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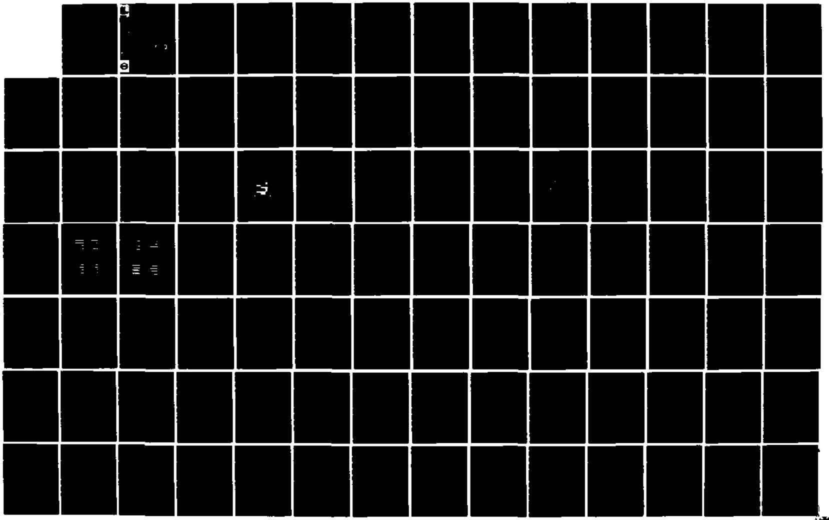

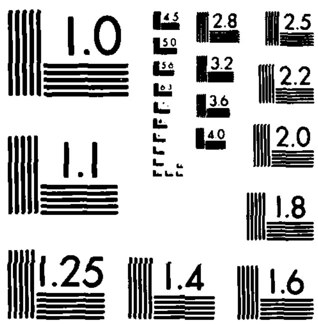
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ENVIRONMENTAL IMPACT
RESEARCH PROGRAM

TECHNICAL REPORT EL-84-4

ECOLOGICAL EFFECTS OF RUBBLE WEIR JETTY CONSTRUCTION AT MURRELLS INLET, SOUTH CAROLINA

VOLUME II: CHANGES IN MACROBENTHIC COMMUNITIES OF SANDY BEACH AND NEARSHORE ENVIRONMENTS

by

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June 1984
Final Report

Approved For Public Release; Distribution Unlimited

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Under EIRP Work Unit 31532

Monitored by Coastal Engineering Research Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

ENVIRONMENTAL LABORATORY

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report EL-84-4	2. GOVT ACCESSION NO. AD-A149211	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ECOLOGICAL EFFECTS OF RUBBLE WEIR JETTY CONSTRUCTION AT MURRELLS INLET, SOUTH CAROLINA; VOL II: CHANGES IN MACROBENTHIC COMMUNITIES OF SANDY BEACH AND NEARSHORE ENVIRONMENTS		5. TYPE OF REPORT & PERIOD COVERED Final report (in two volumes) 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) David M. Knott, Robert F. Van Dolah, and Dale R. Calder		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Marine Resources Research Institute South Carolina Wildlife and Marine Resources Dept. Charleston, S. C. 29412		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Environmental Impact Research Program Work Unit 31532
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers, U. S. Army Washington, D. C. 20314		12. REPORT DATE June 1984 13. NUMBER OF PAGES 98
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) U. S. Army Engineer Waterways Experiment Station Coastal Engineering Research Center P. O. Box 631, Vicksburg, Miss. 39180		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Community composition
Infauna
Jetty effects
Macrobenthos
Murrells Inlet, South Carolina
Sandy beach
Surf zone

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Beach and nearshore areas were sampled at Murrells Inlet, South Carolina, to evaluate the effects of jetty construction on the benthic macroinvertebrate communities in those habitats. Quantitative samples were collected seasonally during jetty construction (1977-78) and again 5 years later along transects located adjacent to and distant from the jetties. Polychaetes, amphipods, and pelecypods were the dominant organisms in both the intertidal and subtidal zones during jetty construction. Although differences were noted in the

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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community structure between these zones, several of the dominant species were abundant in both habitats. Five years later, some of these species were not commonly observed, and oligochaetes and nematodes were abundant in the area. Many of these differences were attributed to normal seasonal and yearly variations. Changes resulting from jetty construction included increased species diversity in a wave-sheltered area, as well as changes in abundance and species composition near the jetties. Many of the observed changes were short term or limited to the area between the jetties where sediment characteristics were altered. Beach and nearshore areas south of the jetties were also changed by extensive shoaling, which presumably altered community structure in that vicinity. Similar modifications in the beach profile were not observed north of the jetties.

PREFACE

This report was sponsored by the Office, Chief of Engineers (OCE), U. S. Army, as part of the Environmental Impact Research Program (EIRP) Work Unit 31532 entitled Ecological Effects of Rubble Structures, which was assigned to the U. S. Army Coastal Engineering Research Center (CERC). The Center, originally located at Fort Belvoir, Va., moved to the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., on 1 July 1983. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker of OCE and Mr. David B. Mathis, Water Resources Support Center.

The study and preparation of a draft final report were accomplished during the time period September 1977 to May 1983; preparation of the reproducible copy was done during October and November 1983.

The report was prepared by Dr. Robert F. Van Dolah, Mr. David M. Knott, and Dr. Dale R. Calder through the Marine Resources Research Institute of the South Carolina Wildlife and Marine Resources Department. Dr. Calder is currently at the Royal Ontario Museum.

The authors are very grateful to Mr. Arthur K. Hurme of the CERC for his role in initiating this investigation, and for his support and encouragement throughout the study. We wish to thank Magdalene Maclin, Beth Roland, and George Steele for their considerable efforts on this project, both in the field and laboratory. Other individuals who frequently assisted us in the field included Mary Jo Clise, Stan Hales, Priscilla Hinde, Terry Hodges, and Caroline O'Rourke. Particular thanks are due to Dr. Reid Wiseman, who identified all of the algae found on the jetties, and to Dr. George Sedberry, who identified and analyzed the fish stomachs. Finally, we wish to thank Nancy Beaumont who typed the various drafts of this report, and Karen Swanson who drafted all the figures.

Mr. Hurme was the CERC Technical Advisor for the contract under the general supervision of Mr. Edward J. Pullen, Chief, Coastal Ecology Branch, and Mr. R. P. Savage, Chief, CERC Research Division. Dr. Roger T. Saucier, WES, was the Program Manager of EIRP.

Technical Director of CERC at Fort Belvoir during the study and preparation of the draft final report was Dr. Robert W. Whalin. Commander and Director of WES during preparation of the reproducible copy was COL Tilford C. Creel, CE; Technical Director was Mr. F. R. Brown.

This report should be cited as follows:

Knott, D. M., Van Dolah, R. F., and Calder, D. R. 1984. "Ecological Effects of Rubble Weir Jetty Construction at Murrells Inlet, South Carolina; Volume II: Changes in Macrobenthic Communities of Sandy Beach and Nearshore Environments," Technical Report EL-84-4, prepared by Marine Resources Research Institute, Charleston, S. C., for Coastal Engineering Research Center, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

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I. INTRODUCTION

Sandy beaches typify most of the coastline along the southeastern United States. These beaches represent an environment of high stress and continued change for intertidal marine infauna. As a result, relatively few macroinvertebrate species inhabitat the intertidal zone as compared with more stable subtidal areas. On beaches of the southeastern United States, important intertidal species include several haustoriid amphipods, the polychaete *Scolelepis squamata*, the coquina clam *Donax variabilis*, and the decapod crustaceans *Emerita talpoida* and *Ocypode quadrata* (Pearse et al., 1942; Croker, 1967, 1968; Dexter, 1967, 1969; Dörjes, 1972, 1977; Howard and Dörjes, 1972; Roberts, 1974; Calder et al., 1976; Matta, 1977). Although these organisms are common on open ocean beaches of South Carolina, quantitative studies on the intertidal beach communities between North Carolina and Georgia are lacking. Similarly, subtidal nearshore benthic communities have been examined off North Carolina and Georgia (e.g., Pearse et al., 1942; Day et al., 1971; Frankenberg and Leiper, 1977), but not off South Carolina, with the exception of an investigation in a dredge disposal area near Charleston (Van Dolah et al., 1983) and a limited assessment of the fauna in the entrance channel at Murrells Inlet (Calder et al., 1976).

Due to shoaling problems at the entrance of Murrells Inlet, an important recreational port in South Carolina, construction of two rock jetties was initiated in 1977. Since few studies have quantitatively investigated the biological impact of such structures on nearby areas (Mulvihill et al., 1980), a biological study of the beach and nearshore environments was also initiated at the same time. Specific goals of this study were to:

1. Quantitatively assess the intertidal and subtidal macrobenthic communities on the front beaches adjacent to Murrells Inlet.

2. Describe changes in those communities over a one-year period during jetty construction to evaluate seasonal differences as well as differences associated with jetty construction.

3. Assess the macrobenthic communities on those beaches five years after jetty construction to evaluate any long-term differences attributable to jetty construction.

One additional component of this biological study included an investigation of colonization and community development of algae, macroinvertebrates and fishes on the jetties. Details of that study component are provided in Volume I of this report.

II. DESCRIPTION OF THE STUDY AREA

Murrells Inlet, located on the northeastern coast of South Carolina, USA (Fig. 1), is a comparatively small coastal system characterized by ocean beaches, sand and mud flats, intertidal shellfish beds, and expanses of saltmarshes intersected by shallow tidal creeks. Salinities are generally

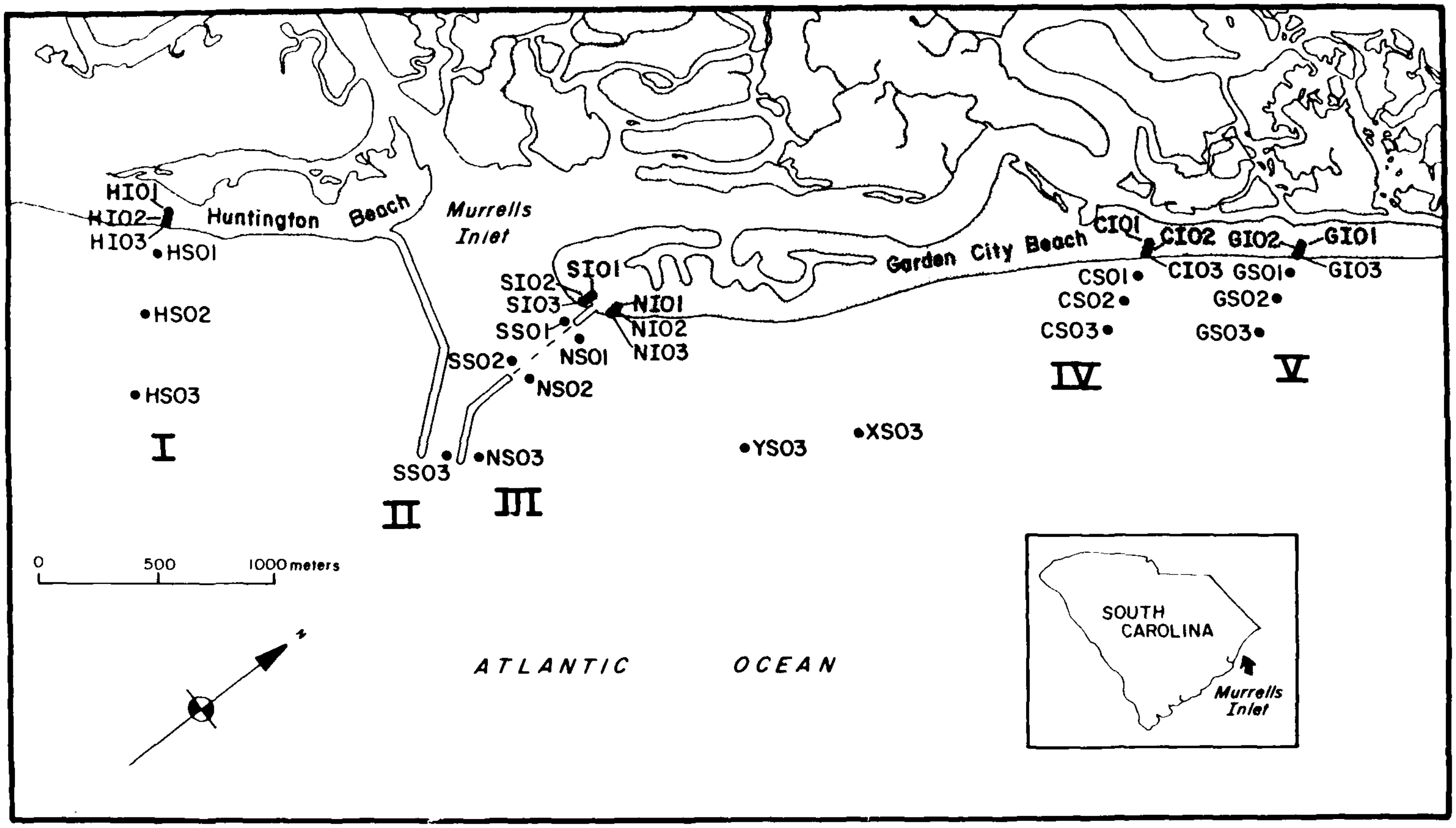

Figure 1. Map showing sampling transects with the location of beach and nearshore stations sampled at Murrells Inlet, South Carolina.

high and stable because of the lack of either a river system flowing into the inlet or contact with the Atlantic Intracoastal Waterway. Water temperatures are variable, being dependent on the season, and tides are semidiurnal with a mean tidal range of 1.4 m (National Ocean Survey, 1981).

At its entrance, Murrells Inlet is flanked by Garden City Beach to the northeast and Huntington Beach to the southwest (Fig. 1). The sediments of these beaches and adjacent nearshore areas consist primarily of medium to fine quartz sand with varying amounts of sand-size shell fragments (see Section IV.1b). The intertidal zone covers a horizontal distance of approximately 30-40 m on Garden City Beach and 55 m on Huntington Beach in the areas investigated. Although exposed to the open ocean, wave energy is moderate on these beaches because waters are shallow for a considerable distance offshore.

Because Murrells Inlet is intensively utilized as the home port for a growing number of commercial and recreational fishing boats, there was a need to stabilize the entrance channel to the inlet. In October 1977, construction began on two quarrystone jetties, located on the north and south sides of the inlet entrance (Fig. 1). The north jetty, which extends 1020 m into the ocean, was completed by February 1979. The landward portion of this jetty includes a 411-m weir section (Fig. 1) designed to allow sand to bypass the jetty and settle into a dredged deposition basin, instead of moving around the jetty and creating shoals at the entrance channel. Construction on the south jetty, which extends 1011 m seaward, began in February 1979 and was completed by May 1980. This jetty has no weir section and is topped with an asphalt walkway.

III. MATERIALS AND METHODS

1. Station Locations and Sampling Periods

For the initial phase of the study (1977-78), three transects near the entrance of Murrells Inlet were sampled seasonally (i.e., November, February, May, August). Transect I (HI01-HS03) extended offshore from Huntington Beach and served as a control for comparison with Transects II (SI01-SS03) and III (NI01-NS03), which were located on Garden City Beach and paralleled both sides of the proposed north jetty location (Fig. 1).

Sampling was repeated along Transects II and III during the summer and fall of 1982; however, Transect I was not included in this follow-up phase of the study. Considerable shoaling had occurred off Huntington Beach after completion of the south jetty, and the development of intertidal sand bars in this vicinity rendered subtidal stations HS01-HS03 inaccessible by boat. Additionally, intertidal stations on this transect could not be relocated in 1982 due to radical changes in the beach profile and the construction of an access road to the south jetty. For these reasons, new control stations were established in 1982 which were located north of the jetties, beyond the area influenced by beach renourishment that occurred during jetty construction. These new control transects (Transects IV and V; Fig. 1) were more representative of undisturbed areas than the obviously altered stations on Transect I. Selection of two control transects was intended to provide an indication of the natural variability in undisturbed communities.

Three intertidal and three subtidal stations were chosen on each transect. Intertidal stations were located with reference to permanent landmarks near mean high water (MHW), mean tide level (MTL), and mean low water (MLW). Subtidal stations were located using fixed landmarks ashore and included one station adjacent to the beach in depths of 1-2 m (nearshore), one in depths of 2-3 m (midshore), and one in depths of 4-5 m (offshore) on each transect.

Two additional stations (XS03, YS03) were also sampled during both seasons of 1982 for further "control" comparisons with the jetty stations SS03 and NS03. These sites were in depths equivalent to the other offshore stations, and were located approximately 1.5 km north of the jetties (Fig. 1). The stations were added because muddy sediments were observed at the control stations CS03 and GS03, but not at stations SS03, NS03, XS03 or YS03. Data obtained from samples at YS03 and XS03 were substituted for data from CS03 and GS03 in the interpretation and analyses presented in this report, with the exception of cluster analysis (see Section IV.2b).

