22). The most diverse groups in the qualitative sample were the midges (19 taxa) and the caddisflies (8 taxa). The planaria Dugesia sp., the naidid Stylaria fossularis, the amphipods Hyalella azteca and Gammarus pseudolimnaeus, the mayfly Baetis pygmaeus, the caddisfly Cheumatopsyche sp., and the midge Cricotopus cylindraceus group were abundant or very abundant in the August qualitative collection.

The biotic index value calculated for Station 3A was 3.73 in August (Table 23). The high biotic index value was the result of Hyalella azteca (tolerance value = 4) dominating the sample.

TABLE 20 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 5 IN SWAMP CREEK, 10 MAY 1983

	Substrate											
	Sand				Silt				Gravel			
	Replicate		Mean	Percent	Replicate		Mean	Percent	Replicate		Mean	Percent
Taxa	A	B	No./M^2	Occurrence	A	B	No./M^2	Occurrence	A	B	No./M^2	Occurrence
Platyhelminthes												
Planariidae												
Dugesia sp.	-	-			-	-			-	1	21.7	1.6
Nematoda												
Unidentified Nematoda	-	-			-	-			-	6	129.9	9.8
Annelida												
Oligochaeta												
Naididae												
Nais communis	-	-			-	-			-	1	21.7	1.6
N. pardalis	-	-			-	-			-	4	86.6	6.6
Tubificidae												
Ilyodrilus templetoni	-	-			10	36	995.9	5.8	-	-		
Isochaetides freyi	-	1	21.7	0.6	-	-			-	-		
Limnodrilus hoffmeisteri	2	2	86.6	2.4	56	52	2,338.2	13.7	-	-		
L. udekemianus	2	-	43.3	1.2	7	20	584.6	3.4	-	-		
Immature w/ cap. chaetae	1	-	21.7	0.6	-	4	86.6	0.5	-	-		
Immature w/o cap. chaetae	27	13	866.0	23.5	22	36	1,255.7	7.3	-	2	43.3	3.3
Hirudinea												
Erpobdellidae												
Erpobdella punctata	-	-			-	-			-	1	21.7	1.6
Arthropoda												
Crustacea												
Isopoda												
Asellus r. racovitzai	-	-			1	-	21.7	0.1	-	-		
Amphipoda												
Gammarus pseudolimnaeus	-	-			2	1	65.0	0.4	-	-		
Hyalella azteca	-	1	21.7	0.6	25	112	2,966.1	17.3	-	-		
Arachnida												
Hydracarina	3	2	108.3	2.9	1	8	194.9	1.1	-	-		
Insecta												
Ephemeroptera												
Ephemeridae												
Hexagenia limbata	-	-			2	2	86.6	0.5	-	-		
Baetiscidae												
Baetisca obesa	-	-			1	4	108.3	0.6	-	-		
Baetidae												
Baetis sp.	-	-			-	4	86.6	0.5	-	-		
Odonata												
Aeshnidae												
Basiaeschna janata	-	-			-	4	86.6	0.5	-	-		
Trichoptera												
Limnephilidae												
Platycentropus sp.	-	-			1	-	21.7	0.1	-	-		
Pycnopsyche sp.	-	-			-	2	43.3	0.3	-	-		
Molannidae												
Molanna tryphena	-	-			-	4	86.6	0.5	-	-		
Coleoptera												
Elmidae												
Dubiraphia sp.	-	1	21.7	0.6	17	28	974.3	5.7	-	-		
Stenelmis sp.	-	-			-	-			1	1	43.3	3.3
Diptera												
Chironomidae												
Chironominae												
Cladotanytarsus sp.	6	18	519.6	14.1	-	-			-	-		
Cladotanytarsus sp. pupa	2	2	86.6	2.4	-	-			-	-		
Cryptochironomus sp.	1	2	65.0	1.8	1	12	281.5	1.6	-	-		
Endochironomus sp.	-	-			-	4	86.6	0.5	-	-		
Micropsectra curvicornis	-	-			1	12	281.5	1.6	-	-		
Microtendipes sp.	-	-			1	24	541.3	3.2	-	-		
Nilothauma babiyi	-	-			3	-	65.0	0.4	-	-		
Paralauterborniella sp.	-	-			-	32	692.8	4.0	-	-		
Paratanytarsus sp.	-	-			-	4	86.6	0.5	-	-		
Paratendipes sp.	-	-			1	4	108.3	0.6	-	-		
Polypedilum scalaenum type	4	4	173.2	4.7	8	8	346.4	2.0	-	-		
P. simulans type	-	-			17	36	1,147.5	6.7	-	-		
Polypedilum sp. pupa	4	13	368.1	10.0	4	8	259.8	1.5	-	-		
Rheotanytarsus sp.	-	-			1	4	108.3	0.6	-	-		
Stempellina sp.	1	-	21.7	0.6	-	-			-	-		
Stictochironomus sp.	11	4	324.8	8.8	3	4	151.6	0.9	-	2	43.3	3.3
Tanytarsus sp.	1	3	86.6	2.4	4	4	173.2	1.0	-	-		
Tribelos sp.	-	-			4	-	86.6	0.5	-	-		
Zavrelia sp.	-	1	21.7	0.6	-	-			-	-		
Tanypodinae												
Ablabesmyia sp.	-	-			-	-			-	3	65.0	4.9
Clinotanypus sp.	-	-			1	1	43.3	0.3	-	-		
Natarsia sp.	1	-	21.7	0.6	2	-	43.3	0.3	2	3	108.3	8.2
Procladius sp.	10	8	389.7	10.6	12	44	1,212.4	7.1	-	-		
Thienemannimyia series	-	-			1	12	281.5	1.6	1	4	108.3	8.2

Taxa	Substrate: Sand — Replicate A	Sand — Replicate B	Sand — Mean No./M²	Sand — Percent Occurrence	Silt — Replicate A	Silt — Replicate B	Silt — Mean No./M²	Silt — Percent Occurrence	Gravel — Replicate A	Gravel — Replicate B	Gravel — Mean No./M²	Gravel — Percent Occurrence
Orthocladiinae												
Corynoneura sp.	-	-			-	-			-	20	433.0	32.8
Cricotopus bicinctus group	-	-			-	-			-	1	21.7	1.6
C. trifascia	-	-			-	4	86.6	0.5	-	-		
Nanocladius sp.	1	-	21.7	0.6	-	-			-	-		
Parakiefferiella	-	-			2	-	43.3	0.3	-	-		
Parametriocnemus sp.	-	-			1	-	21.7	0.1	-	-		
Tabanidae												
Chrysops sp.	-	-			1	-	21.7	0.1	-	-		
Ceratopogonidae	6	7	281.5	7.6	6	4	216.5	1.3	-	1	21.7	1.6
Mollusca												
Gastropoda												
Hydrobiidae												
Unidentified Hydrobiidae	2	1	65.0	1.8	6	-	129.9	0.8	1	1	43.3	3.3
Viviparidae												
Campeloma sp.	-	-			17	8	541.3	3.2	-	-		
Planorbidae												
Gyraulus sp.	-	-			-	-			-	5	108.3	8.2
Pelecypoda												
Sphaeriidae												
Pisidium sp.	2	-	43.3	1.2	2	-	43.3	0.3	-	-		
Sphaerium striatinum	-	-			1	-	21.7	0.1	-	-		
Total Benthos			3,681.2				17,126.2				1,321.1	
Total Taxa			20				43				16	

TABLE 21 MEAN DENSITY AND PERCENT OCCURRENCE OF THE DOMINANT(*) BENTHIC MACROINVERTEBRATES COLLECTED WITH A PONAR GRAB SAMPLER FROM SWAMP CREEK, 15-16 AUGUST 1983

Taxa	Station 4				Station 5					
	Sand		Silt		Sand		Silt		Gravel	
	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%
Platyhelminthes										
Dugesia sp.	195	5.3	866	10.3	260	3.1	173	3.2	563	8.0
Nematoda	260	7.1	411	4.9	65	0.8	87	1.6	43	0.6
Annelida										
Oligochaeta										
Naididae	22	0.6	866	10.3	152	1.8	87	1.6	195	2.8
Tubificidae	325	8.9	736	8.7	931	11.1	1,212	22.1	1,710	24.3
Crustacea										
Amphipoda										
Hyalella azteca	282	7.7	3,074	36.5	823	9.8	606	11.1	1,104	15.7
Insecta										
Coleoptera										
Dubiraphia sp.	--	--	22	0.3	65	0.8	433	7.9	22	0.3
Diptera										
Chironomidae	1,992	54.4	1,819	21.6	5,391	64.3	2,511	45.8	2,339	33.2
Mollusca										
Gastropoda										
Hydrobiidae	87	2.4	195	2.3	152	1.8	--	--	390	5.5
Pelecypoda										
Sphaeriidae	303	8.3	108	1.3	--	--	43	0.8	--	--
Total Benthos	3,660		8,423		8,380		5,478		7,038	
Total Taxa	24		32		38		26		42	

(*) Taxa or groups that compose ≥5% of the total benthos at any substrate type.

TABLE 22 COMPOSITION AND RELATIVE ABUNDANCE(*) OF AQUATIC MACROINVERTEBRATES COLLECTED BY QUALITATIVE TECHNIQUES FROM SWAMP CREEK, 15-16 AUGUST 1983

Taxa	Station 3A	Station 4	Station 5
Platyhelminthes			
Planariidae			
Dugesia sp.	A	A	A
Annelida			
Oligochaeta			
Naididae			
Pristina longiseta leidyi	-	0	-
Stylaria fossularis	A	C	-
Lumbriculidae			
Unidentified Lumbriculidae	-	0	-
Hirudinea			
Glossiphoniidae			
Immature Glossiphoniidae	-	-	0
Placobdella ornata	-	0	0
Theromyzon sp.	-	0	-
Erpobdellidae			
Erpobdella punctata	0	0	-
Anthropoda			
Crustacea			
Isopoda			
Asellidae			
Asellus r. racovitzai	-	0	-
Amphipoda			
Gammaridae			
Gammarus pseudolimnaeus	A	C	C
Talitridae			
Hyalella azteca	V	V	A
Decapoda			
Astacidae			
Immature Astacidae	-	-	0
Orconectes propinquus	-	-	0
Orconectes virilis	0	C	0
Arachnida			
Hydracarina	0	0	-

(*) 0 = Occasional, 1-4 organisms
C = Common, 5-24 organisms
A = Abundant, 25-99 organisms
V = Very abundant, 100+ organisms
- = Not collected

Taxa	Station 3A	4	5
Insecta			
Ephemeroptera			
Heptageniidae			
Stenacron interpunctatum	C	O	C
Stenonema vicarium	-	O	O
Baetidae			
Baetis amplus	C	-	C
Baetis pygmaeus	A	V	A
Callibaetis sp.	-	-	O
Leptophlebiidae			
Leptophlebia sp.	C	-	-
Odonata			
Aeshnidae			
Aeshna umbrosa	O	-	-
Anax junius	-	O	O
Basiaeschna janata	O	C	C
Corduliidae			
Dorocordulia libera	O	-	-
Epitheca sp.	O	-	-
Gomphidae			
Gomphus lividus	O	-	O
Coenagrionidae			
Enallagma sp.	O	O	O
Calopterygidae			
Calopteryx sp.	C	O	C
Hemiptera			
Corixidae	-	C	A
Nepidae			
Ranatra fusca	-	-	O
Belostomatidae			
Belostoma flumineum	O	-	O
Notonectidae			
Notonecta sp.	-	-	O
Megaloptera			
Corydalidae			
Chauliodes sp.	O	O	-
Trichoptera			
Molannidae			
Molanna tryphena	-	-	O
Polycentropodidae			
Polycentropus sp.	O	-	O
Hydropsychidae			
Cheumatopsyche sp.	A	O	C
Hydropsyche betteni	-	-	C
Brachycentridae			
Brachycentrus numerosus	-	O	V

Taxa	Station 3A	4	5
Hydroptilidae			
Oxyethira sp.	C	C	-
Hydroptila sp.	C	C	O
Leptoceridae			
Mystacides sepulchralis	O	O	-
Oecetis sp.	C	C	C
Triaenodes sp.	C	C	O
Limnephilidae			
Pycnopsyche sp.	C	C	C
Pychopsyche sp. pupa	O	O	O
Phryganeidae			
Immature Phryganeidae	-	O	C
Coleoptera			
Gyrinidae			
Gyrinus sp. (adult)	O	-	-
Dytiscidae			
Unidentified Dytiscidae	O	-	-
Haliplidae			
Haliplus sp.	O	-	-
Elmidae			
Ancyronyx variegata	-	-	O
Dubiraphia sp.	O	O	C
Dubiraphia vittata adult	O	-	-
Macronychus glabratus	O	-	O
Macronychus glabratus adult	-	-	C
Stenelmis sp.	O	-	-
Stenelmis crenata adult	O	-	-
Diptera			
Chironomidae			
Chironominae			
Cladotanytarsus sp.	O	O	-
Cryptochironomus sp.	O	-	-
Cryptotendipes sp.	-	-	O
Dicrotendipes sp.	O	O	-
Lauterborniella sp.	O	O	-
Micropsectra sp.	C	A	C
Micropsectra curvicornis	-	O	-
Microtendipes sp.	O	-	C
Paralauterborniella sp.	O	-	-
Paratanytarsus sp.	-	-	O
Phaenopsectra sp.	O	-	-
Polypedilum convictum type	C	O	C
Rheotanytarsus sp.	-	-	C
Rheotanytarsus sp. pupa	-	-	O
Stenochironomus sp.	-	O	O
Stictochironomus sp.	O	-	-
Tanytarsus sp.	C	A	A
Tribelos sp.	-	O	O

Taxa	Station 3A	4	5
Zavrelia sp.	-	0	-
Tanypodinae			
Ablabesmyia sp.	0	C	0
Ablabesmyia sp. pupa	0	0	-
Clinotanypus sp.	-	-	0
Pentaneura sp.	0	C	-
Pentaneura sp. pupa	-	C	0
Procladius sp.	-	-	C
Orthocladiinae			
Cricotopus sp. pupa	0	0	0
C. cylindraceus group	A	A	C
Eukiefferiella discoloripes group	-	-	0
Nanocladius sp.	0	0	-
Parametriocnemus sp.	0	-	-
Psectrocladius sp.	-	0	0
Synorthocladius sp.	0	-	-
Thienemanniella sp.	-	-	0
Thienemanniella sp. pupa	-	-	0
Simuliidae			
Simulium sp.	-	-	0
Ceratopogonidae pupa	0	0	-
Tipulidae			
Dicranota sp.	-	-	0
Lepidoptera			
Pyralidae			
Paraponyx sp.	0	-	C
Mollusca			
Gastropoda			
Hydrobiidae			
Unidentified Hydrobiidae	C	A	C
Viviparidae			
Campeloma sp.	C	0	0
Lymnaeidae			
Lymnaea sp.	-	0	-
Physidae			
Physa sp.	-	0	0
Planorbidae			
Helisoma sp.	0	-	0
Ancylidae			
Ferrissia sp.	0	-	0
Pelecypoda			
Sphaeriidae			
Pisidium sp.	-	0	0
Sphaerium sp.	0	0	-
Sphaerium striatinum	0	-	-
Immature Sphaeriidae	C	0	-

Taxa	Station 3A	4	5
Unionidae			
Anodonta grandis	0	-	-
Subtotal taxa	65	55	64
Total taxa (all stations)		103	

TABLE 23 HILSENHOFF BIOTIC INDICES OF MACROINVERTEBRATE COLLECTIONS FROM SWAMP CREEK, 15-16 AUGUST 1983

Taxa	Tolerance Value	Station 3A	Station 4	Station 5
Crustacea				
Gammarus pseudolimnaeus	2	6(*)	--	1
Hyalella azteca	4	67	41	3
Ephemeroptera				
Baetis pygmaeus	2	7	58	5
Stenacron interpunctatum	3	4	--	--
Stenonema vicarium	1	5	--	--
Leptophlebia sp.	2	1	1	--
Trichoptera				
Hydropsyche betteni	3	--	--	6
Cheumatopsyche sp.	3	1	1	14
Polycentropus sp.	2	--	1	--
Molanna sp.	1	--	--	1
Hydroptila sp.	3	1	7	2
Oecetis sp.	2	1	1	5
Triaenodes sp.	2	--	19	1
Mystacides sepulchralis	2	--	--	1
Brachycentrus numerosus	1	--	--	45
Coleoptera				
Dubiraphia sp.	3	1	--	2
Stenelmis sp.	3	2	--	--
S. crenata	3	1	--	--
Diptera				
Cladotanytarsus sp.	3	2	--	2
Cryptochironomus sp.	4	--	--	1
Micropsectra sp.	3	2	--	4
Paralauterborniella sp.	3	--	--	4
Paratendipes sp.	2	--	--	2
Phaenopsectra (Tribelos) sp.	4	--	1	--
Polypedilum sp.	3	--	2	5
Rheotanytarsus sp.	3	--	--	13
Tanytarsus sp.	3	--	7	6
Thienemanniella sp.	2	--	1	4
Ablabesmyia sp.	3	--	4	--
Pentaneura sp.	2	--	2	--
Thienemannimyia series	3	1	2	1
Cricotopus sp.	4	14	--	--
Nanocladius sp.	1	1	--	--
Unid. Empididae	3	--	1	--

(*) Number of individuals per station.

