

A Distributional Study
of Estuarine Macrobenthos
in the Sandy Littoral
of the Pamlico River, North Carolina

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by
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A DISTRIBUTIONAL STUDY
OF ESTUARINE MACROBENTHOS
IN THE SANDY LITTORAL
OF THE PAMLICO RIVER, NORTH CAROLINA

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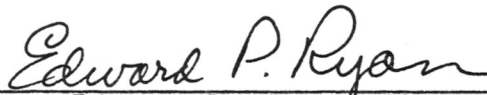
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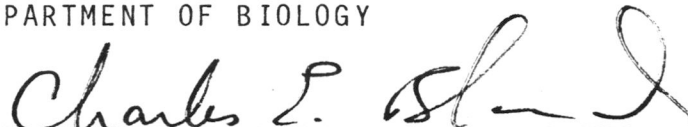
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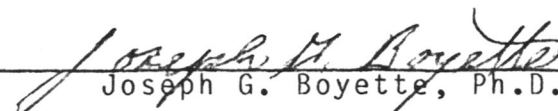

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ABSTRACT

Seasonal species composition, vertical and horizontal distribution, density, and diversity of macrobenthos were studied in the oligohaline area of the Pamlico River, an estuary in North Carolina. Samples were taken monthly from six sites located in 1 m or less of water. Salinity, temperature, dissolved oxygen levels, and sediment particle size and organic content were determined. Water temperatures ranged from 3°C during January to 31.5°C during June. Salinity of the water column ranged from 15.1‰ to 0.6‰. Temperature and salinity of interstitial water was less than that of bottom and surface water. Dissolved oxygen of the water column ranged from 2.4 ml/L to 16.6 ml/L while interstitial values ranged from 5.4 ml/L to undetectably low levels. Sediments consisted primarily of sand particles. Mean organic content was found to be approximately 0.2% of the total dry weight.

Macrobenthos were found to have low diversity and fluctuating densities. The Shannon-Weaver diversity index revealed low values of 1.24 to 2.77 and Pielou evenness values ranged from 0.05 to 0.73. Twenty four species of macroinvertebrates were identified. The majority of these organisms exhibited low densities and were transient. However, several opportunistic species exhibited large pulses in their density during various times of the year. Recruitment of juveniles during spring and fall accounted for a large portion of these high densities. The polychaetes Laeonereis culveri, Hypaniola florida, and Scolecoplepides viridis and the amphipod Gammarus tigrinus (group) were the primary opportunistic species encountered. Harsh environmental conditions created by changing

salinity, dissolved oxygen, and unstable sediments favor such species which are adapted to exploit short term pristine environments. The macrobenthos underwent significant seasonal changes in species composition as a result of seasonal reproductive programming and changing environmental stresses.

Investigation of macrophyte presence and macrobenthos densities revealed higher densities of fauna in dense macrophyte vegetation. Fifty nine percent of the invertebrates found were from sites containing vegetation. This value conceivably could have been even higher if the organisms studied had been less motile. It is believed that macrophytes play an important role in the productivity of the estuary by providing detritus for the detrital pathway, protection from predation, surface for epiphytes and epifauna, and stabilizing sediments.

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INTRODUCTION

The objective of this research was to quantitatively evaluate the seasonal species composition, vertical and horizontal distribution, density, and diversity of estuarine benthic macroinvertebrates in oligohaline areas of the Pamlico River, North Carolina. A number of studies have been concerned with fluctuation in populations of estuarine organisms (Corey, 1967; McErlean and Mihursky, 1973), but few have dealt with low salinity estuaries and little has been studied except for species with commercial value (Tenore, 1972). Although only a few species of invertebrates may be of direct economic importance, "all form some part of the food web that ultimately sustains commercial fisheries" (Williams and Thomas, 1967).

Another goal of this study was to investigate the influence of submersed macrophyte communities upon the distribution of invertebrates. During the last two decades benthic studies in the Pamlico River have become more numerous, but few have dealt with estuarine seagrass communities and their associated fauna. The importance of macrophytes in providing microhabitats for invertebrates, a source of organic detritus for the detrital pathway, and shelter from predation has been well established (Marsh, 1970; Orth, 1973; Davis and Brinson, 1976). Macrophytes have also been shown to stabilize bottom sediments, reduce shore erosion, accelerate sedimentation, and serve as an inorganic nutrient sink and source (Wood et al., 1969; Davis and Brinson, 1976).

Recently, emphasis has been placed on the use of community parameters such as species richness and diversity in estimating the functional characteristics of communi-

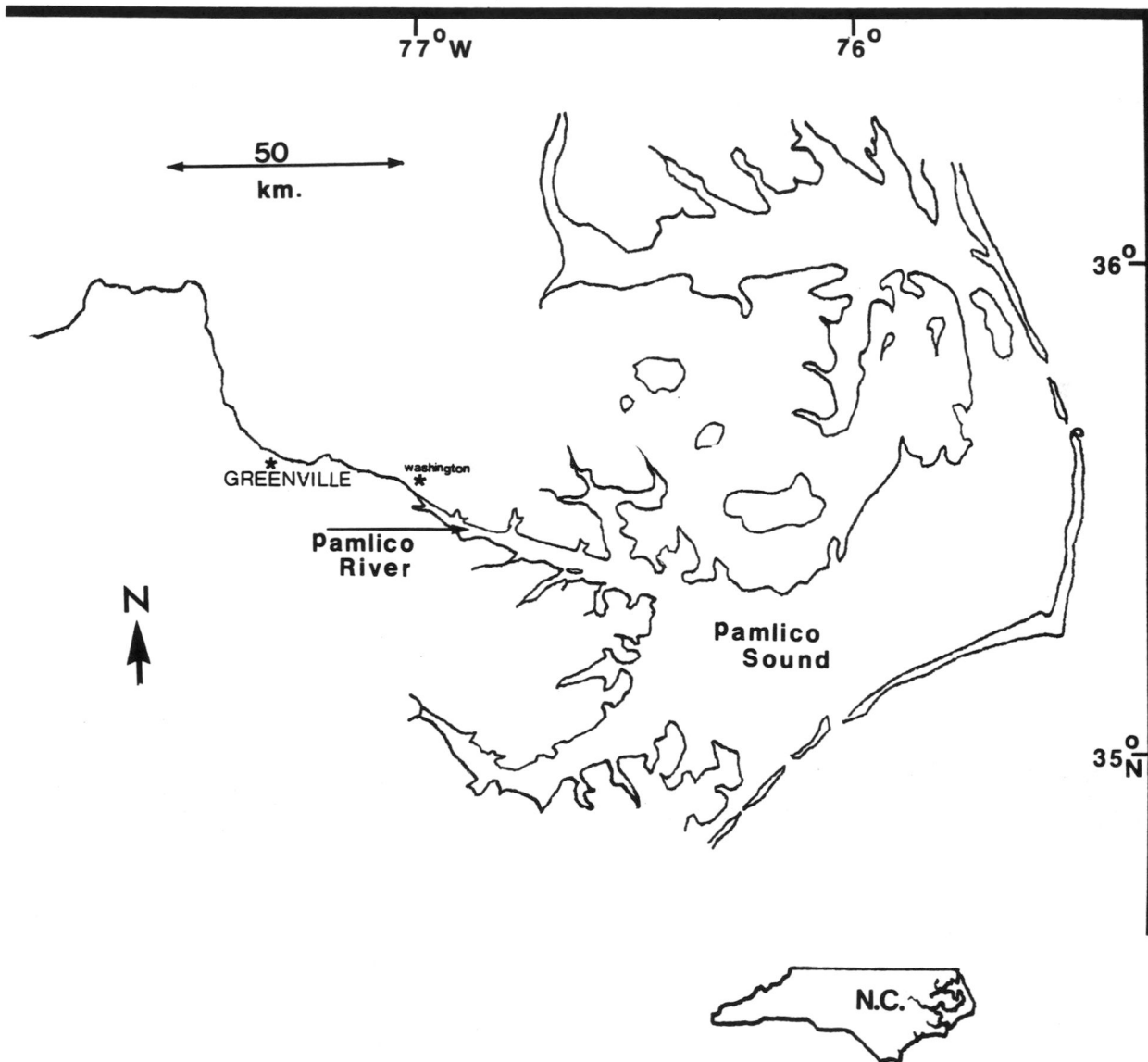
ties (Dahlberg and Odum, 1970; McErlean and Mihursky, 1973). The Shannon-Weaver Diversity Index and Pielou Evenness test have often been utilized in the analysis of benthic communities (Livingston et al., 1976). Model I analysis of variance is commonly encountered as the primary method for evaluation of multiple factor experimental models (Zar, 1974).

Salinity, dissolved oxygen, temperature, and sediment composition have been shown to exert a tremendous influence on the biota (Livingston, 1975). Tenore (1972) proposed that salinity was probably the single most important factor affecting the distribution of benthos in the Pamlico River. Dissolved oxygen was also reported to influence the fauna of the estuary especially where stratification of the water column occurs in response to periods of calm with resultant anoxic conditions (Davis et al., 1978). The effects of temperature extremes upon the biota of shallow estuaries has received only limited attention during the past few decades but is also of major importance to the survival of many invertebrate species (C. E. Jenner, 1976, personal communication). Sediment composition has also been shown to influence the distribution of the benthos (Tenore, 1970; Boesch, 1973).

Descripton of The Pamlico River

The Pamlico River extends approximately 62 km from its main tributary, the Tar River near Washington, to the Pamlico Sound (Figure 1). The width of the estuary varies from 0.5 km near Washington to 6.5 km at its effluence into the Sound. The water depth varies from an average of 1 m near shore to 4-6 m in the deeper central areas of the river. Sediments vary from a predominantly sandy

FIGURE 1. The location of the Pamlico River.



composition near the shore to a silt and clay composition in the vicinity of mid-channel (Tenore, 1972). Although the effect of lunar tides are minimal (15 cm mean amplitude) due to the damping effect of barrier islands along the North Carolina coast (Jarrett, 1966), wind tides occasionally vary the amplitude up to 1 meter (Dean, 1973). According to the Venice classification of brackish waters, the Pamlico River can be characterized as an oligohaline-mesohaline system. Salinities within the estuary range from freshwater to 20‰. Low salinities are attributed to high runoff from the many tributaries while higher salinity values are the result of periods of low precipitation and strong wind tides forcing salt water from the Pamlico Sound into the estuary. Salinities on the north shore are usually higher than those on the south shore, apparently due to the Coriolis effect and prevailing winds (Hobbie, 1970). Salinity stratification often becomes pronounced during summer months with accompanying periods of calm (Davis et al., 1978).

The dominant submerged rooted macrophytes of the Pamlico River are Vallisneria americana, Ruppia maritima, Potamogeton perfoliatus var. bupleuroides, and Najas quadalupensis (Davis and Brinson, 1976). Davis et al. (1978) found that of the total annual organic carbon input to the Pamlico River 0.3% was from macrophyte production and 63.5% was from phytoplankton production. An earlier study established that diatoms and dinoflagellates were the dominant phytoplankton groups of the estuary with blooms of Gymnodinium, Gyrodinium and Polykrikos during the summer and Heterocapsa (Peridinium) triquetrum during the winter (Hobbie, 1971). Deoxygenation has been reported to occur as a result of large blooms of these dinoflagellates

(M. White and D. Kornegay, unpublished data). The copepod Acartia tonsa dominates the zooplankton (Peters, 1968). During summer months the migrating ctenophore, Mnemiopsis leydii, and the jellyfish, Chrysaora quinquecirrha, become an important part of the food chain (Miller, 1970; Miller and Williams, 1972).

The blue crab Callinectes, the shrimp Penaeus, and the eel Anguilla have been commercially harvested for many years in the Pamlico River and are economically important to the nearby fishing communities. During the late 60's the clam Rangia was harvested and shipped to New York where it was processed as a cocktail sauce (P. Comar, personal communication). Presently much of the Pamlico is closed to shellfishing with Rangia no longer being used commercially. In addition to commercial fishing, sport fishing is very popular in the Pamlico River with sustained populations of southern flounder, croaker, spot, speckled and gray trout, and bluefish as well as the migrating striped bass, alewife, shad and herring.

MATERIALS AND METHODS

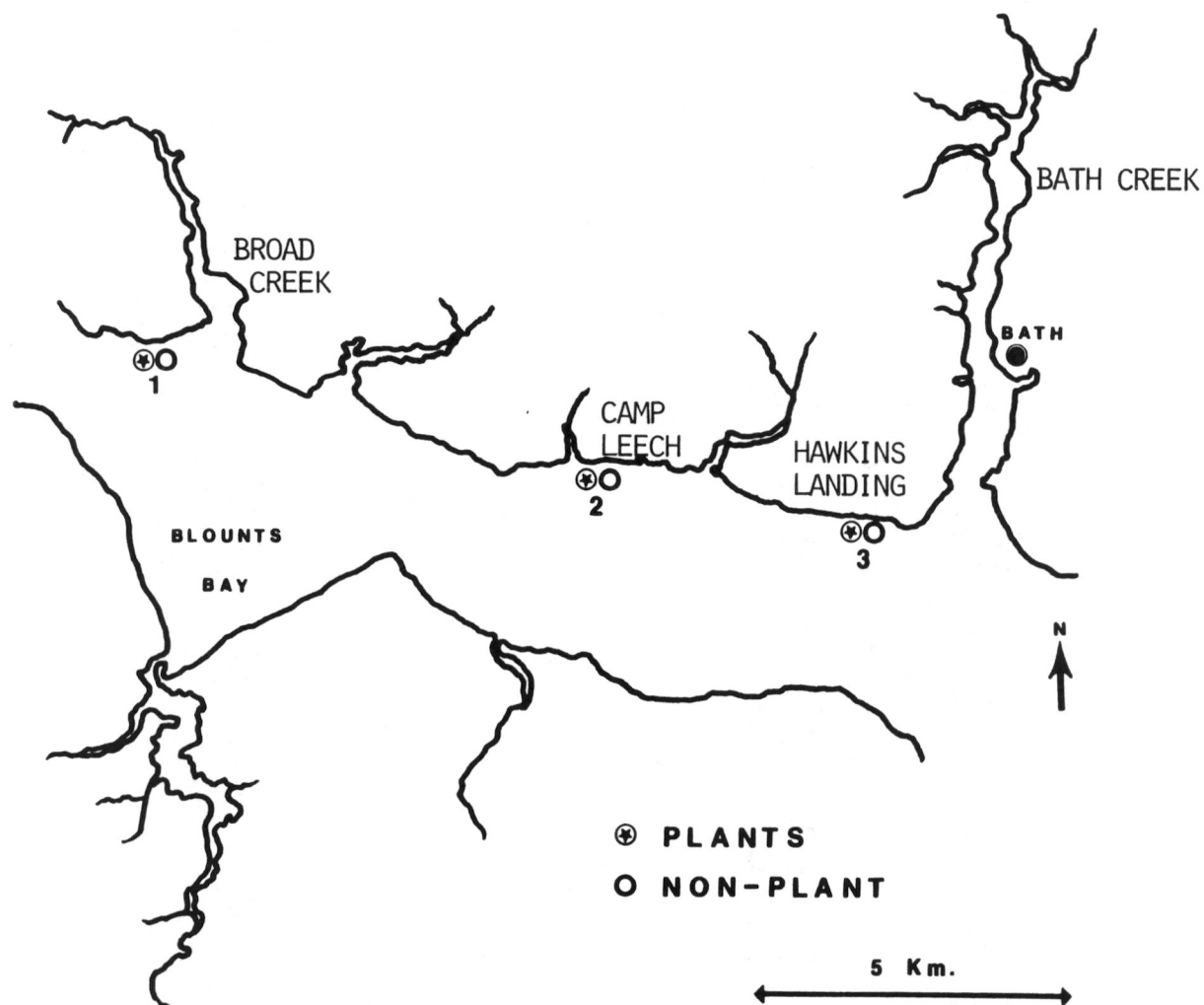
Sampling

Three stations were established along the north shore of the oligohaline-mesohaline portion of the Pamlico River (Figure 2). Station 1 was located at Blounts Bay near the Broad Creek entrance, Station 2 at Camp Leach, and Station 3 at Hawkins Landing. Each station consisted of two 25 m by 25 m sample sites. Paired sample sites at each station consisted of one site virtually void of vascular macrophytes and the other site dominated by dense macrophyte vegetation consisting of Potamogeton and Vallisneria. All sample sites were located in less than 1 m average depth of water and had predominantly sandy sediments. Paired sample sites at each station were located within 200 m of each other. Samples were collected monthly from each of the six sample sites.