2. Sampling Methods

Three replicate samples were collected at all stations during each seasonal visit. Rarefaction curves (cumulative species number versus number of replicates) based on previous studies of beach and nearshore subtidal areas in South Carolina indicated that this number of replicates was sufficient to characterize species number (Calder, unpublished). Intertidal samples of 0.05 m^2 and 11 cm in depth were taken using a quadrat frame and shovel. Subtidal samples were collected using a 0.10-m^2 modified Van Veen grab. All samples were gently washed on a 0.5-mm-mesh sieve to remove excess sediment and preserved in a 10% formaldehyde-seawater solution with rose bengal stain. In the laboratory, macrofaunal organisms sorted from the samples were preserved in 70% isopropanol, identified to the lowest taxon possible, and counted.

Samples for sediment analysis were collected at all stations during the first four seasons of benthic sampling. In the laboratory, the percentage of shell hash in the sediments was determined by digestion of calcium carbonate with HCl, and the remaining quartz fraction was sieved for 30 minutes on a Ro-Tap machine using a ¼ Ø-unit nest of Tyler screens. During the follow-up study in 1982, sediment texture and composition was evaluated only qualitatively during sampling and subsequent sieving.

Samples for measurement of water temperature and salinity were collected at 1 m below the surface and 0.3 m above the bottom during each sampling interval at the innermost and outermost subtidal stations of all transects. Temperatures were read directly from a stem thermometer mounted in a Van Dorn bottle, or by using a Yellow Springs Instrument Company Model 33 S-C-T meter. Salinity samples were returned to the laboratory and analyzed using a Beckman RS7B induction salinometer.

3. Data Analysis

Analyses of community structure were undertaken using several equations. Species diversity was measured using Shannon's formula (Pielou, 1977):

$$H' = -\Sigma\ p_i \log_2 p_i$$

where H' is the diversity in bits of information per individual, and p_i equals n_i/N or the proportion of the sample belonging to the i^{th} species. Species richness was calculated on the basis of the formula:

$$SR = \frac{s-1}{\ln N}$$

where s is the number of species and lnN is the natural logarithm of the total number of individuals of all species in the sample. Evenness, a measure of the distribution of individuals among the various species, was measured by:

$$J' = \frac{H'}{\log_2 s}$$

where H' is the species diversity and s is the number of species.

A cluster analysis of faunal similarity was undertaken on the data using the Bray-Curtis similarity coefficient on log-transformed abundance. The Bray-Curtis coefficient is defined by Boesch (1977) as:

$$S_{jk} = \frac{2 \sum_i \min (X_{ij}, X_{ik})}{\sum_i (X_{ij} + X_{ik})}$$

Clustering was done using flexible sorting with $\beta = -0.25$ (Lance and Williams, 1967). Both normal (site group) and inverse (species group) analyses were performed on the data obtained during the initial phase of this study (1977-78). The resulting dendrograms were evaluated using a variable "stopping rule" (Boesch, 1977) in order to form groups of stations and species. Those groups were then subjected to nodal analysis (Lambert and Williams, 1962) and their coincidence was expressed by graded constancy and fidelity. Constancy expresses the frequency with which species of a particular group are found in a given collection group and fidelity measures the degree to which species are restricted to a particular collection group. Only normal (site group) analyses were performed on 1982 data since these analyses were only intended to assess changes in station similarity that were attributable to jetty effects.

To avoid confusion in interpreting the cluster analysis, rare species which occurred at fewer than three stations and accounted for <1% of the total number of individuals were deleted from the data set. Specimens of indeterminate identity were also deleted, except in those cases where they could be consistently recognized as being unique species.

IV. RESULTS AND DISCUSSION

1. Environmental Parameters

a. Hydrographic Conditions

Surface and bottom water temperatures at the subtidal stations varied widely from season to season (Table 1). South Carolina experienced an unusually cold winter in 1977-78 (Purvis, 1978), and water temperatures in the Murrells Inlet area during February (6.0-8.4°C) reflected the cold weather. Water temperatures had risen significantly by May of 1978 (18.2-20.8°C) and were highest during August of both 1978 and 1982 (27.5-28.7°C). Little evidence of thermocline development was apparent from the data, indicating that waters at these shallow stations were well mixed. Differences from station to station during a given sampling interval were also relatively minor, and reflected normal daily variations.

Salinities fluctuated little and were in the euryhaline range (30-40 °/oo) at all stations throughout the study (Table 1). Values were lowest in February 1978 (31.9-32.4 °/oo) and highest in August of that year (35.3-35.4 °/oo). As with temperature, salinity differences were generally negligible from surface to bottom and from station to station on a given date. Similar salinity observations were recorded from the Murrells Inlet area during May of 1975 by Calder et al. (1976). They observed a range in salinity of 33.1-34.0 °/oo, and did not detect a horizontal salinity gradient in waters of the area. A difference of less than 0.4 °/oo salinity was reported from a station located approximately 1.6 km offshore to another at the head of Main Creek near the town of Murrells Inlet. Refractometer readings during 1982 indicated that salinities that year were in the same range as those previously recorded during equivalent seasons of the 1977-78 sampling period.

b. Sediment Characteristics

Sediments at the 18 stations sampled during 1977-78 consisted entirely of sand and shell, with no measurable quantities of either silts or clays being present. Considerable variability was noted with respect to sand grain-size and carbonate content (Appendix A), although several trends were apparent. Intertidally, sediments were usually finest and carbonate content lowest at the high-tide stations. However, finer sediments appeared to move in at stations SI02 and SI03 after November 1977, due to sheltering as jetty construction proceeded seaward. Sands were coarser and generally contained a greater percentage of $CaCO_3$ on Transects II and III (Garden City Beach) than on Transect I (Huntington Beach). Sands also tended to be coarser on the beaches during autumn, and especially winter, than in the spring. Subtidally, sediments tended to be coarser in spring than during autumn and winter. Finally, the mean grain-size was generally larger in samples from intertidal stations than from subtidal stations.

Qualitative observations of sediments in 1982 grab and quadrat samples indicated similar patterns to those noted above. On all four transects, sediments at the high-tide stations were fine sand with relatively little

Table 1. Temperature and salinity measurements taken during sampling periods at nearshore and offshore stations. Dashes indicate no samples collected.

SEASON	SS01 Surf.	SS01 Bott.	SS03 Surf.	SS03 Bott.	NS01 Surf.	NS01 Bott.	NS03 Surf.	NS03 Bott.	HS01 Surf.	HS01 Bott.	HS03 Surf.	HS03 Bott.	CS01 Surf.	CS01 Bott.	CS03 Surf.	CS03 Bott.	GS01 Surf.	GS01 Bott.	GS03 Surf.	GS03 Bott.
TEMPERATURE (^{o}C)																				
November 1977	15.4	15.3	16.0	15.7	16.0	15.9	15.9	15.8	15.9	15.0	15.6	14.3	-		-		-		-	
February 1978	6.0	6.1	7.1	6.9	8.4	8.4	7.4	6.9	6.6	6.7	7.5	7.4	-		-		-		-	
May 1978	18.2	19.8	20.8	20.8	19.8	19.8	18.8	18.2	18.8	18.8	19.0	19.8	-		-		-		-	
August 1978	27.9	27.8	28.0	28.0	28.0	28.0	28.7	28.3	28.5	28.4	28.0	27.9	-		-		-		-	
August 1982	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	-		-		28.0	28.0	28.0	28.0	28.0	28.0	28.0	27.5
November 1982	19.0	19.0	19.0	18.5	18.5	18.5	18.5	18.0	-		-		19.0	18.5	18.5	18.0	18.5	18.5	18.5	18.0
SALINITY ($^{o}/oo$)																				
November 1977	35.1	35.0	35.2	35.2	35.2	35.1	35.3	35.3	35.2	35.1	35.0	35.0	-		-		-		-	
February 1978	32.2	32.3	32.0	32.1	31.9	31.9	32.0	32.1	32.4	32.4	32.0	32.0	-		-		-		-	
May 1978	32.6	32.6	32.5	32.9	32.6	32.6	32.6	33.0	33.0	33.0	32.8	32.8	-		-		-		-	
August 1978	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.4	35.3	35.4	35.3	-		-		-		-	
August 1982	← NO DATA →								-		-		← NO DATA →							
November 1982	← NO DATA →								-		-		← NO DATA →							

shell hash. Sediments were generally coarser at the lower intertidal levels, although fine sands were also present, and the samples contained a moderate to large amount of shell hash. Subtidal sites were usually represented by sandy sediments of fine to medium grain-size with small to moderate amounts of shell hash. Stations SS02, SS03, CS03, and GS03 were exceptions to this pattern. Sediments at SS02 and SS03 were coarser than at the other sites, especially at station SS03, where only very coarse sand with a lot of shell hash was observed. The strong tidal currents on the channel side of the jetty obviously removed fine sediments from the bottom at these sites. Sediments at stations CS03 and GS03 were quite muddy compared to all other stations, which had clean sands with little or no evidence of silts or clays. Additional qualitative samples were taken at several locations north of these transects in similar depths. Those samples indicated that muddy sediments were prevalent in the 4- to 5-m depth zone even farther north than the Kingfisher Inn Pier at Garden City. As a result, the additional stations (XS03, YS03) were sampled in both seasons (Fig. 1). Sediments at these latter sites were more similar to those noted at NS03, where clean sand of fine to moderate grain-size was present.

2. Benthic Community

a. Initial Changes During Jetty Construction (1977-78)

We collected 223 species of benthic macroinvertebrates at the 18 stations sampled during 1977-78. Collections from subtidal stations contained 205 species, whereas those from intertidal stations yielded 88 species. Polychaetes dominated the fauna, both in terms of species (Table 2) and numbers of individuals (Table 3). Together with amphipods and pelecypods, they accounted for more than 95% of the individuals and 70% of the species. The 10 most abundant species, comprising nearly 82% of the fauna, were *Spiophanes bombyx, Scolelepis squamata, Protohaustorius deichmannae, Donax variabilis, Acanthohaustorius millsi, Neohaustorius schmitzi, Tellina* sp., *Ensis directus,* Platyischnopidae A, and *Parahaustorius longimerus*. Complete listings of all organisms collected at each station are provided in Appendices B-D.

(1). Intertidal Community Composition

The spionid *Scolelepis squamata* accounted for 80% of all polychaetes at the intertidal stations and was present throughout the year. This species was especially abundant at the middle and lower intertidal stations in winter and spring on all three transects (Fig. 2). The only other polychaete represented by substantial numbers in the intertidal zone was another spionid, *Spiophanes bombyx*. This species was absent from intertidal samples during November, but was present in February (Fig. 2) and numerically co-dominant with *S. squamata* at stations SI02 and SI03. During May and August, *S. bombyx* was present only at SI03.

Haustoriid amphipods were well represented in the intertidal zone. *Neohaustorius schmitzi* was the most abundant, accounting for 77% of the total number of amphipods collected at beach sites. Densities of *N. schmitzi* were lowest in November and highest during February and May (Fig. 2). This species was most prevalent at middle and lower intertidal stations.

Table 2. Number of species representing each of the major macroinvertebrate taxa in intertidal and subtidal samples collected from Murrells Inlet during 1977-78.

Taxon	No. Species Intertidally	No. Species Subtidally	No. Species Both Areas Combined	Percent of Total	Cumul. Percent
Polychaeta	25	83	89	39.91	39.91
Amphipoda	25	31	38	17.04	56.95
Pelecypoda	13	27	30	13.45	70.40
Decapoda	4	17	17	7.62	78.02
Gastropoda	2	12	12	5.38	83.40
Isopoda	5	8	10	4.48	87.88
Echinodermata	3	6	6	2.69	90.57
Cumacea	5	5	5	2.24	92.81
Mysidacea	1	4	4	1.79	94.60
Anthozoa	0	2	2	0.90	95.50
Hydroida	1	1	1	0.45	95.95
Turbellaria	1	1	1	0.45	96.40
Rhynchocoela	1	1	1	0.45	96.85
Brachiopoda	1	1	1	0.45	97.30
Oligochaeta	0	1	1	0.45	97.75
Tanaidacea	0	1	1	0.45	98.20
Hemichordata	1	1	1	0.45	98.65
Ascidiacea	0	1	1	0.45	99.10
Cephalochordata	0	1	1	0.45	99.55
Unknown Taxon	0	1	1	0.45	100.00
TOTAL	88	205	223		

Table 3. Numbers of individuals of each of the major macroinvertebrate taxa in intertidal and subtidal samples collected from Murrells Inlet during 1977-78.

Taxon	No. Individuals Intertidally	No. Individuals Subtidally	Total Numbers	Percent of Total Fauna	Cumul. Percent
Polychaeta	4899	18253	23152	61.00	61.00
Amphipoda	2239	6166	8405	22.15	83.15
Pelecypoda	1546	3082	4628	12.19	95.34
Decapoda	60	237	297	0.78	96.12
Cumacea	31	243	274	0.72	96.84
Isopoda	64	161	225	0.59	97.43
Rhynchocoela	21	169	190	0.50	97.93
Tanaidacea	0	146	146	0.39	98.32
Echinodermata	5	135	140	0.37	98.69
Hydroida	62	33	95	0.25	98.94
Oligochaeta	0	89	89	0.23	99.17
Anthozoa	0	81	81	0.21	99.38
Mysidacea	2	77	79	0.21	99.59
Gastropoda	3	73	76	0.20	99.79
Unknown Taxon	0	52	52	0.14	99.93
Turbellaria	1	10	11	0.03	99.96
Ascidiacea	0	5	5	0.01	99.97
Hemichordata	2	1	3	0.01	99.98
Brachiopoda	1	1	2	0.01	99.99
Cephalochordata	0	2	2	0.01	100.00
TOTAL	8936	29016	37952		

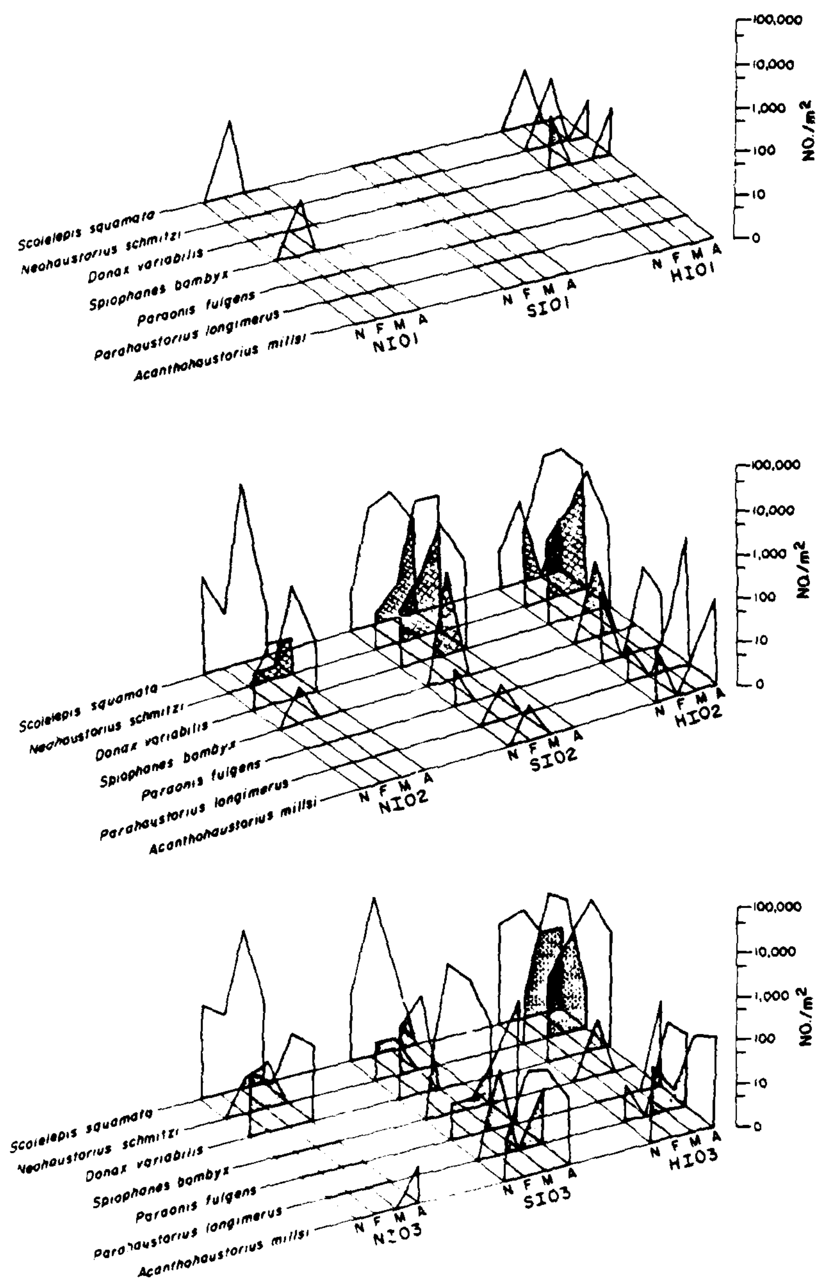

Figure 2. Seasonal abundance of dominant macroinvertebrates at MHW, MTL, and MLW intertidal stations along the three transects sampled during 1977-78. Vertical scales are logarithmic.

Two other haustoriids that were found in substantial numbers in the low intertidal zone on Transects II and III were *Acanthohaustorius millsi* and *Parahaustorius longimerus*.