Taxa	Tolerance Value	Station 3A	Station 4	Station 5
Lepidoptera				
Paraponyx sp.	1	--	1	--
Total Number of Taxa		17	17	22
Total Number of Individuals		107	150	128
Biotic Index Value		3.73	2.71	2.16

Station 4

Chironomid midges and the amphipod Hyalella azteca dominated the benthic fauna at Station 4 in August (Table 21). The most commonly collected midges included Cladotanytarsus sp. and Tanytarsus sp. in the sand substrate, and Micropsectra sp. and Tribelos sp. in the silt substrate (Table 24). Hyalella azteca was especially abundant (3,074 individuals/m2, 37 percent of the benthos) in the silt substrate at Station 4. Although the difference was not as pronounced as in May, the community inhabiting the silt substrate continued to be larger and more diverse than the fauna in the sand substrate. However, the communities in both the sand and silt substrates in August were greatly reduced from those recorded in May.

The qualitative sample from Station 4 in August yielded 55 macroinvertebrate taxa (Table 22). The most abundant taxa included Hyalella azteca, the mayfly Baetis pygmaeus, the planaria Dugesia sp., the midges Micropsectra sp., Tanytarsus sp., and Cricotopus cylindraceus group, and hydrobiid snails. Midges (16 taxa) and caddisflies (9 taxa) were the most diverse groups in the qualitative collection at Station 4.

A value of 2.71 was calculated for the biotic index sample collected at Station 4 in August (Table 23). Baetis pygmaeus and Hyalella azteca (tolerance values = 2 and 4, respectively) were the dominant organisms in the sample.

Station 5

Chironomid midges, tubificid oligochaetes, and Hyalella azteca (in decreasing order of importance) were the predominant taxa in all three substrates at Station 5 in August (Table 21). Midges were especially abundant (5,391 individuals/m2, 64 percent of the benthos) in the sand substrate. The dominant midges included Stictochironomus sp. (in all substrates), Cladotanytarsus sp. (in the sand substrate), Micropsectra sp. (in the silt substrate), and Paralauterborniella sp. (from the gravel substrate) (Table 25). Macroinvertebrate densities were relatively similar in all substrate types in August. The community in the silt substrate declined noticeably in density and diversity from May, while the faunas in the sand and gravel substrates increased.

Sixty-four macroinvertebrate taxa were collected in the qualitative collections at Station 5 in August (Table 22). The groups with the most taxa were the midges (18 taxa) and caddisflies (10 taxa). The caddisfly Brachycentrus numerosus, the planaria Dugesia sp., Hyalella azteca, the mayfly Baetis pygmaeus, water boatmen (Corixidae), and the midge Tanytarsus sp. were the predominant taxa sampled in August. The caddisfly B. numerosus was rare in previous collections from this reach of Swamp Creek and the net-spinning caddisfly Hydropsyche betteni (which was common at Station 5 in August) has not been collected in previous Swamp Creek collections downstream from Rice Lake (Ecological Analysts 1983). Ross (1944) noted the preference of these two caddisfly species for riffle habitats.

TABLE 24 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 4 IN SWAMP CREEK, 16 AUGUST 1983

	Substrate							
	Sand				Silt			
	Replicate		Mean	Percent	Replicate		Mean	Percent
Taxa	A	B	No./m^2	Occurrence	A	B	No./m^2	Occurrence
Platyhelminthes								
Planariidae								
Dugesia sp.	1	8	194.9	5.3	33	7	866.0	10.3
Nematoda								
Unidentified Nematoda	4	8	259.8	7.1	10	9	411.4	4.9
Annelida								
Oligochaeta								
Naididae								
Arcteonais lomondi	--	1	21.7	0.6	21	9	649.5	7.7
Dero digitata	--	--			1	1	43.3	0.5
Slavina appendiculata	--	--			3	2	108.3	1.3
Stylaria fossularis	--	--			2	--	43.3	0.5
Uncinais uncinata	--	--			--	1	21.7	0.3
Tubificidae								
Aulodrilus piqueti	--	1	21.7	0.6	--	--		
Limnodrilus hoffmeisteri	1	2	65.0	1.8	1	2	65.0	0.8
L. udekemianus	1	--	21.7	0.6	1	8	194.9	2.3
Immature w/ cap. chaetae	1	1	43.3	1.2	2	1	65.0	0.8
Immature w/o cap. chaetae	4	4	173.2	4.7	11	8	411.4	4.9
Arthropoda								
Crustacea								
Amphipoda								
Hyalella azteca	1	12	281.5	7.7	102	40	3,074.3	36.5
Arachnida								
Hydracarina	--	--			--	1	21.7	0.3

TABLE 24 (Cont.)

Taxa	Substrate: Sand Replicate A	Sand Replicate B	Sand Mean No./m²	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./m²	Silt Percent Occurrence
Insecta								
Ephemeroptera								
Emphemeridae								
Hexagenia limbata	--	1	21.7	0.6	--	--		
Baetidae								
Baetis pygmaeus	--	--			2	2	86.6	1.0
Caenidae								
Brachycercus sp.	--	1	21.7	0.6	--	--		
Trichoptera								
Hydropsychidae								
Cheumatopsyche sp.	--	--			--	4	86.6	1.0
Leptoceridae								
Triaenodes sp.	--	--			1	1	43.3	0.5
Coleoptera								
Elmidae								
Dubiraphia sp.	--	--			--	1	21.7	0.3
Diptera								
Chironomidae								
Chironominae								
Cladotanytarsus sp.	19	14	714.5	19.5	--	4	86.6	1.0
Cladotanytarsus sp. pupa	2	--	43.3	1.2	--	--		
Cryptochironomus sp.	4	1	108.3	3.0	--	--		
Cryptotendipes sp.	--	--			--	1	21.7	0.3
Dicrotendipes sp.	--	--			1	1	43.3	0.5
Micropsectra sp.	1	1	43.3	1.2	10	15	541.3	6.4
Microtendipes sp.	1	1	43.3	1.2	--	1	21.7	0.3
Paralauterborniella sp.	1	2	65.0	1.8	--	--		
Stictochironomus sp.	14	--	303.1	8.3	2	1	65.0	0.8
Stictochironomus sp. pupa	1	--	21.7	0.6	--	--		
Tanytarsus sp.	7	10	368.1	10.1	5	11	346.4	4.1
Tanytarsus sp. pupa	--	1	21.7	0.6	--	1	21.7	0.3

TABLE 24 (Cont.)

Taxa	Substrate: Sand, Replicate A	Sand, Replicate B	Sand, Mean No./m^2	Sand, Percent Occurrence	Silt, Replicate A	Silt, Replicate B	Silt, Mean No./m^2	Silt, Percent Occurrence
Tribelos sp.	--	1	21.7	0.6	6	15	454.7	5.4
Zavrelia sp.	--	--			--	2	43.3	0.5
Tanypodinae								
Clinotanypus sp.	--	--			3	3	129.9	1.5
Procladius sp.	8	3	238.2	6.5	1	1	43.3	0.5
Ceratopogonidae	3	--	65.0	1.8	1	2	65.0	0.8
Tabanidae								
Chrysops sp.	--	--			--	1	21.7	0.3
Mollusca								
Gastropoda								
Hydrobiidae								
Unidentified Hydrobiidae	1	3	86.6	2.4	4	5	194.9	2.3
Viviparidae								
Campeloma sp.	--	4	86.6	2.4	5	--	108.3	1.3
Pelecypoda								
Sphaeriidae								
Immature Sphaeriidae	--	14	303.1	8.3	--	--		
Total Benthos			3,659.7				8,422.8	
Total Taxa			24				32	

TABLE 25 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 5 IN SWAMP CREEK, 15 AUGUST 1983

	Substrate											
	Sand				Silt				Gravel			
Taxa	Replicate A	Replicate B	Mean No./m^2	Percent Occurrence	Replicate A	Replicate B	Mean No./m^2	Percent Occurrence	Replicate A	Replicate B	Mean No./m^2	Percent Occurrence
Platyhelminthes												
Planariidae												
Dugesia sp.	-	12	259.8	3.1	8	--	173.2	3.2	9	17	562.9	8.0
Nematoda												
Unidentified Nematoda	1	2	65.0	0.8	4	--	86.6	1.6	1	1	43.3	0.6
Nemertinea												
Unidentified Nemertinea	--	--			--	--			1	1	43.3	0.6
Annelida												
Oligochaeta												
Naididae												
Arcteonais lomondi	--	2	43.3	0.5	--	--			--	--		
Dero digitata	1	--	21.7	0.3	--	--			--	--		
Piguetiella michiganensis	2	--	43.3	0.5	--	--			3	--	65.0	0.9
Slavina appendiculata	--	--			4	--	86.6	1.6	1	--	21.7	0.3
Specaria josinae	--	--			--	--			--	1	21.7	0.3
Uncinais uncinata	2	--	43.3	0.5	--	--			4	-	86.6	1.2
Tubificidae												
Ilyodrilus templetoni	3	--	65.0	0.8	--	--			3	1	86.6	1.2
Isochaetides freyi	2	-	43.3	0.5	--	4	86.6	1.6	--	--		
Limnodrilus hoffmeisteri	3	7	216.5	2.6	4	4	173.2	3.2	9	2	238.2	3.4
L. hoffmeisteri varient	1	--	21.7	0.3	--	--			--	--		
L. udekemianus	1	3	86.6	1.0	4	10	303.1	5.5	--	2	43.3	0.6
Immature w/ cap. chaetae	1	3	86.6	1.0	8	--	173.2	3.2	3	1	86.6	1.2
Immature w/o cap. chaetae	13	6	411.4	4.9	16	6	476.3	8.7	41	17	1,255.7	17.8
Hirudinea												
Glossiphoniidae												
Helobdella stagnalis	--	--			--	--			1	--	21.7	0.3
Erpobdellidae												
Erpobdella punctata	--	--			--	--			--	2	43.3	0.6
Arthropoda												
Crustacea												
Isopoda												
Asellus r. racovitzai	--	1	21.7	0.3	--	--			--	1	21.7	0.3
Amphipoda												
Gammarus pseudolimnaeus	--	--			--	--			1	--	21.7	0.3
Hyalella azteca	1	37	822.7	9.8	24	4	606.2	11.1	26	25	1,104.2	15.7
Arachnida												
Hydracarina	7	3	216.5	2.6	4	2	129.9	2.4	1	--	21.7	0.3
Insecta												
Ephemeroptera												
Ephemeridae												
Hexagenia limbata	--	1	21.7	0.3	4	--	86.6	1.6	1	--	21.7	0.3
Caenidae												
Caenis sp.	--	--			--	--			1	--	21.7	0.3
Trichoptera												
Hydropsychidae												
Cheumatopsyche sp.	--	2	43.3	0.5	--	--			--	--		
Leptoceridae												
Mystacides sepulchralis	--	--			--	--			--	2	43.3	0.6
Oecetis sp.	--	1	21.7	0.3	--	2	43.3	0.8	--	--		
Triaenodes sp.	--	--			--	--			--	1	21.7	0.3
Polycentropodidae												
Neureclipsis sp.	--	1	21.7	0.3	--	--			--	--		
Molannidae												
Molanna tryphena	--	--			--	--			--	4	86.6	1.2
Coleoptera												
Elmidae												
Dubiraphia sp.	--	3	65.0	0.8	20	--	433.0	7.9	1	--	21.7	0.3
Diptera												
Chironomidae												
Chironominae												
Cladotanytarsus sp.	45	31	1,645.4	19.6	--	4	86.6	1.6	7	4	238.2	3.4
Cladotanytarsus sp. pupa	3	3	129.9	1.6	--	--			--	--		
Cryptochironomus sp.	--	5	108.3	1.3	--	6	129.9	2.4	4	2	129.9	1.8
Cryptotendipes sp.	--	1	21.7	0.3	--	--			--	--		
Dicrotendipes sp.	--	--			8	--	173.2	3.2	--	1	21.7	0.3
Micropsectra sp.	1	7	173.2	2.1	32	--	692.8	12.6	4	6	216.5	3.1
M. curvicornis	--	1	21.7	0.3	4	--	86.6	1.6	--	--		
Microtendipes sp.	3	2	108.3	1.3	--	--			--	2	43.3	0.6
Paralauterborniella sp.	8	19	584.6	7.0	--	--			15	8	498.0	7.1
Paralauterborniella sp. pupa	--	--			--	--			1	--	21.7	0.3
Polypedilum fallax type	--	--			--	--			--	1	21.7	0.3
P. scalaenum type	5	7	259.8	3.1	4	--	86.6	1.6	8	3	238.2	3.4
P. simulans type	--	2	43.3	0.5	--	--			--	1	21.7	0.3
Stictochironomus sp.	25	57	1,775.3	21.2	--	22	476.3	8.7	10	7	368.1	5.2
Stictochironomus sp. pupa	--	--			--	--			1	--	21.7	0.3
Tanytarsus sp.	5	7	259.8	3.1	16	8	519.6	9.5	2	3	108.3	1.5
Tanytarsus sp. pupa	1	--	21.7	0.3	--	2	43.3	0.8	--	1	21.7	0.3

	Substrate											
	Sand				Silt				Gravel			
	Replicate		Mean	Percent	Replicate		Mean	Percent	Replicate		Mean	Percent
Taxa	A	B	No./m^2	Occurrence	A	B	No./m^2	Occurrence	A	B	No./m^2	Occurrence
Tribelos sp.	--	2	43.3	0.5	--	--			2	1	65.0	0.9
Tribelos sp. pupa	1	--	21.7	0.3	--	--			--	--		
Zavrelia sp.	--	1	21.7	0.3	--	--			--	--		
Tanypodinae												
Ablabesmyia sp.	--	--			4	--	86.6	1.6	2	--	65.0	0.9
Procladius sp.	5	1	129.9	1.6	--	4	86.6	1.6	8	2	216.5	3.1
Thienemannimyia series	--	--			--	--			1	--	21.7	0.3
Orthocladiinae												
Cricotopus cylindraceus group	--	--			--	2	43.3	0.8	--	--		
Thienemanniella sp.	--	1	21.7	0.3	--	--			--	--		
Ceratopogonidae	7	2	194.9	2.3	--	--			5	4	194.9	2.8
Mollusca												
Gastropoda												
Hydrobiidae												
Unidentified Hydrobiidae	1	6	151.6	1.8	--	--			6	12	389.7	5.5
Viviparidae												
Campeloma sp.	--	--			2	1	65.0	1.2	--	5	108.3	1.5
Pelecypoda												
Sphaeriidae												
Immature Sphaeriidae	--	--			--	2	43.3	0.8	--	--		
Total Benthos			8,379.6				5,477.5				7,037.7	
Total Taxa			38				26				42	

Brachycentrus numerosus (tolerance value = 1) was also the dominant arthropod in the August biotic index sample from Station 5 (Table 23). The dominance of this species was the principal reason for the low (2.16) index value at Station 5, which was the lowest value recorded in 1983.

Drift

Naidid oligochaetes (especially Stylaria fossularis), the amphipod Hyalella azteca, water mites (Hydracarina), the mayflies Baetis sp. and Leptophlebia sp., and chironomid midges were the dominant taxa in the August drift collections from Swamp Creek (Table 26). Upstream Station 1 yielded greater densities (759 versus 220 individuals/100 m^3) and greater diversity (36 versus 28 total taxa) than occurred at Station 3. In addition, the densities of all dominant taxa (except Hydracarina) were greater at Station 1 than at Station 3. Larvae and pupa of the midge Pentaneura sp. occurred commonly (a total of 49 individuals/100 m^3 at Station 1) in the drift. This taxon has been rare or absent in all previous collections in this portion of Swamp Creek (Ecological Analysts 1983).

3.2.4 November 1983

The dominant taxa collected from Swamp Creek in November included tubificid oligochaetes, the amphipods Hyalella azteca and Gammarus pseudolimnaeus, the mayfly Leptophlebia sp., the caddisfly Platycentropus sp., and chironomid midges (Tables 27 and 28). The community changes from August to November in density and diversity at each substrate type were variable. The total number of taxa in the qualitative samples decreased from 103 in August to 87 in November. The November biotic index values for Swamp Creek ranged from 2.35 at Station 4 to 3.53 at Station 5 (Table 29).

Station 3A

Forty-five macroinvertebrate taxa were found in the November qualitative samples at Station 3A (Table 28). The dominant taxa at Station 3A were the planaria Dugesia sp., the amphipod Hyalella azteca, the mayfly Leptophlebia sp., and the caddisfly Platycentropus sp. Abundant taxa included the amphipod Gammarus pseudolimnaeus, the mayfly Baetis pygmaeus, the net-spinning caddisfly Cheumatopsyche sp., adults of the whirligig beetle Gyrinus sp., and hydrobiid snails. Caddisflies (9 taxa) and midges (7 taxa) were the most diverse assemblages sampled in November.

The biotic index sample from Station 3A had a value of 3.35 in November (Table 29) due primarily to the large number of Hyalella azteca (tolerance value = 4) that were captured. Leptophlebiid mayflies (tolerance value = 2) were also common.

Station 4

Chironomid midges (especially Stictochironomus sp.), the amphipod Hyalella azteca, and tubificid oligochaetes (primarily immature individuals) were the most commonly collected organisms at Station 4 in

TABLE 26 DENSITY AND PERCENT OCCURRENCE OF DRIFTING MACROINVERTEBRATES COLLECTED FROM SWAMP CREEK, 15 AUGUST 1983

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 M^3	Station 1 %	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 M^3	Station 3 %
Cnidaria								
Hydra sp.	-	1	1.0	0.1	-	-		
Platyhelminthes								
Planariidae								
Dugesia sp.	1	22	23.8	3.1	1	-	0.9	0.4
Annelida								
Oligochaeta								
Naididae								
Dero sp.	-	1	1.0	0.1	-	-		
Nais variabilis	3	4	7.2	0.9	-	2	1.9	0.9
Stylaria fossularis	25	101	130.1	17.1	5	2	6.5	3.0
S. lacustris	12	20	33.0	4.3	-	1	0.9	0.4
Arthropoda								
Crustacea								
Amphipoda								
Hyalella azteca	2	78	82.6	10.9	17	44	56.6	25.8
Arachnida								
Hydracarina	5	56	59.9	7.9	16	64	74.2	33.8
Insecta								
Ephemeroptera								
Baetiscidae								
Baetisca obesa	-	-			-	1	0.9	0.4
Caenidae								
Caenis sp.	-	2	2.1	0.3	-	-		
Baetidae								
Baetis sp.	9	38	48.5	6.4	3	23	24.1	11.0

TABLE 26 (Cont.)