Faunal Sampling and Analysis

Substrate samples for faunal analysis were taken by a 5 cm diameter plexiglas core sampler. Core sampling proved to be more reproducible and accurate than dredge sampling especially when sampling fast-moving epibenthic fauna capable of avoiding dredges. This sampling technique also allowed for vertical separation of samples. Each core sample was taken to a depth of 15 cm. As samples were collected, they were immediately divided into the three 5 cm vertical strata and placed into individual glass containers which were placed on ice. Samples were collected monthly with four replicate 15 cm depth samples taken at each of the six sample sites. Samples were held at 4°C

FIGURE 2. Location of sample sites along the
 oligohaline-mesohaline portion of the
 Pamlico River.



until examination. This method for short term preservation proved more convenient than chemical preservation and made subsequent faunal identification easier. Samples were elutriated using a 500 um (U.S. Standard Sieve Mesh No. 35) brass sieve. Organisms retained by the sieving procedure were classified as macrobenthos and retained for further examination. Specimens were identified to species where possible. Densities of each species were recorded and then preserved in 80% ethanol for future reference. Model I - nested factor analysis of variance was utilized for statistical evaluation of invertebrate densities.

Sediment Sampling and Analysis

Samples for sediment analysis were taken during February from each of the six sample sites. Samples were collected in replicates of four by use of the core sampler used for faunal collections. Each core sample was divided into three vertical strata as previously described. Data for percent mud/sand, grain size, and percent organics were obtained using sediment analysis techniques as described by Folk (1961). All samples were initially wet sieved by means of a 62.5 um (U.S. Standard Sieve Mesh No. 230) brass sieve which retained sediment particles classified as sand by the Wentworth Scale for sediments. Mud sediments which passed through the sieve were retained for further analysis. All weights were obtained at ambient temperature and humidity to prevent excessive variation due to moisture absorption (Folk, 1961). After sieving, the sand portions of the samples were analyzed for organic matter. This was accomplished by calculating percent loss on ignition using the following equation:

$$\frac{(\text{wt. loss}(s) \times 100)}{\text{oven-dry, wt.}(s)}$$

s = sample

Bound water lost during the ashing procedure was reintroduced by wetting the sediment with distilled water and then drying at 105°C before weighing (Folk, 1961). A temperature of 450°C for 16 hours was utilized for ashing as described by S. E. Allen et al. (1974). After ashing, the sand sediments were subjected to mechanical agitation for separation into coarse, medium, and fine grain sizes according to the Wentworth Scale. Mud sediments obtained from the initial wet-sieving procedure were also analyzed for percent organics by the loss on ignition method as previously described. Since the mud samples were contained within one liter or more of distilled water, as a result of the wet-sieving procedure, subsampling was necessary. This was accomplished by pipetting a 100 ml aliquot of sample during simultaneous mechanical stirring. The subsample was then filtered through a 0.22 um Millipore type-GS membrane filter which retained all mud sediments. The mud sediments and filter were ashed at 450°C for 16 hours. Bound water was then reintroduced as described for sand sediments. Post ashing weights were determined and recorded.

Hydrographic Sampling and Analysis

Hydrographic data were collected from each sample site at the time of benthic sampling. Water samples were transported to the laboratory where salinity was determined by titration with 1.0 N silver nitrate and with 5 ml of potassium dichromate as the indicator. Dissolved oxygen samples were fixed at the time of collection and later

measured by a modified Winkler titration procedure (Carpenter, 1965). Interstitial water samples for dissolved oxygen and salinity were obtained by means of a pyrex sampler which penetrated the sediment to a depth of approximately 6 cm (Makemson, 1972). Temperatures were measured at time of sample collection using a thermister unit equipped with a 5 cm probe for interstitial readings.

RESULTS AND DISCUSSION

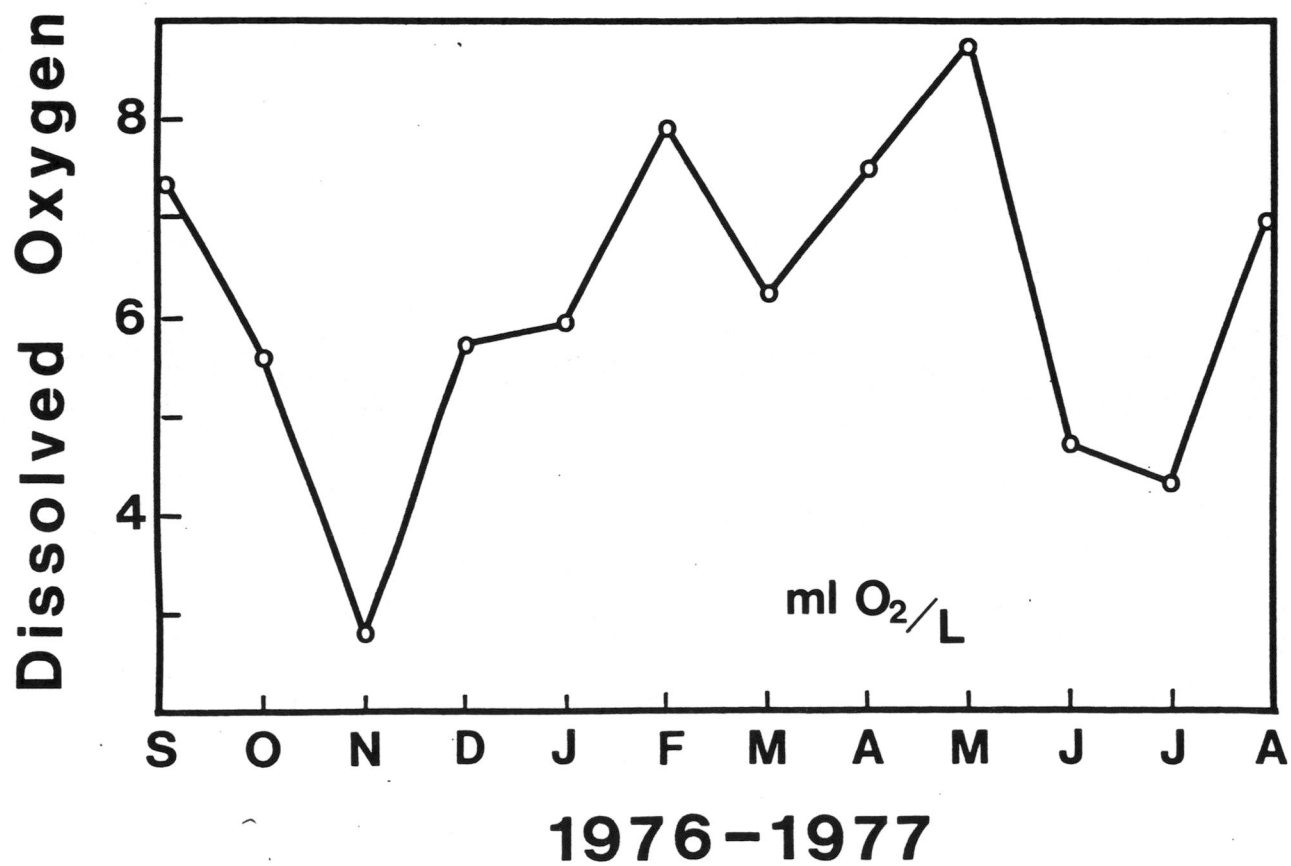
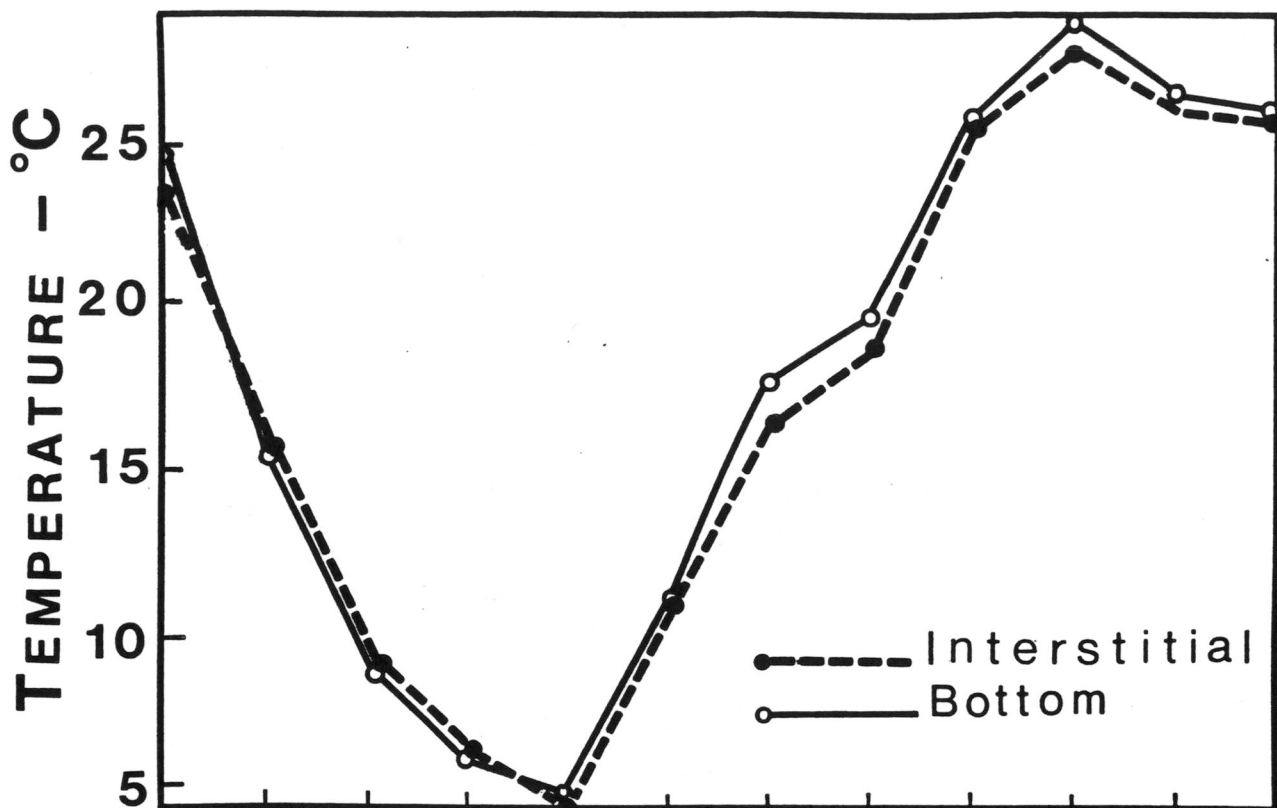
Hydrography and Sediment

Water temperatures (Appendix Table 1-3), as determined from observations at each of six sample sites (Figure 2), showed seasonal extremes varying between 3°C to 31.5°C. The highest temperatures were observed during June and the lowest temperatures during January. Large portions of the shallow areas of the Pamlico River were covered with ice for a period of about four days in January due to a winter storm. The effects of this winter storm were felt throughout the coastal areas of North Carolina and believed to be responsible for the near eradication of several species of marine invertebrates (H. Porter, personal communication). Temperatures between plant and non-plant sample sites, and between stations showed little variation with a maximum difference of 4.5°C (between stations) observed on any one sample date. The surface, bottom, and interstitial water temperatures paralleled each other in a very predictable fashion. As would be expected the greatest temperature extremes were observed at the surface. A lag in temperature was observed from September until December with the interstitial water remaining warmer than the bottom water (Figure 3). Similarly, from January until August the interstitial water remained consistently cooler than the bottom layer of water despite the fact that bottom water continued to warm throughout this period of the year. Only a small variation between surface and bottom water temperatures was observed. This may have been the result of thorough mixing of the water column by wave action.

Dissolved oxygen levels on an average monthly basis ranged from 4 ml/L to 11 ml/L for the surface layer of water (Appendix Table 4). Similarly the average monthly bottom

FIGURE 3. Average bottom and interstitial water temperatures for the Pamlico River.

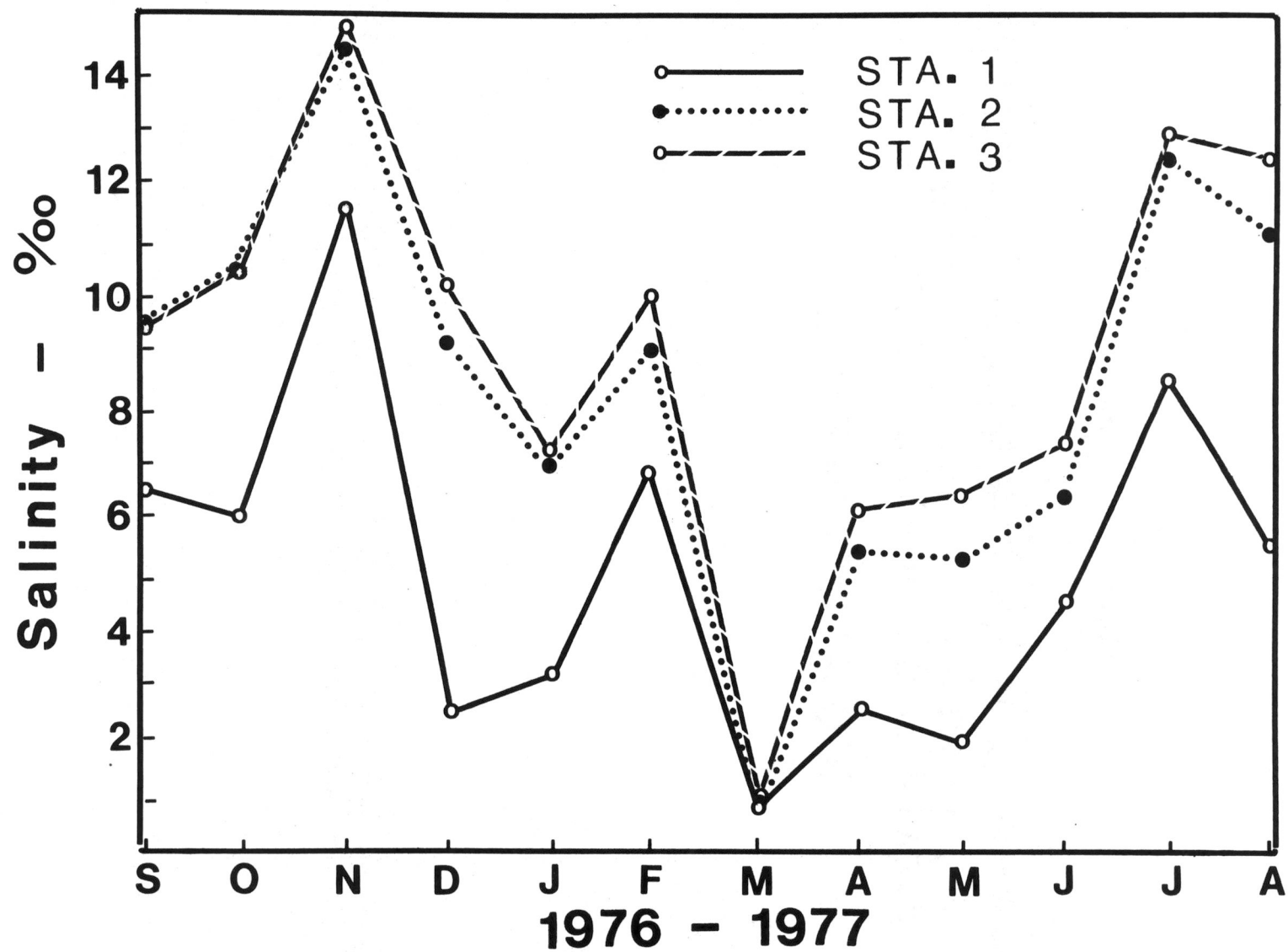
FIGURE 4. Average dissolved oxygen levels of the bottom water at study sites for the Pamlico River.