Thirteen species of pelecypods were collected intertidally, but only the coquina clam *Donax variabilis* was numerically abundant (Table 4). This species was generally more prevalent in samples from Transect I than from Transects II and III (Fig. 2). Specimens were collected intertidally throughout the year, but largest numbers were present in May samples. Maximum densities were found at HI03 in May, and densities declined on all three transects between May and August.

(2). Subtidal Community Composition

Spiophanes bombyx was numerically dominant at subtidal stations, accounting for about 45% of the total subtidal fauna (Table 5) and more than 36% of the macroinvertebrates from all intertidal and subtidal stations combined. This spionid underwent large seasonal fluctuations in abundance due to juvenile recruitment (Fig. 3). Densities at most stations increased substantially between November and February, with most of the specimens collected being quite small. Furthermore, the average size of *S. bombyx* increased over subsequent sampling periods. Numbers of *S. bombyx* were typically highest at the outermost stations on Transects II and III and at all three Huntington Beach stations (Fig. 3), where sediments were mostly fine sand.

The polychaete *Scolelepis squamata* was also abundant subtidally, especially during the winter. This species was moderately numerous in May, and infrequent in samples taken during August and November (Fig. 3). Maximum densities of *S. squamata* occurred at the shallow subtidal stations, and few specimens were collected at the deepest stations of each transect.

Six species of amphipods (*Protohaustorius deichmannae, Acanthohaustorius millsi*, Platyischnopidae A, *Bathyporeia parkeri, Parahaustorius longimerus*, and *Rhepoxynius epistomus)* were common throughout the year at subtidal stations (Fig. 3). *Protohaustorius deichmannae* was most abundant, and frequently dominant, at two of the subtidal stations nearest the beach (NS01, HS01). Maximum numbers of this species were observed in spring samples at HS01. *Parahaustorius longimerus* was also common at nearshore stations, particularly on Transects II and III, but was absent at the outermost station on each transect. *Acanthohaustorius millsi* and *Bathyporeia parkeri* were most prevalent at midshore stations on each subtidal transect, and *A. millsi* was the numerically dominant macroinvertebrate at all subtidal stations of Transect I during November. *Bathyporeia parkeri* was frequently observed in winter and spring samples but was scarce in August samples.

Platyischnopidae A occurred in greatest numbers at midshore and offshore stations. More specimens of this species were collected during February than any other sampling interval. The phoxocephalid *Rhepoxynius epistomus* was also more frequent at midshore and offshore stations than elsewhere.

Table 4. Numbers of individuals and ranked abundance of dominant macroinvertebrate species collected at nine intertidal stations at Murrells Inlet during 1977-78. (Only species comprising ≥ 1% of the total number collected are presented.)

	MHW	MTL	MLW	Total	% of Fauna	Cumul. %	Rank by Number
Scolelepis squamata	11	2223	1680	3914	43.8	43.8	1
Neohaustorius schmitzi	7	1201	520	1728	19.3	63.1	2
Donax variabilis	5	623	733	1361	15.2	78.3	3
Spiophanes bombyx	3	69	657	729	8.2	86.5	4
Paraonis fulgens	0	24	144	168	1.9	88.4	5
Parahaustorius longimerus	0	40	125	165	1.8	90.2	6
Acanthohaustorius millsi	0	21	137	158	1.8	92.0	7
Others (81 species)	18	343	352	713	8.0	100.0	-

Table 5. Numbers of individuals and ranked abundance of dominant macroinvertebrate species collected at nine subtidal stations at Murrells Inlet during 1977-78. (Only species comprising ≥1% of the total number collected are presented.)

	Nearshore	Midshore	Offshore	Total	% of Fauna	Cumul. %	Rank by Number
[illegible]	436	935	11,828	13,199	45.5	45.5	1
[illegible]	1,851	378	105	2,334	8.0	53.5	2
[illegible]	1,552	403	15	1,970	6.8	60.3	3
[illegible]	542	1,069	19	1,630	5.6	65.9	4
[illegible] sp.	285	102	1,028	1,415	4.9	70.8	5
[illegible]	399	311	3	713	2.5	73.3	6
[illegible]	1	16	607	624	2.2	75.5	7
Platyischnopidae [illegible]	34	299	229	562	1.9	77.4	8
Maldanidae (undet.)	0	0	412	412	1.4	78.8	9
[illegible]	57	349	4	410	1.4	80.2	10
[illegible]	171	201	0	372	1.3	81.5	11
[illegible]	40	145	112	297	1.0	82.5	12
Others ([illegible] species)	969	1,477	2,632	5,078	17.5	100.0	-

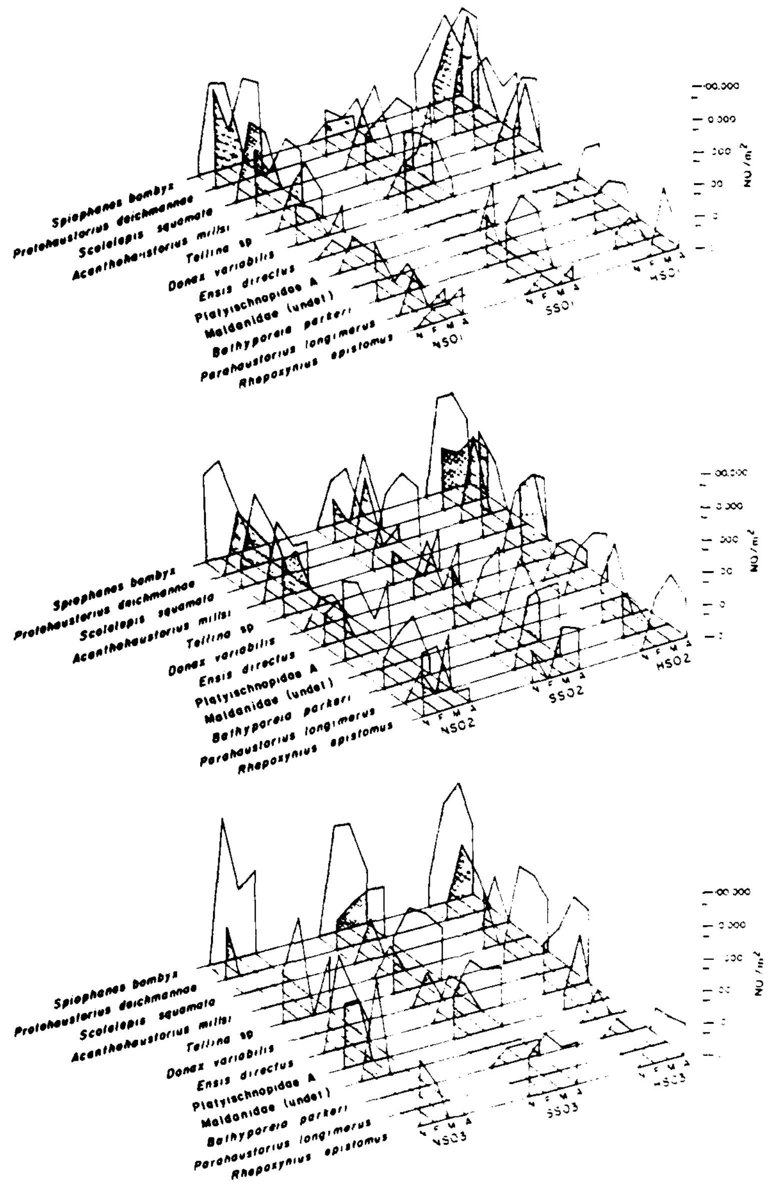

Figure 3. Seasonal abundance of dominant macroinvertebrates at nearshore, midshore, and offshore subtidal stations along the three transects sampled during 1977-78. Vertical scales are logarithmic.

Three species of pelecypods were also common subtidally. *Donax variabilis* was present almost exclusively at nearshore and midshore sites. Large numbers of juveniles were present in samples from February, but this species was scarce in subtidal samples by May. This decline may reflect a migration into the intertidal zone, since substantial increases in density were observed between February and May at most middle and lower intertidal stations (Fig. 2). In contrast to *D. variabilis*, the razor clam *Ensis directus* was collected primarily in fine sands offshore. Length-frequency relationships indicated that a single spawning of *E. directus* occurred during the study, with the first recruits collected in high densities during February. A third pelecypod, *Tellina* sp., appeared to spawn at approximately the same time as *E. directus* and was also prevalent at offshore stations.

(3). Community Structure

Differences in species numbers and overall faunal density occurred along the length of each transect (Table 6). The fauna was scarce at all high intertidal stations, with maximum number of species at this level being five, and overall densities never exceeding 10.7 individuals per 0.1 m^2. Species numbers and species richness increased seaward along each transect, with abrupt changes occurring between MHW and MTL. A substantial increase in faunal richness was also noted between intertidal and subtidal stations on Transects I and III; however, this difference was less marked on Transect II (Table 6). Midshore and offshore stations typically had the greatest number of species on each transect.

Species diversity (H'), evenness (J'), and species richness (SR) varied considerably from season to season at a given station (Table 6), probably reflecting the different reproductive periodicities of several dominant species. Diversity was generally lowest in samples from the high intertidal stations and in samples with unusually high faunal densities (i.e., May samples at NI02 and NI03, February sample at NS03) which were dominated by a single species. The highest diversity was noted at offshore sites on Transects II and III, and at the midshore site on Transect I. Despite the temporal differences observed in species diversity, consistent seasonal patterns were not clearly reflected by these indices.

Four station groups were chosen from the normal cluster analysis (Fig. 4). Group 1 consisted of the three MHW intertidal stations, all of which lacked a characteristic and persistent suite of macroinvertebrate species, and which were generally represented by very few species and individuals. The internal similarity of this group was lower than other groups, with SI01 being least similar to all other intertidal stations. Samples from two seasons at this station contained no organisms (Table 6), and only five animals were collected there during the entire study. Three of those five specimens were *Talorchestia megalophthalma*, a talitrid amphipod that is generally restricted to the higher intertidal level of sandy beaches (Bousfield, 1973). Although this species was deleted prior to computation of similarity, its presence illustrates an affinity to the high intertidal level, and for this reason SI01 was included with the other higher intertidal stations to form Group 1.

Table 6. Number of species, estimated numbers of individuals per 0.1 m^2, species diversity (H') in bits, evenness (J'), and species richness (SR) for each station during the 1977-78 sampling period at Murrells Inlet.

	TRANSECT I						TRANSECT II						TRANSECT III					
Month	Station	No. Spp.	No. Ind. per 0.1m^2	H'	J'	SR	Station	No. Spp.	No. Ind. per 0.1m^2	H'	J'	SR	Station	No. Spp.	No. Ind. per 0.1m^2	H'	J'	SR
Nov.	HI01	1	2.0	0.0	0.0	0.0	SI01	0	0.0	-	-	-	NI01	3	3.3	1.5	1.0	1.2
Feb.		2	6.0	0.9	0.9	0.5		0	[illegible]	-	-	-		5	10.7	1.9	0.8	1.4
May		1	0.7	0.0	0.0	0.0		1	0.7	0.0	0.0	0.0		1	0.7	0.0	0.0	0.0
Aug.		2	2.0	0.9	0.9	0.9		3	2.7	1.5	1.0	1.4		1	0.7	0.0	0.0	0.0
Nov.	HI02	11	26.2	2.8	0.8	2.7	SI02	[illegible]	[illegible]	2.6	0.9	2.7	NI02	6	26.2	1.3	0.5	1.4
Feb.		10	295.7	1.1	0.3	1.5		30	[illegible]	3.1	0.6	5.4		8	7.5	2.8	1.0	2.9
May		10	449.6	1.6	0.5	1.4		9	[illegible]	1.8	0.6	1.3		7	1340.8	0.3	0.1	0.8
Aug.		10	169.9	1.7	0.5	1.6		10	[illegible]	1.6	0.5	1.6		7	10.1	2.3	0.8	2.2
Nov.	HI03	8	45.5	2.3	0.8	1.7	SI03	[illegible]	[illegible]	3.3	0.9	3.5	NI03	7	24.7	1.9	0.7	1.7
Feb.		11	345.1	1.6	0.5	1.6		42	[illegible]	2.1	0.4	5.6		11	23.6	2.8	0.8	2.8
May		9	509.0	1.6	0.5	1.2		18	166.1	2.1	0.5	3.0		5	508.2	0.2	0.1	0.6
Aug.		9	81.4	2.2	0.7	1.7		16	100.7	1.9	0.5	3.0		9	41.5	2.5	0.8	1.9
Nov.	HS01	23	55.9	2.9	0.6	4.3	SS01	19	57.8	2.5	0.6	3.5	NS01	20	156.2	1.8	0.4	3.1
Feb.		16	634.2	1.6	0.4	2.0		16	77.2	2.1	0.5	2.8		28	99.4	2.8	0.6	4.5
May		34	364.3	2.7	0.5	4.7		24	126.4	3.5	0.8	3.9		25	217.3	2.0	0.4	3.7
Aug.		30	134.3	3.1	0.6	4.8		28	86.9	2.9	0.6	4.9		18	96.2	1.8	0.4	3.0
Nov.	HS02	17	276.8	1.2	0.3	2.4	SS02	23	43.4	3.7	0.8	4.5	NS02	22	117.0	2.5	0.6	3.6
Feb.		35	298.9	3.3	0.6	5.0		22	67.1	3.2	0.7	3.8		33	275.9	3.1	0.6	4.8
May		52	252.6	3.8	0.7	7.7		22	224.0	2.9	0.6	3.2		35	48.4	4.3	0.8	6.9
Aug.		43	92.4	4.3	0.8	7.5		35	96.5	3.9	0.8	5.8		22	66.5	3.3	0.7	4.0
Nov.	HS03	25	29.7	4.0	0.9	5.3	SS03	[illegible]	51.5	4.4	0.9	6.6	NS03	27	57.0	3.8	0.8	5.1
Feb.		35	300.8	2.8	0.5	5.0		33	330.6	2.4	0.4	7.5		65	3516.2	1.4	0.2	6.9
May		52	662.4	2.2	0.4	6.7		48	263.1	2.2	0.4	7.0		49	176.7	4.4	0.8	7.7
Aug.		30	65.1	3.7	0.8	5.5		[illegible]	47.3	4.4	0.9	6.6		50	172.5	3.4	0.6	7.8

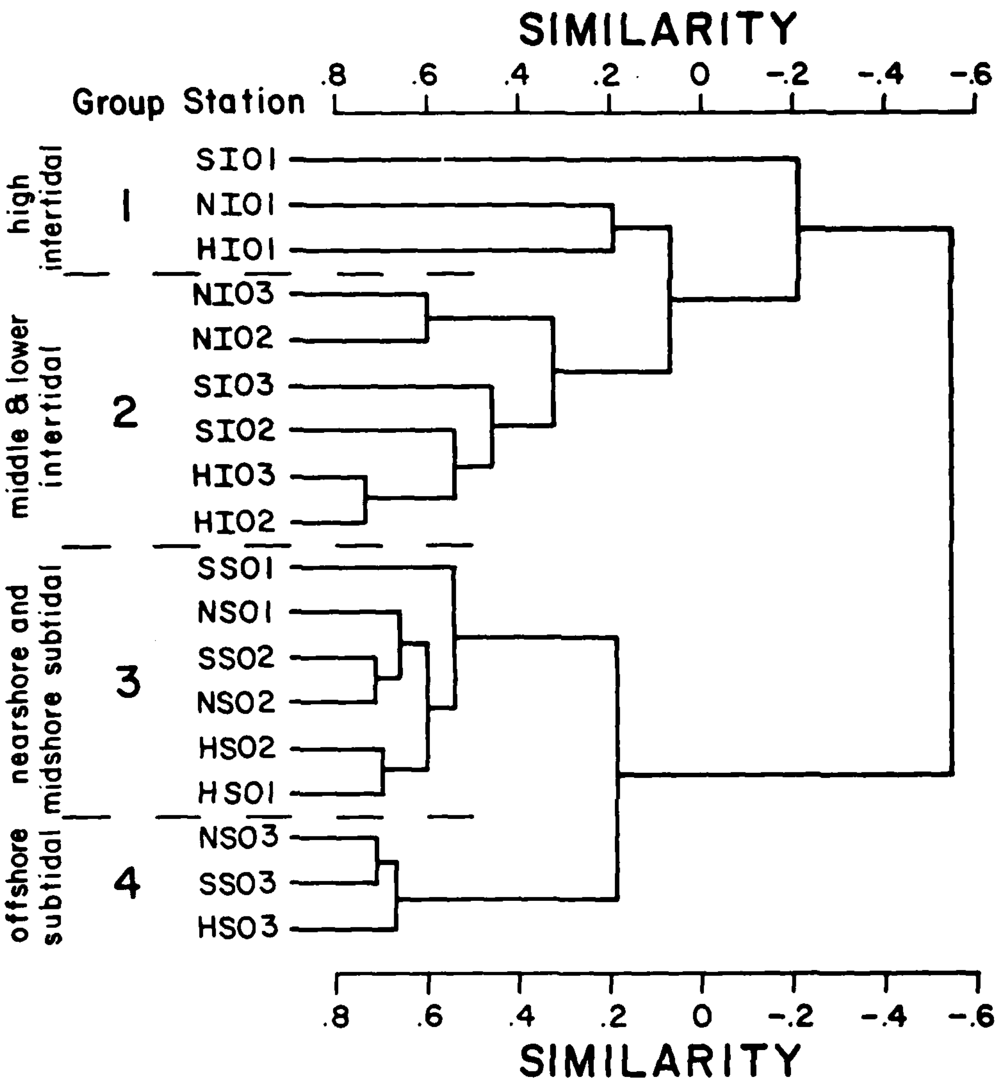

Figure 4. Normal cluster dendrogram of 1977-78 samples showing station groups formed using the Bray-Curtis similarity coefficient and flexible sorting.