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 M^3	Station 1 %	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 M^3	Station 3 %
Leptophlebiidae								
Leptophlebia sp.	-	82	84.7	11.2	-	7	6.5	3.0
Hemiptera								
Corixidae	-	1	1.0	0.1	-	-		
Trichoptera								
Polycentropodidae								
Polycentropus sp.	-	1	1.0	0.1	-	-		
Hydropsychidae								
Cheumatopsyche sp.	-	1	1.0	0.1	-	-		
Hydroptilidae								
Hydroptila sp.	-	-			2	2	3.7	1.7
Oxyethira sp.	-	5	5.2	0.7	-	1	0.9	0.4
Oxyethira sp. pupa	-	2	2.1	0.3	-	-		
Leptoceridae								
Oecetis sp.	1	1	2.1	0.3	-	-		
Triaenodes sp.	-	5	5.2	0.7	-	2	1.9	0.9
Phryganeidae								
Phryganea sp.	-	-			1	-	0.9	0.4
Coleoptera								
Dytiscidae								
Ilybius sp.	-	1	1.0	0.1	-	-		
Diptera								
Chironomidae								
Chironominae								
Cladotanytarsus sp.	1	-	1.0	0.1	-	-		
Dicrotendipes sp.	2	5	7.2	0.9	-	-		
Dicrotendipes sp. pupa	3	5	8.3	1.1	-	-		
Micropsectra curvicornis	1	18	19.6	2.6	-	-		
Micropsectra sp.	-	15	15.5	2.0	1	-	0.9	0.4
Paratanytarsus sp.	-	4	4.1	0.5	-	-		
Paratanytarsus sp. pupa	-	1	1.0	0.1	-	-		

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 M^3	Station 1 %	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 M^3	Station 3 %
Polypedilum convictum type	-	3	3.1	0.4	-	-		
Polypedilum sp. pupa	-	7	7.2	0.9	-	-		
Rheotanytarsus sp.	-	2	2.1	0.3	-	1	0.9	0.4
Rheotanytarsus sp. pupa	4	38	43.4	5.7	1	4	4.6	2.1
Tanytarsus sp.	1	25	26.8	3.5	4	3	6.5	3.0
Tanytarsus sp. pupa	-	33	34.1	4.5	-	3	2.8	1.3
Tanypodinae								
Ablabesmyia sp.	-	12	12.4	1.6	-	1	0.9	0.4
Ablabesmyia sp. pupa	-	1	1.0	0.1	-	-		
Labrundinia sp.	-	1	1.0	0.1	-	1	0.9	0.4
Pentaneura sp.	2	40	43.4	5.7	-	2	1.9	0.9
Pentaneura sp. pupa	-	5	5.2	0.7	-	-		
Procladius sp.	-	-			-	1	0.9	0.4
Thienemannimyia series	-	3	3.1	0.4	1	-	0.9	0.4
Orthocladiinae								
Cricotopus bicinctus group	-	2	2.1	0.3	-	-		
C. cylindraceus group	-	2	2.1	0.3	1	6	6.5	3.0
C. tibialis group	-	-			1	-	0.9	0.4
Cricotopus sp. pupa	-	-			-	2	1.9	0.9
Nanocladius sp.	-	1	1.0	0.1	-	-		
Psectrocladius sp.	1	15	16.5	2.2	-	-		
Psectrocladius sp. pupa	-	3	3.1	0.4	-	-		
Synorthocladius sp.	-	-			1	-	0.9	0.4
Thienemanniella sp.	-	-			1	-	0.9	0.4
Ceratopogonidae	-	-			1	-	0.9	0.4
Mollusca								
Gastropoda								
Hydrobiidae	-	2	2.1	0.3	-	7	6.5	3.0

TABLE 26 (Cont.)

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 M^3	Station 1 %	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 M^3	Station 3 %
Total Benthos			758.9				219.6	
Total Taxa			36				28	

TABLE 27 MEAN DENSITY AND PERCENT OCCURRENCE OF THE DOMINANT(*) BENTHIC MACROINVERTEBRATES COLLECTED WITH A PONAR GRAB SAMPLER FROM SWAMP CREEK, 14-15 NOVEMBER 1983

	Station 4				Station 5					
	Sand		Silt		Sand		Silt		Gravel	
Taxa	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%	No./m^2	%
Platyhelminthes										
Dugesia sp.	--	--	108	2.0	22	0.2	1,126	5.3	130	4.0
Annelida										
Oligochaeta										
Naididae	--	--	736	13.5	347	2.5	563	2.6	43	1.3
Tubificidae	390	6.6	845	15.5	3,464	25.1	3,248	15.2	1,169	36.2
Crustacea										
Amphipoda										
Hyalella azteca	476	8.1	1,559	28.6	173	1.3	1,516	7.1	22	0.7
Acari										
Hydracarina	520	8.8	173	3.2	43	0.3	996	4.7	87	2.7
Insecta										
Ephemeroptera										
Leptophlebia sp.	43	0.7	108	2.0	--	--	996	4.7	--	--
Diptera										
Chironomidae	2,620	44.5	996	18.3	8,833	63.9	9,396	44.0	780	24.2
Ceratopogonidae	1,061	18.0	22	0.4	195	1.4	43	0.2	217	6.7
Mollusca										
Gastropoda										
Hydrobiidae	390	6.6	282	5.2	130	0.9	43	0.2	65	2.0
Campeloma sp.	65	1.1	152	2.8	65	0.5	217	1.0	433	13.4
Total Benthos	5,890		5,457		13,813		21,369		3,227	
Total Taxa	27		33		41		63		29	

(*) Taxa or groups that compose $\geq$5% of the total benthos at any substrate type.

TABLE 28 COMPOSITION AND RELATIVE ABUNDANCE(*) AQUATIC MACROINVERTEBRATES COLLECTED BY QUALITATIVE TECHNIQUES FROM SWAMP CREEK, 14-15 NOVEMBER 1983

Taxa	Station 3A	Station 4	Station 5
Coelenterata			
Hydra sp.	-	0	-
Platyhelminthes			
Planariidae			
Dugesia sp.	V	A	C
Nematoda	-	0	0
Annelida			
Oligochaeta			
Naididae			
Arcteonais lomondi	-	0	-
Dero digitata	C	C	-
Nais communis	-	0	0
N. variabilis	-	0	0
Slavina appendiculata	-	-	C
Tubificidae			
Ilyodrilus templetoni	C	-	0
Limnodrilus udekemianus	C	-	-
Immature w/ capilliform chaetae	-	C	-
Immature w/o capilliform chaetae	-	0	-
Lumbriculidae	C	-	-
Anthropoda			
Crustacea			
Isopoda			
Asellidae			
Asellus r. racovitzai	-	C	0
Amphipoda			
Gammaridae			
Gammarus pseudolimnaeus	A	A	A
Talitridae			
Hyalella azteca	V	V	V
Decapoda			
Astacidae			
Orconectes virilis	0	-	-
Arachnida			
Hydracarina	-	C	-

(*) 0 = Occasional, 1-4 organisms
C = Common, 5-24 organisms
A = Abundant, 25-99 organisms
V = Very abundant, 100+ organisms
\- = Not collected

Taxa	Station 3A	4	5
Insecta			
Plecoptera			
Perlidae			
Immature Perlidae	0	-	-
Ephemeroptera			
Heptageniidae			
Stenacron interpunctatum	0	-	0
Stenonema vicarium	-	-	0
Baetidae			
Baetis pygmaeus	A	A	0
Callibaetis sp.	-	-	0
Leptophlebiidae			
Leptophlebia sp.	V	V	V
Odonata			
Gomphidae			
Gomphus lividus	-	0	0
Ophiogomphus sp.	0	-	-
Aeshnidae			
Anax junius	0	-	-
Basiaeschna janata	-	0	0
Corduliidae			
Epitheca sp.	0	-	-
Libellulidae			
Plathemis lydia	-	0	-
Coenagrionidae			
Enallagma sp.	0	0	-
Calopterygidae			
Calopteryx sp.	C	-	0
Hemiptera			
Corixidae	0	-	-
Nepidae			
Ranatra fusca	-	0	-
Notonectidae			
Notonecta sp.	C	0	-
Trichoptera			
Polycentropodidae			
Polycentropus sp.	C	C	0
Hydropsychidae			
Cheumatopsyche sp.	A	0	A
Hydroptilidae			
Hydroptila sp.	-	0	-
Hydroptila waubesiana	0	-	-
Oxyethira sp.	C	C	C
Oxyethira sp. pupa	0	-	-
Leptoceridae			
Triaenodes sp.	C	C	0

Taxa	Station 3A	4	5
Limnephilidae			
Nemotaulius hostilis	-	O	-
Platycentropus sp.	V	V	A
Pycnopsyche sp.	O	-	C
Brachycentridae			
Brachycentrus numerosus	-	-	C
Phryganeidae			
Agrypnia vestita	O	-	-
Ptilostomis sp.	O	O	C
Coleoptera			
Gyrinidae			
Dineutus sp. (adult)	-	-	O
Gyrinus sp. (adult)	A	O	C
Elmidae			
Ancyronyx variegata	-	-	O
Dubiraphia sp.	O	O	O
Macronychus glabratus	-	-	C
Stenelmis sp.	O	-	-
Diptera			
Chironomidae			
Chironominae			
Dicrotendipes sp.	-	C	C
Micropsectra sp.	-	C	A
Microtendipes sp.	-	C	A
Paratanytarsus sp.	-	-	C
Phaenopsectra sp.	O	O	C
Polypedilum convictum type	C	-	-
P. fallax type	-	O	O
P. simulans type	-	C	O
Tanytarsus sp.	-	C	-
Stictochironomus sp.	-	-	C
Tanypodinae			
Clinotanypus sp.	O	C	O
Procladius sp.	-	-	O
Thienemannimyia series	-	-	C
Orthocladiinae			
Cricotopus cylindraceus group	C	O	O
C. tremulus group	-	-	O
Diplocladius sp.	O	-	C
Hydrobaenus sp.	-	-	O
Orthocladius sp.	C	-	O
Parakiefferiella sp.	-	-	O
Parametriocnemus sp.	C	O	O
Synorthocladius sp.	-	O	-
Thienemanniella sp.	-	-	O
Ceratopogonidae	-	-	O

Taxa	Station 3A	4	5
Tipulidae			
Tipula sp.	0	-	-
Simuliidae			
Prosimulium sp.	-	-	0
Simulium vittatum	-	-	0
Lepidoptera			
Pyralidae			
Paraponyx sp.	0	0	-
Mollusca			
Gastropoda			
Ancylidae			
Ferrissia sp.	0	0	-
Hydrobiidae			
Unidentified Hydrobiidae	A	C	C
Viviparidae			
Campeloma sp.	0	0	0
Lymnaeidae			
Lymnaea sp.	0	-	0
Physidae			
Physa sp.	0	0	-
Planorbidae			
Gyraulus sp.	-	-	0
Pelecypoda			
Sphaeriidae			
Sphaerium sp.	-	-	0
Subtotal taxa	45	47	57
Total taxa (all stations)		87	

TABLE 29 HILSENHOFF BIOTIC INDICES OF MACROINVERTEBRATE COLLECTIONS FROM SWAMP CREEK, 14-15 NOVEMBER 1983

Taxa	Tolerance Value	Station 3A	Station 4	Station 5
Crustacea				
Gammarus pseudolimnaeus	2	4(*)	1	3
Hyalella azteca	4	91	15	92
Ephemeroptera				
Stenacron interpunctatum	3	5	--	--
Baetis pygmaeus	2	1	2	--
Caenis sp.	3	1	--	--
Leptophlebia sp.	2	26	93	15
Odonata				
Enallagma sp.	3	1	--	--
Calopteryx sp.	2	--	--	1
Trichoptera				
Polycentropus sp.	2	2	1	--
Cheumatopsyche sp.	3	10	14	--
Chimarra obscura	2	1	--	--
Triaenodes sp.	2	2	4	1
Ptilostomis sp.	2	--	--	1
Platycentropus sp.	2	--	10	--
Brachycentrus numerosus	1	--	1	--
Coleoptera				
Dubiraphia sp.	3	1	--	4
Stenelmis sp.	3	1	--	--
Diptera				
Dicrotendipes sp.	4	--	--	4
Micropsectra sp.	3	--	--	7
Microtendipes sp.	3	--	--	1
Phaenopsectra sp.	4	--	1	--
Polypedilum sp.	3	--	1	--
Rheotanytarsus sp.	3	--	1	--
Clinotanypus sp.	3	--	--	2
Stictochironomus sp.	3	--	--	1
Thienemannimyia series	3	--	3	--
Diplocladius sp.	4	2	--	--
Orthocladius sp.	3	10	--	--
Parametriocnemus sp.	3	--	2	1
Tipula sp.	2	--	--	1

(*) Number of individuals per station.

Taxa	Tolerance Value	Station 3A	Station 4	Station 5
Lepidoptera				
Paraponyx sp.	1	1	--	1
Total Number of Taxa		16	14	15
Total Number of Individuals		159	149	135
Biotic Index Value		3.35	2.35	3.53

November (Table 30). The sand and silt substrates were dominated by midges (45 percent of the benthos) and Hyalella azteca (29 percent), respectively (Table 27). Other commonly collected taxa at Station 4 included biting midges (Ceratopogonidae) in the sand substrate and naidid oligochaetes (especially Arcteonais lomondi) in the silt habitat. The density (total benthos) and diversity (total taxa) of organisms were similar in both substrate types.

Qualitative sampling at Station 4 yielded 47 macroinvertebrate taxa in November (Table 28). Hyalella azteca, the mayfly Leptophlebia sp., and the caddisfly Platycentropus sp. were very abundant at Station 4. Abundant taxa were the planaria Dugesia sp., the amphipod Gammarus pseudolimnaeus, and the mayfly Baetis pygmaeus. The most diverse groups sampled in November were the midges (11 taxa) and the caddisflies (8 taxa).

A value of 2.35 was calculated from the biotic index sample collected from Station 4 in November (Table 29). This value was primarily the result of the large number of the mayfly Leptophlebia sp. (tolerance value = 2) that were collected.

Station 5

Chironomid midges and tubificid oligochaetes dominated all substrate types at Station 5 in November (Table 27). The predominant midges at Station 5 were Microtendipes sp. and Micropsectra sp. in the sand and silt substrates and Stictochironomus sp. in the gravel and sand substrates (Table 31). The Tubificidae were primarily immature individuals without capilliform chaetae. As was observed in May, the density and diversity of organisms at Station 5 in November were greatest in the silt substrate and lowest in the gravel substrate. The most dramatic community change from August to November was the increase in total taxa of the fauna in the silt substrate.

Fifty-seven macroinvertebrate taxa were collected in the qualitative collections from Station 5 in November (Table 28). The amphipod Hyalella azteca and the mayfly Leptophlebia sp. were the dominant organisms. The amphipod Gammarus pseudolimnaeus, the caddisflies Cheumatopsyche sp. and Platycentropus sp., and the midges Micropsectra sp. and Microtendipes sp. were abundant in November. Midges (19 taxa) and caddisflies (8 taxa) were the most diverse assemblages present in the qualitative collections from Station 5.

The biotic index sample from Station 5 had a value of 3.53 in November (Table 29). This sample was strongly dominated by Hyalella azteca (tolerance value = 4).

Drift

The mayflies Leptophlebia sp. and Baetis pygmaeus, and the caddisfly Oxyethira sp. were the dominant taxa in the November drift samples from Swamp Creek (Table 32). Midges (especially Orthocladius sp.) were also commonly collected at Station 1 in November. In contrast to the August samples, the November drift fauna at Station 3 had greater densities and total taxa than at Station 1. Densities and number of taxa in the drift declined at both stations (but particularly at Station 1) from August to November.