O₂ levels ranged from 2.8 ml/L to 8.8 ml/L (Appendix Table 5). Anoxic conditions for the water column of the shallow shoreline areas of this study never existed. Although seasonal anoxic conditions do occur in the deeper areas of the estuary, wind probably prevents stratification of the water column in areas less than 2 m in depth. Figure 4 shows average monthly O₂ values for the bottom layer of water. November values were the lowest for the entire period of the study. Previous studies of the Pamlico River have shown low O₂ levels during late summer and early fall but no indication of low levels for November were found (Tenore, 1972). Average monthly interstitial water levels of O₂ ranged from 0.3 ml/L during August to 2.4 ml/L during June. The range for the year was 5.4 ml/L to 0.0 ml/L (Appendix Table 6). In summary, we can say that O₂ levels within the substrate are relatively stable and usually low. The lower values encountered during August could be a result of greater O₂ demand by sediments at higher water temperatures.

Salinity ranged from a maximum of 15.1‰ to a minimum of 0.6‰. November values were the highest recorded during the study with average monthly salinities of 13.6‰, 13.7‰, and 11.8‰ for the surface, bottom, and interstitial layers of water, respectively. The lowest average monthly salinity was recorded in March with 0.9‰, 0.9‰, and 1.8‰ for the surface, bottom, and interstitial water, respectively. These maximum and minimum extremes (Figure 5) coincide with the seasonal salinity peaks observed by Dean (1973). Generally, salinity was lower at Station 1, located at Blounts Bay, and higher at the two down-river stations at Camp Leach and Hawkins Landing (Figure 5). Monthly salinity variation between stations and between vertical layers of

FIGURE 5. Average of surface and bottom monthly
 salinity values of the water column for
 each station.



the water column was small. Stratification of salinity was undiscernable as a result of the instability of the water column. Low salinities occurred in association with fresh water runoff from the Tar and Pamlico River watershed. Seasonally high salinities usually coincided with periods of little rainfall and prolonged southeasterly winds. Winds from this direction forced water of higher salinity upriver from the Pamlico Sound.

Analysis of the sediment from the February sampling revealed a predominately sand substrate (Table 1). Sand composed an average of 98% of all samples. Such a high composition of sand could be explained by the high energy exerted by wave action in the shallow near shore areas of the estuary resulting in transport and removal of finer particles. In contrast, the deeper areas of the estuary (more than 2 m) are composed primarily of a mud sediment (Tenore, 1972). Analysis of grain size revealed averages of 25%, 34%, and 41% for coarse, medium, and fine particle sizes, respectively. Vertical analysis of the sediment fractions revealed minor variations of no significance. The mean organic matter content of the sand fraction was 0.201%. Tenore (1972) reported an average value of 0.57% organics for sand sediments in the Pamlico River. Both of these values represent sediment sampled from the shallow shoreline areas of the estuary. Tenore (1972) reported much higher values for organic matter in the more central mud areas of the River.

Table 1. Sediment analysis of substrate from the February sampling of the Pamlico River.

Surface to 5 cm ^a					
<u>Station 1</u>	% b Sand	<u>Sand Grain Size Analysis</u>			% b Organics
Plant		%Coarse	%Medium	%Fine	
1 ^c	98.36	9.53	30.20	60.27	.199
2	98.71	4.04	28.45	67.50	.354
3	98.71	7.15	25.46	67.39	.191
4	97.34	3.14	28.79	68.07	.287
Non-Plant					
1					
2	99.51	55.32	16.46	28.21	.114
3	99.36	30.18	21.65	48.17	.124
4	99.40	33.61	28.96	37.43	.119
<u>Station 2</u>					
Plant					
1	98.88	4.35	43.46	52.19	.195
2	99.08	6.13	48.77	45.11	.162
3	99.15	3.37	47.70	48.93	.115
4	99.16	3.34	48.18	48.48	.167
Non-Plant					
1	99.16	80.36	13.36	6.28	.232
2	98.78	70.55	19.29	10.17	.316
3	96.74	13.16	21.53	65.31	.565
4	99.49	88.29	5.76	5.94	.255
<u>Station 3</u>					
Plant					
1	98.47	10.26	55.91	33.83	.162
2	98.90	12.00	54.08	33.92	.138
3	99.08	7.79	57.64	34.57	.141
4	99.40	7.33	58.48	34.19	.139
Non-Plant					
1	99.90	60.86	35.21	3.93	.094
2	99.63	35.39	46.57	18.04	.089
3	88.82	21.22	23.74	55.04	.361
4	92.69	15.38	43.80	40.82	1.132

Table 1. (continued)

5 cm to 10 cm ^a					
<u>Station 1</u>	% ^b Sand	<u>Sand Grain Size Analysis</u>			% ^b Organics
Plant		%Coarse	%Medium	%Fine	
1 ^c	99.51	17.01	40.27	42.71	.083
2	99.49	11.38	34.78	53.84	.095
3	99.21	16.29	30.98	52.74	.099
4	98.93	10.32	36.84	52.84	.098
Non-Plant					
1	99.81	26.74	39.60	33.67	.060
2	99.35	19.47	27.54	53.00	.077
3	97.74	10.97	23.72	65.31	.111
4	98.77	20.69	27.40	51.91	.072
<u>Station 2</u>					
Plant					
1	98.09	9.58	51.32	39.10	.210
2	99.60	7.21	49.80	42.99	.187
3	99.60	6.09	55.94	37.96	.202
4	99.65	5.09	54.52	40.39	.183
Non-Plant					
1	99.85	75.12	23.05	1.82	.106
2	99.20	79.04	8.60	12.36	.542
3	97.25	4.18	11.80	84.02	.203
4	99.69	92.24	2.34	5.42	.203
<u>Station 3</u>					
Plant					
1	99.33	15.38	52.44	32.18	.147
2	99.26	18.45	48.62	32.94	.126
3	99.53	10.99	65.78	23.24	.143
4	99.62	14.14	59.06	26.80	.141
Non-Plant					
1	99.85	31.69	52.90	15.41	.112
2	99.71	34.44	49.68	15.88	.119
3	94.95	4.62	15.92	79.46	.322
4	99.16	16.22	46.24	37.55	.319

Table 1. (concluded)

10 cm to 15 cm ^a					
<u>Station 1</u>	% b	<u>Sand Grain Size Analysis</u>			% b
	Sand	%Coarse	%Medium	%Fine	Organics
Plant					
1 ^c	98.94	29.45	35.88	34.66	.156
2	97.91	24.19	36.90	38.91	.149
3	97.09	25.68	32.90	41.42	.138
4	95.96	9.85	33.16	56.99	.197
Non-Plant					
1	99.72	8.53	42.67	48.80	.068
2	94.72	13.07	14.26	72.68	.269
3	96.54	6.86	29.31	63.83	.145
4	98.45	27.63	33.43	38.93	.090
<u>Station 2</u>					
Plant					
1	97.98	5.93	30.43	63.64	.257
2	99.35	15.36	48.01	36.63	.124
3	99.29	3.79	38.25	57.96	.083
4	99.75	10.49	57.49	32.02	.081
Non-Plant					
1	99.41	68.39	19.27	12.34	.164
2	93.31	64.05	6.41	29.54	1.955
3	93.76	6.72	16.96	76.32	.148
4	99.39	80.28	8.69	11.04	.221
<u>Station 3</u>					
Plant					
1	99.31	22.67	38.81	38.52	.089
2	99.32	23.59	29.17	47.24	.087
3	98.89	16.75	32.93	50.32	.092
4	99.32	23.22	36.61	40.17	.153
Non-Plant					
1	99.85	60.10	31.70	8.20	.049
2	99.49	27.03	42.10	30.87	.523
3	90.77	3.87	14.86	81.27	.878
4					

- ^a Sediment profile
^b Percentage by weight
^c Sample replicates

Fauna of the estuary

Invertebrates Associated with Macrophyte Presence

The greatest densities of macrobenthos for each season were found in sample sites containing macrophyte vegetation (Table 2). A total of 1530 individuals were collected during the twelve sample periods from plant sites. This value represents 57.6% of the invertebrates collected. The largest difference in the number of individuals collected between plant and non-plant sites was during the summer months with 63.6% of the macrobenthic individuals found in plant sites. The lowest difference between sites was during the winter with 56.1% found in plant sites.

Seasonal comparisons of major taxonomic groups of fauna collected from plant and non-plant sample sites are shown in Figures 6-9. F-values were determined for each of four taxonomic groups; annelids, crustaceans, insects and mollusks. Analyses involved a paired comparison of macrophyte and non-macrophyte sample areas at each station and interactions of these areas based on season, sediment depth, and location. Annelid and mollusk F-values were found significant at the 0.05 level for a one tailed distribution and (2,144) degrees of freedom for comparisons of macrophyte and non-macrophyte sample sites indicating that densities of these macrobenthos are different for plant and non-plant areas (Table 3). Annelid densities at station 1 were slightly higher for the non-plant site (375:345). Mean densities at station 2 (Figure 6) were slightly higher for the plant site (397:448). Station 3, however, had an almost three fold increase in density of annelids within the plant site (127:347). A trend in annelid dominance in

Table 2 Seasonal totals of macrobenthos from plant and non-plant sample sites, 1976-77

SPECIES	b FALL		WINTER		SPRING		SUMMER		TOTALS	
	a Plant	Non-Plant	Plant	Non-Plant	Plant	Non-Plant	Plant	Non-Plant	Plant	Non-Plant
<u>Corophium lacustre</u>	c 3	3	0	5	0	5	1	0	4	13
<u>Gammarus mucronatus</u>	10	0	0	0	0	0	0	0	10	0
<u>Gammarus tigrinus</u> group	111	104	37	21	6	12	1	1	155	138
<u>Lepidactylus dytiscus</u>	2	0	1	0	7	0	0	1	10	1
<u>Monoculodes edwardsi</u> group	0	2	3	2	0	0	0	0	3	4
Curacean Shrimp	0	1	0	1	0	0	0	0	0	2
<u>Palaemonetes pugio</u>	5	1	0	0	0	2	0	0	5	3
<u>Rhythropanopeus harrisi</u>	5	0	1	1	0	2	0	0	6	3
Coenagrionidae Naiad	3	0	1	0	0	0	0	0	4	0
Tendipes Larvae	12	2	11	10	2	2	15	19	40	33
<u>Cassidinidea lunifrons</u>	8	0	2	0	0	0	0	0	10	0
<u>Cyathura polita</u>	28	11	28	6	30	9	10	4	96	30
<u>Edotea triloba</u>	0	0	0	0	0	0	0	1	0	1
Mysid Shrimp	0	3	1	1	0	0	0	0	1	4
<u>Heteromastus filiformis</u>	15	4	32	5	8	7	8	6	63	22
<u>Hypaniola florida</u>	140	108	72	81	8	1	11	2	231	192
<u>Laeonereis culveri</u>	203	219	136	136	63	46	121	78	523	479
<u>Nereis succinea</u>	1	0	0	0	0	1	3	4	4	5
<u>Polydora</u> sp.	23	3	6	1	0	0	1	1	30	5
<u>Scolecotelepis viridis</u>	23	3	83	58	140	104	47	12	293	177
<u>Myzobdella</u> sp.	0	1	0	0	1	1	3	1	4	3
<u>Myzobdella lugubris</u>	1	0	0	0	2	0	0	0	3	0
<u>Carpelora</u> sp.	9	0	1	0	0	0	1	0	11	0
<u>Rangia cuneata</u>	12	11	4	0	3	1	5	0	24	12
Totals	614	476	419	328	270	193	227	130	1530	1127

a Represent sample sites at each station

b Seasons represented as follows: Fall, September - November
 Winter, December - February
 Spring, March - May
 Summer, June - August

c Numbers of individuals collected per 235.5 cm²

TABLE 3. Nested factor analysis of variance*

	DEGREES OF FREEDOM	F-Values				∞ (1) .05
		CRUSTACEANS	ANNELIDS	MOLLUSKS	INSECTS	
Station	2,144	17.03	7.97	4.00	14.75	3.06
Site (Station)	3,144	0.98	3.61	3.16	0.41	2.67
Season	3,144	17.63	12.75	10.13	3.39	2.87
Depth	2,144	62.33	155.45	29.57	34.36	3.06
Station by Season	6,144	10.91	3.17	4.10	4.49	2.16
Station by Depth	4,144	15.98	7.00	3.33	13.85	2.44
Season by Depth	6,144	16.59	9.58	10.62	3.06	2.16
Site by Season (Station)	9,144	0.68	0.88	0.30	0.79	1.95
Site by Depth (Station)	6,144	0.60	0.83	2.85	0.46	2.16
Station by Season by Depth	12,144	10.87	1.66	4.41	4.02	1.82
Site by Season by Depth (Station)	18,144	0.60	0.70	0.40	0.98	1.68

* Model I - nested factor analysis of variance.

Release 76.4 of the Statistical Analysis System (S.A.S.),
Triangle Universities Computation Center, North Carolina

Station refers to 3 sample areas along the Pamlico River, each
comprised of a plant and non-plant sample site.

Site (Station) refers to plant and non-plant sample sites, each
of the 3 stations.

1976/77

Seasons: Fall, September - November
Winter, December - February
Spring, March - May
Summer, June - August

Depth: Surface to 5 cm
5 cm to 10 cm
10 cm to 15 cm

plant sites can be seen clearly for station 2 and 3 (Figure 6). Annelids at station 1 were dominant in the non-plant site from September through March (Figure 6).

Densities of mollusks were usually very low for both plant and non-plant sample sites. It is noteworthy that approximately 58% of the mollusks collected were from plant sites (Table 2). Table 2 further shows that both species of mollusks had higher seasonal densities in plant sites. Campeloma were found only in plant sites and R. cuneata were found to be twice as abundant in plant sites as non-plant sites.

Although crustaceans and insects were found non-significant for plant site comparisons (Table 3), 57.1% of the insects and 60.1% of the crustaceans collected during this study came from macrophyte sites (Table 2). The crustacean densities at station 1 and 2 were predominately higher in plant sites (Figure 7) except for a peak during October and November at station 1.

FIGURE 6. Seasonal comparisons of annelids in plant and non-plant sites.

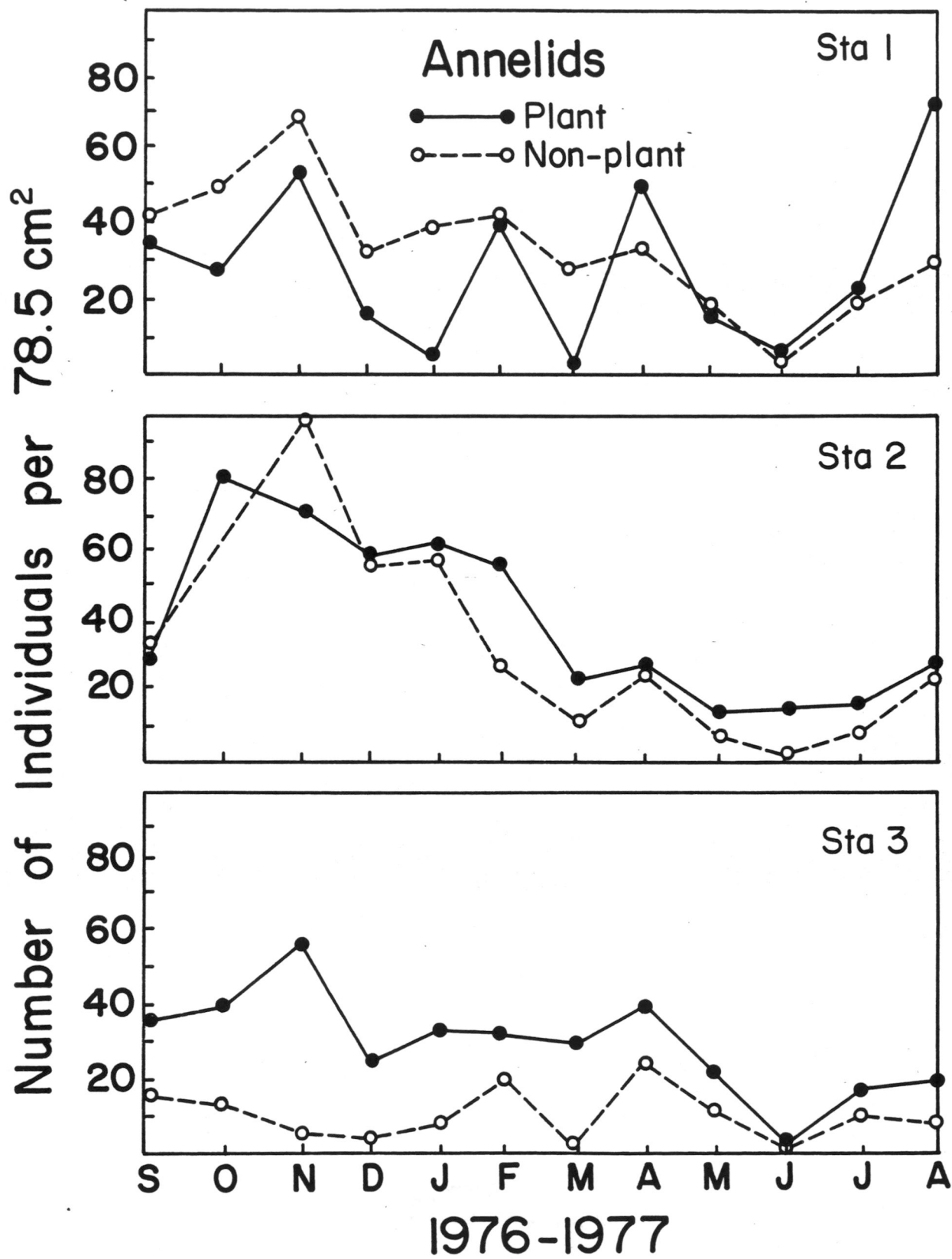


FIGURE 7. Seasonal comparisons of crustaceans in plant and non-plant sites.