The remaining intertidal stations formed Group 2 (Fig. 4). This group had closer resemblance to the high intertidal stations than to the subtidal stations. Inspection of the matrix of similarity values revealed that resemblance between middle and lower intertidal levels on Transects I and III (i.e., between HI02 and HI03, and between NI02 and NI03) was greater than between equivalent levels on different transects. However, such a strong resemblance was not apparent between the middle and lower intertidal stations on Transect II (SI02 and SI03), which were largely sheltered from wave exposure by the jetty.

Subtidal stations formed two groups, both dissimilar to intertidal stations. These groups differed from one another primarily as a function of their distance from shore. Group 3 was composed of midshore and nearshore stations, and offshore stations comprised Group 4 (Fig. 4).

Inverse cluster analysis of the 92 species remaining after data reduction (see Methods) resulted in the selection of 11 species groups (Table ?) whose hierarchical arrangement is illustrated in Fig. 5. Nodal diagrams of constancy and fidelity (Fig. 5) indicate distinct distribution patterns for most of these species groups.

Species groups A, B, C, and D were frequent (i.e., had high constancy) at offshore stations (Group 4) and were also moderately to highly restricted (faithful) to those stations (Fig. 5). Group E was moderately constant in both subtidal station groups, but was not particularly faithful to either group. While the species comprising Groups A through E were characteristic of the deeper subtidal stations, they were not especially abundant there, and none contributed as much as 1% of the total number of individuals collected subtidally.

Species in Groups H through K, on the other hand, were abundant in the subtidal zone, and Group J was comprised of the most dominant species. These included *Scolelepis squamata*, *Donax variabilis*, *Spiophanes bombyx*, *Acanthohaustorius millsi*, *Paraonis fulgens*, and *Parahaustorius longimerus*, all of which were fairly ubiquitous at all but the highest intertidal level. Numerically dominant species which clustered into Group H included *Protohaustorius deichmannae*, *Rhepoxynius epistomus*, and Platyischnopidae A, and the dominant subtidal species *Ensis directus* and *Bathyporeia parkeri* were found in Groups I and K, respectively.

Species groups H, I, J, and K were highly constant at subtidal stations (Fig. 5), and Group J was highly constant at lower and middle intertidal stations as well. Unlike species in previously mentioned subtidal groups (A through E), those of Groups H through K were ubiquitous throughout the subtidal zone. As a consequence, their fidelity was generally low for subtidal station groups, with the exception of Group I, a large assemblage which was more restricted to the deeper offshore stations (Fig. 5).

Group F consisted of species which were frequently collected at middle and lower intertidal stations and which were largely restricted to those stations (Fig. 5). This group was the only assemblage which exhibited a distinct intertidal preference, and consisted of one isopod species, one decapod species, and four haustoriid amphipod species, including

Table 7. Species groups resulting from inverse numerical classification of data. (Am = Amphipoda; Cn = Cnidaria; Cu = Cumacea; D = Decapoda; E = Echinodermata; I = Isopoda; Mo = Mollusca; My = Mysidacea; P = Polychaeta; T = Tanaidacea).

Group A
- *Ogyrides limicola* (D)
- *Travisia* sp. (P)
- *Trachypenaeus constrictus* (D)
- *Apanthura magnifica* (I)
- *Phyllodoce arenae* (P)
- *Olivella mutica* (Mo)
- *Nassarius trivittatus* (Mo)
- *Magelona phyllisae* (P)
- *Polynices duplicatus* (Mo)
- *Turbonilla* sp. (Mo)
- *Podarke obscura* (P)
- *Paraprionospio pinnata* (P)

Group B
- *Hemipholis elongata* (E)
- unknown Pelecypoda #3 (Mo)
- *Unciola serrata* (Am)
- *Eulalia sanguinea* (P)
- *Chione cancellata* (Mo)
- unknown Pelecypoda #9 (Mo)
- unknown Polychaeta #26
- *Crassinella lunulata* (Mo)
- unknown Polychaeta #31

Group C
- *Terebra dislocata* (Mo)
- unknown Cumacea #2
- *Mulinia lateralis* (Mo)
- *Magelona rosea* (P)
- *Erichthonius brasiliensis* (Am)

Group D
- *Heteromastus filiformis* (P)
- *Edotea montosa* (I)
- *Corophium tuberculatum* (Am)
- *Mysidopsis bigelowi* (My)
- *Sabellaria vulgaris* (P)
- *Euceramus praelongus* (D)
- *Onuphis eremita* (P)
- *Scoloplos rubra* (P)
- *Tiron tropakis* (Am)
- *Brania clavata* (P)

Group E
- *Nucula* sp. (Mo)
- *Parapleustes aestuarius* (Am)
- *Metamysidopsis munda* (My)
- Callianassidae (D)

Group F
- *Exosphaeroma diminutum* (I)
- *Amphiporeia virginiana* (Am)
- *Emerita talpoida* (D)
- *Haustorius longirostris* (Am)
- *Neohaustorius schmitzi* (Am)
- *Lepidactylus dytiscus* (Am)

Group G
- unknown Pelecypoda #2
- *Jassa falcata* (Am)
- *Gammarus* sp. (Am)

Group H
- *Nephtys picta* (P)
- *Haploscoloplos* sp. (P)
- *Protohaustorius deichmannae* (Am)
- Platyischnopidae A (Am)
- *Rhepoxynius epistomus* (Am)
- *Synchelidium americanum* (Am)
- *Magelona papillicornis* (P)
- *Renilla reniformis* (Cn)

Group I
- *Tharyx marioni* (P)
- *Amastigos caperatus* (P)
- *Batea catherinensis* (Am)
- *Owenia fusiformis* (P)
- *Ancinus depressus* (I)
- unknown Polychaeta #15
- *Tellina alternata* (Mo)
- *Microprotopus raneyi* (Am)
- unknown Pelecypoda #1
- *Ensis directus* (Mo)
- *Spisula solidissima* (Mo)
- *Scolelepis texana* (P)
- *Caulleriella killariensis* (P)
- *Oxyurostylis smithi* (Cu)
- *Glycera dibranchiata* (P)
- *Dissodactylus mellitae* (D)
- *Mellita quinquiesperforata* (E)
- *Pagurus longicarpus* (D)

Group J
- *Scolelepis squamata* (P)
- *Donax variabilis* (Mo)
- *Spiophanes bombyx* (P)
- *Acanthohaustorius millsi* (Am)
- *Paraonis fulgens* (P)
- *Parahaustorius longimerus* (Am)
- *Lovenella gracilis* (Cn)

Group K
- *Bowmaniella* sp. (My)
- *Ogyrides alphaerostris* (D)
- *Chiridotea stenops* (I)
- unknown Cumacea #3
- *Eteone heteropoda* (P)
- *Dispio uncinata* (P)
- *Leptognatha caeca* (T)
- *Bathyporeia parkeri* (Am)
- *Acanthohaustorius intermedius* (Am)
- unknown Polychaeta #11

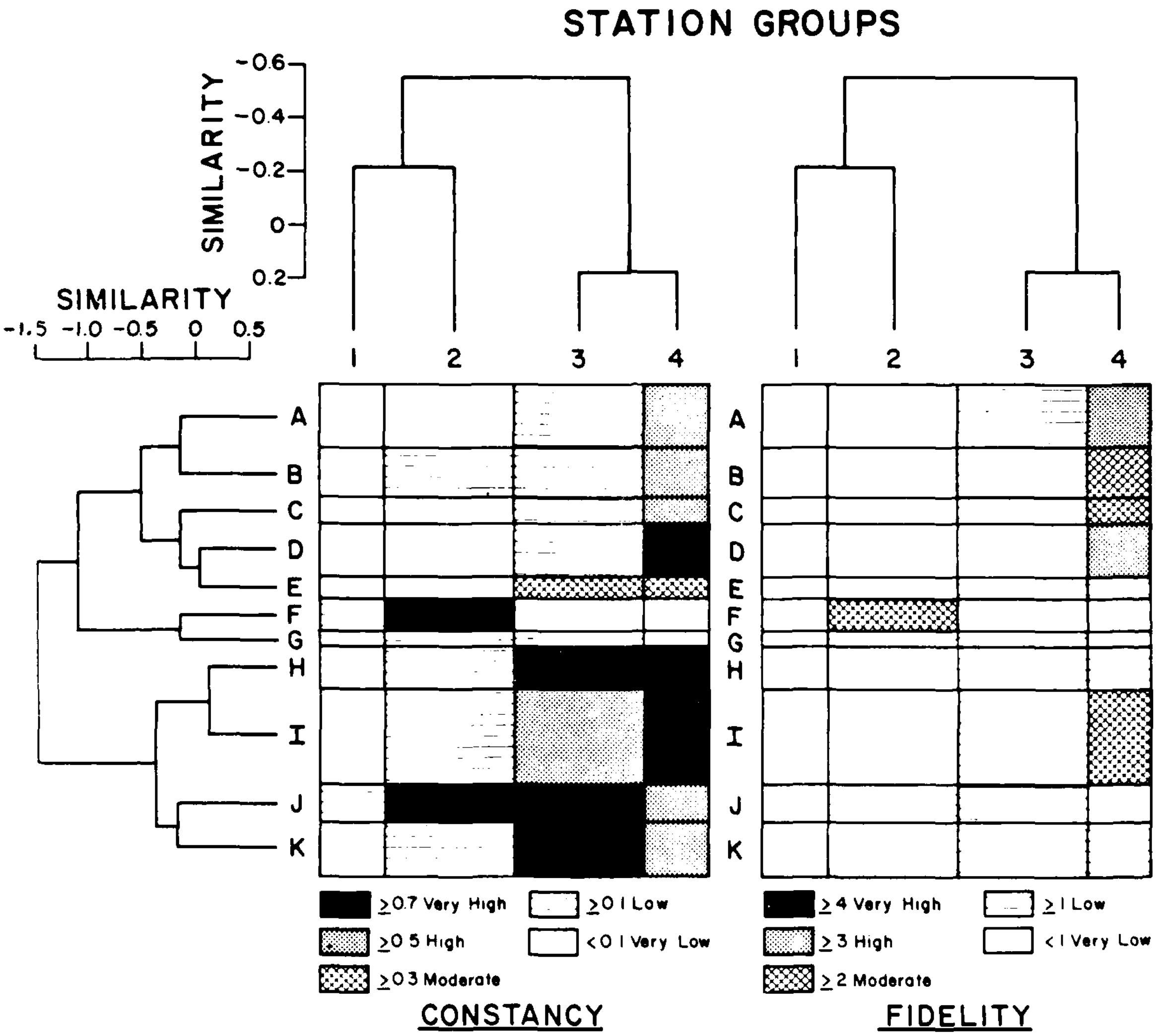

Figure 5. Normal and inverse classification hierarchies, and nodal diagrams showing constancy and fidelity of station-species groups coincidence among samples collected during 1977-78.

Neohaustorius schmitzi, which ranked second in abundance among intertidal species (Table 4).

Three species comprised Group G, and none were abundant or frequently collected. Constancy and fidelity for this group were low in station groups 2 and 3, and no specimens were collected at station groups 1 or 4. No apparent ecological factors or habitat preferences were observed that would characterize this species group.

b. Long-term Changes Following Jetty Construction

Samples collected during the summer and fall of 1982 at the four transects on Garden City Beach contained 156 species of macroinvertebrates, with 150 species found at subtidal stations and only 26 species found at intertidal levels (Appendices E-I). As in 1977-78, polychaetes accounted for the greatest number of species overall (Table 8), followed by amphipods and pelecypods. Taken together, these three taxa comprised greater than 60% of the total species, which was similar to their relative importance in 1977-78 samples (Table 2). In the intertidal zone, however, substantially fewer species of polychaetes and pelecypods were collected during 1982, and amphipods accounted for nearly half of the number of species in the samples. Furthermore, in terms of their numerical abundance, polychaetes did not dominate the intertidal and subtidal collections in 1982 as was noted in 1977-78 (Table 3). Subtidally, amphipods and pelecypods were most abundant in 1982, while oligochaetes and nematodes largely dominated the intertidal fauna (Table 9).

(1). Intertidal Community Composition

Oligochaetes were particularly abundant at the middle intertidal stations in 1982, and were generally restricted to that level and the highest intertidal level (Table 10). Nematodes were also abundant in the upper intertidal zone, with greatest densities at the highest elevations. At the low intertidal level, *Emerita talpoida, Donax variabilis,* and *Scolelepis squamata* were co-dominant, and along with oligochaetes and nematodes, they comprised nearly 98% of the intertidal fauna.

Several of the species which were dominant in the intertidal zone during 1977-78 were notably reduced in abundance in 1982 samples. Most of these differences may be attributed to the normal seasonal variation in abundance. For example, *Scolelepis squamata, Spiophanes bombyx,* and *Neohaustorius schmitzi* were all dominant in 1977-78 when all four seasons were sampled (Table 4), but were considerably reduced in importance during 1982 summer and fall sampling. Each of these species exhibited peak abundances during the winter or spring of 1978 (see Section IV.2a), thus accounting for their decreased relative abundance in the latter sampling period.

In order to evaluate jetty effects on the composition of the intertidal community, the abundance of species which were dominant during summer and fall was compared between equivalent sampling periods in 1977-78 vs. 1982, and between near-jetty Transects II and III and control Transects IV and V (Fig. 6). Samples collected during winter and spring of 1978 were not included in this comparison, nor were those from Transect I, which was only

Table 8. Number of species representing each of the major macroinvertebrate taxa in intertidal and subtidal samples collected from Murrells Inlet during 1982.

Taxon	No. Species Intertidally	No. Species Subtidally	No. Species Both Areas Combined	Percent of Total	Cumul. Percent
Polychaeta	3	42	44	28.2	28.2
Amphipoda	12	29	33	21.2	49.4
Pelecypoda	3	18	18	11.5	60.9
Decapoda	2	18	18	11.5	72.4
Gastropoda	0	8	8	5.1	77.5
Isopoda	1	8	8	5.1	82.6
Mysidacea	1	7	7	4.5	87.1
Turbellaria	0	5	5	3.2	90.3
Cumacea	1	4	4	2.6	92.9
Echinodermata	0	3	3	1.9	94.8
Anthozoa	1	2	2	1.3	96.2
Oligochaeta	1	1	1	0.6	96.8
Tanaidacea	0	1	1	0.6	97.5
Nematoda	1	1	1	0.6	98.1
Sipunculida	0	1	1	0.6	98.8
Cephalochordata	0	1	1	0.6	99.4
Rhynchocoela	0	1	1	0.6	100.0
TOTAL	26	150	156		

Table 9. Numbers of individuals of each of the major macroinvertebrate taxa in intertidal and subtidal samples collected from Murrells Inlet during 1982.

Taxon	No. Individuals Intertidally	No. Individuals Subtidally	Total Numbers	Percent of Total	Cumul. Percent
Pelecypoda	921	1753	2674	19.2	19.2
Polychaeta	858	1405	2263	16.2	35.4
Amphipoda	100	2152	2252	16.2	51.6
Nematoda	1428	793	2221	15.9	67.5
Oligochaeta	2105	13	2118	15.2	82.7
Decapoda	1178	242	1420	10.2	92.9
Turbellaria	0	351	351	2.5	95.4
Mysidacea	6	220	226	1.6	97.0
Tanaidacea	0	129	129	0.9	97.9
Isopoda	2	94	96	0.7	98.6
Anthozoa	1	56	57	0.4	99.0
Echinodermata	0	56	56	0.4	99.4
Gastropoda	0	31	31	0.2	99.6
Cumacea	1	19	20	0.1	99.8
Rhynchocoela	0	16	16	0.1	99.9
Cephalochordata	0	8	8	<0.1	99.9
Sipunculida	0	1	1	<0.1	100.0
TOTAL	6600	7339	13939		

Table 10. Numbers of individuals and ranked abundance of dominant macroinvertebrate species collected at twelve intertidal stations at Murrells Inlet during 1982. (Only species comprising $\geq$ 1% of the total number are presented.)