TABLE 30 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 4 IN SWAMP CREEK, 15 NOVEMBER 1983

Taxa	Substrate: Sand — Replicate A	Sand — Replicate B	Sand — Mean No./m^2	Sand — Percent Occurrence	Silt — Replicate A	Silt — Replicate B	Silt — Mean No./m^2	Silt — Percent Occurrence
Platyhelminthes								
Planariidae								
Dugesia sp.	--	--			3	2	108.3	2.0
Nematoda								
Unidentified Nematoda	--	1	21.7	0.4	3	4	151.6	2.8
Annelida								
Oligochaeta								
Naididae								
Arcteonais lomondi	--	--			9	8	368.1	6.7
Dero digitata	--	--			6	2	173.2	3.2
Nais communis	--	--			2	1	65.0	1.2
Specaria josinae	--	--			6	--	129.1	2.4
Tubificidae								
Ilyodrilus templetoni	--	1	21.7	0.4	2	1	65.0	1.2
Limnodrilus udekemianus	--	1	21.7	0.4	5	1	129.9	2.4
Immature w/ cap. chaetae	1		21.7	0.4	7	4	238.2	4.4
Immature w/o cap. chaetae	8	7	324.8	5.5	11	8	411.4	7.5
Arthropoda								
Crustacea								
Amphipoda								
Hyalella azteca	5	17	476.3	8.1	21	51	1,558.8	28.6
Acari								
Hydracarina	12	12	519.6	8.8	4	4	173.2	3.2

TABLE 30

Taxa	Sand Replicate A	Sand Replicate B	Sand Mean No./m^2	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./m^2	Silt Percent Occurrence
Insecta								
Ephemeroptera								
Emphemeridae								
Hexagenia limbata	--	4	86.6	1.5	--	--		
Caenidae								
Caenis sp.	1	3	86.6	1.5	--	--		
Baetidae								
Baetis pygmaeus	3	--	65.0	1.1	--	1	21.7	0.4
Leptophlebiidae								
Leptophlebia sp.	2	--	43.3	0.7	--	5	108.3	2.0
Odonata								
Gomphidae								
Gomphus lividus	1	1	43.3	0.7	2	--	43.3	0.8
Trichoptera								
Hydroptilidae								
Oxyethira sp.	1	--	21.7	0.4	--	--		
Leptoceridae								
Oecetis sp.	--	--			--	1	21.7	0.4
Triaenodes sp.	--	--			--	2	43.3	0.8
Coleoptera								
Elmidae								
Dubiraphia sp.	--	--			5	2	151.6	2.8
Diptera								
Chironomidae								
Chironominae								
Cladotanytarsus sp.	2	3	108.3	1.8	1	--	21.7	0.4
Cryptochironomus sp.	1	5	129.9	2.2	2	--	43.3	0.8
Dicrotendipes sp.	1	2	65.0	1.1	1	--	21.7	0.4
Lauterborniella sp.	1	--	21.7	0.4	--	--		
Micropsectra sp.	--	--			--	2	43.3	0.8

TABLE 30

Taxa	Sand Replicate A	Sand Replicate B	Sand Mean No./m^2	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./m^2	Silt Percent Occurrence
Polypedilum scalaenum type	2	--	43.3	0.7	1	4	108.3	2.0
Stictochironomus sp.	26	35	1,320.7	22.4	10	9	411.4	7.5
Tanytarsus sp.	2	5	151.6	2.6	6	2	173.2	3.2
Tribelos sp.	--	--			1	--	21.7	0.4
Tanypodinae								
Clinotanypus sp.	--	3	65.0	1.1	3	2	108.3	2.0
Coelotanypus sp.	--	--			1	--	21.7	0.4
Procladius sp.	13	18	671.2	11.4	--	1	21.7	0.4
Thienemannimyia series	--	1	21.7	0.4	--	--		
Orthocladiidae								
Hydrobaenus sp.	--	1	21.7	0.4	--	--		
Ceratopogonidae	19	30	1,060.9	18.0	1	--	21.7	0.4
Mollusca								
Gastropoda								
Hydrobiidae								
Unidentified Hydrobiidae	10	8	389.7	6.6	5	8	281.5	5.2
Viviparidae								
Campeloma sp.	2	1	65.0	1.1	2	5	151.6	2.8
Pelecypoda								
Sphaeriidae								
Sphaerium striatinum	--	--			1	1	43.3	0.8
Total Benthos			5,889.7				5,456.9	
Total Taxa			27				33	

TABLE 31 MEAN DENSITY AND PERCENT OCCURRENCE OF BENTHIC MACROINVERTEBRATES QUANTITATIVELY COLLECTED FROM STATION 5 IN SWAMP CREEK, 14 NOVEMBER 1983

	Substrate											
	Sand				Silt				Gravel			
Taxa	Replicate A	Replicate B	Mean No./m²	Percent Occurrence	Replicate A	Replicate B	Mean No./m²	Percent Occurrence	Replicate A	Replicate B	Mean No./m²	Percent Occurrence
Platyhelminthes												
Planariidae												
Dugesia sp.	1	--	21.7	0.2	4	48	1,125.8	5.3	--	6	129.9	4.0
Nematoda												
Unidentified Nematoda	1	1	43.3	0.3	8	--	173.2	0.8	1	--	21.7	0.7
Nemertinea												
Unidentified Nemertinea	--	--			--	8	173.2	0.8	--	--		
Annelida												
Oligochaeta												
Enchytraeidae	--	--			2	4	129.9	0.6	1	--	21.7	0.7
Naididae												
Dero digitata	2	--	43.3	0.3	--	6	129.9	0.6	--	1	21.7	0.7
Nais behningi	--	--			--	2	43.3	0.2	--	--		
N. communis	--	--			--	2	43.3	0.2	--	--		
N. pardalis	--	--			2	--	43.3	0.2	--	--		
Piguetiella michiganensis	--	1	21.7	0.2	--	--			1	--	21.7	0.7
Pristina longiseta leidyi	--	--			4	--	86.6	0.4	--	--		
Slavina appendiculata	--	--			4	--	86.6	0.4	--	--		
Specaria josinae	8	4	259.8	1.9	2	2	86.6	0.4	--	--		
Stylaria fossularis	--	--			2	--	43.3	0.2	--	--		
Uncinais uncinata	1	--	21.7	0.2	--	--			--	--		
Tubificidae												
Ilyodrilus templetoni	2	5	151.6	1.1	--	2	43.3	0.2	--	--		
Limnodrilus hoffmeisteri	--	--			2	--	43.3	0.2	--	--		
L. udekemianus	3	12	324.8	2.4	34	6	866.0	4.1	--	--		
Immature w/ cap. chaetae	5	11	346.4	2.5	12	4	346.4	1.6	3	3	129.9	4.0
Immature w/o cap. chaetae	28	94	2,641.3	19.1	36	54	1,948.5	9.1	38	10	1,039.2	32.2
Lumbriculidae	--	--			2	--	43.3	0.2	--	--		
Hirudinea												
Glossiphoniidae												
Helobdella stagnalis	--	--			--	--			--	1	21.7	0.7
Placobdella ornata	--	--			--	--			--	1	21.7	0.7
Arthropoda												
Crustacea												
Isopoda												
Asellus r. racovitzai	--	--			--	2	43.3	0.2	1	1	43.3	1.3
Amphipoda												
Gammarus pseudolimnaeus	--	1	21.7	0.2	8	10	389.7	1.8	--	--		
Hyalella azteca	5	3	173.2	1.3	34	36	1,515.5	7.1	1	--	21.7	0.7
Acari												
Hydracarina	2	--	43.3	0.3	44	2	995.9	4.7	3	1	86.6	2.7
Insecta												
Ephemeroptera												
Baetiscidae												
Baetisca obesa	--	2	43.3	0.3	--	--			--	--		
Ephemeridae												
Hexagenia limbata	1	1	43.3	0.3	--	2	43.3	0.2	--	--		
Heptageniidae												
Stenacron interpunctatum	--	--			--	2	43.3	0.2	--	--		
Baetidae												
Baetis pygmaeus	1	--	21.7	0.2	--	6	129.9	0.6	--	--		
Leptophlebiidae												
Leptophlebia sp.	--	--			26	20	995.9	4.7	--	--		
Odonata												
Gomphidae												
Gomphus lividus	--	1	21.7	0.2	2	2	86.6	0.4	--	--		
Megaloptera												
Sialidae												
Sialis sp.	--	--			2	--	43.3	0.2	--	--		
Hemiptera												
Belostomatidae												
Belostoma flumineum	--	--			2	--	43.3	0.2	--	--		
Trichoptera												
Hydropsychidae												
Cheumatopsyche sp.	3	--	65.0	0.5	--	28	606.2	2.8	--	--		
Hydroptilidae												
Hydroptila waubesiana	--	1	21.7	0.2	--	--			--	--		
Leptoceridae												
Mystacides sepulchralis	2	1	65.0	0.5	--	2	43.3	0.2	--	--		
Triaenodes sp.	--	--			--	2	43.3	0.2	--	--		
Brachycentridae												
Brachycentrus numerosus	--	--			--	2	43.3	0.2	--	--		
Limnephilidae												
Pycnopsyche sp.	--	--			--	4	86.6	0.4	--	--		
Phryganeidae												
Ptilostomis sp.	--	--			2	--	43.3	0.2	--	--		
Molannidae												
Molanna tryphena	--	--			--	2	43.3	0.2	--	--		
Coleoptera												
Elmidae												
Dubiraphia sp.	5	2	151.6	1.1	16	10	562.9	2.6	1	1	43.3	1.3

Taxa	Sand Replicate A	Sand Replicate B	Sand Mean No./m^2	Sand Percent Occurrence	Silt Replicate A	Silt Replicate B	Silt Mean No./m^2	Silt Percent Occurrence	Gravel Replicate A	Gravel Replicate B	Gravel Mean No./m^2	Gravel Percent Occurrence
Diptera												
Chironomidae												
Chironominae												
Cladotanytarsus sp.	--	2	43.3	0.3	--	--			--	--		
Cryptochironomus sp.	20	8	606.2	4.4	14	12	562.9	2.6	--	--		
Dicrotendipes sp.	16	2	389.7	2.8	14	12	562.9	2.6	1	1	43.3	1.3
Micropsectra sp.	26	10	779.4	5.6	66	24	1,948.5	9.1	--	--		
Microtendipes sp.	84	84	3,637.2	26.3	44	96	3,031.0	14.2	1	4	108.3	3.4
Paralauterborniella sp.	10	2	259.8	1.9	18	2	433.0	2.0	--	--		
Phaenopsectra sp.	--	16	346.4	2.5	--	2	43.3	0.2	1	--	21.7	0.7
Polypedilum convictum type	--	--			--	2	43.3	0.2	--	--		
P. scalaenum type	8	8	346.4	2.5	4	6	216.5	1.0	2	--	43.3	1.3
P. simulans type	--	--			2	4	129.9	0.6	--	--		
Stictochironomus sp.	26	46	1,558.8	11.3	--	14	303.1	1.4	13	4	368.1	11.4
Tanytarsus sp.	4	--	86.6	0.6	8	24	692.8	3.2	--	--		
Tribelos sp.	--	--			--	--			--	1	21.7	0.7
Tanypodinae												
Clinotanypus sp.	--	--			2	4	129.9	0.6	--	--		
Coelotanypus sp.	--	--			2	--	43.3	0.2	--	--		
Larsia sp.	--	--			4	6	216.5	1.0	--	--		
Procladius sp.	14	12	562.9	4.1	20	4	519.6	2.4	3	--	65.0	2.0
Procladius sp. pupa	--	--			--	--			2	--	43.3	1.3
Thienemannimyia series	--	--			4	8	259.8	1.2	--	--		
Orthocladiinae												
Diplocladius sp.	--	2	43.3	0.3	--	6	129.9	0.6	--	--		
Hydrobaenus sp.	2	--	43.3	0.3	--	--			1	1	43.3	1.3
Orthocladius sp.	2	--	43.3	0.3	--	--			--	--		
Parakiefferiella sp.	--	4	86.6	0.6	--	--			1	--	21.7	0.7
Parametriocnemus sp.	--	--			--	6	129.9	0.6	--	--		
Ceratopogonidae	5	4	194.9	1.4	2	--	43.3	0.2	9	1	216.5	6.7
Tabanidae												
Chrysops sp.	--	--			--	--			--	1	21.7	0.7
Tipulidae	--	--			6	2	173.2	0.8	--	--		
Lepidoptera												
Pyralidae												
Paraponyx sp.	--	--			--	2	43.3	0.2	--	--		
Mollusca												
Gastropoda												
Hydrobiidae												
Unidentified Hydrobiidae	4	2	129.9	0.9	--	2	43.3	0.2	--	3	65.0	2.0
Viviparidae												
Campeloma sp.	1	2	65.0	0.5	6	4	216.5	1.0	7	13	433.0	13.4
Ancylidae												
Ferrissia sp.	--	--			--	6	129.9	0.6	--	--		
Pelecypoda												
Sphaeriidae												
Immature Sphaeriidae	--	2	43.3	0.3	2	--	43.3	0.2	--	2	43.3	1.3
Pisidium sp.	--	--			--	--			2	--	43.3	1.3
Sphaerium striatinum	--	--			--	1	21.7	0.1	--	--		
Total Benthos			13,813.4				21,368.6				3,226.6	
Total Taxa			41				63				29	

TABLE 32 DENSITY AND PERCENT OCCURRENCE OF DRIFTING MACROINVERTEBRATES COLLECTED FROM SWAMP CREEK, 14 NOVEMBER 1983

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 m^3	Station 1 Percent Occurrence	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 m^3	Station 3 Percent Occurrence
Platyhelminthes								
Planariidae								
Dugesia sp.	-	-			-	1	1.3	0.7
Annelida								
Oligochaeta								
Naididae								
Dero digitata	-	-			1	1	2.7	1.4
Slavina appendiculata	2	-	3.1	2.3	-	-		
Specaria josinae	-	1	1.5	1.1	-	1	1.3	0.7
Arthropoda								
Crustacea								
Amphipoda								
Hyalella azteca	-	-			9	20	38.5	19.7
Insecta								
Ephemeroptera								
Caenidae								
Caenis sp.	-	-			-	1	1.3	0.7
Baetidae								
Baetis pygmaeus	1	12	20.1	15.0	6	32	50.5	25.9
Callibaetis sp.	-	1	1.5	1.1	-	-		
Leptophlebiiedae								
Leptophlebia sp.	2	23	38.7	28.8	9	39	63.8	32.7
Odonata								
Coenagrionidae								
Enallagma sp.	-	1	1.5	1.1	-	1	1.3	0.7
Trichoptera								
Hydropsychidae								
Cheumatopsyche sp.	-	-			1	3	5.3	2.7

TABLE 32 (Cont.)

Taxa	Station 1 Replicate A	Station 1 Replicate B	Station 1 Mean No./100 m^3	Station 1 Percent Occurrence	Station 3 Replicate A	Station 3 Replicate B	Station 3 Mean No./100 m^3	Station 3 Percent Occurrence
Hydroptilidae								
Hydroptila sp.	-	-			-	3	4.0	2.1
Oxyethira sp.	3	24	41.7	31.1	4	5	12.0	6.2
Leptoceridae								
Triaenodes sp.	-	-			1	-	1.3	0.7
Limnephilidae								
Platycentropus sp.	-	-			-	1	1.3	0.7
Diptera								
Chironomidae								
Chironominae								
Micropsectra sp.	-	1	1.5	1.1	1	-	1.3	0.7
Rheotanytarsus sp.	-	-			-	1	1.3	0.7
Stictochironomus sp.	-	-			-	1	1.3	0.7
Tanypodinae								
Thienemannimyia series	-	-			-	1	1.3	0.7
Orthocladiinae								
Diplocladius sp.	-	2	3.1	2.3	-	2	2.7	1.4
Orthocladius sp.	3	8	17.0	12.7	-	-		
Parakiefferiella sp.	-	1	1.5	1.1	-	-		
Simuliidae								
Prosimulium sp.	-	-			1	-	1.3	0.7
Simulium sp.	-	1	1.5	1.1	-	-		
Lepidoptera								
Pyralidae								
Paraponyx sp.	1	-	1.5	1.1	-	-		

TABLE 32 (Cont.)

	Station 1				Station 3			
Taxa	Replicate A	Replicate B	Mean No./100 m^3	Percent Occurrence	Replicate A	Replicate B	Mean No./100 m^3	Percent Occurrence
Mollusca								
Gastropoda								
Hydrobiidae								
Unidentified Hydrobiidae	-	-			-	1	1.3	0.7
Total Benthos			134.2				195.1	
Total Taxa			13				20	

4. DISCUSSION

4.1 FISH

4.1.1 Comparisons with Other Studies

Previous studies in Swamp Creek have been summarized and discussed elsewhere (Ecological Analysts 1983) so a detailed discussion of these earlier studies is not necessary. Briefly, these earlier studies (Becker 1966; Wisconsin DNR 1974; Section 2.5 of the EIR [Exxon Minerals Company 1982], and Ecological Analysts 1983) have shown that Swamp Creek downstream of Rice Lake possesses a cool water fish community that contains at least 31 species (Table 33) and is dominated by members of the minnow family (13 species), particularly common shiners and hornyhead chubs. Other commonly collected species included bluntnose minnow, black bullhead, rock bass, white sucker, central mudminnow, Johnny darter, yellow perch, and mottled sculpin.

Only seven species (hornyhead chub, common shiner, white sucker, black bullhead, rock bass, Johnny darter, and yellow perch) have been reported in each of the fisheries studies that have been conducted in Swamp Creek downstream of Rice Lake (Table 33).

Swamp Creek downstream of Rice Lake does not support trout (Wisconsin DNR 1974), and species that prefer riffles and hard substrates (e.g., longnose dace [*Rhinichthys cataractae*] and largescale stoneroller [*Campostoma oligolepis*]) are rare or absent. Brook stickleback was the only species collected in 1983 that had not been reported previously from Swamp Creek (Table 33).