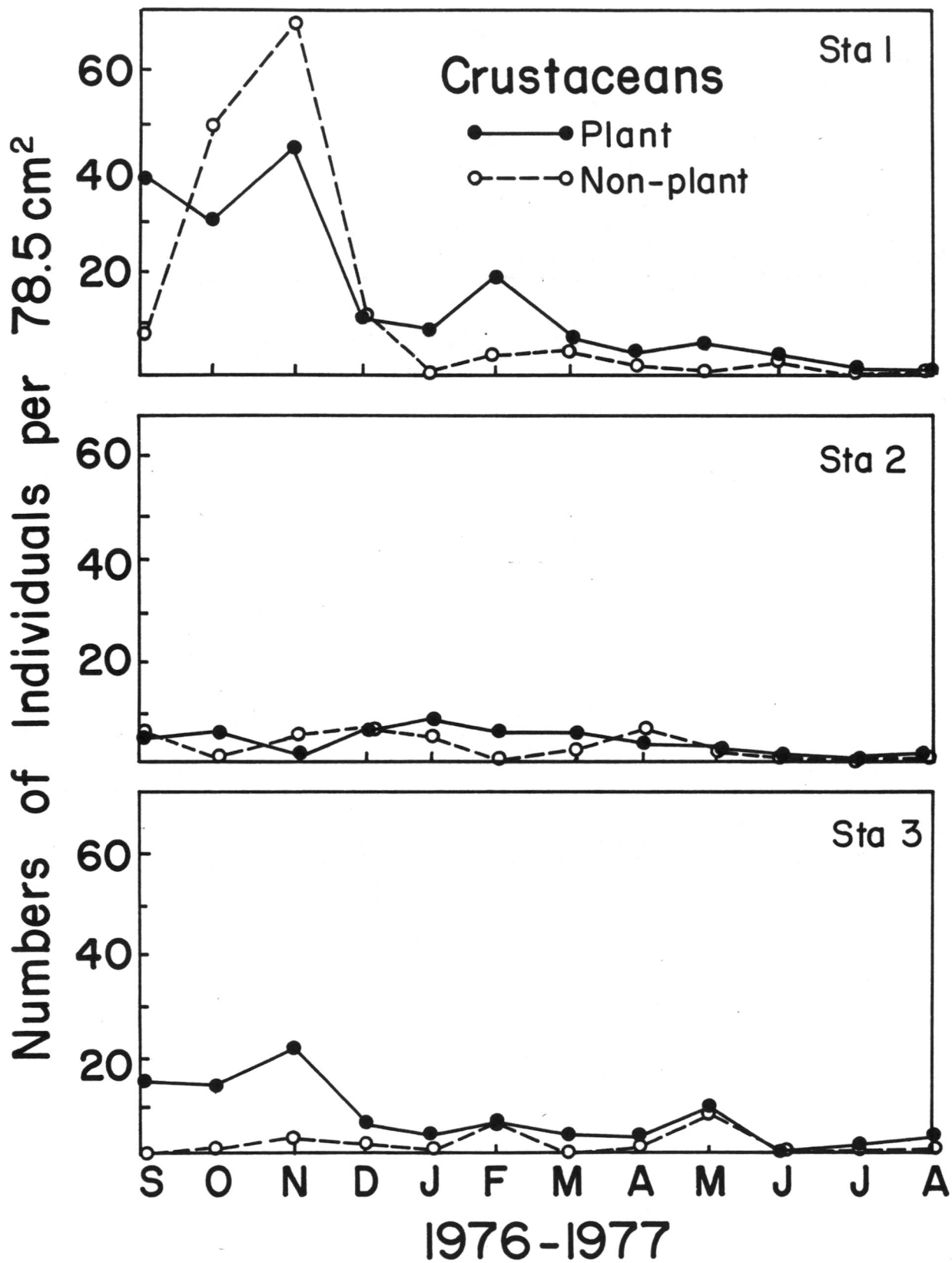


FIGURE 8. Seasonal comparisons of insects in plant and non-plant sites.

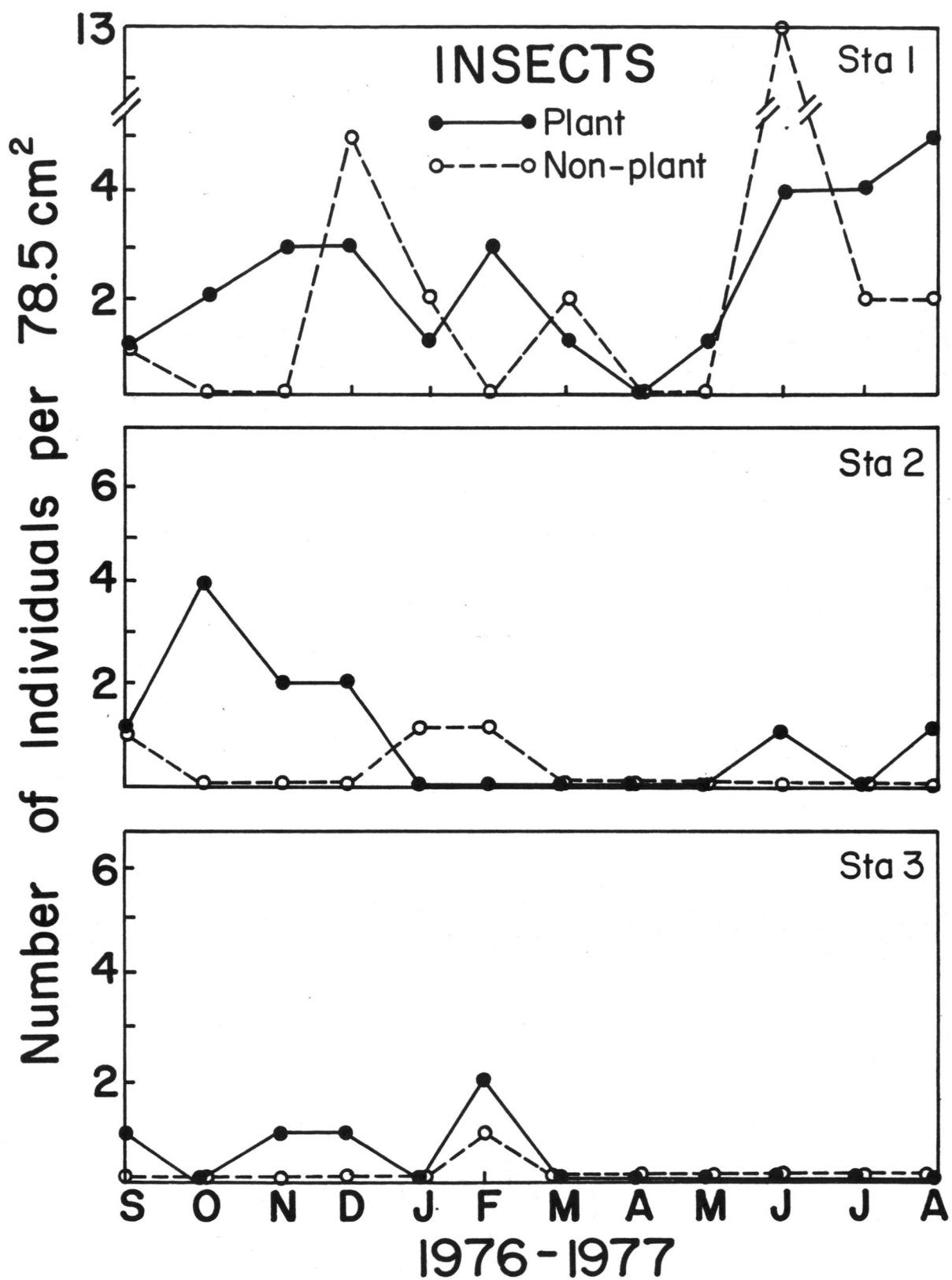
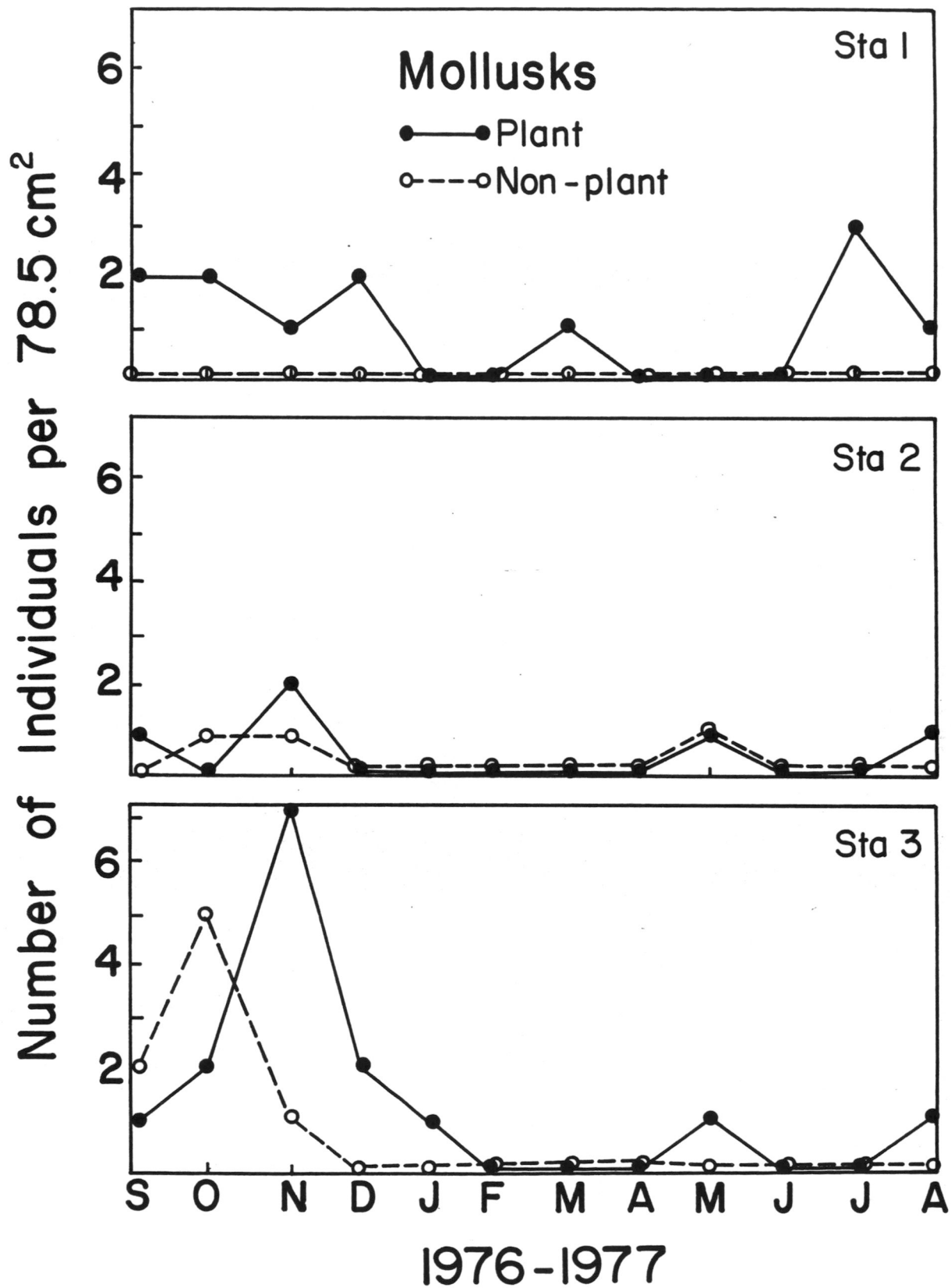


FIGURE 9. Seasonal comparisons of mollusks in plant and non-plant sites.



Hooks et al. (1969), Wood et al. (1969), and Orth (1973) reported higher densities of macroinvertebrates in areas of submersed macrophyte vegetation. Wood et al. (1969) described the function of seagrass as "having a controlling effect on the fertility of estuarine flats". These researchers concluded that macrophytes provided substrate for epiphytes and epifauna, abundant detritus for the detrital pathway, stability for bottom sediments, and protection of fauna from predation.

Seasonal distribution and diversity

A total of 24 species of macrobenthos were sampled during this study. These species were grouped into two major categories according to seasonal distribution. The first category was comprised of those species which were ubiquitous throughout the study. Based on seasonal variation of these organisms they were further divided into two subgroups: (1) annual species and (2) equilibrium species. The second major category was comprised of those organisms which were tenuous in their presence throughout the study.

Annual species exhibit large seasonal pulses in their densities primarily as a result of reproductive programming (Boesch et al., 1976). Gammarus tigrinus (group), Hypaniola florida, and Laeonereis culveri exhibited large increases in densities during late fall of the 1976 sampling of the Pamlico River (Figure 10 and 11), while Scolecoplepides viridis exhibited large densities during late winter and spring. Large numbers of juvenile sets of these organisms were found during their respective peaks in density, indicating a recent spawning. Increases in densities of G. tigrinus (group), H. florida, and L. culveri coincided with a period of increasing salinity while an increase of S. viridis density occurred during a period of increasing temperature following winter. Similar annual pulses in densities were reported for L. culveri in the Mystic River, Connecticut (Pettibone, 1971) and S. viridis in the James River, Virginia (Boesch, 1973). Annual species have been described as exhibiting rapid growth and high fecundity which allow them to rapidly recover from high mortalities encountered from external perturbations such as salinity,

oxygen deficiencies, and pollution (Boesch et al., 1976). These species are adapted for short-term exploitation of unpredictable habitats as often encountered in temperate estuarine ecosystems.

In contrast, equilibrium species usually exhibit a low reproductive potential, slow growth and maturation, and low mortality rates. It is noteworthy that most species usually occupy a space somewhere between these two extremes (Boesch et al. 1976). Rangia cuneata, however, best exemplifies the description of an equilibrium species. Rangia maintains relatively constant densities throughout the year and within each of several age groups (Paul Comer, personal communication). This organism is also characterized by slow growth and maturation but exhibits high reproductive levels. High reproductive levels are important in compensation for high juvenile mortalities resulting from harsh environmental conditions (Boesch et al., 1976). Wolfe and Petteway (1968) reported that Rangia pelagic larval dispersal is only successful in a restricted salinity regime. Because of high juvenile mortalities, a stable low density adult population is maintained. In a more recent study, Boesch (1976) found Rangia cuneata and Mulinia lateralis to be the two most abundant macrobenthos in the James River, Virginia. In the present investigation, Mulinia was not found in any samples collected from the Pamlico River. These results are contrary to the findings of Tenore (1972) who reported high densities of Mulinia in more saline areas of the estuary. The apparent replacement of Mulinia by Rangia possibly indicates a distributional limitation based on salinity. Rangia has been shown to inhabit extremely low salinities or even poikilohaline environments, both of which can inflict heavy mortalities on Mulinia (Wolfe and Petteway, 1968).