	MHW	MTL	MLW	Total	% of Fauna	Cumul. %	Rank by Number
Oligochaeta	174	1930	1	2105	31.9	31.9	1
Nematoda	752	597	79	1428	21.6	53.5	2
Emerita talpoida	2	301	873	1176	17.8	71.3	3
Donax variabilis	5	171	720	896	13.6	84.9	4
Scolelepis squamata	0	206	650	856	13.0	97.9	5
Others (21 species)	8	21	110	139	2.1	100.0	-

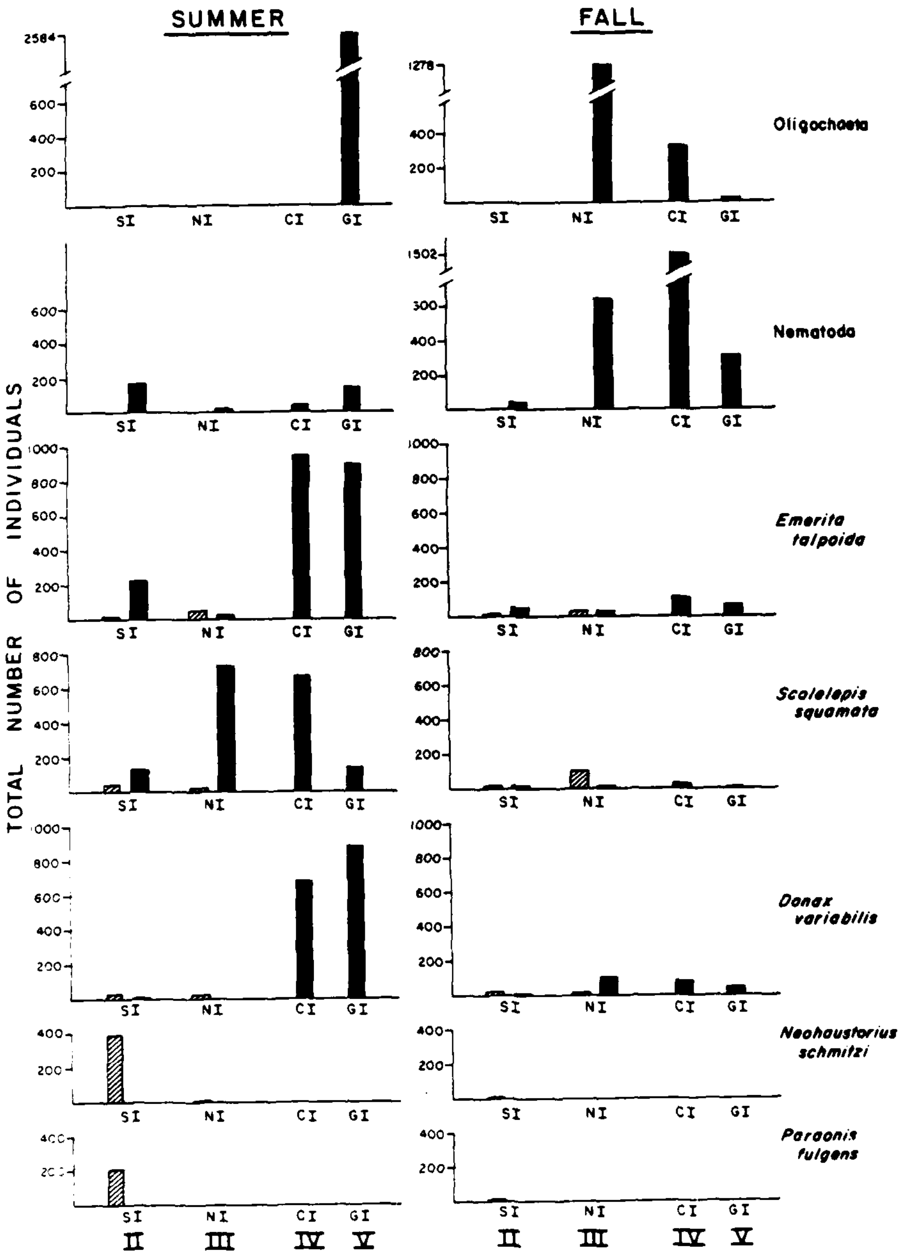

Figure 6. Comparison of relative abundance of dominant macroinvertebrates in intertidal samples on the near-jetty and control transects. Cross-hatched bars represent 1977-78 samples and solid bars represent 1982 samples.

sampled during 1977-78. The results of these comparisons (Fig. 6) indicate differences in the abundance and distribution of some species, but similarities for others.

Oligochaetes were not collected in 1977-78, but were moderately abundant on both control transects and on Transect III during either the summer or fall of 1982 (Fig. 6). Nematodes were also low in abundance during 1977-78, but were found in substantially greater numbers in 1982, especially during the fall on the control transects and Transect III. The lack of any consistent pattern of abundance (control vs. near-jetty transects; prior to vs. following construction) illustrates the temporal and spatial variability in the distribution of these organisms, and is probably not indicative of any direct impact from construction of the jetties.

The mole crab *Emerita talpoida* and the coquina clam *Donax variabilis* showed little difference between intial densities and those five years later on Transects II and III (Fig. 6). During the summer of 1982, however, densities on both control transects were considerably higher than on near-jetty Transects II and III, indicating a possible jetty effect on the distribution of these species during their period of maximum abundance.

The most abundant intertidal species in 1977-78 (*S. squamata* and *N. schmitzi*) were found in high densities on only two transects in the summer of 1982, and were relatively rare during the fall (Fig. 6). The reduced numbers of these species, compared to the initial sampling period, is related to their seasonal pattern of abundance, since peak densities in 1977-78 occurred during winter and spring months, which were not sampled in 1982.

(2). Subtidal Community Composition

Three of the dominant species of macroinvertebrates collected in the subtidal zone during 1982 were restricted to the offshore stations. These were the pelecypod *Crassinella martinicensis*, the polychaete *Podarke obscura* and an undetermined flatworm, Turbellaria A (Table 11). Additionally, the fossorial amphipods *Rhepoxynius epistomus* and Platyischnopidae A were most abundant at offshore stations, although they were also observed in lower densities at the shallower stations. Other species, such as the amphipod *Protohaustorius deichmannae*, the mysid *Bowmaniella* sp., the polychaete [illegible], and nematodes were found throughout the subtidal zone, but were most abundant at midshore stations. Finally, certain species, including [illegible] and the amphipod *Bathyporeia parkeri*, were largely restricted to the nearshore stations (Table 11).

The overwhelming numerical dominance of the subtidal community by *Spiophanes bombyx* that was observed in 1977-78 (Table 5) was not apparent during 1982. Once again, this difference is most likely a result of the peak abundances of this species during seasons (winter and spring) that were not sampled in 1982 (Fig. 3).

The distribution of three species (*C. martinicensis*, *P. obscura*, and Nematoda), which were collected only during 1982, may reflect the effects of jetty construction, particularly along the channel portion of Transect II (Fig. 7). *Crassinella martinicensis* and *P. obscura* were collected only

Table 11. Numbers of individuals and ranked abundance of dominant macroinvertebrate species collected at twelve subtidal stations at Murrells Inlet during 1982. (Only species comprising ≥ 2% of the total number are presented.)

	Nearshore	Midshore	Offshore	Total	Percent of Fauna	Cumul. Percent	Rank by Number
Crassinella martinicensis	0	0	1134	1134	15.4	15.4	1
Protohaustorius deichmannae	148	495	150	793	10.8	26.2	2
Nematoda	213	428	152	793	10.8	37.0	2
Platyischnopidae A	30	79	513	622	8.4	45.4	4
[illegible] obscura	0	0	587	587	8.0	53.4	5
Donax variabilis	393	8	0	401	5.4	58.8	6
Magelona papillicornis	100	139	26	265	3.6	62.4	7
Rhepoxynius epistomus	15	78	160	253	3.4	65.8	8
Turbellaria A	0	0	246	246	3.3	69.1	9
Bathyporeia parkeri	156	18	13	187	2.5	71.6	10
Bowmaniella sp.	74	91	10	175	2.4	74.0	11
Others (139 species)	507	585	814	1906	26.0	100.0	-

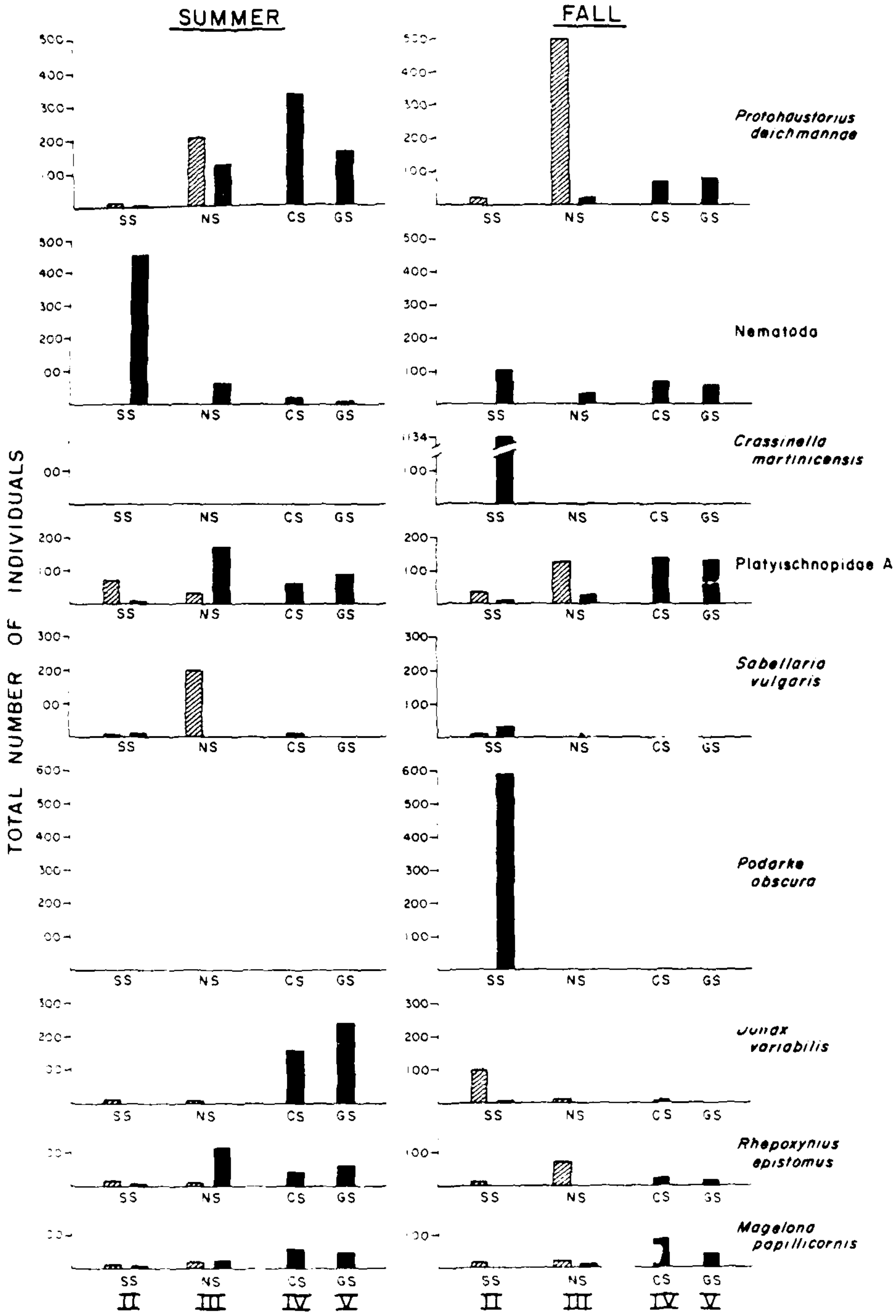

Figure 7. Comparison of relative abundance of dominant macro-invertebrates in subtidal samples on the near-jetty and control transects. Cross-hatched bars represent 1977-78 samples and solid bars represent 1982 samples.

at SS03 (Appendix E), where sediments were very coarse and contained larger amounts of shell hash than other stations. Nematodes were also considerably more abundant on Transect II, especially during the summer. Jetty construction may also have affected the subtidal distribution of *[illegible]. variabilis*, since it was only abundant at control stations in 1982.

Most of the other dominant species, such as the amphipods *P. deichmannae*, Platyischnopidae A, and *R. epistomus*, and the polychaete *M. papillicornis*, were less abundant on Transect II than on the other transects sampled in 1982. These differences are not necessarily related to the impact of the jetties, however, since similar differences were observed between Transects II and III during the fall of 1977, prior to jetty construction (Fig. 7).

(3). Community Structure

The trends noted in species richness and diversity of 1977-78 samples were generally repeated in the subsequent sampling period. Species numbers and species richness increased seaward along the transects, although the abrupt change noticed between MHW and MTL was not as clear in 1982 (Table 12). This is probably the result of the abundance of nematodes and oligochaetes observed at the MHW level on Transects III, IV, and V during the latter sampling period, when faunal densities were far greater than those observed initially at that level (Tables 6 and 12). Another similarity with the initial sampling period was the occurrence of lowest diversity values at the upper intertidal level and greatest diversity at the midshore or offshore stations on each transect (Table 12).

Although species richness and diversity estimates at each station revealed no consistent differences among the four transects sampled in 1982 (Table 12), differences were noted in the total number of species and individuals on the intertidal transects sampled in 1977-78 vs. 1982 (Fig. 8). During the summer of 1978, before rock removal created the weir section in the jetty, the finer sediments at sheltered intertidal stations (SI) contained twice as many species as the number collected on the exposed side (NI). By 1982, SI stations were less sheltered because the weir section allowed wave action to cross the jetty, and the number of species at those stations was reduced substantially. Additionally, the number of species on both near-jetty transects was lower than on control transects (CI and GI). The number of individuals in intertidal samples was also lowest at the SI stations. These low abundances noted on Transect II reflect, in part, the absence of animals at the highest intertidal level during 1982 (Appendix E).

In the subtidal zone, no consistent differences were noted among transects with respect to the number of species, either between years or among transects within a sampling period (Fig. 9). Furthermore, no consistent differences were noted in overall abundance, except on the channel transect (SS) where *C. [illegible]* and *[illegible]* were very abundant during the fall of 1982 (Fig. 7).

Normal cluster analysis of summer and fall samples showed clear separation of intertidal and subtidal collections (Figs. 10 and 11). Intertidal stations formed three station groups (1, 2, and 6) among summer samples, and two groups (1 and 2) in fall collections. Comparisons of the

Table 12. Number of species, estimated numbers of individuals per 0.1 m^2, species diversity (H') in bits, evenness (J'), and species richness (SR) for each station sampled at Murrells Inlet during 1982.

	TRANSECT II						TRANSECT III						TRANSECT IV						TRANSECT V					
Month	Station	No. Spp.	No. Ind. per 0.1m²	H'	J'	SR	Station	No. Spp.	No. Ind. per 0.1m²	H'	J'	SR	Station	No. Spp.	No. Ind. per 0.1m²	H'	J'	SR	Station	No. Spp.	No. Ind. per 0.1m²	H'	J'	SR
July	SI01	0	0.0	-	-	-	NI01	2	6.7	0.5	0.5	0.4	CI01	4	4.7	2.0	1.0	1.5	GI01	3	3.3	1.4	0.9	1.2
Nov.		0	0.0	-	-	-		2	17.3	0.4	0.4	0.3		4	521.3	0.8	0.4	0.5		2	111.0	0.3	0.3	0.2
July	SI02	4	174.0	1.6	0.8	0.5	NI02	3	20.7	0.9	0.6	0.6	CI02	6	110.0	1.6	0.6	1.0	GI02	7	1048.7	1.0	0.4	0.8
Nov.		2	6.0	0.5	0.5	0.5		6	605.3	1.0	0.4	0.7		6	140.0	1.5	0.6	0.9		4	46.0	1.2	0.6	0.7
July	SI03	5	12.7	2.1	0.9	1.4	NI03	7	247.3	0.6	0.2	1.0	CI03	6	677.3	1.6	0.6	0.7	GI03	9	522.0	1.4	0.4	1.2
Nov.		5	29.3	1.8	0.8	1.1		5	64.7	1.4	0.6	0.9		8	35.3	2.2	0.7	1.8		10	33.3	2.4	0.7	2.3
July	SS01	17	47.7	2.3	0.6	3.2	NS01	27	159.0	3.3	0.7	4.2	CS01	15	118.7	2.3	0.6	2.4	GS01	14	101.7	1.4	0.4	2.3
Nov.		8	20.3	2.0	0.7	1.7		10	16.5	2.9	0.9	2.6		15	47.7	2.3	0.6	2.8		12	39.3	2.4	0.7	2.3
July	SS02	37	156.7	2.1	0.4	5.9	NS02	33	108.3	4.0	0.8	5.5	CS02	26	153.0	2.5	0.5	4.1	GS02	25	98.7	2.7	0.6	4.2
Nov.		18	33.7	3.0	0.7	3.7		18	29.7	3.5	0.8	3.8		13	48.5	2.7	0.7	2.6		17	28.0	2.9	0.7	3.6
July	SS03	23	55.3	2.9	0.6	4.3	NS03	38	120.3	3.8	0.7	6.3	CS03	117	421.0	4.6	0.7	16.2	GS03	85	235.3	4.7	0.7	12.8
Nov.		25	737.0	2.1	0.4	3.1		22	30.3	3.8	0.9	4.7		36	92.0	3.4	0.7	6.2		49	108.0	4.4	0.8	8.3
July													YS03	35	90.0	3.6	0.7	6.1	XS03	32	80.0	3.4	0.7	5.7
Nov.														27	76.3	2.6	0.5	4.8		32	79.0	3.0	0.6	5.7