The 1982 study of Swamp Creek, which was conducted as part of the Crandon Project EIR (Ecological Analysts 1983), has been the most comprehensive study to date of Swamp Creek downstream of Rice lake, and therefore is the one most appropriate for direct comparison with the present study. Moreover, there is considerable overlap between the 1982 and 1983 studies, both in terms of stations and gear types. Both studies included sampling at Stations 1, 2, and 3, and both used seining and electrofishing. Despite the overall similarities between the studies, several differences also existed. First, the 1982 study did not include sampling at Stations 4 and 5. Second, the 1982 study used a sampling method (block electrofishing) not used during the present study. Third, different periods of the year were sampled (June and November in 1982 versus April in 1983). Finally, and perhaps most importantly, because of the extra sampling period, the total level of effort in 1982 was approximately double that in 1983. This difference in level of effort can be summarized as follows:

1982

$$\frac{\text{2 sampling periods}}{\text{(June, November)}} \times \frac{\text{3 stations}}{\text{period}} \times \frac{\text{3 gears}}{\text{station}} = 18$$

TABLE 33 FISH SPECIES COLLECTED IN SWAMP CREEK DOWNSTREAM OF RICE LAKE

Species	Becker (1966)	WDNR (1974)	Ecological Analysts (1983)	This Study
Brown trout			x	
Central mudminnow		x	x	x
Northern pike		x	x	x
Largescale stoneroller			x	
Brassy minnow	x		x	
Hornyhead chub	x	x	x	x
Golden shiner		x	x	x
Common shiner	x	x	x	x
Blackchin shiner			x	x
Blacknose shiner	x		x	x
Northern redbelly dace	x			
Bluntnose minnow	x		x	x
Blacknose dace	x	x	x	
Longnose dace		x		
Creek chub		x	x	x
Pearl dace			x	
White sucker	x	x	x	x
Northern hogsucker			x	
Shorthead redhorse			x	
Black bullhead	x	x	x	x
Yellow bullhead		x	x	
Tadpole madtom			x	
Brook stickleback				x
Rock bass	x	x	x	x
Pumpkinseed		x	x	x
Bluegill		x		
Largemouth bass		x		
Black crappie			x	
Iowa darter			x	x
Johnny darter	x	x	x	x
Yellow perch	x	x	x	x
Mottled sculpin		x	x	x
Totals	12	18	27	
		31		18
			32	

1983

$$\frac{1 \text{ sampling period}}{\text{(April)}} \times \frac{5 \text{ stations}}{\text{period}} \times \frac{2 \text{ gears}}{\text{station}} =$$

10 - 1 (because only one gear was used at Station 2) = 9

However, within a given month, the level of effort was comparable among the studies. As shown in Table 34, the results among two of the three study months are similar. However, the samplings in June 1982 yielded a somewhat larger number of species and considerably more individuals than did the samplings in November 1982 and April 1983. The agreement among numbers of species and individuals between the latter two periods (i.e., November and April) is excellent. The difference in the numbers of species among the three study periods is attributable to seven species (brown trout, largescale stoneroller, blacknose dace, brassy minnow, shorthead redhorse, tadpole madtom, and black crappie) collected only during the June 1982 sampling. Each of these species was represented by ≤10 individuals, and four were represented by single specimens (Table 34). Given their low abundance, it is not surprising that these species have not been found during the two subsequent samplings.

Combined, the three recent samplings have accounted for 28 of the 32 species known from Swamp Creek downstream of Rice Lake (Table 33). Largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), northern redbelly dace (*Phoxinus eos*); and longnose dace are the only species reported from Swamp Creek (Becker 1966, Wisconsin DNR 1974) that were not found during the 1982 or 1983 studies, and each is represented by only a single specimen. Based on all four studies, but particularly on the 1982 and 1983 studies, the 32 species comprising the fish community of Swamp Creek downstream of Rice Lake can be characterized as follows:

Abundant
- Common shiner
- Hornyhead chub

Very Common
- Black bullhead
- Rock bass
- Yellow perch
- Bluntnose minnow

Common
- Central mudminnow
- White sucker
- Johnny darter
- Creek chub

Uncommon
- Northern pike
- Brassy minnow
- Golden shiner
- Blackchin shiner
- Blacknose shiner
- Blacknose dace
- Yellow bullhead
- Tadpole madtom
- Iowa darter
- Mottled sculpin
- Pumpkinseed

Rare
- Brown trout
- Largescale stoneroller
- Northern redbelly dace
- Longnose dace
- Pearl dace
- Northern hogsucker
- Shorthead redhorse
- Brook stickleback
- Bluegill
- Largemouth bass
- Black crappie

TABLE 34 SUMMARY OF FISHES CAPTURED IN SWAMP CREEK, JUNE AND NOVEMBER 1982 AND APRIL 1983

Species	June 1982 No.	June 1982 Comp. (%)	November 1982 No.	November 1982 Comp. (%)	April 1983 No.	April 1983 Comp. (%)	All Dates No.	All Dates % Comp. Average	All Dates % Comp. Range
Brown trout	1	<1	--	--	--	--	1	<1	NA
Largescale stoneroller	1	<1	--	--	--	--	1	<1	NA
Blacknose dace	4	<1	--	--	--	--	4	<1	NA
Creek chub	51	2	6	<1	2	<1	59	1	<1-2
Pearl dace	--	--	2	<1	--	--	2	<1	NA
Hornyhead chub	410	18	109	9	81	11	600	14	9-18
Bluntnose minnow	43	2	79	6	17	3	139	3	2-6
Golden shiner	4	<1	36	3	6	1	46	1	<1-3
Brassy minnow	10	<1	--	--	--	--	10	<1	NA
Common shiner	1,216	53	906	71	433	58	2,555	59	53-71
Blacknose shiner	--	--	41	3	16	2	57	1	0-3
Blackchin shiner	2	<1	2	<1	3	<1	7	<1	NA
White sucker	38	2	13	1	13	2	64	1	1-2
Northern hog sucker	--	--	1	<1	--	--	1	<1	NA
Shorthead redhorse	1	<1	--	--	--	--	1	<1	NA
Northern pike	6	<1	16	1	3	<1	25	<1	<1-1
Brook stickleback	--	--	--	--	1	<1	1	<1	NA
Black bullhead	62	3	21	2	21	3	104	2	2-3
Yellow bullhead	15	1	3	<1	--	--	18	<1	0-3
Tadpole madtom	10	<1	--	--	--	--	10	<1	NA
Central mudminnow	68	3	4	<1	2	<1	74	2	<1-3
Yellow perch	54	2	12	1	67	9	133	3	1-9
Iowa darter	4	<1	--	--	11	1	15	<1	0-1
Johnny darter	38	2	4	<1	19	3	61	1	<1-3
Rock bass	196	9	11	1	46	6	253	6	1-9
Pumpkinseed	25	1	9	1	1	<1	35	1	<1-1
Black crappie	1	<1	--	--	--	--	1	<1	NA
Mottled sculpin	25	1	4	<1	3	<1	32	1	<1-1
Total number	2,285		1,279		745		4,309		
Total species	24		19		18		28		

Only common shiners and hornyhead chubs can be considered abundant in Swamp Creek. In the 1982 and 1983 studies combined, they accounted for 73 percent of all the fish captured (Table 34). No other species accounted for more than six percent. Black bullhead, rock bass, bluntnose minnow, and yellow perch were very common, each comprising 2-6 percent of the catch. They were found at all stations (often in very high numbers) during the present study and, except for bluntnose minnow, all were found during each of the previous investigations of Swamp Creek (Becker 1966, Wisconsin DNR 1974). White sucker, creek chub, Johnny darter, and central mudminnow were common in Swamp Creek. These species were collected at most stations on most dates (Table 34) and were well represented in previous collections from Swamp Creek (Becker 1966, Wisconsin DNR 1974). During the recent studies on Swamp Creek, each of these species constituted one percent of the catch. Nine of the 11 species in the uncommon category were collected in low numbers (≤35 individuals) during the two recent studies on Swamp Creek, with five of these being represented by 15 or fewer individuals (Table 34). Two of the 11 species, blacknose shiner and golden shiner, were represented by 57 and 46 individuals, respectively. However, they were not considered as common because of their nonuniform spatial or temporal distribution in the stream and the fact that each was reported during only one of the two previous surveys of Swamp Creek (Becker 1966, Wisconsin DNR 1974). Ten of the 11 species classified as rare in Swamp Creek were represented by single specimens, while the eleventh species (pearl dace) was represented by two specimens.

The results of the 1982 study (Ecological Analysts 1983) indicated that Swamp Creek downstream of Rice Lake was dominated by species preferring habitats that included one or all of the following characteristics: slow currents, abundant macrophyte communities, sand or silt substrates, and cool water temperatures. The results of the present study confirm the accuracy of this description, as well as documenting that species preferring cold waters (e.g., salmonids), high current velocities (e.g., longnose dace), hard substrates (e.g., largescale stoneroller), and headwater areas (e.g., northern redbelly dace) are rare or absent in Swamp Creek downstream of Rice Lake.

4.1.2 Temporal and Spatial Considerations

As indicated previously, the results of the present study are very similar to those reported in November 1982, whereas the catch during both of these periods was noticeably smaller than in June 1982 (Table 33). The lower catches during November 1982 and April 1983 might be attributable to lower sampling efficiencies caused by the higher water levels and cooler water temperatures during these months compared to the conditions that existed in June 1982. High water levels reduce efficiencies by (1) spreading the fish over a much larger area, (2) restricting the amount of area that can be seined, (3) giving the fish more avenues of escape, and (4) increasing depth in the water column and thereby reducing electrofishing efficiency. Cool water temperatures reduce efficiencies by reducing the activity levels in many species of fish to the point where they spend most of their time in areas with heavy cover and/or greater depths (Becker 1983), thus reducing their vulnerability to capture. This reduced success is demonstrated by the fact that mean electrofishing CPE values at Stations 1 and 3 (combined) declined from 0.67 in June 1982, to 0.47 in November 1982, to 0.35 during April in the present study. Regardless of the factors involved, it is reasonable to conclude that June is a considerably better time to capture fish in Swamp Creek compared to November or April (Table 34).

Although temporal effects, as discussed above, were important in evaluating the results of the fisheries studies in Swamp Creek, spatial factors (i.e., station location) were generally greater and more predictable factors. When the three recent sampling months were combined, there was not a noticeable difference in total catch among the three stations (Table 35). However, for the three sampling periods combined, mean electrofishing CPE values (the gear least likely to be affected by the temporal variables) were three times higher at Station 3 than at Station 1. Similarly, Station 3 produced more species for the study as a whole and during two of the three study periods (Table 35). Station-specific differences were also evident in the catch rates of certain species. Based on data for the three sampling periods combined, the first six species listed below were more numerous at Station 3, the mottled sculpin was common at both Stations 2 and 3, the next three species were more abundant at Station 1, while only Johnny darters exhibited a distinct preference for Station 2.

Species	Station 1	Station 2	Station 3
Central mudminnow	0	3	71
Yellow perch	4	12	80
Rock bass	11	51	174
Tadpole madtom	0	0	10
Iowa darter	0	0	7
Creek chub	7	22	30
Mottled sculpin	1	16	14
Golden shiner	35	1	7
Blacknose shiner	35	9	12
Bluntnose minnow	60	59	21
Johnny darter	6	34	13

The distributional pattern of these 11 species can be explained based primarily on their general habitat preferences (Becker 1983). For example, the first five species listed above show the strongest association with Station 3. These five species all prefer moderately to heavily vegetated areas and all but rock bass show a distinct preference for soft substrates (Becker 1983). Thus, all prefer the types of habitat found at Station 3. Creek chubs and mottled sculpins show less of a preference for this type of habitat and similarly, their preference for Station 3 is less evident. Golden shiners and blacknose shiners are primarily lake forms (Becker 1983) which suggests that their increased abundance at Station 1 may be related to the proximity of that station to Rice Lake. The greater abundance of bluntnose minnows at Stations 1 and 2 can be explained by their avoidance of heavily vegetated areas like Station 3 (Scott and Crossman 1973). Finally, the greater abundance of Johnny darters at Station 2 is probably attributable to this species' preference for medium-velocity sand flats.

TABLE 35 COMPARISON (BY STATION) OF FISHES COLLECTED FROM SWAMP CREEK IN JUNE AND NOVEMBER 1982 AND APRIL 1983

	Station 1						Station 2						Station 3					
	JUN		NOV		APR		JUN		NOV		APR		JUN		NOV		APR	
Common Name	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brown trout	0	0	0	0	0	0	0	0	0	0	0	0	1	<1	0	0	0	0
Largescale stoneroller	0	0	0	0	0	0	1	<1	0	0	0	0	0	0	0	0	0	0
Blacknose dace	0	0	0	0	0	0	1	<1	0	0	0	0	3	<1	0	0	0	0
Creek chub	6	2	1	<1	0	0	17	1	5	1	0	0	28	4	0	0	2	1
Pearl dace	0	0	1	<1	0	0	0	0	0	0	0	0	0	0	1	<1	0	0
Hornyhead chub	107	30	8	1	2	4	123	10	80	23	0	0	180	25	21	9	45	16
Bluntnose minnow	12	3	46	7	2	4	26	2	28	8	3	3	5	1	5	2	11	4
Golden shiner	3	1	32	5	0	0	0	0	0	0	1	1	1	<1	4	2	2	1
Brassy minnow	5	1	0	0	0	0	5	<1	0	0	0	0	0	0	0	0	0	0
Common shiner	171	48	553	78	30	61	904	75	168	49	81	89	141	19	185	81	126	45
Blacknose shiner	0	0	34	5	1	2	0	0	6	2	3	3	0	0	1	<1	11	4
Blackchin shiner	0	0	1	<1	0	0	1	<1	0	0	0	0	1	<1	1	<1	1	<1
White sucker	10	3	6	1	1	2	2	<1	6	2	0	0	26	4	1	<1	4	1
Shorthead redhorse	1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern hogsucker	0	0	0	0	0	0	0	0	1	<1	0	0	0	0	0	0	0	0
Central mudminnow	0	0	0	0	0	0	3	<1	0	0	0	0	65	4	4	2	2	1
Northern pike	2	1	1	<1	1	2	1	<1	15	4	0	0	3	<1	0	0	0	0
Black bullhead	21	6	16	2	6	12	19	2	4	1	0	0	22	3	1	<1	7	3
Yellow bullhead	0	0	3	<1	0	0	6	1	0	0	0	0	9	1	0	0	0	0
Tadpole madtom	0	0	0	0	0	0	0	0	0	0	0	0	10	1	0	0	0	0
Yellow perch	0	0	2	<1	2	4	3	<1	9	3	0	0	51	7	1	<1	28	10
Iowa darter	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	3	1
Johnny darter	2	1	0	0	4	8	27	2	4	1	3	3	9	1	0	0	4	1
Rock bass	10	3	1	<1	0	0	42	4	9	3	0	0	144	20	1	<1	29	10
Pumpkinseed	5	1	1	<1	0	0	6	1	5	1	0	0	14	2	3	1	1	<1
Black crappie	0	0	0	0	0	0	0	0	0	0	0	0	1	<1	0	0	0	0
Mottled sculpin	1	<1	0	0	0	0	12	1	4	1	0	0	12	2	0	0	2	1
Brook stickleback	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<1
Total number	356		706		49		1,199		344		91		730		229		278	
All months combined			1,111						1,634						1,237			
Total species	14		15		9		18		14		5		21		13		17	
All months combined			19						20						24			

No recent fisheries studies have been conducted in the vicinity of Stations 4 and 5. However, the Wisconsin DNR electrofished these two stations in 1973 (Wisconsin DNR 1974). They did not report distances electrofished so quantitative comparisons are not possible. However, qualitatively their results and those of the present study were comparable. Agreement was particularly good at Station 4 which yielded 14 species in both 1973 and 1983 (Table 36) and, except for central mudminnow and yellow perch, differences in the species composition between the studies were related to the presence or absence of rare or uncommon species. The lower number of species captured during the present study at Station 5 may be attributable to the fact that the present study was conducted in April when flows were high, whereas the 1973 study was conducted in August when collecting conditions should have been nearly optimal.

The degree to which habitat influences the structure of fish communities can be assessed by examining the results of the collections made at Stations 3 and 4 during the present study. These two stations are very similar according to all key measures of habitat diversity. Both had similar (1) morphometry (i.e., depth, width, number of pools, etc.), (2) substrates (i.e., silt and sand), and (3) cover (e.g., extensive aquatic macrophyte beds). These two stations, while similar to each other, were different from Stations 1, 2, or 5. Stations 1 and 2 were shallower, straighter, had less pools and considerably less macrophyte growth, and had harder substrates. Station 5 was deeper and had more bends than Stations 3 and 4 and had somewhat less macrophyte growth. Overall, Stations 3 and 4 were more similar than any other pair of stations. Thus, the similarity in the fish community at these two stations is not surprising. The numbers of individuals and species captured at both stations were comparable (see Table 1). The species composition at each station was also similar, with the stations having 13 species in common (see Table 1).

4.1.3 Summary of the Swamp Creek Fish Community

Yellow perch, black bullhead, rock bass, and white sucker were the only sport or food species captured in sufficient numbers to warrant size distribution analysis. The mean length of three of these species decreased from 1982 averages (Table 37), while the mean length of white suckers was similar both years (Table 38). The mean length of yellow perch declined from 114 mm in 1982 to 95 mm in 1983 (Table 37). This was the result of two-thirds of the yellow perch captured in 1983 being Age I fish between 40 and 79 mm, with few adults being captured. Despite the preponderance of small perch, more adult perch (≥140 mm) were captured in 1983 than in 1982. Approximately half of the adult perch were in spawning condition, suggesting that they may have been migrants from one of the adjacent waterbodies. Although it is impossible to determine whether this, in fact, was the case, yellow perch are more migratory than is commonly believed (Becker 1983).

The mean length of black bullheads captured in Swamp Creek declined from 178 mm in 1982 to 133 mm in 1983. This decline was attributable to the low number of large (≥180 mm) black bullheads in the 1983 catch (Table

TABLE 36 COMPARISON BETWEEN THE RESULTS OF ELECTROFISHING SURVEYS CONDUCTED AT STATIONS 4 AND 5 IN 1973 AND 1983

Species	Station 4 This Study 1983	Station 4 WDNR 1973	Station 5 This Study 1983	Station 5 WDNR 1973
Largemouth bass	--	1	--	--
Pumpkinseed	--	1	--	1
Bluegill	--	1	--	--
Yellow bullhead	--	2	--	--
Central mudminnow	--	14	--	12
Bluntnose minnow	--	--	1	--
Blacknose shiner	1	--	--	--
Creek chub	1	1	--	1
Golden shiner	1	5	1	20
Hornyhead chub	23	4	7	25
Blackchin shiner	2	--	--	--
Common shiner	126	10	13	17
White sucker	1	3	7	2
Northern pike	1	--	--	18
Black bullhead	6	4	2	10
Yellow perch	24	--	--	2
Iowa darter	1	--	--	--
Johnny darter	7	6	--	1
Rock bass	4	3	3	6
Mottled sculpin	1	16	--	3
Total Number	199	71	34	118
Total Species	14	14	7	13

TABLE 37 LENGTH FREQUENCY DISTRIBUTIONS FOR YELLOW PERCH, BLACK BULLHEAD, AND ROCK BASS COLLECTED IN 1982 AND 1983 FROM SWAMP CREEK

Length Interval (mm)(*)	Yellow Perch		Black Bullhead		Rock Bass	
	1982	1983	1982	1983	1982	1983
<40	--	--	--	--	34	25
40-59	6	9	1	--	35	2
60-79	10	36	1	--	23	5
80-99	4	1	5	1	27	1
100-119	21	--	7	8	6	2
120-139	18	2	5	6	8	--
140-159	9	9	4	1	4	2
160-179	2	5	8	1	3	--
180-199	1	1	17	2	10	--
200-219	--	3	22	1	8	--
220-239	--	--	4	--	7	--
240-259	--	--	6	--	3	--
260-279	--	--	2	--	--	--
280-299	--	--	1	--	--	--
Total number	71	66	83	20	168	37
Minimum	47	50	46	97	31	25
Maximum	185	216	284	205	250	155
Average	114	95	178	133	94	49

(*) 25.4 mm = 1 inch.