FIGURE 10. Seasonal densities of amphipod and isopod crustaceans in the Pamlico River.

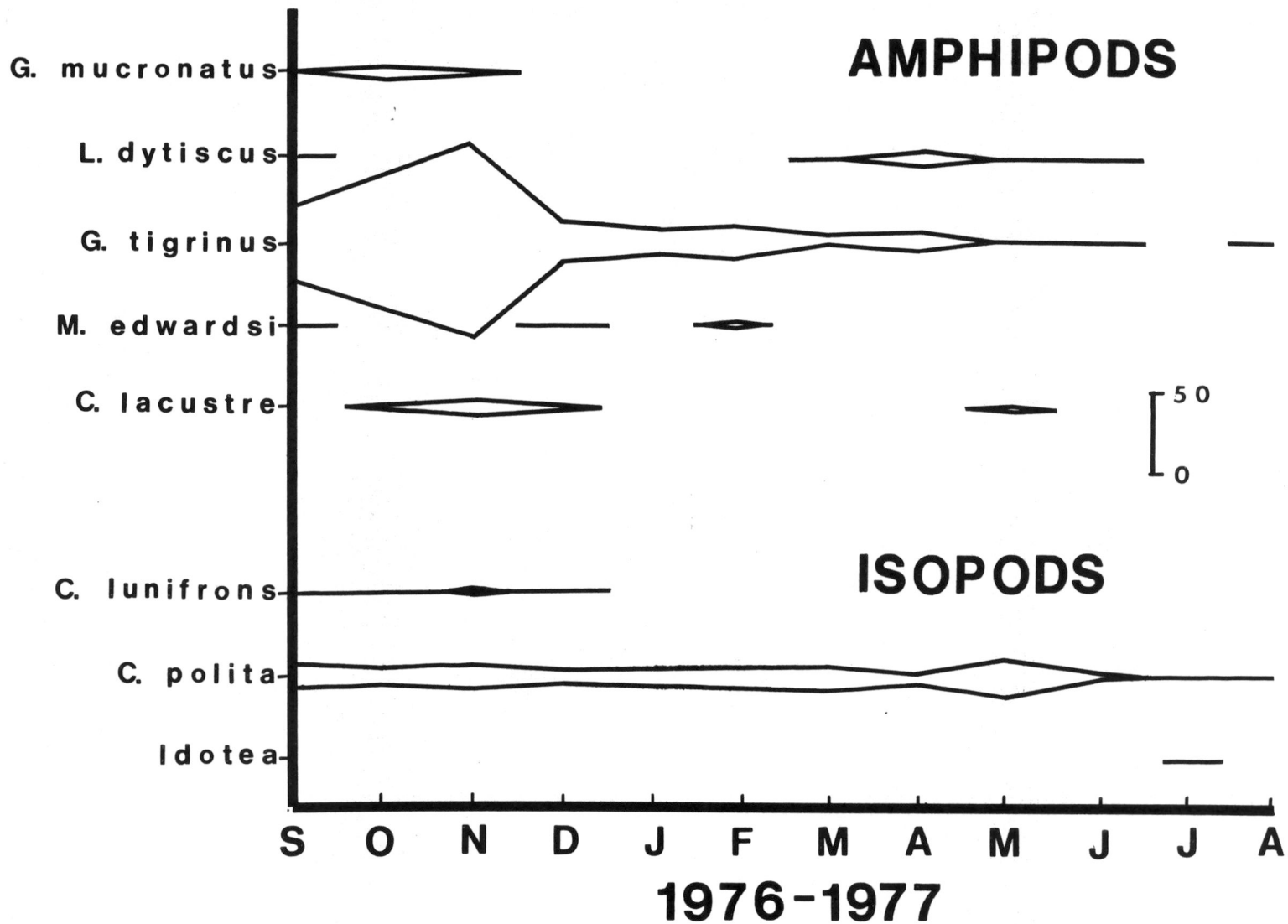
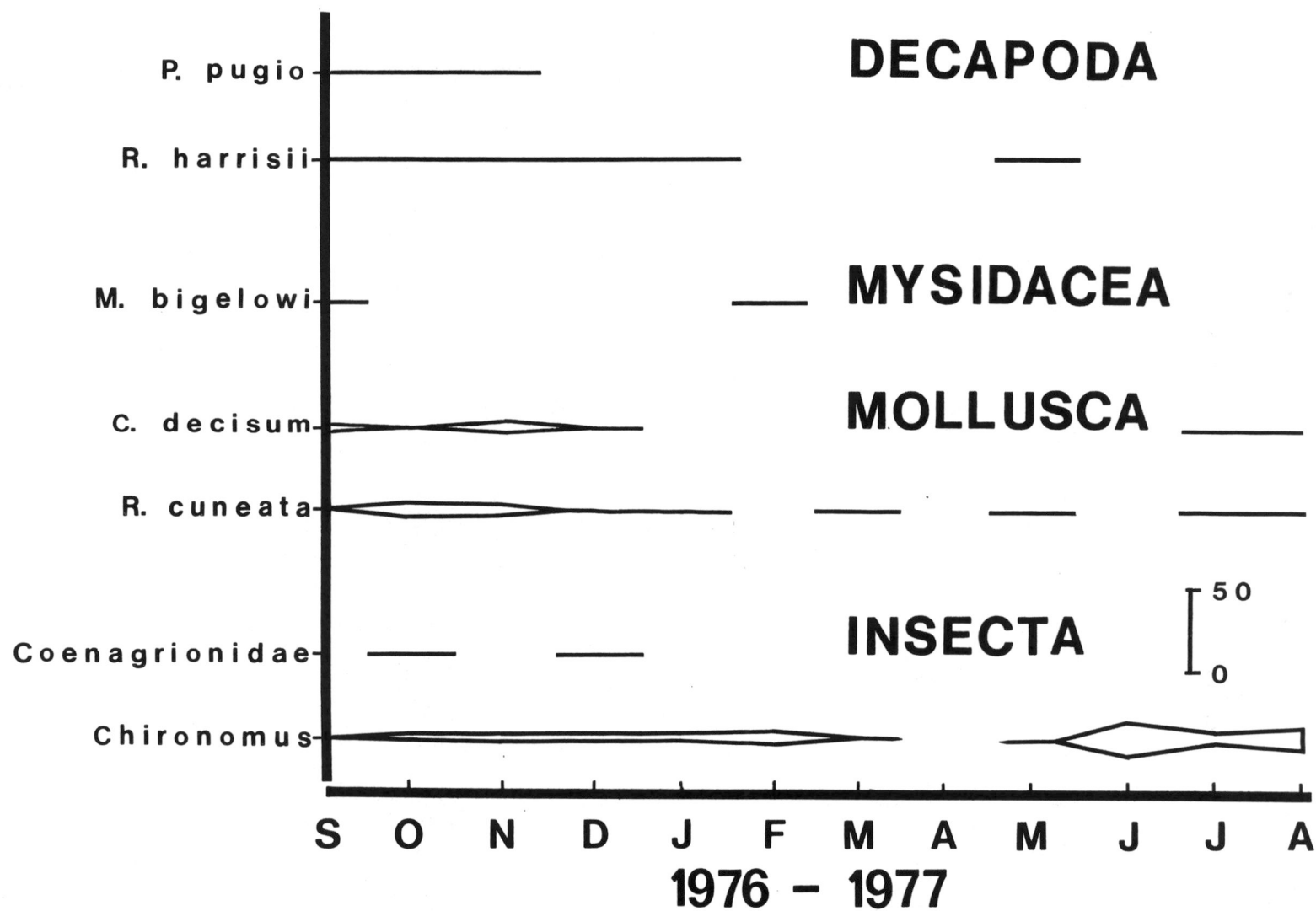


FIGURE 12. Seasonal densities of annelids in the Pamlico River.



FIGURE 11. Seasonal densities of decapod crustaceans, mysidaceans, mollusks, and insects in the Pamlico River.



Tenuous species consisted of organisms which were only present in samples collected two seasons or less out of the year. Since these organisms maintained relatively low densities, their inconsistent distribution is probably related to the small sample size (Cox, 1958). Organisms comprising this group included G. mucronatus, M. edwardsi (group), cumacean shrimp (A), Palaemonetes pugio, Coenagrionidae naiad (A), Cassidinidea lunifrons, Edotea triloba, mysid shrimp (A), and Myzobdella lugubrius (Figures 10, 11, and 12).

Most of the remaining organisms found were rarely encountered and were in relatively small densities when present. The dominant macrobenthos, however, were persistent in their seasonal presence and exhibited large seasonal fluctuations in their densities (Figures 10, 11, and 12). These combined changes in persistence and density reflect varying levels of diversity throughout the year (Table 5). The largest number of species were found during the fall sampling period (Table 4). During this sampling period the macrobenthos was dominated by a small number of species which contained relatively high densities. An overall diversity of 2.4 was obtained for this period (Table 5). The highest seasonal diversity was obtained for the winter sampling period. Although fewer numbers of species were encountered during the winter, invertebrate densities were more equally distributed among species than those reported for fall. Summer had the lowest diversity recorded for this study (Table 5). Heteromastus filiformis and Tendipes larvae (Chironomus) were the only species with their highest densities occurring during summer. Laeonereis culveri and N. succinea also showed high densities during

Table 4. Shannon-Weaver Diversity Index (H) and Pielou Evenness (J)

		STA 1	STA 2	STA 3	
FALL:	H =	2.0	1.7	2.8	
	H MAX =	3.8	3.8	4.0	
	J =	0.5	0.4	0.7	
WINTER:	H =	2.5	2.0	2.6	
	H MAX =	3.6	3.3	3.7	
	J =	0.7	0.6	0.7	
SPRING:	H =	1.6	2.2	2.0	
	H MAX =	3.0	3.3	3.5	
	J =	0.5	0.7	0.6	
SUMMER:	H =	1.8	1.2	2.3	
	H MAX =	3.3	3.0	3.2	
	J =	0.5	0.4	0.7	
FALL:	H =	2.4	SPRING:	H =	2.2
	H MAX =	4.3		H MAX =	3.7
	J =	0.6		J =	0.6
WINTER:	H =	2.6	SUMMER:	H =	2.0
	H MAX =	4.1		H MAX =	3.8
	J =	0.6		J =	0.5

1976-77

Fall,	September	-	November
Winter,	December	-	February
Spring,	March	-	May
Summer,	June	-	August

this period. Tenore (1970) concluded that L. culveri and N. succinea were able to tolerate high temperatures better than many of the other macrobenthic species. This might also account for Heteromastus and Tendipes densities for this period, although summer spawning is perhaps a more reasonable explanation. The highest diversity among locations was found for station 3. The higher salinities at this location could conceivably account for the higher diversity. All seasonal and location evenness values were low (Table 4). Evenness values are influenced by distribution of individuals among the species. These low evenness values appear to be the result of a few dominant species containing the majority of the organisms. Hooks et al. (1976) cited that the reduction in diversity and consequent reduction in competing taxa account for the large numbers of individuals per species found in temperate estuaries. The dominant organisms possess characteristics which allow them to take advantage or exist when resources or habitats are scarce.

In an estuary such as the Pamlico River, many of the species of macrobenthos are ubiquitous throughout the estuary; however, their largest densities may be limited to a restricted area where environmental conditions are optimal. Under these circumstances, the continued recruitment of larvae for organisms living in the periphery of their distribution range is necessary to maintain survival of the species under suboptimal conditions. This could account for the large seasonal fluctuations of many of the species encountered during this study.

Table 5 Seasonal totals of macrobenthos by station, 1976-77

SPECIES	a	b FALL			WINTER			SPRING			SUMMER			TOTALS		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
<u>Corophium lacustre</u>	c	4	0	2	3	0	2	0	2	3	0	0	1	7	2	8
<u>Gammarus mucronatus</u>		0	0	10	0	0	0	0	0	0	0	0	0	0	0	10
<u>Gammarus tigrinus</u> group		192	4	19	31	19	8	4	10	4	1	0	1	228	33	32
<u>Lepidactylus dytiscus</u>		0	0	2	0	0	1	0	4	3	0	0	1	0	4	7
<u>Monoculodes edwardsi</u> group		2	0	0	0	0	5	0	0	0	0	0	0	2	0	5
Curacean Shrimp		1	0	0	1	0	0	0	0	0	0	0	0	2	0	0
<u>Palaemonetes pugio</u>		2	3	1	0	0	0	2	0	0	0	0	0	4	3	1
<u>Rhithropanopeus harrisi</u>		0	2	3	1	1	0	0	0	2	0	0	0	1	3	5
Coenagrionidae Naiad		1	2	0	1	0	0	0	0	0	0	0	0	2	2	0
Tendipes Larvae		6	6	2	13	4	4	4	0	0	32	2	0	55	12	6
<u>Cassidinidea lunifrons</u>		5	0	3	2	0	0	0	0	0	0	0	0	7	0	3
<u>Cyathura polita</u>		23	7	9	22	8	4	20	4	15	8	2	4	73	21	32
<u>Edotea triloba</u>		0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Mysid Shrimp		0	3	0	0	1	1	0	0	0	0	0	0	0	4	1
<u>Heteromastus filiformis</u>		1	3	15	2	5	30	0	3	12	0	0	14	3	11	71
<u>Hypaniola florida</u>		89	110	49	49	90	14	1	7	1	13	0	0	152	207	64
<u>Laonereis culveri</u>		144	221	57	78	158	36	33	50	26	114	64	21	369	493	140
<u>Nereis succinea</u>		0	0	1	0	0	0	0	0	1	0	1	6	0	1	8
<u>Polydora</u> sp.		3	2	21	0	7	0	0	0	0	1	1	0	4	10	21
<u>Scolecoplepis viridis</u>		3	17	6	45	55	41	111	46	87	21	18	20	180	136	154
<u>Myzobdella</u> sp.		1	0	0	0	0	0	2	0	0	2	2	0	5	2	0
<u>Myzobdella lugubris</u>		0	0	1	0	0	0	0	0	2	0	0	0	0	0	3
<u>Campeloma</u> sp.		4	2	3	0	0	1	0	0	0	1	0	0	5	2	4
<u>Rangia cuneata</u>		1	3	19	2	0	2	1	2	1	3	1	1	7	6	23
Totals		482	385	223	250	348	149	178	128	157	196	91	70	1106	952	599

a Numbers represent stations

b Seasons represented as follows:

1976 / 1977

Fall, September - November
 Winter, December - February
 Spring, March - May
 Summer, June - August

c Numbers of individuals collected per 78.5 cm²

Table 6 Seasonal totals of macrobenthos by depth, 1976-77

SPECIES	b FALL			WINTER			SPRING			SUMMER			TOTALS		
	a A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<i>Corophium lacustre</i>	c 6	0	0	5	0	0	5	0	0	1	0	0	17	0	0
<i>Gammarus mucronatus</i>	10	0	0	0	0	0	0	0	0	0	0	0	10	0	0
<i>Gammarus tigrinus</i> group	212	1	2	58	0	0	18	0	0	2	0	0	290	1	2
<i>Lepidactylus dytiscus</i>	2	0	0	1	0	0	7	0	0	0	1	0	10	1	0
<i>Monoculodes edwardsi</i> group	2	0	0	5	0	0	0	0	0	0	0	0	7	0	0
Curacean Shrimp	1	0	0	1	0	0	0	0	0	0	0	0	2	0	0
<i>Palaemonetes pugio</i>	6	0	0	0	0	0	2	0	0	0	0	0	8	0	0
<i>Rhithropanopeus harrisi</i>	5	0	0	2	0	0	2	0	0	0	0	0	9	0	0
Coenagrionidae Naiad	3	0	0	1	0	0	0	0	0	0	0	0	4	0	0
Tendipes Larvae	12	1	1	21	0	0	4	0	0	33	1	0	70	2	1
Cassidinidea lunifrons	8	0	0	2	0	0	0	0	0	0	0	0	10	0	0
<i>Cyathura polita</i>	33	3	3	29	5	0	36	3	0	12	2	0	110	13	3
<i>Edotea triloba</i>	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Mysid Shrimp	3	0	0	2	0	0	0	0	0	0	0	0	5	0	0
<i>Heteromastus filiformis</i>	16	2	1	28	7	2	10	4	1	7	7	0	61	20	4
<i>Hypaniola florida</i>	246	1	1	145	7	1	9	0	0	13	0	0	413	8	2
<i>Laeonereis culveri</i>	364	49	9	222	42	8	78	26	5	181	17	1	845	134	23
<i>Nereis succinea</i>	0	1	0	0	0	0	1	0	0	7	0	0	8	1	0
<i>Polydora</i> sp.	26	0	0	7	0	0	0	0	0	2	0	0	35	0	0
<i>Scolecoteptides viridis</i>	3	12	11	110	23	8	207	27	10	18	30	11	338	92	40
<i>Myzobdella</i> sp.	0	1	0	0	0	0	2	0	0	4	0	0	6	1	0
<i>Myzobdella lugubris</i>	0	1	0	0	0	0	1	1	0	0	0	0	1	2	0
<i>Campeloma</i> sp.	8	1	0	1	0	0	0	0	0	1	0	0	10	1	0
<i>Rangia cuneata</i>	22	1	0	4	0	0	3	1	0	5	0	0	34	2	0
Totals	482	385	223	250	348	149	385	62	16	287	58	12	2304	278	75

a Numbers represent stations

b Seasons represented as follows:

1976 / 1977

Fall, September	- November
Winter, December	- February
Spring, March	- May
Summer, June	- August

c Numbers of individuals collected per 78.5 cm²

Another important distributional characteristic of the macrobenthos was the virtual absence of epifauna, except for those species found on macrophyte vegetation. The oyster, Crassostrea virginica, was not found during this study probably as a result of the absence of a stable substrate for colonization. Under such conditions the benthos are often dominated by infaunal species of annelids and mollusks.