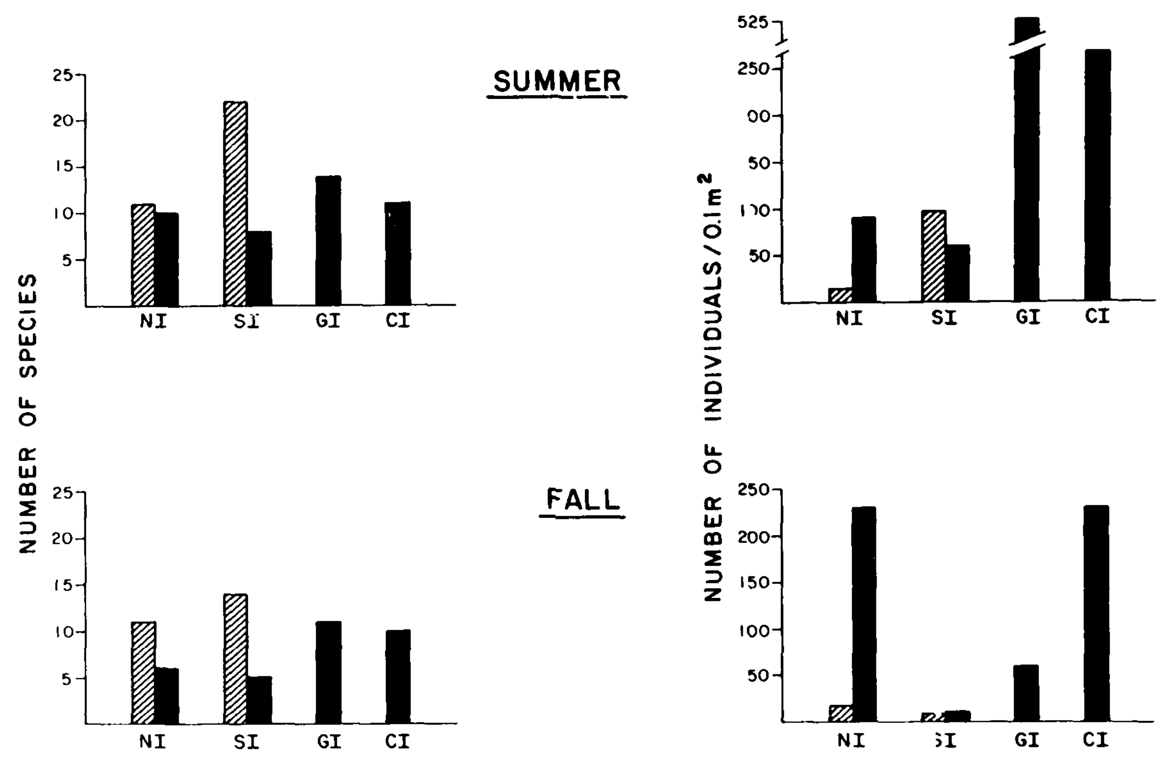

Figure 8. Comparison of the number of species and individuals in pooled intertidal samples from the near-jetty and control transects. Cross-hatched bars represent 1977-78 samples and solid bars represent 1982 samples.

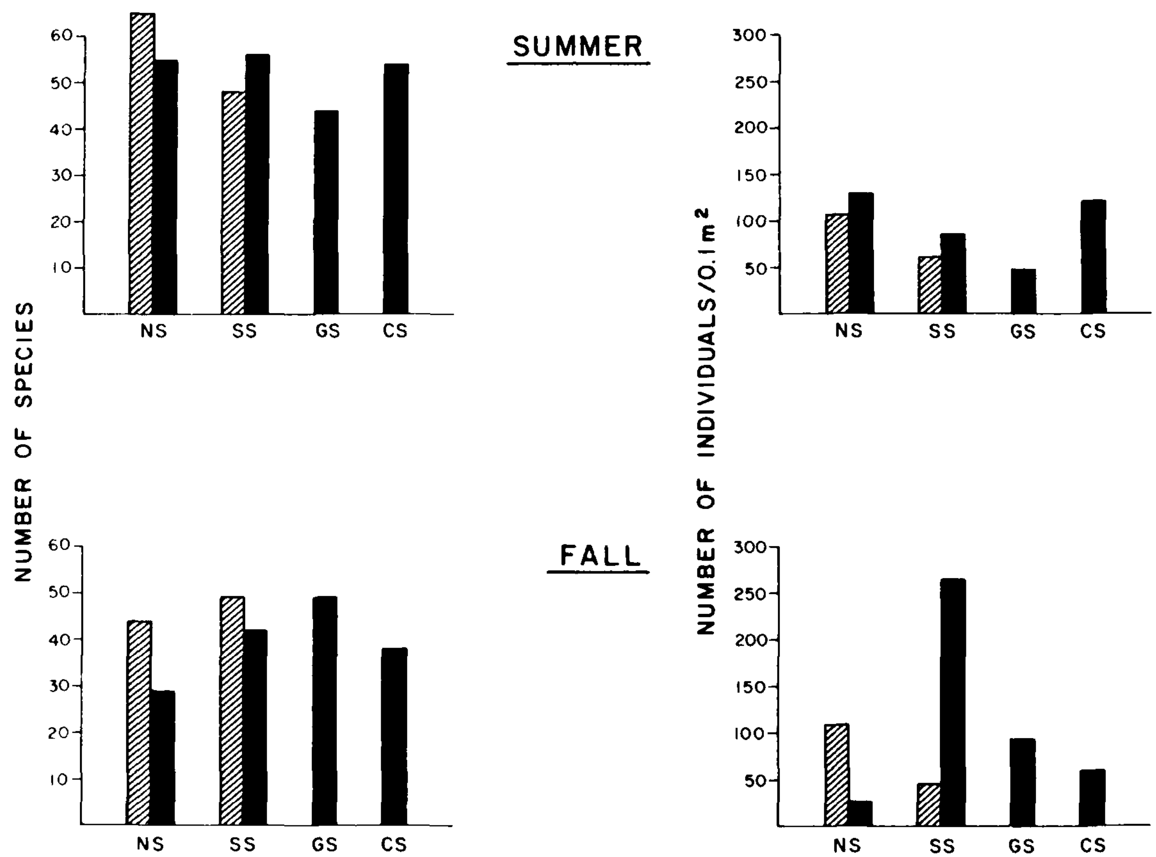

Figure 9. Comparison of the number of species and individuals in pooled subtidal samples from the near-jetty and control transects. Cross-hatched bars represent 1977-78 samples and solid bars represent 1982 samples.

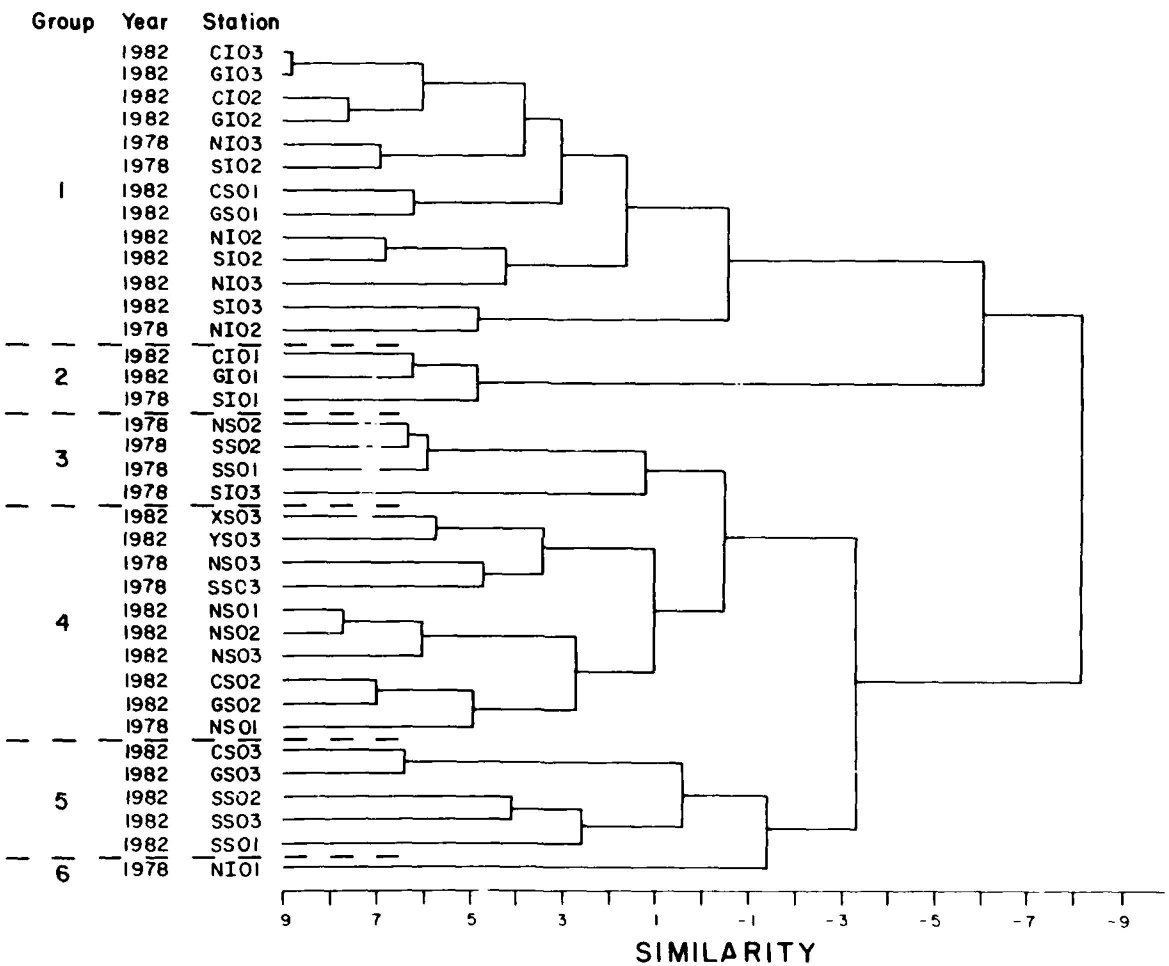

Figure 10. Normal cluster dendrogram of summer samples showing station groups formed using the Bray-Curtis similarity coefficient and flexible sorting.

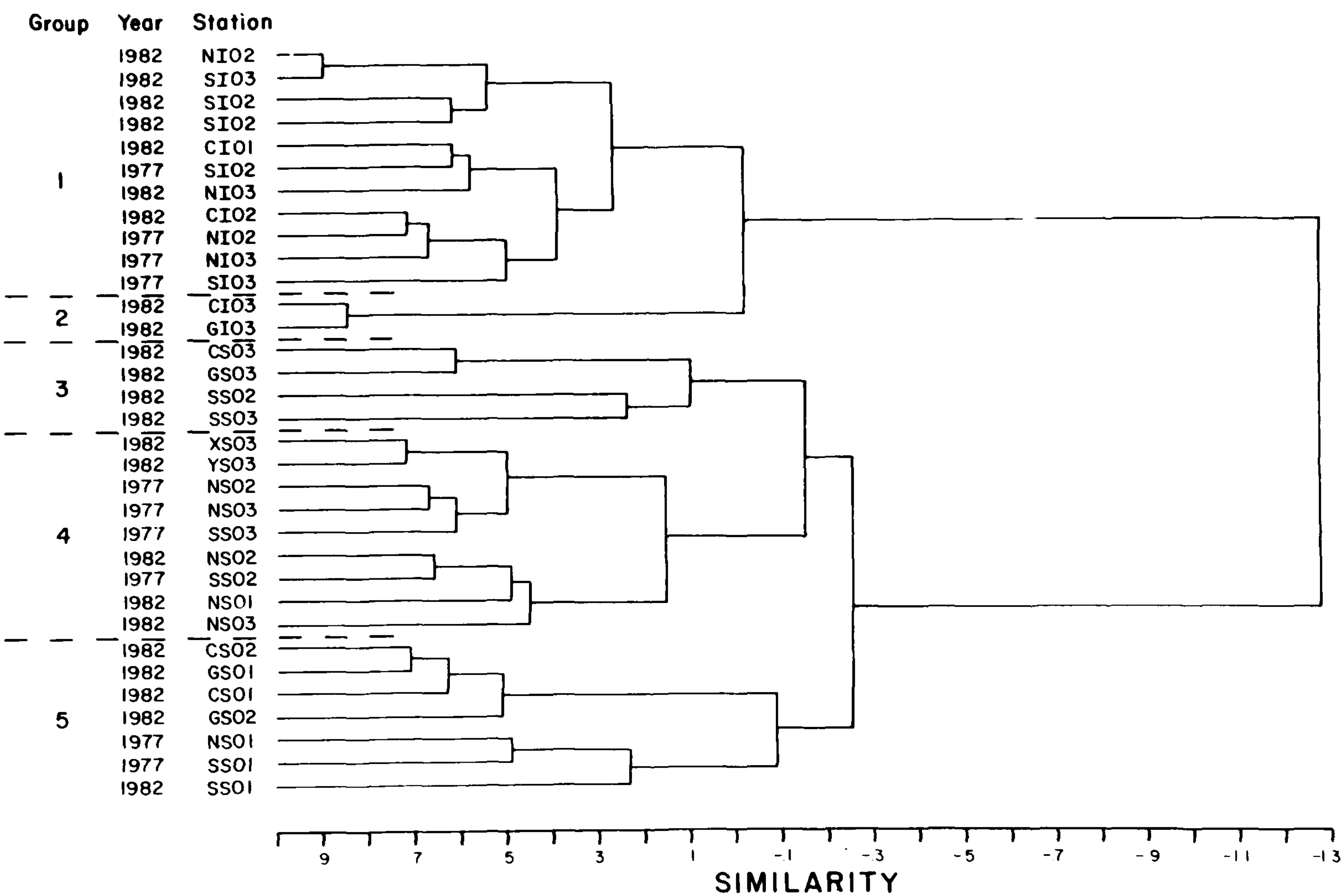

Figure 11. Normal cluster dendrogram of fall samples showing station groups formed using the Bray-Curtis similarity coefficient and flexible sorting.

entities within those groups showed no well-defined differences attributable to jetty effects. In general, the highest intertidal stations (01's) were low in similarity to other intertidal stations (e.g., groups 2 and 6, Fig. 10). Similarity was also low during the fall between control stations CI03 and GI03 and all other intertidal stations (Fig. 11), although this difference was not noted in the analysis of summer samples.

Subtidal stations formed the remaining groups in both dendrograms (Groups 3, 4, and 5). During both seasons of 1982, most SS stations were dissimilar to all other subtidal stations, except the two atypical (muddy) "control" stations CS03 and GS03. They were also dissimilar to SS stations sampled in 1977-78, probably as a result of the modified conditions on this transect which were due to jetty construction. Subtidal stations on the north side of the jetty (NS), however, generally showed greater similarity to the control transects and to NS and SS stations sampled in 1977-78.

c. General Discussion

Many previous studies of the benthic macroinvertebrate fauna inhabiting sandy beaches have been limited to the intertidal zone (Croker, 1967, 1968, 1970, 1977; Dexter, 1967, 1969, 1979; Croker et al., 1975; Holland and Dean, 1977; Saloman and Naughton, 1977, 1978; Simon and Dauer, 1977; Croker and Hatfield, 1980) or to shallow subtidal waters (Frankenberg, 1971; Frankenberg and Leiper, 1977; Maurer et al., 1979a; Oliver et al., 1980). Treatment of the intertidal and subtidal zones as distinctly separate habitats is most likely the result of convenience and economy of sampling, with the mean low water mark being traditionally regarded as the transition between intertidal and subtidal communities (Dexter, 1969; Croker, 1977). The results of the present study confirm that a distinct difference in overall community structure exists between the intertidal and subtidal zones (Figs. 4, 10, 11), but it is important to note that many of the numerically dominant species are prevalent in both zones (Tables 4, 5, 10, 11). *Scolelepis squamata*, for example, was a dominant intertidal species at Murrells Inlet, but it was also important subtidally, ranking third in abundance during 1977-78. Matta (1977) also noted that this species was dominant in the subtidal areas of a high-energy beach in North Carolina, even though it is typically considered an intertidal species (Croker, 1970, 1977; Foster, 1971; Croker et al., 1975; Saloman and Naughton, 1978).

The coquina clam *Donax variabilis* and the polychaete *Spiophanes bombyx* are also important in both intertidal and subtidal assemblages (Appendices A-E). *D. variabilis* is a rapidly burrowing bivalve that is common on beaches along the United States Atlantic coast between New York and Texas (Abbott, 1974), where it is frequently seen in large aggregations. Pearse et al. (1942), Jacobson (1955), and Turner and Belding (1957) reported that populations of *D. variabilis* move up and down the beach with the tide, and our collections in the nearshore and midshore areas document that it is also common subtidally. *Spiophanes bombyx* was the most abundant species at Murrells Inlet in 1977-78, ranking first in abundance subtidally and fourth in the intertidal zone. Although collected both intertidally and subtidally in 1982, the reduced abundance of this spionid during that period was probably a result of the lack of sampling during its peak abundance (winter and spring).