TABLE 38 LENGTH FREQUENCY DISTRIBUTIONS FOR WHITE SUCKER COLLECTED IN 1982 AND 1983 FROM SWAMP CREEK

Length Interval (mm)(*)	1982	1983
<50	--	--
50-99	13	--
100-149	9	2
150-199	9	6
200-249	7	4
250-299	3	--
300-349	3	--
350-399	6	--
400-449	2	1
450-499	--	--
Number	52	13
Minimum	64	120
Maximum	445	434
Average	192	200

(*) 25.4 mm = 1 inch.

37). Rock bass exhibited the greatest decline (48 percent) in mean length, dropping from 94 mm in 1982 to 49 mm in 1983. This decline was due to (1) a preponderance (68 percent) of Age I fish, and (2) the almost complete absence of adult (≥100 mm) fish in the collections (Table 37). The average lengths of white suckers were similar in 1982 and 1983 (Table 38). However, the distribution of individuals in the various length classes was not similar each year. In 1982, suckers of all sizes were represented in the catch, with one-quarter of the catch being less than 100 mm, one-quarter being greater than 249 mm, and one-half being between 100 and 249 mm. In 1983, however, no suckers less than 100 mm were captured and only one fish larger than 249 mm was collected.

Collectively, the results from these four species demonstrated that larger sized individuals of these sport and recreational species were uncommon and/or uncatchable in Swamp Creek during April 1983. The lack of larger black bullheads was probably related to their habitat of burrowing into the mud during the colder months of the year (Becker 1983) and hence become difficult to capture. Yellow perch and especially white suckers would be expected to exhibit migratory movements in Swamp Creek. Thus, the apparent absence of the larger sized individuals of these species may be real.

When water temperatures are cold, rock bass move into deeper water where they remain in a condition of semihibernation (Becker 1983). If the larger rock bass in Swamp Creek behaved in this manner, it is reasonable to conclude that their vulnerability to capture would be decreased.

Condition (K) factors were calculated for these same four species. Average K factors declined for each of these species from 1982 to 1983 (Table 39). The decline was slight for white sucker and yellow perch but more noticeable for rock bass and black bullhead. Because mean length declined for three of these species, a decline in K factors is not unexpected.

The mean K value for white suckers (1.02) was in the range considered as poor for this species in Minnesota (Carlander 1944), and below the mean value of 1.14 reported for a population of Wisconsin fish (Becker 1983). The mean 1983 K value for black bullheads (1.34), although declining from the 1982 value, was near the middle of the range of values (1.11-1.66) reported by Carlander (1969). Carlander (1944) reported that mean K values for yellow perch ranged from 1.43 to 2.58. However, he noted that K increases with length, so the K value of 1.17 for yellow perch in Swamp Creek, which was calculated from fish that were small, may be typical of that size yellow perch. According to the scale developed by Carlander (1944) (<1.80 = poor, 2.02-2.38 = average, and >2.49 = excellent), the 1983 condition factor of 1.85 for rock bass in Swamp Creek is below average, but is not poor. The small sample size (5 fish) precludes definitive statements regarding the condition of rock bass in Swamp Creek.

As discussed in Section 3.1, no threatened or endangered species were collected in Swamp Creek in 1983 (or in 1982; Ecological Analysts 1983). In general, Becker (personal communication) considers the fish community

TABLE 39 SUMMARY OF CONDITION (K) FACTORS CALCULATED FOR FOUR SPECIES OF FISH COLLECTED FROM SWAMP CREEK IN 1982 AND 1983

	$K^{(*)}$					
	1982			1983		
Species	Number	Average	Range	Number	Average	Range
White sucker	49	1.04	0.86-1.62	13	1.02	0.92-1.20
Black bullhead	80	1.52	1.24-1.89	20	1.34	1.04-1.59
Yellow perch	54	1.23	0.88-1.70	20	1.17	0.80-1.44
Rock bass	98	2.03	1.42-2.41	5	1.85	1.74-1.94

(*) Includes only fish $\geq$ 5 g.

of northeastern Wisconsin to be depauperate (i.e., few species are present). To date (i.e., including the 1982 and 1983 studies), 10 species have been captured that potentially could have recreational or commercial importance if available in sufficient numbers. Three of these (brown trout, black crappie, and shorthead redhorse) were represented by single specimens so they would be of no commercial or recreational importance. Pumpkinseed was uncommon and was represented only by small specimens thereby negating any recreational importance. Yellow perch was common but was represented primarily by small specimens. It seems reasonable to conclude that the perch fishery in the stream is small. The best recreational opportunities are for rock bass and bullheads (black and yellow). These groups have abundant populations, and numerous "keeper" sized individuals have been captured, particularly in 1982. The northern pike fishery appears to be limited because most (17 of 25) of the specimens captured were less than 300 mm (12 in.) long and only one large adult (735 mm, 29 in.) was captured. Swamp Creek is used by pike for spawning but only to a limited degree, based on the results of the April survey. The year-round population of pike in Swamp Creek appears to be small. There is a moderate population of white suckers in Swamp Creek that may be supplemented by spawners from adjacent waterbodies each spring. A viable fishery for this species seems likely, particularly in spring.

Overall, the Swamp Creek fish community appears to be ecologically healthy, although not particularly diverse. Functionally, the only unfilled niche is the absence (except for a few northern pike) of a top level predator such as largemouth bass or walleye. This absence is probably a function of the physical and morphometric limitations of Swamp Creek, and is not indicative of any inherent abnormalities in the Swamp Creek fish community. The Swamp Creek fish community is also limited by the small amount of gravel substrate and particularly the lack of riffle habitat. The lack of riffle habitat explains the absence of species such as longnose dace, largescale stoneroller, and other riffle-dwelling species.

4.2 BENTHIC MACROINVERTEBRATES

4.2.1 Community Composition

As was reported in the 1982-1983 study of Swamp Creek (Ecological Analysts 1983), the benthic communities sampled at Stations 3A, 4, and 5 in Swamp Creek during 1983 were considered typical for depositional, slow-moving, warm-water stream environments in Wisconsin. Tubificid oligochaetes, which were abundant in Swamp Creek in 1983, are burrowing organisms that occur primarily in soft substrates of lentic habitats or depositional areas of lotic habitats. Most genera of the Odonata (dragonflies and damselflies) and Ephemeroptera (mayflies) collected from Swamp Creek have been reported primarily from slow-moving streams or standing water (Hilsenhoff 1981). The caddisflies present in Swamp Creek are found primarily in the slower moving portions of streams (Harris and Lawrence 1978). The midges collected from Swamp Creek have been reported from a variety of habitats (Merritt and Cummins 1978).

Physical measurements conducted in conjunction with the 1983 macroinvertebrate sampling (Tables A-2 through A-5, Appendix A) showed that rocky, fast-water habitats were present at Stations 3A and 5. However, these two fast-water habitats were associated with bridge culverts, not riffle areas. Typical riffle habitat is uncommon in this reach of Swamp Creek (Ecological Analysts 1983). In addition, taxa that prefer fast currents (rheophilic taxa) generally were also uncommon in Swamp Creek. Numerous rheophilic and cold-water species of stoneflies, mayflies (especially Paraleptophlebia spp., Isonychia spp., and Ephemerella spp.), and caddisflies (in particular Glossosoma spp. and Hydropsyche spp.), which commonly occur in Swamp Creek upstream from Rice Lake (Section 2.5 of the EIR [Exxon Minerals Company 1982]) and in other streams in Wisconsin (Hilsenhoff et al. 1972; Hilsenhoff 1981), were generally absent or infrequently collected from this portion of Swamp Creek.

The rarity of these taxa downstream of Rice Lake is probably related to the warm water temperatures in the summer (temperatures as high as 29.2 C have been recorded, Ecological Analysts 1984) and the uncommon occurrence of fast-current, rocky habitat. In addition, the extremely low DO levels (1-3 mg/liter) recorded during the night in July and August (Ecological Analysts 1984) suggest that low DO concentrations in Swamp Creek may be a limiting factor for many rheophilic macroinvertebrate species.

The substrates in the study area of Swamp Creek were composed primarily of silt and sand sediments (Tables A-2 through A-5). This substrate classification is based primarily on the overlaying sediment at each habitat. Sand substrates generally occurred in areas of faster current and were less prevalent than silt in most areas of Swamp Creek. Detritus was a large component of all substrate types, especially the sediment type classified here as silt. In contrast to the previous study of Swamp Creek, the silt substrates at Stations 4 and 5 were situated in areas of relative fast current velocity. Gravel substrates (at Stations 3A and 5) compose a small portion of the substrates in Swamp Creek. The gravel substrate at Station 5 was in a deep (>2 m [6.6 ft]), fast-water area (0.15-0.58 m/sec [0.5-1.9 ft/sec]). During 1983, the gravel habitat at Station 5 changed from a sandy gravel substrate to a predominantly sand substrate. This change was probably related to changes in the flow regime and subsequent scouring that occurred at this station when one of the bridge culverts was blocked by debris. As was noted in the 1982-1983 study of Swamp Creek, aquatic macrophytes and their associated macroinvertebrate communities were present in the grab samples and increased the variability in density among substrates and stations. In addition, sediment and current velocity changes resulting from the occurrence of macrophytes also influenced the benthic community at each station. In the present study, macrophytes were especially abundant at Station 4.

Although different stations were sampled in the present study than in the 1982-1983 study of Swamp Creek, the same substrate types (i.e., sand, silt, and gravel) were investigated in both studies, thus allowing for general comparisons between years. The benthic fauna sampled in the present study was, in general, similar in composition to the communities in this reach of Swamp Creek in 1982-1983.

However, the total taxa declined from 191 in 1982-1983 to 178 in the present study. The fewer taxa were probably related to the fewer number of samples collected and greater similarity among the habitat types in 1983.

The predominant organisms in the grab samples of the present study (tubificid oligochaetes, the amphipod Hyalella azteca, and chironomid midges; Table 40) were also commonly collected in the previous (1982-1983) study of Swamp Creek. However, despite these basic similarities, community differences were evident between the two studies. These differences were probably related to substrate and habitat differences between the upstream stations in 1982-1983 (Stations 1, 2, 3) and the downstream stations in 1983 (Stations 4 and 5). The unstable nature of the sediments in the present study was reflected in the structure of the macroinvertebrate community by the increased density of the burrowing tubificids and lower numbers of the mayfly Leptophlebia sp. when compared to the communities sampled in the more stable sediments in 1982-1983.

The qualitative samples in the present study and in 1982-1983 were also dominated by similar taxa. Hyalella azteca, mayflies of the genus Baetis, and chironomid midges were abundant throughout both studies.

The most obvious spatial variation in the composition of the macroinvertebrate community of Swamp Creek in the present study was not among habitat types (i.e., substrates) but between stations. Hyalella azteca and, to a lesser extent, chironomid midges, generally dominated the benthic fauna at Station 4 whereas midges and tubificid oligochaetes (in decreasing order of importance) were the predominant organisms at Station 5 (Table 40).

Community comparisons among the substrates at Stations 4 and 5 revealed numerous differences in density and diversity (Table 41). On most dates, the silt substrate at Stations 4 and 5 yielded much greater total density and total taxa than the other substrates (Table 41). Densities in the silt substrates in 1982-1983 were typically lower than those observed during the present study. This was probably related to the lower current velocities at these habitats in 1982-1983 (Ecological Analysts 1983) compared with the present study (Tables A-2 through A-5).

Although the benthic community varied greatly, some consistent differences related to season and substrate were apparent in the dominant taxa.

As was noted in the previous (1982-1983) study of Swamp Creek, density and relative abundance of the planaria Dugesia sp. were highest in August and November. Probably because of the lack of suitable rocky substrate, Dugesia sp. was generally less abundant in the present study than in 1982-1983. Planarians are, in general, photonegative animals and can be found under rocks, logs, and debris during the day (Pennak 1953). Their food consists primarily of living, dead, or crushed animal matter.

Nematoda (round worms) were collected sporadically in the present study and did not exhibit a preference for a particular substrate type in Swamp Creek. The nematodes were a large component of the benthos of Swamp Creek in 1982-1983 but were less abundant during the present study.

TABLE 40 RELATIVE ABUNDANCE (PERCENT COMPOSITION) OF THE PREDOMINANT(*) BENTHIC MACROINVERTEBRATES IN PONAR GRAB SAMPLES FROM SWAMP CREEK, 1983.

Sampling Date and Taxa	Station 4 Sand	Station 4 Silt	Station 5 Sand	Station 5 Silt	Station 5 Gravel
February 1983					
Tubificidae	7	2	21	12	5
Hyalella azteca	31	53	-	7	1
Leptophlebia sp.	13	10	-	3	<1
Chironomidae	25	15	44	65	70
Ceratopogonidae	1	<1	13	3	4
Hydrobiidae	3	15	5	<1	1
May 1983					
Nematoda	11	1	-	-	10
Tubificidae	10	7	28	31	3
Hyalella azteca	27	41	1	17	-
Chironomidae	15	26	57	36	59
Hydrobiidae	12	6	2	1	3
August 1983					
Dugesia sp.	5	10	3	3	8
Naididae	1	10	2	2	3
Tubificidae	9	9	11	22	24
Hyalella azteca	8	37	10	11	16
Chironomidae	54	22	64	46	33
November 1983					
Naididae	-	14	3	3	1
Tubificidae	7	16	25	15	36
Hyalella azteca	8	29	1	7	1
Chironomidae	45	18	64	44	24
Ceratopogonidae	18	<1	1	<1	7
Campeloma sp.	1	3	1	1	13

(*) Taxa or groups that composed ≥10 percent of the total benthos on at least one sampling date.

TABLE 41 SUMMARY OF THE DENSITY (TOTAL BENTHOS IN NO./M^2) AND DIVERSITY (TOTAL TAXA) OF BENTHIC MACROINVERTEBRATES COLLECTED IN PONAR GRAB SAMPLES FROM SWAMP CREEK, 1983

	Station 4		Station 5		
Sampling Date	Sand	Silt	Sand	Silt	Gravel
February 1983					
Total Benthos	12645	22755	2144	18924	4916
Total Taxa	60	39	19	58	47
May 1983					
Total Benthos	4244	20245	3681	17126	1321
Total Taxa	25	54	20	43	16
August 1983					
Total Benthos	3660	8423	8380	5478	7038
Total Taxa	24	32	38	26	42
November 1983					
Total Benthos	5890	5457	13813	21369	3227
Total Taxa	27	33	41	63	29

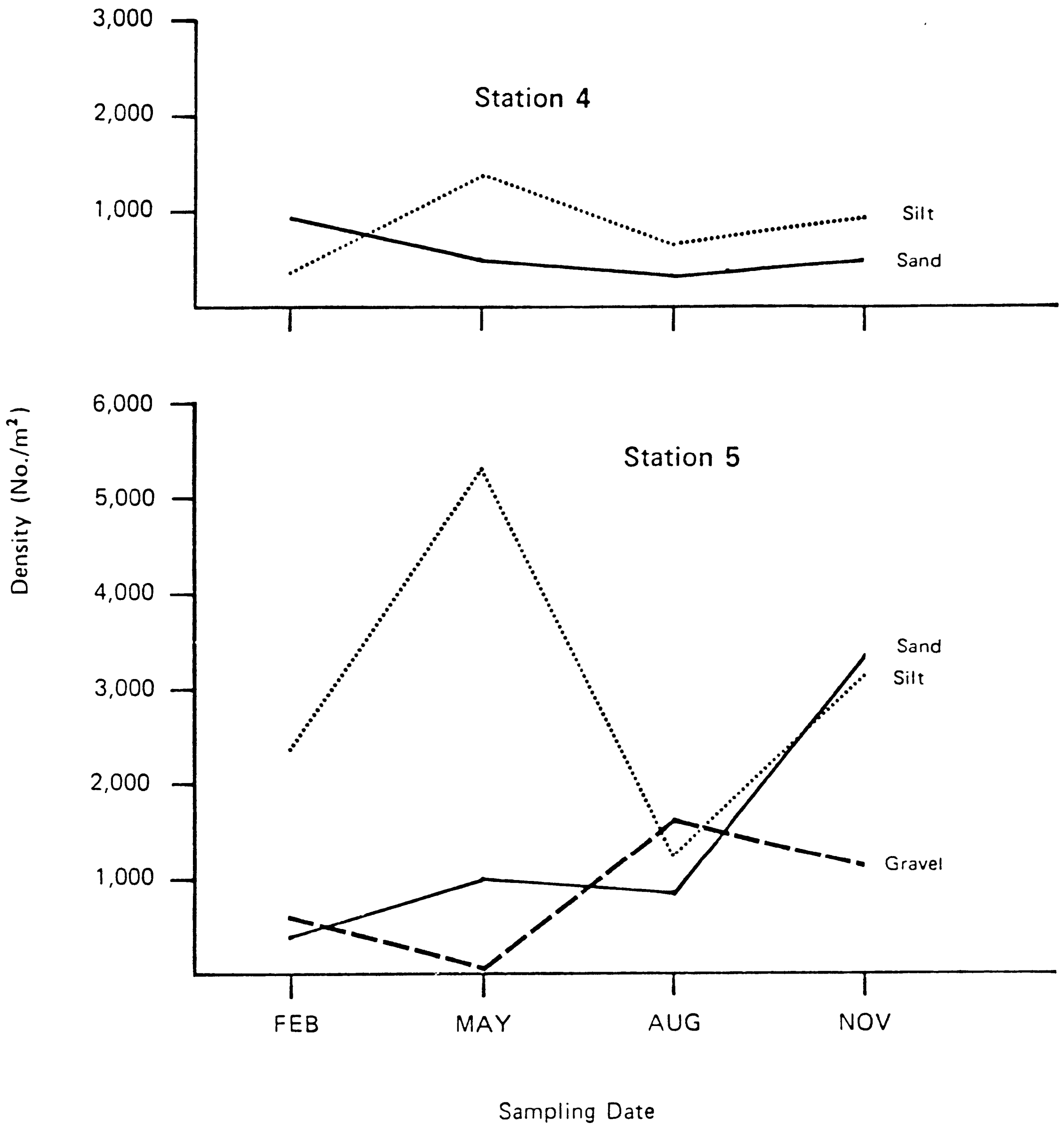
Nematodes feed on a wide variety of plants and animals but apparently do not feed on dead organic matter (Ferris et al. 1976).