The polychaeta comprised 76% of the fauna collected during this study (Table 5). Tenore (1972) reported, the clam, Rangia cuneata and, the polychaeta, Nereis succinea made up 96% of the fauna of the Blounts Bay area. Present findings revealed Rangia constituted less than .05% while Nereis was not found in the respective location. However, the polychaeta, Laeonereis culveri comprised 33% of the fauna of this region, 52% at station 2, Camp Leech, and 23% at station 3, Hawkins Landing. The similarity in appearance of Nereis and Laeonereis or species replacement due to changing environmental conditions could explain the differences in densities of these species encountered during these studies. The small number of Rangia encountered during this study could be attributed to the unstable sediments of the littoral areas.

Of the 2,657 organisms collected during this study, 87% were from, but not necessarily bound to, the 0-5 cm sediment layer (Table 6). The 2,304 organisms comprising this group includes those epifauna on submersed macrophyte vegetation and surface debris. It is difficult to ascertain how many species were restricted to the various sediment layers since the technique of sediment profile separation might have allowed some contamination from one profile to the next.

In addition, low densities of some species of invertebrates prevent an accurate determination of their presence at various sediment profiles. However, 5 of the 24 species collected were observed in sufficient numbers below the 5 cm level to warrant their inclusion in this group. Those organisms found below 5 cm include H. filiformis, H. florida, L. culveri, S. viridis, and C. polita. All of the above species are polychaetes except, the isopod, Cyathura polita. Cyathura polita was the only species, of the above mentioned, found as epifauna on macrophyte vegetation as well as within the sediments. The 5-10 cm group comprised 10% of the organisms collected and the 10-15 cm group, 3%. The polychaetes, S. viridis and L. culveri were the most prevalent organisms at the 10-15 cm layer while H. florida partially replaced S. viridis at the 0-5 cm level. H. florida abundance above the 5 cm level can be explained by its restriction to the mucous tube it constructs. L. culveri and S. viridis are both errant polychaetes capable of survival at low O₂ levels.

There was little seasonal variation in percentages of macrobenthos at the three sediment levels; however, a general decline in density was observed from the fall of 1976 through the summer of 1977. It is noteworthy to reiterate that extremely low temperatures were encountered during the winter of 1976-77, with extensive areas of the littoral waters of the estuary frozen. A similar decline in invertebrate densities was reported in the Beaufort area of North Carolina for this same time period (personal communication, H. Porter).

The fauna of the sand sediments of the Pamlico River were found to be more diverse than that of the mud

substrates as was also reported by Tenore (1972). This phenomena became apparent from preliminary sampling of the estuary prior to this study. Organisms were usually very scarce or often absent in mud sediments of the estuary. Limited O_2 supply and low redox potentials of mud sediments could be a major factor limiting fauna to the sediment surface. Even on the surface, conditions are usually very harsh. Tenore (1972) cited that increased amounts of silt, found in the more central areas of the estuary, clogs the feeding apparatus of filter-feeding organisms and the continual shifting of the sediment prevents habitation by tube dwelling worms. In addition, the absence of a hard substrate hampers larval settlement and thus initial colonization. These deeper areas of the estuary also experience seasonal anoxic conditions, particularly during the summer, and provide little protection from exposure of the fauna to predation. It is conceivable that increased living space is made available to the infauna of sand substrates. Coarse sediments provide a more favorable condition for habitation by fauna by providing higher oxygen levels and an increase in the depth of the redox discontinuity layer (Boesch, 1973). Additional living space in sand provides habitat heterogeneity for various types of invertebrates with differing types of feeding styles (e.g., surface floc-feeders and subsurface sediment-swallowers). The relation of sediment types to fauna has been well documented (Jones, 1950). Sanders (1958) related faunal assemblages to specific sediment types in Long Island Sound and Buzzards Bay. Lie (1968) concluded that the substrate was the most important factor governing differences in faunal assemblages in Puget Sound, Washington.

SUMMARY

Hydrographic data were collected monthly from each sample site throughout this study. Measurements of water temperature, dissolved oxygen, and salinity were taken from the surface and bottom layers of the water column and from a depth of 6 cm below the sediment surface. Temperatures ranged from 3°C during January to 31.5°C during June. Interstitial water temperature was usually less than that of bottom and surface layers. Surface dissolved oxygen levels ranged from 2.4 ml/L during July to 16.6 ml/L during October, while interstitial levels ranged from 5.4 ml/L to nondetectable levels. Salinities ranged from 15.1‰ during November to 0.6‰ during March. Salinities tended to increase toward the Pamlico sound except when fresh water runoff from nearby creeks had a controlling influence during periods of high rainfall.

Sediments from each sample site were collected during February of the sampling regime and analyzed for particle composition and organic content by the loss on ignition method. Mean organic content was determined to be approximately 0.2% of the total weight. Grain size analysis revealed a predominately sand composition.

The macrobenthos population was found to be low in diversity and density. A total of 24 species of invertebrates were identified. The Shannon-Weaver diversity index revealed low values of 1.24 to 2.77, while Pielou evenness values ranged from 0.05 to 0.732. The fauna was usually dominated by large densities of only one or two species with the remaining species densities being relatively low. Large seasonal variations in densities

were observed primarily as a result of seasonal programming in species recruitment. Major reproductive pulses were exhibited during Fall and Spring. The polychaetes dominated the fauna throughout the year with Laeonereis culveri and Hypaniola florida exhibiting large Fall densities and Scolecopelides viridis exhibiting large Spring densities. The amphipod G. tigrinus (group) was the dominate arthropod with high densities during the Fall. However, the isopod Cyathura polita, the insect larvae Chironomus, and the bivalve clam R. cuneata maintained relatively low and stable densities. These latter species due to their stable presence are good pollution indicators whereas the vast majority of the fauna are transient in their presence.

Approximately 59% of the invertebrates collected were from sample sites containing dense macrophyte vegetation. The relationship between macrophyte and faunal densities is still somewhat unclear. Conceivably, plants could provide organic nutrients for the detrital pathway, stabilize bottom sediments, provide a firm substrate, increase the area available for attachment by epifauna, and provide protection from predation. The importance of these shallow littoral areas has been a subject of intensive investigation over the past decade. Previous studies have shown these areas to be vastly more abundant in fauna. These macrophyte areas have been referred to as the breeding grounds of estuaries. The productivity of the entire estuary is conceivably dependent upon the existence of macrophyte areas.

Ancillary studies on macrobenthic populations and life histories will increase our knowledge of estuarine dynamics and provide better baseline data for evaluating

short duration impact studies. Without a through knowledge of community dynamics, the effects of pollutants cannot be accurately differentiated from normal variation.

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APPENDIX

APPENDIX TABLE 1 TEMPERATURE (°C) OF THE SURFACE WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	26.0	25.0	26.0	27.0	26.0	26.0
Oct.	16.0	16.0	15.0	16.0	15.0	15.0
Nov.	10.0	11.0	7.0	8.5	9.5	9.5
Dec.	6.0	6.5	6.5	7.0	5.5	5.5
Jan.	5.0	4.5	5.5	7.5	3.0	3.0
Feb.	12.5	13.5	12.0	11.5	11.0	11.0
March	17.5	18.0	18.0	18.5	17.0	18.0
April	20.5	21.0	19.0	18.0	18.0	19.0
May	27.0	26.5	28.0	28.0	27.0	28.5
June	28.5	28.5	30.0	31.0	----	31.5
July	29.0	----	28.0	29.0	24.5	26.5
Aug.	27.5	28.0	26.5	27.0	26.0	26.0

APPENDIX TABLE 2 TEMPERATURE (°C) OF THE BOTTOM WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	23.0	24.0	23.0	26.0	25.5	26.0
Oct.	16.0	16.0	15.0	16.0	15.0	15.0
Nov.	10.0	11.0	9.0	9.0	9.0	9.5
Dec.	6.0	6.5	6.5	7.0	5.5	5.5
Jan.	4.5	4.5	5.5	7.5	3.0	3.0
Feb.	12.5	13.5	12.0	11.5	11.0	11.0
March	17.5	18.0	18.0	18.5	17.0	18.0
April	20.0	21.0	19.0	19.5	18.0	19.0
May	26.0	26.5	27.0	28.0	26.0	26.5
June	27.0	27.0	29.0	29.5	----	30.5
July	28.5	----	27.5	28.0	24.5	26.0
Aug.	27.0	28.0	26.5	27.0	26.0	26.0

APPENDIX TABLE 3 TEMPERATURE (°C) OF THE INTERSTITIAL WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	23.0	22.0	23.5	24.0	24.0	25.0
Oct.	16.0	16.0	15.5	16.0	16.0	15.5
Nov.	10.5	10.5	9.0	9.5	9.5	9.5
Dec.	6.0	6.0	6.0	8.0	6.0	5.5
Jan.	4.0	3.0	3.5	6.0	3.5	3.0
Feb.	11.5	11.0	10.5	10.0	11.0	11.0
March	16.0	17.0	16.0	17.0	16.0	16.5
April	18.5	19.0	18.0	18.0	17.5	18.0
May	25.0	26.0	26.0	26.5	25.5	25.5
June	25.0	25.0	28.5	27.5	----	29.0
July	27.0	----	26.0	26.5	26.0	26.0
Aug.	26.0	27.0	26.0	27.0	26.0	26.0

APPENDIX TABLE 4 DISSOLVED OXYGEN (ml/l) OF THE SURFACE WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	7.5	12.4	7.8	7.9	9.6	11.2
Oct.	16.6	14.2	12.2	9.8	6.4	7.2
Nov.	3.4	3.8	8.0	2.8	3.6	5.4
Dec.	6.8	6.0	7.2	5.2	7.0	7.6
Jan.	----	----	----	---	7.2	6.4
Feb.	7.4	7.2	9.4	7.4	6.4	7.4
March	7.2	7.2	5.2	5.0	6.4	6.6
April	7.4	7.4	7.4	7.2	7.4	7.6
May	8.8	9.8	7.6	7.8	7.8	7.8
June	5.4	4.8	4.6	5.0	4.6	4.6
July	4.0	3.6	6.6	3.8	2.4	3.6
Aug.	7.2	5.8	6.8	7.6	7.4	7.0

APPENDIX TABLE 5 DISSOLVED OXYGEN (ml/l) OF THE BOTTOM WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	5.9	11.1	9.0	6.8	7.7	7.2
Oct.	8.0	8.6	4.5	4.0	4.6	4.0
Nov.	3.4	3.8	1.7	1.8	2.6	3.6
Dec.	6.2	7.6	5.4	5.2	4.6	5.8
Jan.	5.8	5.2	6.4	5.8	5.6	7.0
Feb.	8.4	7.0	9.7	8.6	6.4	7.6
March	7.6	6.8	5.2	5.0	6.4	6.6
April	7.6	7.6	7.2	7.8	7.2	7.6
May	10.0	10.2	8.0	8.2	8.4	7.8
June	4.8	4.8	4.8	4.6	4.6	4.6
July	3.8	4.8	6.8	4.2	3.2	3.0
Aug.	7.2	6.0	6.8	7.6	7.6	6.8

APPENDIX TABLE 6 DISSOLVED OXYGEN (ml/l) OF THE INTERSTITIAL WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	3.4	3.4	0.8	1.6	4.2	0.0
Oct.	0.4	1.6	0.4	---	1.6	1.5
Nov.	0.7	1.2	0.6	1.6	0.6	0.5
Dec.	0.0	0.2	1.0	0.4	---	---
Jan.	1.2	1.4	0.7	3.2	0.1	1.8
Feb.	0.3	1.6	0.0	5.2	1.4	1.6
March	0.0	1.6	0.2	0.4	1.2	0.6
April	1.2	1.8	1.0	5.4	1.4	2.8
May	0.0	0.0	0.8	0.4	1.6	2.8
June	1.7	0.4	1.2	2.4	4.6	3.8
July	0.6	2.0	0.8	0.8	2.4	0.6
Aug.	0.0	0.0	0.0	0.8	0.0	1.0

APPENDIX TABLE 7 SALINITY (‰) OF THE SURFACE WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	6.13	6.31	8.46	8.73	9.62	9.53
Oct.	5.68	5.41	10.52	10.61	10.52	10.43
Nov.	11.42	11.42	14.65	14.20	14.65	15.10
Dec.	2.27	2.54	9.00	9.27	10.52	10.53
Jan.	-----	-----	-----	-----	7.20	7.29
Feb.	7.12	6.94	8.82	8.46	9.90	10.17
March	0.65	1.19	0.74	1.01	0.65	1.28
April	2.63	2.63	5.50	5.50	6.13	6.13
May	2.00	2.00	5.41	5.50	6.40	6.40
June	4.51	4.51	6.48	6.48	7.74	7.74
July	8.64	8.64	13.03	12.76	12.85	13.03
Aug.	5.95	5.23	11.51	11.15	12.76	12.50

APPENDIX TABLE 8 SALINITY (‰) OF THE BOTTOM WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	6.48	6.48	9.98	8.82	9.53	9.36
Oct.	6.31	5.68	10.70	10.70	10.61	10.43
Nov.	11.87	11.33	14.92	14.20	14.65	15.10
Dec.	2.45	2.45	9.00	9.27	10.16	10.52
Jan.	3.26	3.35	7.11	6.75	7.38	7.20
Feb.	6.85	6.85	9.70	8.37	9.99	10.26
March	0.56	1.19	0.74	1.01	0.65	1.28
April	2.63	2.63	5.50	5.50	6.13	6.13
May	2.00	2.00	5.41	5.50	6.48	6.48
June	4.51	4.51	6.48	6.48	7.74	7.74
July	8.64	8.64	12.85	12.67	12.85	13.12
Aug.	5.95	5.23	11.51	11.15	12.76	12.50

APPENDIX TABLE 9 SALINITY (‰) OF THE INTERSTITIAL WATER

	STATION 1		STATION 2		STATION 3	
	PLANT	NON-PLANT	PLANT	NON-PLANT	PLANT	NON-PLANT
Sept.	7.29	6.75	10.88	10.70	8.10	8.82
Oct.	7.92	7.29	10.79	10.16	9.36	11.60
Nov.	9.89	9.18	13.75	12.67	10.99	14.38
Dec.	5.86	6.31	10.30	9.09	-----	10.34
Jan.	6.66	4.06	8.73	6.93	8.91	8.55
Feb.	7.21	3.89	9.36	9.18	10.35	9.99
March	1.55	2.54	1.64	1.10	2.27	1.46
April	0.65	-----	3.43	5.23	5.59	5.50
May	3.61	3.61	5.68	6.04	7.56	8.64
June	3.88	3.00	6.47	6.13	7.74	7.73
July	10.25	9.62	12.76	11.06	12.59	13.21
Aug.	6.75	5.23	11.24	10.79	11.51	12.41

Appendix Table 10

Numbers of organisms found in the sampling of Station 1
of the Pamlico River estuary.