The dominance of the intertidal zone by oligochaetes and nematodes at Murrells Inlet in 1982 suggests that there may be considerable yearly variability in the dominant species, since these taxa were not common in 1977-78. Additionally, these taxa have not been commonly reported in the literature for similar habitats elsewhere. Specimens of both taxa in our samples were generally rather small, and are often considered meiofauna. Therefore, the large numbers collected in this study may be due, in part, to our use of smaller sieve size (0.5 mm) than that often used in other studies of benthic invertebrates.

The abundance of *S. squamata, D. variabilis, S. bombyx,* and nematodes across the range of beach elevations at Murrells Inlet illustrates that the intertidal and shallow-water sand regions can be considered an ecological unit, as Fincham (1971) has suggested. However, we are not suggesting that there are no differences between intertidal and subtidal assemblages, since many of the less abundant species were primarily habitat-restricted, with most groups confined to subtidal waters. For example, the nodal analysis of 1977-78 data documents that several species groups (A-D) were specifically restricted to the deepest subtidal stations, while others (E, H, I, K) were more widely distributed in the subtidal zone (Fig. 5). Group F, on the other hand, was restricted to the middle and lower intertidal zones. Very few specimens of this group were found at high intertidal stations, and only one specimen occurred in subtidal samples.

The intertidal fauna of U.S. Atlantic coast sandy beaches has typically been characterized as dominated by peracarid crustaceans, especially haustoriid amphipods (Pearse et al., 1942; Croker, 1967, 1977; Dexter, 1969; Sameoto, 1969a; Holland, 1974; Holland and Dean, 1977). These fossorial amphipods have been frequently noted to dominate subtidal assemblages in shallow nearshore waters as well (Sameoto, 1969b; Dörjes, 1972; Maurer et al., 1979b). At Murrells Inlet, however, polychaete worms dominated the intertidal and subtidal faunal assemblages in the 1977-78 sampling period, both in terms of the number of species and number of individuals. Similar domination of sandy beach fauna by polychaetes has been correlated to the degree of exposure to wave action by previous investigators. Croker (1977) observed increased dominance by polychaetes (*S. squamata, Pygospio elegans, Paraonis fulgens*) with increased protection from wave exposure on New England beaches. Oliver et al. (198[illegible]) defined two distinct faunal zones on a subtidal high-energy beach in California. The first zone was a shallow (<14 m) "crustacean zone" in which the relatively mobile haustoriid, oedicerotid, and phoxocephalid amphipods and ostracod crustaceans were predominant. Deeper waters contained the "polychaete zone," which consisted primarily of organisms that maintain relatively permanent tubes and burrows. These authors attributed this distinct zonation to the decrease in wave-induced bottom disturbance that was associated with increased water depth.

At Murrells Inlet the proportion of polychaete to peracarid crustacean species in the 1977-78 sampling period was 1:1.4 intertidally, and 1:0.6 subtidally. This suggests a similar relationship between the degree of exposure to harsh environments and richness of the polychaete fauna (Table 2) when all four seasons are considered. Although polychaetes did not dominate the subtidal community in the two seasons sampled in 1982, they were a more important component of the community in that zone than in the intertidal zone. The apparent success of polychaete species at Murrells Inlet compared with other sandy beach habitats may be attributed in part to the moderate impact of wave energy in this region. Roberts (1974) also noted that the fauna is more diverse and polychaetes are better represented on moderate wave energy beaches of South Carolina and Georgia than on high-energy beaches.

The degree of wave exposure affects other aspects of community structure as well. Croker (1977) found that species richness, evenness, and diversity were all considerably higher on a semi-protected intertidal beach than at a moderately exposed site over the duration of a four-year study. Other studies have noted a similar relationship between species numbers and the degree of exposure (McIntyre, 1970, 1977; Croker et al., 1975). During construction of the jetty at Murrells Inlet we observed increased species richness in the intertidal assemblage on the sheltered side of the jetty by February (Table 6), and values were notably higher than on the other intertidal transects sampled during that season. However, this increased diversity was short term and the number of species was reduced as opportunists were eliminated. Five years later, the number of species in the intertidal community near the jetty was lower than in the control area, although H' values were not consistently different. The presence of the jetty weir may have minimized any differences due to sheltering, since the intertidal area on the south side of the jetty receives wave action during high tide periods.

The effects of sheltering on community structure were not as apparent along the subtidal portions of Transect II during the 1977-78 period. By August, jetty construction had progressed to a point just past SS02, and although species numbers increased at SS01 and SS02, similar increases were observed on Transect I. Differences were more apparent at SS stations five years later, particularly with respect to the density of dominant species (Fig. 7) and overall community composition (Figs. 10 and 11).

In our study, differences due to jetty construction appeared to be short-term and/or confined to the area between the jetties. However, although the Huntington Beach transect was not re-sampled in 1982, extensive shoaling was noted on that beach for a considerable distance south of the jetties. Presumably, any modifications in the beach community structure associated with sheltering and shoaling effects could be expected to occur in that area. North of the jetties on Garden City Beach, no short-term or long-term changes have occurred which can be attributed to jetty construction, but it is probable that planned nourishment activities on that beach will result in at least some short-term modifications in macroinvertebrate community structure (Naqvi and Pullen, 1982).

V. SUMMARY AND CONCLUSIONS

1. Macrobenthic communities of the intertidal and nearshore subtidal environments at Murrells Inlet, South Carolina, were studied during jetty construction and five years later. Since biological impacts of jetty structures are not well understood, the present study was undertaken in order to describe the benthic communities and to assess any short-term or long-term effects on those communities attributable to jetty construction.

2. Jetty construction commenced on the Murrells Inlet Navigation Project during the fall of 1977 and benthic sampling was initiated just prior to construction along three transects: two adjacent to the north jetty and one further away on Huntington Beach. Sampling continued quarterly for the first year during construction of the north jetty. By March of 1980, the jetties were completed and in 1982, sampling was repeated during two seasons. Transects sampled during this latter effort included the two adjacent to the north jetty and two control transects further north.

3. On each transect, replicate infaunal samples were collected at three intertidal stations, from mean high water to mean low water, and at three subtidal stations located in depths between one and five meters. Intertidal samples were collected using a quadrat box, and subtidal collections were made with a Van Veen grab. Sediment samples were taken at each location during the initial study period (1977-78) and hydrographic measurements were made at subtidal stations.

4. Water temperature in the area reflected normal seasonal variation, and ranged from 6.0^{o} - 28.7^{o}C. Salinities were consistently high and ranged from 31.9 - 35.4 ^{o}/oo. Differences between surface and bottom samples were negligible, indicating that these waters were well mixed.

5. Sediments in the area typically consisted of quartz sand and shell hash. Although considerable variability was observed among stations with respect to sediment characteristics, some general patterns of sediment distribution were noted that were related to beach elevation, transect location, and season. Two notable exceptions to these patterns were observed: 1) the appearance of finer sediments and shoaling along the intertidal portion of one transect (Transect II) during jetty construction, and 2) the very coarse, shelly sediments found along the outer subtidal portion of the same transect following jetty construction.

6. The benthic community at Murrells Inlet was initially dominated by several species of polychaetes, amphipods, and pelecypods. In the intertidal zone, the spionid polychaete *Scolelepis squamata* was most abundant while a different spionid, *Spiophanes bombyx*, was dominant at subtidal stations. Overall, polychaetes accounted for 40% of the number of species and greater than 60% of the total number of individuals collected during the initial study period. By 1982, however, this dominance by polychaetes was no longer apparent. Oligochaetes and nematodes numerically dominated the intertidal zone during this latter period, while amphipods and pelecypods were most abundant subtidally. This change was probably not related to jetty construction, but was most likely the result of natural yearly variation and limited sampling in 1982, when collections were not made during winter or spring (periods of maximum abundance of *S. squamata* and *S. bombyx*). The dominance of nearshore and intertidal beach communities by polychaetes has not been frequently reported in the literature and may be attributed in part to the moderate impact of wave energy in this region.

7. Jetty effects were indicated by the distribution and abundance of a few species (*Crassinella martinicensis* and *Podarke obscura*), but this appeared to be restricted to the outer stations on Transect II. Otherwise, comparison of species abundance between years and among transects suggested

no widespread impacts attributable to jetty construction.

8. Species richness and diversity were lowest at the upper intertidal stations, and generally increased in a seaward direction along most transects. One significant exception to this trend occurred at the sheltered intertidal stations on Transect II, where species richness was temporarily elevated following initial sheltering by the jetty. This was a short-term effect, however, and by 1982, indices of species diversity and richness were not markedly different from those observed initially.

9. Cluster analysis showed clear separation of intertidal and subtidal stations. Although several of the numerically dominant species were widely distributed throughout both intertidal and subtidal zones, many of the less abundant species were habitat-restricted. Some dissimilarity was noted between subtidal stations sampled during 1982 on Transect II and the remaining subtidal stations, but no other differences in community structure were apparent that could be strictly related to jetty construction.

10. Impacts from jetty construction appear to have been either short-term or limited to areas where changes in sediment characteristics were associated with altered benthic community structure. Extensive shoaling to the south of these jetties precluded repeated sampling in that area; however, modifications in community structure associated with sheltering and shoaling effects should be expected to occur there as well. The area to the north of the jetties does not appear to have been affected by their presence, although future alterations from proposed beach nourishment may have some impact on the beach community in that area.

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Appendix A. Carbonate content (percent by weight), mean grain size (ϕ units), standard deviation, skewness, and kurtosis of sediments in the Murrells Inlet study area (1977-78).

Station	Month	% $CaCO_3$	$\bar{x}$ Grain Size	Standard Deviation	Skewness	Kurtosis
NI01						
	November	9.38	1.524	0.918	-0.206	-0.657
	February	2.88	1.975	0.474	0.068	0.958
	May	3.26	2.274	0.599	-0.166	0.770
	August	1.50				
NI02						
	November	10.76	1.575	0.888	-0.401	1.023
	February	8.46	1.939	0.774	-0.698	2.860
	May	7.00	2.092	0.725	-0.862	4.936
	August	4.80				
NI03						
	November	11.72	1.768	1.110	-0.475	0.396
	February	17.22	1.323	1.273	-0.338	-0.376
	May	10.18	1.999	0.926	-0.740	2.529
	August	5.00				
NS01						
	November	5.76	2,856	0.523	-0.657	3.149
	February	11.60	1.693	1.046	-0.437	0.457
	May	5.32	2,819	0.519	-0.822	5.467
	August					
NS02						
	November	4.66	2.667	0.527	-0.643	4.057
	February	3.66	2.521	0.532	-0.710	5.132
	May	12.25	1.248	1.046	-0.142	0.476
	August	9.30				
NS03						
	November	6.72	2.482	0.670	-0.455	1.045
	February	13.18	2.687	0.596	0.683	3.421
	May	6.93	0.558	0.853	0.475	0.552
	August	6.50				

(Continued)

Appendix A. (Continued)

Station	Month	% $CaCO_3$	$\bar{x}$ Grain Size	Standard Deviation	Skewness	Kurtosis
SI01						
	November	2.54	2.275	0.548	-0.603	3.565
	February	1.95	2.324	0.401	-0.249	2.126
	May	2.07	2.235	0.392	-0.040	1.707
	August					
SI02						
	November	14.64	1.525	1.104	-0.502	0.400
	February	3.50	2.468	0.371	-0.415	4.908
	May	7.23	2.110	0.733	-0.775	3.585
	August					
SI03						
	November	11.34	1.959	1.016	-0.665	1.594
	February	6.44	2.596	0.333	0.035	2.017
	May	5.44	2.576	0.390	-0.338	2.115
	August					
SS01						
	November	7.24	2.071	0.716	-0.556	1.319
	February	3.36	2.097	0.487	-0.541	2.647
	May	6.28	1.876	0.594	-0.465	1.994
	August	6.80				
SS02						
	November	5.48	2.561	0.518	-0.820	4.923
	February	4.04	2.167	0.534	-0.532	2.749
	May	2.88	2.321	0.502	-0.549	2.741
	August	7.10				
SS03						
	November	5.76	2.603	0.714	-0.772	3.639
	February	11.28	2.592	0.595	-0.879	7.307
	May	4.78	2.623	0.548	-0.752	4.516
	August	6.70				

(Continued)

Appendix A. (Concluded)

Station	Month	% $CaCO_3$	$\bar{x}$ Grain Size	Standard Deviation	Skewness	Kurtosis
HI01						
	November	1.26	2.490	0.374	-0.161	2.495
	February	1.09	2.447	0.407	0.079	1.660
	May	0.11	2.527	0.316	-0.112	3.343
	August	1.30				
HI02						
	November	3.48	2.089	0.594	-0.251	0.455
	February	3.66	2.362	0.425	-0.343	1.687
	May	2.91	2.078	0.488	-0.181	0.800
	August	3.70				
HI03						
	November	4.75	2.040	0.632	0.013	-0.411
	February	3.21	1.976	0.462	-0.079	1.386
	May	2.90	2.131	0.537	-0.323	1.044
	August	3.60				
HS01						
	November	3.75	2.339	0.558	-0.657	3.279
	February	2.66	2.612	0.311	-0.683	10.099
	May	5.43	2.442	0.767	-0.411	-0.196
	August	6.30				
HS02						
	November	2.36	2.510	0.323	-0.246	2.242
	February	3.56	2.461	0.360	-0.279	3.544
	May	3.67	2.756	0.444	-0.293	2.924
	August	6.80				
HS03						
	November	32.10	2.922	0.430	-0.700	11.548
	February	5.40	2.833	0.482	-0.839	7.470
	May	3.88	2.696	0.469	-0.462	3.976
	August	4.80				

Appendix B. Ranked abundance of benthic macroinvertebrates collected during 1977-1978 at intertidal and subtidal stations on the Huntington Beach transect (Transect I). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HI01		
Neohaustorius schmitzi (Am)		4.0		0.7	1.0
Donax variabilis (M)	2.0			1.3	2.0
Scolelepis squamata (P)		2.0			3.0
Microprotopus raneyi (Am)			0.7		4.0
			HI02		
Neohaustorius schmitzi (Am)	4.7	239.3	216.7	66.0	1.0
Donax variabilis (M)	8.7	29.3	188.7	6.7	2.0
Parahaustorius longimerus (Am)	0.7		1.3	80.7	3.0
Paraonis fulgens (P)	5.3		9.3	1.3	4.0
Lepidactylus dytiscus (Am)			14.0		5.0
Haustorius longirostris (Am)	0.7	7.3	6.0		6.0
Acanthohaustorius millsi (Am)	2.0		1.3	10.0	7.0
Lovenella gracilis (Cn)		1.3	11.3		8.0
Scolelepis squamata (P)	0.7	8.7		1.3	9.0
Spiophanes bombyx (P)		6.0			10.0
Exosphaeroma diminutum (I)				2.0	11.0
Mytilidae undetermined (M)		1.3			13.5
Heteromastus filiformis (P)		1.3			13.5
Unknown Polychaete #2	1.3				13.5
Unknown Polychaete #4	1.3				13.5
Emerita talpoida (D)	0.7				20.0
Chiridotea caeca (I)			0.7		20.0
Atylus sp. (Am)		0.7			20.0
Amphipoda	0.7				20.0
Nemertina (undet.)				0.7	20.0
Unknown Bivalve #2 (M)		0.7			20.0
Onuphidae undetermined (P)				0.7	20.0
Nephtys picta (P)				0.7	20.0
Haploscoloplos fragilis (P)			0.7		20.0
			HI03		
Donax variabilis (M)	8.7	64.7	326.7	40.7	1.0
Neohaustorius schmitzi (Am)	2.0	224.7	116.0	0.7	2.0
Scolelepis squamata (P)	20.7	33.3	6.7	6.7	3.0
Acanthohaustorius millsi (Am)	6.0	1.3	17.3	13.3	4.0
Lovenella gracilis (Cn)		6.7	18.0		5.0
Paraonis fulgens (P)			10.7	9.3	6.0

(Continued)

Appendix B. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HI03		
Parahaustorius longimerus (Am)	0.7		10.7	4.7	7.0
Haustorius longirostris (Am)		10.0	2.7		8.0
Cumacea undetermined	2.0			4.7	9.0
Emerita talpoida (D)	2.7				10.5
Amphiporeia virginiana (Am)	2.7				10.5
Spiophanes bombyx (P)		2.0			12.0
Cumacea D (undet.)				0.7	16.0
Microprotopus raneyi (Am)		0.7			16.0
Gastrosaccus johnsoni (My)				0.7	16.0
Nemertina (undet.)			0.7		16.0
Tellina sp. (M)		0.7			16.0
Unknown Bivalve #1 (M)		0.7			16.0
Eteone heteropoda (P)		0.7			
			HS01		
Scolelepis squamata (P)	1.0	447.3	4.3		1.0
Protohaustorius deichmannae (Am)	2.0	31.0	193.7	63.3	2.0
Acanthohaustorius millsi (Am)	28.7	59.3	4.7	10.0	3.0
Donax variabilis (M)	3.0	67.3			4.0
Spiophanes bombyx (P)	1.3	7.3	49.7	3.0	5.0
Tellina sp. (M)		3.3	26.7	16.7	6.0
Acanthohaustorius intermedius (Am)			17.3		7.0
Nephtys picta (P)	1.3	0.7	9.0	6.0	8.0
Magelona papillicornis (P)	3.3	3.0	6.0	3.0	9.0
Synchelidium americanum (Am)	0.3		9.0	4.0	10.0
Rhepoxynius epistomus (Am)			11.0	0.3	11.0
Paraonis fulgens (P)	6.7		3.7		12.0
Pagurus longicarpus (D)			6.7	1.3	13.0
Platyischnopidae A (Am)	0.3		3.7	3.7	14.0
Cumacea undet.		7.0			15.0
Bathyporeia parkeri (Am)	1.3	3.3	2.3		16.0
Acanthohaustorius sp. (Am)				5.0	17.0
Unknown Polychaete #15				4.0	18.0
Haploscoloplos fragilis (P)			1.7	2.3	19.0
Nemertina (undet.)	1.3	0.7	1.3	0.3	20.0
Chiridotea stenops (I)			2.3	0.7	21.0
Cumacea C (Undet.)			2.3		23.0
Mulinia lateralis (M)				2.3	23.0
Magelona rosea (P)	1.0		1.3		23.0
Ogyrides alphaerostris (D)			1.0	1.0	25.5
Cumacea B (undet.)			2.0		25.[illegible]