As in 1982, naidid oligochaetes (segmented worms) obtained highest densities in Swamp Creek during the August and November samplings. The silt substrate generally yielded the highest densities and relative abundance of naidids. A diverse (15 species) assemblage of Naididae was present in Swamp Creek during 1983. The two most commonly collected naidids, Arcteonais lomondi (in the Ponars) and Stylaria fossularis (in the drift and qualitative samples), are both active swimmers (Brinkhurst and Jamieson 1971). Little is known of the ecological requirements of the Naididae; however, Spencer (1980) reported a direct relationship between the presence of Naididae with the occurrence of periphytic algae. Most species are probably dependent on microflora for much of their nutritional demands.

The tubificid oligochaetes were commonly collected at most habitats (i.e., substrates) throughout the 1983 samplings and generally were more abundant than in the previous (1982-1983) study of Swamp Creek. Similar to the Naididae, the tubificids also achieved highest densities in the silt substrate (Figure 2). Brinkhurst and Jamieson (1971) noted that, in general, tubificids are more often found in the softer (fine-grained) sediments of rivers. Tubificids probably derive most of their nutritional requirements from microorganisms ingested along with organic matter in sediments (Brinkhurst and Jamieson 1971). In Swamp Creek, immature forms generally dominated the Tubificidae with Ilyodrilus templetoni, Limnodrilus hoffmeisteri, and Limnodrilus udekemianus being the predominant identifiable species. Ilyodrilus templetoni is common in both lake and river habitats, attaining greatest densities in enriched habitats (Stimpson et al. 1982). Limnodrilus hoffmeisteri and L. udekemianus are widespread in the United States and are found in organically enriched waters as well as oligotrophic waters.

Densities of H. azteca were highest in the silt substrates in Swamp Creek and generally lowest in the gravel substrate of Station 5 (Figure 3). The higher H. azteca densities in the silt substrates were probably related to the slower currents and greater macrophyte occurrence at these habitats. The higher densities of H. azteca at Station 4 also were probably related to the higher macrophyte densities at this station. Hyalella azteca is described as a grazer and deposital feeder (Strong 1972) and is widely distributed in permanent bodies of water with submerged vegetation (Edmondson 1959). Its propensity for aquatic macrophytes is the probable reason for its high densities in the downstream reaches of Swamp Creek. No consistent seasonal trends were evident regarding the occurrence or density of this species in Swamp Creek. Hyalella azteca was also abundant in the qualitative samples (especially at Stations 3A and 4) and in the drift collections from Swamp Creek in 1983.

Densities of the mayfly Leptophlebia sp. were, in general, much lower in the present study than in the 1982-1983 study. This taxon's apparent preference for gravel substrate (Ecological Analysts 1983) which is uncommon in the lower reaches of Swamp Creek may be the reason for its lower densities in the present study. Leptophlebia sp. reached its



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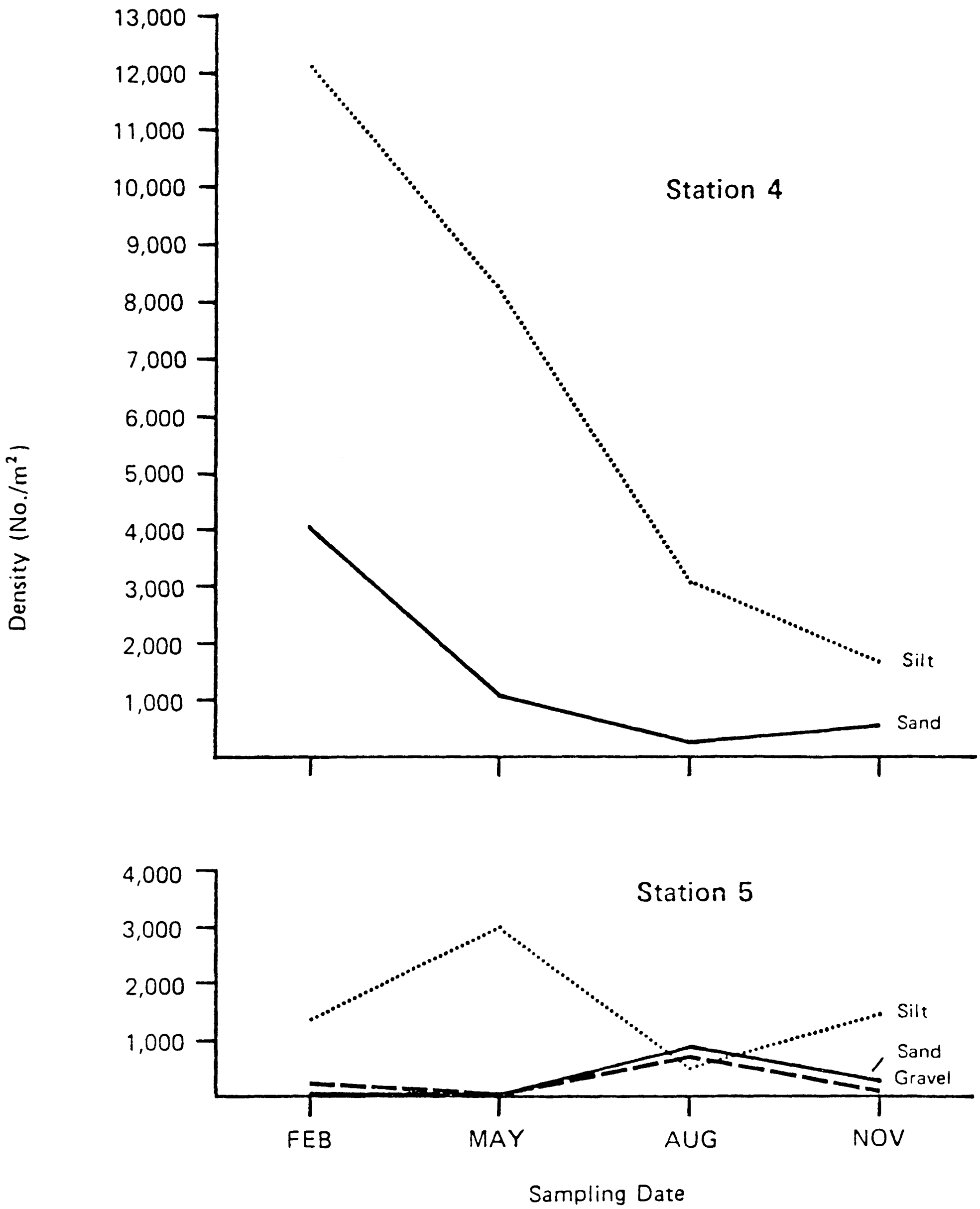
DENSITY OF TUBIFICIDAE FROM TWO SAMPLING STATIONS IN SWAMP CREEK, 1983

ECOLOGICAL ANALYSTS | FIGURE 2



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DENSITY OF HYALELLA AZTECA
FROM TWO SAMPLING STATIONS
IN SWAMP CREEK, 1983

ECOLOGICAL ANALYSTS | FIGURE 3

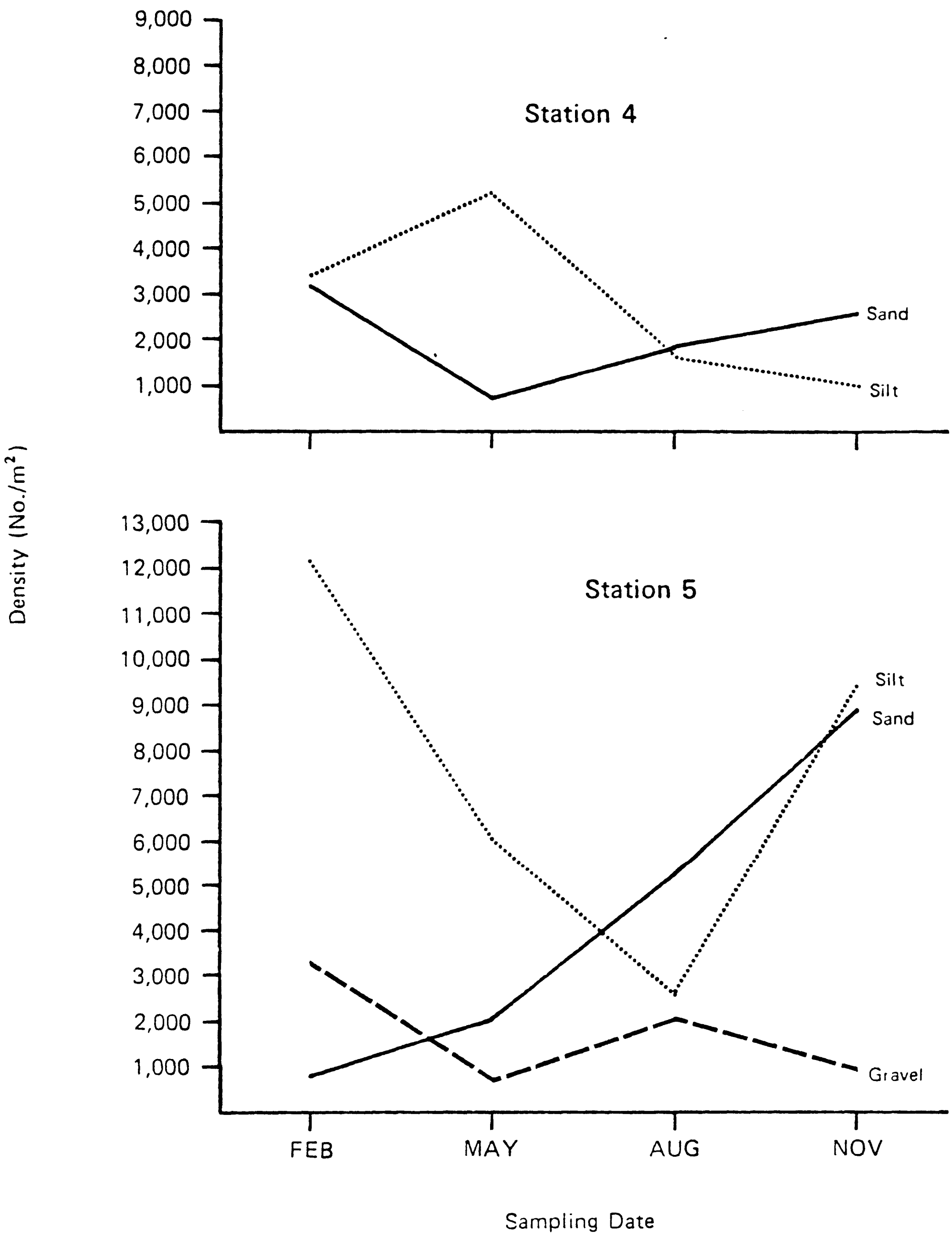
highest densities in February and November. This taxon apparently is univoltine in Wisconsin (Hilsenhoff 1981) and the nymphs leave streams in early spring to enter vernal pools from which they emerge. The presence of mature Leptophlebia sp. nymphs in the May qualitative and Ponar samples indicated that the nymphs had not yet started their migration from the main stream of Swamp Creek. Merritt and Cummins (1978) categorized Leptophlebia sp. in the collector functional group, feeding on fine particulate organic matter.

The mayfly Baetis pygmaeus was abundant in the qualitative and drift collections from Swamp Creek, and also was frequently collected in grab samples. Gut content analysis of B. pygmaeus indicates that this species is a detritivore (Shapas and Hilsenhoff 1976). Baetis pygmaeus has been reported primarily in streams of variable current velocities (Hubbard and Peters 1978).

The net-spinning caddisfly Cheumatopsyche sp. was abundant in the qualitative collections from Stations 3A and 5, and also occurred in low densities in the Ponar and drift samples. This taxon builds retreats on rocks, logs, and other submerged objects in various currents (Hilsenhoff 1981). Cheumatopsyche's need for a stable substrate is the probable reason for its lower relative abundance at Station 4, where the stream bottom is primarily composed of unstable silt, sand, and detritus. Cheumatopsyche was also commonly collected in the 1982 qualitative collections from Swamp Creek (Ecological Analysts 1983) and was the dominant caddisfly larvae collected in a survey of the Pine-Popple River in 1967-1969 (Hilsenhoff et al. 1972).

Midge-fly (Chironomidae) larvae and pupae were a dominant component of the benthos at all substrates and stations in Swamp Creek during 1983. The absence of consistent seasonal trends (Figure 4) for the Chironomidae was attributed to the numerous (58) taxa and variable behavior of this diverse assemblage. Members of this large family are abundant in almost every type of aquatic habitat (Hilsenhoff 1981). In the present study, midges generally were more commonly collected in the silt substrate than in the sand and gravel substrates, and were especially numerous at Station 5 (Figure 4). Micropsectra sp., Stictochironomus sp., and Procladius sp. were the predominant midge taxa collected in the grab samples from Swamp Creek. These midges are generally collected in depositional (slow-water) areas of streams (Merritt and Cummins 1978). Generally, the composition of the midge fauna was similar in the sand and silt substrates. The gravel habitat at Station 5 yielded a variable midge assemblage that usually was different than that seen in the other substrates. Cladotanytarsus sp., which was most commonly collected in the sand substrate, was the only dominant midge to exhibit a definite substrate preference. Except for the carnivorous species, most chironomid larvae are microphagous (collectors), feeding on small plants and animals and detritus (Oliver 1971).

Biting midges (Ceratopogonidae) were commonly collected in all substrates in Swamp Creek, and in all Ponar samplings, except in August. In contrast to the chironomid midges, the Ceratopogonidae were collected in the highest densities at Station 4. Biting midges are generally sprawlers or



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DENSITY OF CHIRONOMIDAE FROM TWO SAMPLING STATIONS IN SWAMP CREEK, 1983

ECOLOGICAL ANALYSTS | FIGURE 4

burrowers and are predators on other small animals (Merritt and Cummins 1978). In a study of 14 Wisconsin lakes (Hilsenhoff and Narf 1968), Ceratopogonidae was the third most abundant insect family in the profundal mud.

Snails of the family Hydrobiidae were commonly collected throughout the 1983 samplings in Swamp Creek but never dominated the benthos as they did in 1982-1983 (EIR, Appendix 2.5G). Hydrobiid snails were most commonly collected in the Ponar grab samples from Station 4, and in the qualitative samples from Stations 3A and 4. The Hydrobiidae are found in permanent waters, lentic or lotic, that contain considerable densities of higher aquatic plants (Harman and Berg 1971).

Samples for determination of Hilsenhoff's (1977, 1982) biotic index were collected from Swamp Creek in May, August, and November. The biotic index values ranged from a low of 2.16 at Station 5 in August to a high of 3.73 at Station 3A in August. The wide variability in index values in 1983 was not related to fluctuations in water quality but was attributed to sampling anomalies. By averaging the values at Stations 3A, 4, and 5 for each month, a more accurate index can be determined. The average seasonal values in 1983 varied from 2.87 in August to 3.08 in November (Table 42). These values fall into the "fair" water quality range which indicates Swamp Creek received "significant organic pollution." The average value for all of 1983 (3.01) was only slightly higher than the average 1982 biotic index value (2.74) calculated from the qualitative samples.

The disparity in biotic index values among stations in the present study was a result of several physical, biological, and chemical influences. First, Swamp Creek does not provide the most suitable habitat (i.e., a fast-flowing riffle) for proper biotic index sampling. Samples in 1983 were collected from a gravel run (Station 3A), submerged branches (Station 4), and a sand run downstream from a culvert (Station 5).

Second, H. azteca, which occurred abundantly in the aquatic macrophytes of Swamp Creek and is not a typical riffle species, dominated many of the biotic index samples thereby strongly influencing the values for those stations. The high tolerance value (4) of H. azteca results in relatively high index values for stations that have a large number of this species. When the biotic indices were recalculated excluding H. azteca, the water quality classification improved to "good" (Table 42). Other than H. azteca, the biotic index samples contained only a few taxa with a tolerance value of 4. All other taxa had lower values of 1, 2, and 3 which indicate better water quality.