Species	Station 1 Plant Bed						September		
	Sample 1			Sample 2			Sample 3		
	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	10	-	-	21	-	-	1	-	-
<u>Palaemonetes pugio</u>	-	-	-	-	-	-	1	-	-
Tendipes larvae	-	-	-	-	-	-	1	-	-
<u>Cassidinidea lunifrons</u>	1	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	1	-	-	3	-	-	-	-	-
<u>Hypaniola florida</u>	2	-	-	-	-	-	2	-	-
<u>Laonereis culveri</u>	2	-	-	7	-	-	1	-	-
Unidentified polychaeta	-	-	-	4	-	-	-	-	-
<u>Campeloma</u> sp.	-	-	-	1	-	-	-	-	-
Nematodes	10	-	-	1 20	-	-	2 2	-	-

Station 1 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	5	-	-	1	-	-
Tendipes larvae	-	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	1	-	-
<u>Hypaniola florida</u>	-	-	-	9	-	-	-	-	-
<u>Laonereis culveri</u>	23	-	-	1 1	-	-	- 1	-	-
Unidentified polychaeta	-	-	-	-	-	-	-	-	-
Nematodes	2	1	-	-	-	-	-	-	-

Appendix Table 10 (continued)

Station 1 Plant Bed

October

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	8	-	1	1	-	1	10	-	-	6	-	-
Coenagrionidae Naiad	-	-	-	1	-	-	-	-	-	-	-	-
Tendipes larvae	-	-	-	1	-	-	-	-	-	-	-	-
<u>Cassidinidea lunifrons</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	1	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	5	-	-	-	-	-	5	-	-	1	-	-
<u>Laonereis culveri</u>	4	-	-	1	-	-	4	-	-	3	-	-
<u>Polydora</u> sp.	1	-	-	-	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	-	-	1	-	1	-	-	-	-	-	-	-
Unidentified polychaeta	-	1	-	-	-	-	-	-	-	-	-	-
<u>Campelora</u> sp.	-	-	-	-	-	-	-	-	-	1	-	-
<u>Rangia cuneata</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	46	22	-	6	72	-	61	23	1	39	7	-

Station 1 Non-Plant

<u>Corophium lacustre</u>	-	-	-	-	-	-	-	-	-	2	-	-
<u>Gammarus tigrinus</u> group	4	-	-	5	-	-	11	-	-	22	-	-
<u>Monoculodes edwardsi</u> group	1	-	-	1	-	-	-	-	-	-	-	-
Crustacean shrimp	1	-	-	-	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	1	-	1	-	-	-	-	-	-	2	-	-
<u>Hypaniola florida</u>	1	-	-	7	-	-	1	-	-	2	-	-
<u>Laonereis culveri</u>	6	5	-	5	1	-	2	1	1	9	-	-
<u>Polydora</u> sp.	-	-	-	-	-	-	1	-	-	-	-	-
<u>Myzobdella</u> sp.	-	1	-	-	-	-	-	-	-	-	-	-
Nematodes	-	3	-	1	-	-	-	3	1	1	3	-

Appendix Table 10 (continued)

Station 1 Plant Bed

November

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Corophium lacustre</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Gammarus tigrinus</u> group	9	-	-	4	-	-	8	-	-	13	-	-
<u>Palaemonetes pugio</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Tendipes</u> larvae	-	-	-	2	-	-	-	-	-	1	-	-
<u>Cassidinidea lunifrons</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	2	-	-	-	-	1	2	-	-	3	-	-
<u>Hypaniola florida</u>	7	-	-	4	-	-	9	-	-	9	-	-
<u>Laonereis culveri</u>	6	-	-	6	-	-	1	1	-	9	-	-
<u>Polydora</u> sp.	-	-	-	-	-	-	-	-	-	1	-	-
<u>Scolecoides viridis</u>	-	-	-	-	-	-	-	1	-	-	-	-
<u>Campeloma</u> sp.	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	28	3	-	19	63	12	20	6	4	11	-	-

Station 1 Non-Plant

<u>Corophium lacustre</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Gammarus tigrinus</u> group	6	-	-	-	-	-	17	-	-	27	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	2	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Hypaniola florida</u>	7	-	-	-	-	-	7	-	-	6	1	-
<u>Laonereis culveri</u>	5	2	-	-	2	-	11	1	-	8	2	-
Unidentified polychaeta	-	-	1	-	-	-	-	-	-	-	-	-
Nematodes	12	-	-	-	10	1	6	-	-	-	2	-

Appendix Table 10 (continued)

Station 1 Plant Bed

December

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	2	-	-	2	-	-	1	-	-	2	-	-
<u>Rhithropanopeus harrisi</u>	-	-	-	-	-	-	1	-	-	-	-	-
Coenagrionidae Naiad	-	-	-	-	-	-	1	-	-	-	-	-
Tendipes larvae	-	-	-	-	-	-	1	-	-	1	-	-
<u>Cassidinidea lunifrons</u>	-	-	-	-	-	-	2	-	-	-	-	-
<u>Cyathura polita</u>	2	-	-	-	-	-	1	-	-	-	-	-
<u>Heteronastus filiformis</u>	1	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	3	-	-	3	-	-	-	-	-	2	-	-
<u>Laonereis culveri</u>	4	-	-	2	-	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	-	-	-	1	-	-	1	-	-	-	-	-
Nematodes	1	25	-	3	2	-	3	15	-	5	1	-

Station 1 Non-Plant

<u>Corophium lacustre</u>	3	-	-	-	-	-	-	-	-	-	-	-
<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	4	-	-	4	-	-
Tendipes larvae	-	-	-	3	-	-	1	-	-	1	-	-
<u>Cyathura polita</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	6	-	-	2	-	-	6	-	-	3	-	-
<u>Laonereis culveri</u>	5	-	-	1	-	-	2	-	-	7	-	-
Nematodes	1	2	1	5	5	1	3	2	-	-	2	-

Appendix Table 10 (continued)

Station 1 Plant Bed

January

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	-	-	-	2	-	-	-	-	-	-	-	-
Tendipes larvae	-	-	-	-	-	-	-	-	-	1	-	-
<u>Cyathura polita</u>	1	-	-	2	-	-	-	1	-	2	1	-
<u>Hypaniola florida</u>	1	-	-	-	-	-	1	-	-	1	-	-
<u>Laeonereis culveri</u>	1	3	-	-	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	3	2	-	-	2	-	5	4	-	3	1	-

Station 1 Non-Plant

<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	-	-	-	-	-	-
Crustacean Shrimp	-	-	-	-	-	-	1	-	-	-	-	-
Tendipes larvae	1	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	6	-	-	-	3	-	1	-	-	-	-	-
<u>Laeonereis culveri</u>	3	-	-	4	8	-	5	1	-	2	2	1
<u>Scolecoides viridis</u>	-	-	-	2	-	-	-	-	-	-	-	-
Nematodes	-	-	4	-	1	23	-	-	-	-	2	-

Appendix Table 10 (continued)

Station 1 Plant Bed

February

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	3	-	-	1	-	-	1	-	-	4	-	-
Tendipes larvae	-	-	-	1	-	-	1	-	-	1	-	-
<u>Cyathura polita</u>	2	-	-	-	-	-	4	-	-	4	-	-
<u>Hypaniola florida</u>	3	-	-	-	-	-	4	-	-	-	-	-
<u>Laonereis culveri</u>	-	2	-	1	-	-	5	-	-	5	-	-
<u>Scolecoides viridis</u>	2	-	-	12	-	-	5	-	-	-	-	-
Nematodes	12	3	-	4	1	-	12	2	-	13	-	-

Station 1 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	2	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	4	-	-	-	-	-	-	-	-
<u>Laonereis culveri</u>	1	-	-	7	-	-	3	1	-	1	1	-
<u>Scolecoides viridis</u>	6	-	-	12	-	-	5	-	-	-	-	-
Unidentified Polychaeta	-	-	-	-	-	-	-	1	-	-	-	-
Nematodes	-	2	-	-	-	-	2	-	-	3	-	-

Appendix Table 10 (continued)

Station 1 Plant Bed

March

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<i>Tendipes</i> larvae	-	-	-	-	-	-	1	-	-	-	-	-
<u><i>Cyathura polita</i></u>	2	-	-	4	-	-	-	-	-	1	1	-
<u><i>Laonereis culveri</i></u>	-	-	-	-	-	-	-	-	-	-	2	-
<u><i>Scolecoides viridis</i></u>	-	-	-	-	-	-	-	-	-	1	-	-
<u><i>Rangia cuneata</i></u>	-	-	-	-	-	-	1	-	-	-	-	-
Nematodes	17	-	-	-	1	-	-	-	-	6	5	-

Station 1 Non-Plant

<u><i>Gammarus tigrinus</i></u> group	-	-	-	-	-	-	1	-	-	-	-	-
<u><i>Palaemonetes pugio</i></u>	-	-	-	-	-	-	2	-	-	-	-	-
<i>Tendipes</i> larvae	1	-	-	-	-	-	-	-	-	1	-	-
<u><i>Cyathura polita</i></u>	-	-	-	-	-	-	-	-	-	2	-	-
<u><i>Laonereis culveri</i></u>	-	-	-	-	-	-	-	-	-	-	1	-
<u><i>Scolecoides viridis</i></u>	18	-	-	-	-	-	4	-	-	3	-	-
Unidentified polychaeta	-	-	-	-	-	-	2	-	-	-	-	-
Nematodes	5	-	-	16	-	-	4	-	-	4	-	-

Appendix Table 10 (continued)

Station 1 Plant Bed

April

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	-	-	-	2	-	-
<u>Cyathura polita</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Laeonereis culveri</u>	3	-	-	1	-	-	-	1	-	-	-	-
<u>Scolecoides viridis</u>	7	-	-	4	1	-	15	-	-	17	-	-
Nematodes	12	-	-	2	5	-	17	4	-	8	-	-

Station 1 Non-Plant

<u>Cyathura polita</u>	-	-	-	-	-	-	1	-	-	-	1	-
<u>Laeonereis culveri</u>	-	-	-	1	-	-	3	-	-	2	-	-
<u>Scolecoides viridis</u>	11	1	-	4	-	-	4	-	-	6	2	-
Nematodes	3	10	-	7	4	1	1	-	-	-	-	-

Appendix Table 10 (continued)

Station 1 Plant Bed

May

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	-	-	-	1	-	-
Tendipes larvae	-	-	-	1	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	2	1	-	2	-	-
<u>Laeonereis culveri</u>	-	-	-	1	-	-	2	-	-	1	-	-
<u>Scolecoides viridis</u>	2	1	-	2	-	-	3	-	-	2	-	-
<u>Myzobdella</u> sp.	-	-	-	-	-	-	-	-	-	1	-	-
Nematodes	-	-	-	6	1	-	14	6	-	17	1	-

Station 1 Non-Plant

<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Laeonereis culveri</u>	3	1	1	4	-	-	1	1	-	1	2	1
<u>Scolecoides viridis</u>	1	-	1	1	-	-	-	-	-	-	-	-
<u>Myzobdella</u> sp.	-	-	-	1	-	-	-	-	-	-	-	-
Nematodes	-	-	-	-	2	-	-	-	-	1	1	-

Appendix Table 10 (continued)

Station 1 Plant Bed

July

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<i>Tendipes</i> larvae	-	-	-	2	-	-	1	-	-	1	-	-
<u><i>Cyathura polita</i></u>	-	-	-	-	-	-	1	-	-	-	-	-
<u><i>Hypaniola florida</i></u>	-	-	-	-	-	-	-	-	-	1	-	-
<u><i>Laonereis culveri</i></u>	4	-	-	3	-	-	2	-	-	5	1	-
<u><i>Scolecoides viridis</i></u>	1	-	-	-	2	-	-	-	-	-	1	-
Unidentified polychaeta	-	-	1	-	-	-	-	-	-	-	-	-
<u><i>Myzobdella</i> sp.</u>	-	-	-	2	-	-	-	-	-	-	-	-
<u><i>Carpelora</i> sp.</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u><i>Rangia cuneata</i></u>	1	-	-	1	-	-	-	-	-	-	-	-
Nematodes	-	-	-	-	-	-	8	-	-	-	-	-

Station 1 Non-Plant

<i>Tendipes</i> larvae	-	-	-	1	-	-	-	-	-	1	-	-
<u><i>Laonereis culveri</i></u>	8	-	-	5	-	-	3	-	-	-	-	-
<u><i>Scolecoides viridis</i></u>	-	-	-	-	2	-	-	-	-	-	-	1
Nematodes	4	-	-	3	-	-	1	-	-	-	-	-

Appendix Table 10 (continued)

Station 1 Plant Bed

August

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<i>Tendipes</i> larvae	2	-	-	2	1	-	-	-	-	-	-	-
<u><i>Cyathura polita</i></u>	1	-	-	-	-	-	-	-	-	-	-	-
<u><i>Hypaniola florida</i></u>	1	-	-	-	-	-	3	-	-	6	-	-
<u><i>Laonereis culveri</i></u>	16	-	-	17	-	-	12	-	-	7	-	-
<u><i>Scolecoides viridis</i></u>	-	1	-	2	3	-	1	2	-	1	-	-
<u><i>Rangia cuneata</i></u>	-	-	-	-	-	-	-	-	-	1	-	-
Nematodes	-	1	1	6	3	-	4	-	-	6	-	-
Station 1 Non-Plant												
<i>Tendipes</i> larvae	3	-	-	-	-	-	-	-	-	1	-	-
<u><i>Hypaniola florida</i></u>	2	-	-	-	-	-	-	-	-	-	-	-
<u><i>Laonereis culveri</i></u>	5	1	-	6	2	-	9	-	-	1	1	-
<u><i>Polydora</i> sp.</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u><i>Scolecoides viridis</i></u>	1	1	-	-	-	-	-	-	-	-	-	-
Nematodes	-	-	-	2	1	-	4	-	-	-	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

October

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Palaeonetes pugio</u>	-	-	-	-	-	-	1	-	-	1	-	-
<u>Rhithropanopeus harrisi</u>	-	-	-	1	-	-	-	-	-	-	-	-
Coenagrionidae Naiad	-	-	-	-	-	-	2	-	-	-	-	-
Tendipes larvae	-	-	-	-	-	-	1	-	-	-	-	1
<u>Cyathura polita</u>	1	1	-	-	-	-	-	-	-	-	-	-
<u>Heteronastus filiformis</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	1	-	-	5	-	-	9	-	-	16	-	-
<u>Laonereis culveri</u>	7	-	-	3	1	-	13	-	-	14	1	-
<u>Scolecoides viridis</u>	-	-	-	-	1	2	-	1	3	-	-	2
Nematodes	15	5	16	11	3	1	9	7	9	24	12	24

Station 2 Non-Plant

<u>Hypaniola florida</u>	2	-	-	6	-	-	2	-	-	2	-	-
<u>Laonereis culveri</u>	22	-	-	21	1	-	4	-	-	2	-	-
Unidentified polychaeta	-	2	-	-	-	-	-	1	-	-	-	-
<u>Rangia cuneata</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	-	3	-	1	-	-	3	1	-	-	2	-

Appendix Table 11 (continued)

Station 2 Plant Bed

November

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	-	-	-	-	-	-
Tendipes larvae	-	-	-	-	-	-	2	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	5	-	-	3	-	-	4	-	-	2	-	-
<u>Laeonereis culveri</u>	8	2	-	1	1	1	16	1	-	16	1	1
<u>Polydora</u> sp.	1	-	-	1	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	1	3	1	-	-	-	-	-	-	-	-	1
<u>Carpelora</u> sp.	1	-	-	-	-	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	-	-	-	-	-	-	1	-	-	-	-	-
Nematodes	2	-	3	8	3	8	16	9	5	12	3	34