The third influence on the biotic index values of Swamp Creek was the dramatic diel fluctuation in DO during the summer which precluded the year-round occurrence of many euoxyphilous (occurring in high oxygen concentration), riffle species which typically require high DO levels in addition to fast current velocities. Thus, other oligoxyphilous (low oxygen) taxa were occupying these fast-flowing habitats which would normally be colonized by riffle species.

TABLE 42 SUMMARY OF HILSENHOFF BIOTIC INDEX VALUES FROM SAMPLES IN SWAMP CREEK, 1982 AND 1983

Sampling Date	Station 3A	Station 4	Station 5	1983 Mean	1982 Mean
May					
Biotic Index	3.24	2.61	3.35	3.07	2.83
(Biotic Index w/o *H. azteca*)	(2.72)	(2.30)	(2.73)	(2.58)	
August					
Biotic Index	3.73	2.71	2.16	2.87	2.82
(Biotic Index w/o *H. azteca*)	(3.42)	(2.23)	(2.12)	(2.59)	
November					
Biotic Index	3.35	2.35	3.53	3.08	2.59
(Biotic Index w/o *H. azteca*)	(2.47)	(2.16)	(2.53)	(2.39)	
Annual Mean					
Biotic Index	3.44	2.56	3.01	3.01	2.74
(Biotic Index w/o *H. azteca*)	(2.87)	(2.23)	(2.46)	(2.52)	

The combination of the three influences described above is the probable reason that Hilsenhoff's index would classify the water quality in Swamp Creek as "fair." Although Swamp Creek contains large amounts of organic detrital matter, the chemical and biological surveys in this reach of the stream revealed no evidence of "significant organic pollution."

Drift sampling was conducted at Stations 1 and 3 in Swamp Creek in August and November. Sampling was started at sunset in order to collect the maximum number and types of organisms. Night-active periodicity of most macroinvertebrates has been reported by many researchers and is believed to be the result of nocturnal foraging and pre-pupation and pre-emergence activities (Waters 1972). The replicate samples at each station were not true replicates but represent two parts of a 30-minute sampling which was started at sunset. Thus, on each date, Replicate A represents drift densities immediately prior to the night-time peak and Replicate B represents peak night-time drift. The mean of these two replicates probably approximated the mean drift densities for that sampling date. All organisms (except minor taxa) exhibited greater drift densities in Replicate B than in Replicate A.

The amphipod _H. azteca_, the mayflies _B. pygmaeus_ and _Leptophlebia_ sp., and chironomid midges were the dominant drifting macroinvertebrates in August and November. All the above taxa, except midges, are vigorous swimmers (Bousefield 1958; Burks 1953). An especially diverse assemblage of midges (22 taxa) was collected in August. The numerous midge pupa in the drift was probably a result of pre-emergence activity and not foraging activity since these organisms do not feed in the pupal stage.

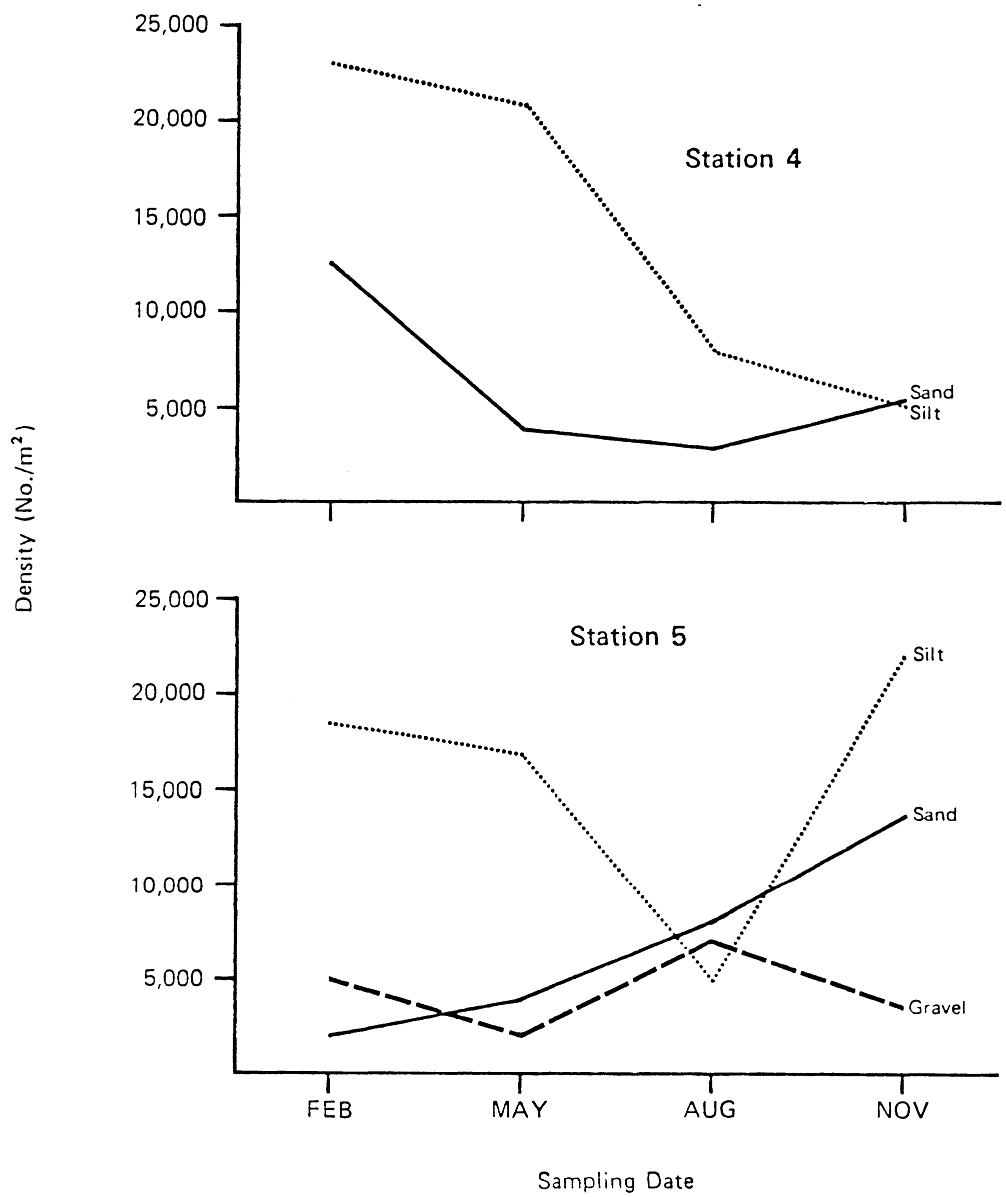
Other commonly collected taxa in the drift were the naidid oligochaetes and water mites (Hydracarina) in August, and the microcaddisfly _Oxyethira_ sp. in November. Drift densities, especially at Station 1, decreased from August to November. Lower drift rates in November were probably related to the reduced reproduction activity and the lower inter- and intra-specific competition typically associated with this cold-water period.

4.2.2 General Summary

Ponar grab samples revealed variable seasonal fluctuations in total benthos at individual substrates and stations in 1983 (Figure 5). In general, the silt substrates yielded the highest densities in 1983 and the greatest seasonal fluctuations. Conversely, the gravel substrate had the lowest densities and the least seasonal variation.

The seasonal community changes observed in the present study were, in general, dissimilar from the previous (1982-1983) study. These differences were undoubtedly influenced by the differences in sampling stations and habitats between the 1982-1983 study and the present study; however, the variability of the Swamp Creek community, which was evident in 1982-1983, also could have caused the fluctuations observed in the present study.

Spatial variations in the densities of the dominant taxa were evident in the present study. Tubificid oligochaetes were generally more abundant



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TOTAL DENSITY OF BENTHIC MACROINVERTEBRATES FROM TWO SAMPLING STATIONS IN SWAMP CREEK, 1983

ECOLOGICAL ANALYSTS | FIGURE 5

in the silt substrate than in the sand and gravel substrates, and had greater densities at Station 5 than at Station 4 (Figure 2). In 1982-1983, tubificid densities were generally highest in the sand substrate.

Hyalella azteca was most commonly collected from the silt substrates in the present study and achieved highest densities at Station 4 (Figure 3). In 1982-1983, this species did not exhibit a definite substrate preference.

Chironomid midges were generally more abundant in the softer substrates (sand and silt) than in the gravel substrate, and reached their highest densities at Station 5 (Figure 4). No substrate preference was evident for the midges in 1982-1983; however, maximum densities for the study were observed in the gravel substrate.

Taxa that were occasionally abundant in the previous quantitative sampling of Swamp Creek (e.g., nematodes, the mayfly Leptophlebia sp., and hydrobiid snails) were less important in the present study.

The relatively homogeneous communities and fewer taxa (122 versus 154) collected in the present quantitative benthos study, when compared to the results in 1982-1983, were probably related to the similarity among the habitats sampled in 1983 compared to the diverse habitat types sampled during the 1982-1983 study.

The occurrence of benthic macroinvertebrates in all habitats of Swamp Creek during 1983 is summarized in Table 43. Chironomid midges and H. azteca were abundant in nearly all habitats. In addition to the above taxa, tubificid oligochaetes were also abundant in the sand and silt substrates. Other abundant taxa in the qualitative samplings of the shoreline structures and macrophytes were the planaria Dugesia sp.; the amphipod Gammarus pseudolimnaeus; the mayflies Baetis spp. (primarily B. pygmaeus) and Leptophlebia sp.; the net-spinning caddisfly Cheumatopsyche sp.; caddisflies of the family Limnephilidae (predominantly Pycnopsyche sp. and Platycentropus sp.); and hydrobiid snails. The mayflies Baetis spp. and Leptophlebia sp. were also abundant in the drift of Swamp Creek.

Similar faunas would be expected when sampling similar habitats at other locations in this reach of Swamp Creek. However, as evidenced by the differences between the present study and the 1982-1983 studies, the benthic community of Swamp Creek is highly variable. The benthic fauna at any one location is strongly influenced by season and the hydrological, chemical, physical, and biological characteristics of the surrounding area.

TABLE 43 OCCURRENCE(*) OF THE DOMINANT BENTHIC MACROINVERTEBRATES IN VARIOUS HABITATS IN SWAMP CREEK AS INDICATED BY QUANTITATIVE, QUALITATIVE, AND DRIFT SAMPLING, 1983

	Habitat				
Taxa	Sand	Silt	Gravel	Shoreline/Macrophyte	Drift
Platyhelminthes					
Dugesia sp.	++	++	++	+++	+
Oligochaeta					
Naididae	++	++	++	+	++
Tubificidae	+++	++++	+++	+	
Amphipoda					
Gammarus pseudolimnaeus	+	+		+++	
Hyalella azteca	+++	++++	+	++++	+++
Insecta					
Baetis spp.	+	+	+	++++	++++
Leptophlebia sp.	++	++	+	++++	++++
Oxyethira sp.	+	+	+	++	++
Cheumatopsyche sp.	+	+	+	+++	+
Limnephilidae		+		+++	+
Chironomidae	++++	++++	++++	++++	+++
Gastropoda					
Hydrobiidae	++	++	+	+++	+

(*) + = present
++ = common
+++ = abundant
++++ = very abundant

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APPENDIX A

PHYSICOCHEMICAL PARAMETERS

TABLE A-1. RESULTS OF PHYSICOCHEMICAL MEASUREMENTS MADE 20 AND 21 APRIL IN CONJUNCTION WITH FISH SAMPLING ON SWAMP CREEK.

Parameter	Station 1		Station 3		Station 4		Station 5	
	Seine	Shock	Seine	Shock	Seine	Shock	Seine	Shock
Temperature (C)	6.0	6.0	7.0	8.0	8.0	8.0	6.0	7.0
Dissolved oxygen (mg/l)	12.2	12.2	11.3	11.0	11.3	11.3	11.5	11.5
pH (units)	6.7	6.7	7.0	7.0	7.5	7.5	7.5	7.5
Spec. conductance (μmhos/cm)	169	172	147	147	147	147	154	153
Current velocity (ft/sec)	0.5-0.7	0.2-0.7	0.1-1.2	0.1-1.2	0.1-1.4	0.1-1.4	0.1-1.0	0.1-1.5
Depth (m)	0.3-1.2	0.3-1.4	0.3-1.3	0.3-1.8	0.1-1.4	0.5-2.0	0.1-1.5	0.5-2.0

TABLE A-2 PHYSICAL MEASUREMENTS CONDUCTED AT BENTHIC MACROINVERTEBRATE SAMPLING STATIONS IN SWAMP CREEK, 17 FEBRUARY 1983

	Station 4		Station 5		
	Silt	Sand	Silt	Sand	Gravel
PARAMETER					
Depth (cm)	128	210	75	57	260
Current velocity (ft/sec)	0.1	0.4	0.4	0.6	0.7
Dissolved oxygen (mg/l)	5.4	5.4	4.6	4.6	4.6
Temperature (C)	0.5	0.5	0.5	0.5	0.5

	Station 4 Silt		Station 4 Sand		Station 5 Silt		Station 5 Sand		Station 5 Gravel	
	A(a)	B	A	B	A	B	A	B	A	B
SUBSTRATE (%)										
Gravel	0	0	0	0	0	0	0	0	60	60
Coarse sand	0	0	0	0	0	0	0	0	40	40
Fine sand	0	0	70	70	10	10	90	90	<10	<10
Silt	50	50	30	30	40	40	10	10	<10	<10
Detritus	50	50	<10	<10	50	50	<10	<10	0	0
Macrophytes	+(b)	+	+	+	+	+				

(a) Sample replicate value.
(b) + = present in sample.

TABLE A-3 PHYSICAL MEASUREMENTS CONDUCTED AT BENTHIC MACROINVERTEBRATE SAMPLING STATIONS IN SWAMP CREEK, 10 MAY 1983

	Station 3A	Station 4		Station 5		
	Gravel	Silt	Sand	Silt	Sand	Gravel
PARAMETER						
Depth (cm)	39-52	80	167	83	53	220
Current velocity (ft/sec)	1.5-1.7	0.7	0.9	0.7	0.4	1.6-1.9
Dissolved oxygen (mg/l)	12.0	9.9	9.9	8.8	8.8	8.8
Temperature (C)	10.6	11.0	11.0	15.6	15.6	15.6

	Station 3A Gravel	Station 4 Silt A(a)	Station 4 Silt B	Station 4 Sand A	Station 4 Sand B	Station 5 Silt A	Station 5 Silt B	Station 5 Sand A	Station 5 Sand B	Station 5 Gravel A	Station 5 Gravel B
SUBSTRATE (%)											
Gravel	70	0	0	0	0	0	0	0	0	50	50
Coarse sand	30	0	0	0	0	0	0	0	0	50	50
Fine sand	<10	0	<10	50	50	0	0	80	80	<10	<10
Silt	0	50	50	20	20	40	40	<10	<10	<10	<10
Detritus	0	50	50	30	30	60	60	20	20	0	0
Macrophytes		+(b)	+								

(a) Sample replicate value.
(b) + = present in sample.

TABLE A-4 PHYSICAL MEASUREMENTS CONDUCTED AT BENTHIC MACROINVERTEBRATE SAMPLING STATIONS IN SWAMP CREEK, 15-16 AUGUST 1983

	Station 3A	Station 4		Station 5		
	Gravel	Silt	Sand	Silt	Sand	Gravel
PARAMETER						
Depth (cm)	85	85	145	78	64	200
Current velocity (ft/sec)	0.7	0.3	0.3	0.4	0.3	0.5-0.8
Dissolved oxygen (mg/l)	4.6	8.5	8.5	8.0	7.8	7.9
Temperature (C)	22.4	25.5	25.5	25.0	25.0	25.0

	Station 3A Gravel	Station 4 Silt A(a)	Station 4 Silt B	Station 4 Sand A	Station 4 Sand B	Station 5 Silt A	Station 5 Silt B	Station 5 Sand A	Station 5 Sand B	Station 5 Gravel A	Station 5 Gravel B
SUBSTRATE (%)											
Rubble	0	0	0	0	0	0	0	0	0	20	0
Gravel	60	0	0	0	0	0	0	0	0	40	60
Coarse sand	20	0	0	0	0	0	0	0	0	20	20
Fine sand	10	10	0	50	50	10	20	70	50	10	10
Silt	10	60	70	20	30	60	50	20	30	10	10
Detritus	0	30	30	30	20	30	30	10	20	0	0
Macrophytes	+(b)					+	+				

(a) Sample replicate value.
(b) + = present in sample.

TABLE A-5 PHYSICAL MEASUREMENTS CONDUCTED AT BENTHIC MACROINVERTEBRATE SAMPLING STATIONS IN SWAMP CREEK, 14-15 NOVEMBER 1983

PARAMETER	Station 3A Gravel	Station 4 Silt	Station 4 Sand	Station 5 Silt	Station 5 Sand	Station 5 Gravel
Depth (cm)	30	69	86	75	38	200
Current velocity (ft/sec)	1.0	0.3	0.5	0.4	0.8	1.2
Dissolved oxygen (mg/l)	--(a)	11.4	11.6	11.1	11.1	11.3
Temperature (C)	2.4	2.0	2.0	0.6	0.6	0.6

SUBSTRATE (%)	Station 3A Gravel	Station 4 Silt A(b)	Station 4 Silt B	Station 4 Sand A	Station 4 Sand B	Station 5 Silt A	Station 5 Silt B	Station 5 Sand A	Station 5 Sand B	Station 5 Gravel A	Station 5 Gravel B
Gravel	60	0	0	0	0	0	0	0	0	0	0
Coarse sand	20	0	0	0	0	0	0	0	0	80	80
Fine sand	10	10	10	80	90	20	20	80	70	0	0
Silt	10	50	50	<10	<10	30	30	<10	10	0	0
Detritus	0	40	40	20	10	50	50	20	20	20	20

(a) No reading collected.
(b) Sample replicate value.