Station 2 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	-	-	-	1	-	-
<u>Palaemonetes pugio</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	2	-	-
<u>Hypaniola florida</u>	6	-	-	10	-	1	10	-	-	19	-	-
<u>Laeonereis culveri</u>	4	8	1	13	2	3	2	-	1	11	3	-
<u>Scolecoides viridis</u>	-	-	-	1	-	-	-	-	-	-	-	-
Unidentified polychaeta	-	-	-	-	-	-	-	3	-	-	-	-
<u>Rangia cuneata</u>	-	-	-	-	-	-	1	-	-	-	-	-
Nematodes	4	1	2	2	-	-	6	-	-	11	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

December

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	2	-	-	1	-	-
Tendipes larvae	1	-	-	-	-	-	-	-	-	1	-	-
<u>Cyathura polita</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	2	1	-	2	-	-	4	-	-	7	-	-
<u>Laeonereis culveri</u>	5	-	-	3	-	1	14	1	-	6	-	-
<u>Polydora</u> sp.	1	-	-	-	-	-	2	-	-	3	-	-
<u>Scolecoides viridis</u>	-	-	3	1	-	-	-	-	-	-	2	-
Nematodes	38	11	1	-	-	-	13	4	2	16	9	-

Station 2 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	1	-	-	1	-	-
<u>Cyathura polita</u>	-	-	-	2	-	-	-	-	-	2	-	-
<u>Heteromastus filiformis</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	7	-	-	3	-	-	3	-	-	6	-	-
<u>Laeonereis culveri</u>	6	1	-	11	-	-	6	2	-	10	-	-
<u>Scolecoides viridis</u>	-	1	-	-	-	-	-	-	-	-	-	-
Nematodes	5	-	-	11	-	-	-	-	-	-	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

January

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	4	-	-	3	-	-
<u>Cyathura polita</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	1	-	-	-	-	-	-	-	-	-	1	-
<u>Hypaniola florida</u>	6	1	-	6	-	-	3	1	-	4	-	-
<u>Laonereis culveri</u>	9	-	1	3	-	1	8	1	-	6	-	-
<u>Scolecoides viridis</u>	-	-	-	1	1	1	1	3	1	-	2	-
Nematodes	4	1	1	11	4	2	3	3	28	1	-	1

Station 2 Non-Plant

<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	1	-	-	1	-	-
<u>Rhithropanopeus harrisi</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Tendipes</u> larvae	-	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	8	-	-	10	-	-	4	-	-	5	-	-
<u>Laonereis culveri</u>	9	1	-	2	1	-	3	1	-	2	-	-
<u>Polydora</u> sp.	1	-	-	-	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	-	-	-	3	2	-	3	-	-	-	-	-
Nematodes	14	-	-	-	14	-	3	-	-	-	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

February

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	1	-	-	1	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	1	-	-
Mysid shrimp	-	-	-	1	-	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	1	-	-	-	1	-	1	-	-	-	-	1
<u>Laeonereis culveri</u>	-	1	1	3	-	-	12	1	-	8	-	-
<u>Scolecoides viridis</u>	5	2	-	2	1	-	5	-	-	8	2	-
Nematodes	-	1	-	12	-	-	27	-	-	7	-	-

Station 2 Non-Plant

Tendipes larvae	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	2	-	-	1	-	-	-	-	-	-	-	-
<u>Laeonereis culveri</u>	1	3	1	2	3	-	4	-	-	4	-	-
<u>Scolecoides viridis</u>	1	-	-	2	-	-	2	-	-	-	-	-
Nematodes	13	-	-	12	-	-	1	-	-	-	1	-

Appendix Table 11 (continued)

Station 2 Plant Bed

March

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	2	-	-	1	-	-
<u>Lepidactylus dytiscus</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	2	-	-	-	-	-	1	-	-	3	-	-
<u>Laeonereis culveri</u>	2	1	-	1	-	-	-	-	-	-	3	-
<u>Scolecoides viridis</u>	-	1	-	-	-	-	6	-	1	2	-	-
Nematodes	4	8	-	14	3	-	8	1	-	15	2	-

Station 2 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Laeonereis culveri</u>	-	-	-	1	-	-	2	-	-	1	-	-
<u>Scolecoides viridis</u>	-	-	-	-	-	-	4	-	-	2	-	-
Nematodes	9	-	-	28	7	-	2	-	-	21	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

April

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Lepidactylus dytiscus</u>	-	-	-	-	-	-	1	-	-	1	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	1	1	-	-	-	-
<u>Laonereis culveri</u>	5	-	-	1	-	-	2	-	-	3	1	-
<u>Scolecoides viridis</u>	3	1	-	4	1	-	1	-	-	3	-	-
Nematodes	6	9	6	-	-	1	-	4	2	-	4	4

Station 2 Non-Plant

<u>Gammarus tigrinus</u> group	1	-	-	-	-	-	5	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Laonereis culveri</u>	4	-	-	4	-	-	4	-	-	1	-	-
<u>Scolecoides viridis</u>	3	1	-	4	-	-	1	-	-	2	-	-
Nematodes	13	1	-	7	-	-	3	1	-	1	4	-

Appendix Table 11 (continued)

Station 2 Plant Bed

May

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Lepidactylus dytiscus</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Laonereis culveri</u>	3	-	-	1	2	-	1	-	-	2	-	-
<u>Scolecoides viridis</u>	-	-	-	-	1	-	-	1	-	1	-	-
Unidentified polychaeta	-	1	-	-	-	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	-	-	-	-	-	-	-	-	-	1	-	-
Nematodes	-	1	-	-	-	-	1	-	-	-	-	-
Station 2 Non-Plant												
<u>Corophium lacustre</u>	-	-	-	2	-	-	-	-	-	-	-	-
<u>Laonereis culveri</u>	1	-	-	-	1	-	1	-	-	2	-	-
<u>Scolecoides viridis</u>	-	-	-	-	-	-	-	1	2	-	-	-
<u>Rangia cuneata</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	-	-	-	-	-	-	4	-	-	1	-	-

Appendix Table 11 (continued)

Station 2 Plant Bed

June

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<i>Tendipes</i> larvae	-	-	-	-	-	-	1	-	-	-	-	-
<u><i>Cyathura polita</i></u>	1	-	-	-	-	-	-	-	-	-	-	-
<u><i>Laonereis culveri</i></u>	1	1	1	6	-	-	1	1	-	1	1	-
<u><i>Scolecoides viridis</i></u>	-	-	-	-	-	-	1	-	-	-	-	-
Nematodes	-	-	-	-	-	-	-	-	-	3	-	2

Station 2 Non-Plant

<u><i>Cyathura polita</i></u>	-	-	-	-	-	-	1	-	-	-	-	-
Unidentified polychaeta	1	-	-	1	-	-	-	-	-	-	-	-
Nematodes	-	1	-	-	-	-	1	-	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

October

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus mucronatus</u>	3	-	-	1	-	-	1	-	-	-	-	-
<u>Gammarus tigrinus</u> group	-	-	-	2	-	-	1	-	-	-	-	-
<u>Rhithropanopeus harrisi</u>	1	-	-	-	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	1	1	-	2	-	-	-	-	-
<u>Heteromastus filiformis</u>	1	-	-	3	-	1	1	-	-	-	-	-
<u>Hypaniola florida</u>	7	-	-	2	-	-	2	-	-	-	-	-
<u>Laeonereis culveri</u>	5	-	-	4	1	-	4	-	-	4	-	-
<u>Myzobdella lugubris</u>	-	-	-	-	1	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	-	-	-	2	-	-	-	-	-	-	-	-
Nematodes	11	13	-	5	16	-	7	6	-	2	3	-

Station 3 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	1	-	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	1	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	3	-	-	1	-	-	-	-	-
<u>Laeonereis culveri</u>	1	1	-	-	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	-	-	-	-	1	-	-	-	-	-	1	-
Unidentified polychaeta	-	-	-	4	-	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	2	-	-	2	-	-	1	-	-	1	-	-
Nematodes	1	-	-	1	6	-	1	-	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

November

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Corophium lacustre</u>	2	-	-	-	-	-	-	-	-	-	-	-
<u>Gammarus mucronatus</u>	-	-	-	-	-	-	-	-	-	3	-	-
<u>Gammarus tigrinus</u> group	1	-	-	5	-	-	3	1	-	1	-	-
<u>Rhithropanopeus harrisi</u>	1	-	-	-	-	-	-	-	-	-	-	-
Tendipes larvae	-	-	-	-	-	-	-	-	-	1	-	-
<u>Cassidinidea lunifrons</u>	1	-	-	1	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	1	-	-	-	-	1	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	4	-	-	1	1	-
<u>Hypaniola florida</u>	8	-	-	-	-	-	4	-	-	7	-	-
<u>Laonereis culveri</u>	4	-	-	2	-	-	1	-	-	3	1	-
<u>Polydora</u> sp.	6	-	-	4	-	-	4	-	-	5	-	-
<u>Scolecopides viridis</u>	-	-	-	-	-	-	1	-	-	-	2	-
<u>Campeloma</u> sp.	1	-	-	1	-	-	-	-	-	-	-	-
<u>Rangia cuneata</u>	1	-	-	-	-	-	2	-	-	2	-	-
Nematodes	36	-	-	17	3	26	13	4	-	6	1	2

Station 3 Non-Plant

<u>Gammarus tigrinus</u> group	2	-	-	1	-	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	-	-	-	2	-	-	-	-	-
<u>Laonereis culveri</u>	-	-	-	-	-	-	2	-	-	-	-	-
<u>Polydora</u> sp.	-	-	-	-	-	-	2	-	-	-	-	-
Nematodes	-	-	-	-	-	-	1	-	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

December

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Gammarus tigrinus</u> group	2	-	-	-	-	-	1	-	-	-	-	-
<u>Lepidactylus dytiscus</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Monoculodes edwardsi</u> group	1	-	-	-	-	-	-	-	-	-	-	-
Tendipes larvae	1	-	-	-	-	-	-	-	-	-	-	-
<u>Heterorastus filiformis</u>	2	-	-	1	-	-	2	2	1	-	1	-
<u>Hypaniola florida</u>	-	-	-	-	-	-	-	-	-	4	-	-
<u>Laonereis culveri</u>	2	1	1	1	-	-	-	-	1	1	1	-
<u>Scolecopides viridis</u>	-	-	-	1	-	-	-	-	1	-	-	1
<u>Campeloma</u> sp.	-	-	-	-	-	-	-	-	-	1	-	-
<u>Rangia cuneata</u>	-	-	-	1	-	-	-	-	-	-	-	-
Nematodes	5	-	-	-	8	-	-	1	29	-	1	2

Station 3 Non-Plant

<u>Corophium lacustre</u>	-	-	-	1	-	-	-	-	-	1	-	-
<u>Heterorastus filiformis</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Laonereis culveri</u>	-	-	-	1	-	-	1	-	-	-	-	-
Nematodes	-	-	-	3	-	-	2	1	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

January

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Cyathura polita</u>	1	1	-	-	1	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	3	-	-	2	-	-	-	-	1	2	2	-
<u>Hypaniola florida</u>	2	-	-	3	-	-	-	-	-	2	-	-
<u>Laonereis culveri</u>	2	-	-	1	2	-	1	1	-	4	-	-
<u>Scolecoides viridis</u>	-	3	-	-	-	-	-	1	-	-	1	1
<u>Rangia cuneata</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	1	2	1	2	5	39	-	3	-	3	1	-

Station 3 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	-	-	-	1	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	1	1	-	-	-	-	-	-	-
<u>Laonereis culveri</u>	-	-	-	1	1	-	-	1	-	3	-	-
Nematodes	-	1	-	2	-	-	1	-	-	1	1	-

Appendix Table 12 (continued)

Station 3 Plant Bed

March

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Cyathura polita</u>	2	-	-	1	-	-	-	-	-	-	-	-
<u>Hypaniola florida</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Laeonereis culveri</u>	2	2	-	4	-	-	1	-	-	-	-	1
<u>Scolecoides viridis</u>	4	-	-	9	-	-	3	-	-	3	-	-
Nematodes	6	-	-	22	2	-	12	1	-	21	7	-

Station 3 Non-Plant

<u>Scolecoides viridis</u>	-	-	-	2	-	-	-	-	-	-	-	-
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Appendix Table 12 (continued)

Station 3 Plant Bed

April

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Lepidactylus dytiscus</u>	2	-	-	-	-	-	1	-	-	-	-	-
<u>Heteromastus filiformis</u>	1	-	-	-	-	-	-	-	-	2	1	-
<u>Laonereis culveri</u>	1	1	-	1	1	-	1	-	-	-	2	-
<u>Scolecoides viridis</u>	6	2	-	3	2	2	2	2	1	5	2	-
<u>Myzobdella lugubris</u>	-	1	-	1	-	-	-	-	-	-	-	-
Nematodes	1	3	-	7	11	2	3	1	-	1	-	-

Station 3 Non-Plant

<u>Gammarus tigrinus</u> group	-	-	-	1	-	-	1	-	-	-	-	-
<u>Heteromastus filiformis</u>	1	-	-	2	-	-	-	-	-	2	-	-
<u>Laonereis culveri</u>	-	-	-	-	-	-	-	-	-	1	-	-
<u>Scolecoides viridis</u>	7	-	-	2	-	-	1	-	-	8	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

May

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Cyathura polita</u>	4	-	-	3	-	-	2	-	-	1	-	-
<u>Heterorastus filiformis</u>	-	1	-	-	-	-	-	-	1	-	-	-
<u>Laonereis culveri</u>	-	-	1	-	-	-	1	2	-	-	2	1
<u>Scolecoides viridis</u>	1	-	1	3	-	1	-	4	-	1	2	-
<u>Rangia cuneata</u>	-	-	-	-	-	-	-	-	-	-	1	-
Nematodes	3	4	-	4	3	3	5	2	2	2	1	-

Station 3 Non-Plant

<u>Corophium lacustre</u>	-	-	-	1	-	-	2	-	-	-	-	-
<u>Gammarus tigrinus</u> group	-	-	-	2	-	-	-	-	-	-	-	-
<u>Rhithropanopeus harrisi</u>	-	-	-	1	-	-	1	-	-	-	-	-
<u>Cyathura polita</u>	1	-	-	-	-	-	-	-	-	1	-	-
<u>Heterorastus filiformis</u>	-	-	-	-	-	-	-	-	-	-	1	-
<u>Laonereis culveri</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Nereis succinea</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Scolecoides viridis</u>	3	1	-	1	-	1	-	-	-	2	-	-
Nematodes	-	-	-	1	-	-	-	-	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

June

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Cyathura polita</u>	-	-	-	-	-	-	-	-	-	-	1	-
<u>Laonereis culveri</u>	1	-	-	-	-	-	1	-	-	1	-	-
<u>Scolecoides viridis</u>	-	-	-	-	-	1	-	-	-	-	-	-
Nematodes	1	2	-	2	-	-	1	-	-	2	-	-
Station 3 Non-Plant												
<u>Lepidactylus dytiscus</u>	-	1	-	-	-	-	-	-	-	-	-	-
<u>Nereis succinea</u>	-	-	-	2	-	-	-	-	-	-	-	-

Appendix Table 12 (continued)

Station 3 Plant Bed

August

Species	Sample 1			Sample 2			Sample 3			Sample 4		
	A	B	C	A	B	C	A	B	C	A	B	C
<u>Corophium lacustre</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Gammarus tigrinus</u> group	-	-	-	1	-	-	-	-	-	-	-	-
<u>Cyathura polita</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Heteromastus filiformis</u>	1	1	-	1	4	-	-	-	-	-	1	-
<u>Laeonereis culveri</u>	2	-	-	1	-	-	1	-	-	2	-	-
<u>Nereis succinea</u>	-	-	-	2	-	-	-	-	-	-	-	-
<u>Scolecoides viridis</u>	-	-	-	-	-	-	-	-	-	-	1	2
<u>Rangia cuneata</u>	1	-	-	-	-	-	-	-	-	-	-	-
Nematodes	7	-	-	3	-	-	5	-	-	3	-	-

Station 3 Non-Plant

<u>Cyathura polita</u>	-	-	-	1	-	-	-	-	-	-	-	-
<u>Heteromastus filiformis</u>	-	-	-	-	1	-	1	-	-	1	-	-
<u>Laeonereis culveri</u>	-	-	-	-	-	-	1	-	-	-	-	-
<u>Scolecoides viridis</u>	2	1	-	1	-	-	-	-	-	-	1	-