Appendix B. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
HS01					
Renilla reniformis (Cn)	0.7		0.3	0.7	27.0
Gastrosaccus johnsoni (My)				1.3	31.0
Leptognatha caeca (T)		1.0	0.3		31.0
Lovenella gracilis (Cn)		1.3			31.0
Terebra dislocata (M)				1.3	31.0
Tharyx marioni (P)	0.3			1.0	31.0
Unknown Polychaete #2	1.3				31.0
Unknown Polychaete #14	0.3		1.0		31.0
Parahaustorius longimerus (Am)	0.3	0.7			35.5
Glycera dibranchiata (P)			0.3	0.7	35.5
Microprotopus raneyi (Am)			0.7		38.0
Heteromastus filiformis (P)		0.7			38.0
Eteone heteropoda (P)		0.7			38.0
Corophium tuberculatum (Am)			0.3	0.3	40.0
Trachypeneus constrictus (D)				0.3	50.0
Dissodactylus mellitae (D)				0.3	50.0
Batea catharinensis (Am)			0.3		50.0
Erichthonius brasiliensis (Am)			0.3		50.0
Metamysidopsis munda (My)				0.3	50.0
Ancinus depressus (I)				0.3	50.0
Cirripedia undet.	0.3				50.0
Turbellaria sp.			0.3		50.0
Mellita quinquiesperforata (E)				0.3	50.0
Anachis obesa (M)				0.3	50.0
Nassarius trivittatus (M)				0.3	50.0
Tellina alternata (M)	0.3				50.0
Pelecypoda (M)			0.3		50.0
Nucula sp. (M)			0.3		50.0
Olividae (undet.) (M)			0.3		50.0
Dispio uncinata (P)	0.3				50.0
Polydora websteri (P)	0.3				50.0
Spio pettiboneae (P)	0.3				50.0
Ampharete americana (P)			0.3		50.0
HS02					
Acanthohaustorius millsi (Am)	219.3	17.3			1.0
Spiophanes bombyx (P)		94.3	96.0	8.7	2.0
Donax variabilis (M)	33.7	60.3			3.0
Scolelepis squamata (P)	0.3	39.0			4.0
Bathyporeia parkeri (Am)	2.3	25.0			5.0
Protohaustorius deichmannae (Am)	9.3	4.3	9.3	3.0	6.0
Tellina sp. (M)			13.3	8.0	7.0
Rhepoxynius epistomus (Am)		4.3	14.3	2.3	8.0
Owenia fusiformis (P)		0.3	19.0	0.3	9.0
Unknown Polychaete #15				17.7	10.0

(Continued)

Appendix B. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HS02		
Batea catharinensis (Am)			15.3		11.0
Microprotopus raneyi (Am)			13.7	0.3	12.0
Nemertina (undet.)	0.3	10.3	1.3	0.3	13.0
Magelona papillicornis (P)	3.0	3.7		3.7	14.0
Platyischnopidae A (Am)		2.0	5.0	3.3	15.0
Tharyx marioni (P)			2.0	8.0	16.0
Metamysidopsis munda (My)				8.0	17.0
Synchelidium americanum (Am)	0.7	0.7	2.3	3.3	18.0
Lovenella gracilis (Cn)		6.7			19.5
Nephtys picta (P)	1.0	0.7	3.3	1.7	19.5
Haploscoloplos fragilis (P)		0.7	1.3	4.3	21.0
Cucumaria sp. (E)			6.0		22.5
Thyone sp. (E)			6.0		22.5
Paraonis fulgens (P)	0.7	5.3			24.0
Renilla reniformis (Cn)		1.7	1.3	2.7	25.0
Tellina alternata (M)		5.3			26.0
Corophium tuberculatum (Am)			5.0		27.0
Anadara ovalis (M)			4.3	0.7	28.0
Unknown Polychaete #14			4.3		29.5
Ampharete americana (P)			4.3		29.5
Mitrella lunata (M)			4.0		31.0
Chiridotea stenops (I)	2.0	1.7			32.0
Parahaustorius longimerus (Am)	2.7	0.7			33.0
Mysidopsis bigelowi (My)			0.3	3.0	34.5
Unknown Bivalve #1 (M)		3.3			34.5
Glycera dibranchiata (P)			2.0	0.7	36.0
Mellita quinquiesperforata (E)		1.3	1.0		37.5
Ensis sp. (M)		1.0	1.0	0.3	37.5
Oxyurostylis smithi (C)		1.0	1.0		39.5
Mytilidae undet. (M)			2.0		39.5
Ogyrides alphaerostris (D)		0.3		1.7	41.0
Ancinus depressus (I)	0.3	1.3		0.3	42.0
Molgula manhattensis (A)			1.7		44.0
Mediomastus californiensis (P)			1.7		44.0
Clymenella torquata (P)			1.7		44.0
Dispio uncinata (P)	0.3			1.3	46.0
Acetes americanus (D)				1.3	48.5
Acanthohaustorius intermedius (Am)		1.3			48.5
Leptognatha caeca (T)		1.3			48.5
Terebra dislocata (M)		1.0		0.3	48.5
Callianassidae undet. (D)				1.0	51.0
Unciola serrata (Am)			0.7		56.5
Parapleustes aestuarius (Am)				0.7	56.5
Sthenelais boa (P)			0.7		56.5

(Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HS02		
Sabellaria vulgaris (P)				0.7	56.5
Drilonereis magna (P)				0.7	56.5
Eteone heteropoda (P)		0.7			56.5
Caulleriella killariensis (P)			0.7		56.5
Nereis sp. (P)			0.7		56.5
Polydora sp. (P)			0.7		56.5
Magelona rosea (P)			0.7		56.5
Libinia emarginata (D)			0.3	0.3	63.5
Mysidacea	0.3		0.3		63.5
Apanthura magnifica (I)			0.3	0.3	63.5
Phyllodoce arenae (P)			0.3	0.3	63.5
Trachypeneus constrictus (D)				0.3	80.5
Ogyrides limicola (D)				0.3	80.5
Euceramus praelongus (D)			0.3		80.5
Pagurus longicarpus (D)			0.3		80.5
Dissodactylus mellitae (D)			0.3		80.5
Pinnixa cristata (D)				0.3	80.5
Gammarus sp. (Am)			0.3		80.5
Paraphoxus spinosus (Am)			0.3		80.5
Listriella barnardi (Am)				0.3	80.5
Edotea montosa (I)			0.3		80.5
Gastrosaccus johnsoni (My)				0.3	80.5
Cumacea undet.		0.3			80.5
Hemipholis elongata (E)			0.3		80.5
Saccoglossus kowalevskii (H)				0.3	80.5
Nudibranchia (M)			0.3		80.5
Olivella mutica (M)				0.3	80.5
Polinices duplicatus (M)				0.3	80.5
Nassarius trivittatus (M)				0.3	80.5
Mulinia lateralis (M)				0.3	80.5
Unknown Bivalve #13 (M)			0.3		80.5
Turbonilla sp. (M)				0.3	80.5
Nucula sp. (M)			0.3		80.5
Olividae (undet.) (M)		0.3			80.5
Unknown Bivalve #3 (M)			0.3		80.5
Heteromastus filiformis (P)		0.3			80.5
Travisia sp. (P)		0.3			80.5
Paraprionospio pinnata (P)	0.3				80.5
Unknown Polychaete #2	0.3				80.5
Sabellidae (undet.) (P)		0.3			80.5
Phyllodocidae (undet.) (P)			0.3		80.5

(Continued)

Appendix B. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HS03		
Spiophanes bombyx (P)	0.7	131.7	453.7	14.3	1.0
Tellina sp. (M)	0.3	77.0	29.3	4.0	2.0
Ensis sp. (M)		8.7	63.0	18.0	3.0
Protohaustorius deichmannae (Am)	0.3	17.0	1.7		4.0
Clymenella torquata (P)			17.7		5.0
Unknown Polychaete #14	1.0	2.3	12.0	1.0	6.0
Platyischnopidae A (Am)	0.3	15.7			7.0
Scolelepis texana (P)		12.0	2.3		8.0
Nephtys picta (P)	1.7	3.0	7.3	1.3	9.0
Glycera dibranchiata (P)	1.3	0.3	6.0	3.7	10.0
Oxyurostylis smithi (C)	1.3	2.0	7.0		11.0
Tharyx marioni (P)	2.3	0.3	5.3	2.0	12.0
Rhepoxynius epistomus (Am)		6.0	2.3	1.0	13.0
Renilla reniformis (Cn)	3.3	2.3	0.3	1.3	14.0
Owenia fusiformis (P)		0.7	5.0	0.7	15.0
Caulleriella killariensis (P)		2.3	4.0		16.0
Haploscoloplos fragilis (P)	0.3	0.7	1.0	4.0	17.0
Acanthohaustorius millsi (Am)	5.7				18.0
Nemertina (undet.)	0.3	2.3	3.0		19.5
Magelona papillicornis (P)	2.0	2.3	1.0	0.3	19.5
Synchelidium americanum (Am)	0.3	3.7	0.7		21.0
Magelona rosea (P)			4.3		22.0
Mactra fragilis (M)			4.0		23.5
Scolelepis squamata (P)			4.0		23.5
Euceramus praelongus (D)			3.7		26.0
Microprotopus raneyi (Am)		0.3	2.7	0.7	26.0
Ensis directus (M)	3.7				26.0
Magelona phyllisae (P)	0.7		2.3	0.3	28.0
Batea catharinensis (Am)			0.7	2.0	29.5
Phyllodocidae (undet.) (P)			2.7		29.5
Veneridae A (undet.) (M)			2.3	0.3	31.0
Mellita quinquiesperforata (E)	0.3	0.7	0.7	0.7	32.0
Nassarius trivittatus (M)			1.0	1.0	33.5
Heteromastus filiformis (P)		2.0			33.5
Cirratulus sp. (P)			1.7		36.0
Sabellaria vulgaris (P)				1.7	36.0
Onuphis eremita (P)	1.0		0.7		36.0
Oligochaeta undet.		0.7	0.7		38.0
Mysidopsis bigelowi (My)				1.3	41.5
Metamysidopsis munda (My)				1.3	41.5
Edotea montosa (I)	0.3	0.3	0.7		41.5
Corophium tuberculatum (Am)			1.3		41.5
Mulinia lateralis (M)			0.3	1.0	41.5

(Continued)

Appendix B. (Concluded)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			HS03		
Paraonis fulgens (P)		1.3			41.5
Tiron tropakis (Am)			1.0		47.0
Pelecypoda (M)		1.0			47.0
Polydora websteri (P)	1.0				47.0
Ampharetidae (undet.) (P)		1.0			47.0
Brania clavata (P)		1.0			47.0
Pagurus longicarpus (D)			0.7		53.0
Unciola serrata (Am)			0.7		53.0
Gastrosaccus johnsoni (My)				0.7	53.0
Cumacea B (undet.)			0.7		53.0
Unknown Polychaete #13	0.7				53.0
Unknown Polychaete #15				0.7	53.0
Maldanidae Undet. (P)		0.7			53.0
Dissodactylus mellitae (D)		0.3		0.3	57.5
Terebra dislocata (M)			0.3	0.3	57.5
Acetes americanus (D)				0.3	70.0
Pinnixa sayana (D)		0.3			70.0
Callianassidae undet. (D)				0.3	70.0
Cumacea C (undet.)			0.3		70.0
Bathyporeia parkeri (Am)		0.3			70.0
Erichthonius brasiliensis (Am)			0.3		70.0
Polinices duplicatus (M)				0.3	70.0
Unknown Bivalve #12 (M)			0.3		70.0
Mytilidae undet. (M)		0.3			70.0
Turbonilla sp. (M)			0.3		70.0
Minuspio cirrifera (P)			0.3		70.0
Paranaitis sp. (P)			0.3		70.0
Nereis acuminata (P)				0.3	70.0
Scoloplos rubra (P)			0.3		70.0
Dispio uncinata (P)		0.3			70.0
Sigambra tentaculata (P)			0.3		70.0
Scoloplos sp. (P)	0.3				70.0
Diopatra cuprea (P)			0.3		70.0
Podarke obscura (P)		0.3			70.0
Poecilochaetus sp. (P)			0.3		70.0
Nereidae undet. (P)	0.3				70.0
Paraprionospio pinnata (P)	0.3				70.0
Ampharete americana (P)			0.3		70.0

Appendix C. Ranked abundance of benthic macroinvertebrates collected during 1977-1978 at intertidal and subtidal stations on the south jetty transect (Transect II). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
SI01					
Talorchestia megalophthalma (Am)			0.7	1.3	1.0
Amphiporeia virginiana (Am)				0.7	2.5
Exosphaeroma diminutum (I)				0.7	2.5
SI02					
Neohaustorius schmitzi (Am)	0.7	2.0	139.3	130.7	1.0
Scolelepis squamata (P)	0.7	52.0	95.3	12.7	2.0
Donax variabilis (M)	2.0	10.0	110.0	11.3	3.0
Spiophanes bombyx (P)		39.3			4.0
Exosphaeroma diminutum (I)				24.0	5.0
Haustorius longirostris (Am)	0.7		10.7	2.7	6.0
Microprotopus raneyi (Am)		9.3			7.0
Emerita talpoida (D)	0.7		0.7	4.7	8.0
Tellina sp. (M)		6.0			9.0
Ensis sp. (M)		5.3			10.0
Paracaprella tenuis (Am)		2.7			11.0
Unknown Bivalve #1 (M)		2.0			12.5
Unknown Bivalve #3 (M)		2.0			12.5
Mytilidae Undet. (M)			1.3	0.7	14.0
Nemertina (undet.)		0.7	0.7		15.0
Talorchestia megalophthalma (Am)				1.3	18.5
Cumacea Undet.		1.3			18.5
Corophium tuberculatum (Am)		1.3			18.5
Ophiuroidea (E)		1.3			18.5
Unknown Bivalve #2 (M)		1.3			18.5
Polydora sp. (P)		1.3			18.5
Lepidactylus dytiscus (Am)			0.7		31.5
Chiridotea caeca (I)			0.7		31.5
Synchelidium americanum (Am)				0.7	31.5
Rhepoxynius epistomus (Am)		0.7			31.5
Amphiporeia virginiana (Am)		0.7			31.5
Parahaustorius longimerus (Am)		0.7			31.5
Acanthohaustorius millsi (Am)		0.7			31.5
Oxyurostylis smithi (C)		0.7			31.5
Ancinus depressus (I)		0.7			31.5
Caprella penantis (Am)		0.7			31.5
Jassa falcata (Am)		0.7			31.5

(Continued)

Appendix C. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
SI02					
Holothuroidea (E)		0.7			31.5
Nudibranchia (M)		0.7			31.5
Unknown Bivalve #14 (M)				0.7	31.5
Pholadidae (undet.) (M)		0.7			31.5
Unknown Bivalve #4 (M)		0.7			31.5
Nereidae Undet. (P)	0.7				31.5
Paraonis fulgens (P)	0.7				31.5
Eulalia sanguinea (P)		0.7			31.5
Unknown Polychaete #23		0.7			31.5
SI03					
Scolelepis squamata (P)	4.7	516.0	12.7		1.0
Spiophanes bombyx (P)		305.3	91.3	6.0	2.0
Paraonis fulgens (P)	0.7	0.7	4.7	70.0	3.0
Acanthohaustorius millsi (Am)	0.7	30.7	18.0	3.3	4.0
Tellina sp. (M)		24.0	14.7	4.0	5.0
Ensis sp. (M)		31.3			6.0
Donax variabilis (M)	4.7	18.7			7.0
Parahaustorius longimerus (Am)		8.7		2.0	8.0
Nephtys picta (P)		2.7	5.3	0.7	9.0
Cumacea Undet.		2.0	4.7	1.3	10.0
Haploscoloplos fragilis (P)		0.7		6.7	11.0
Protohaustorius deichmannae (Am)		5.3	2.0		12.0
Amphiporeia virginiana (Am)	5.3				13.0
Microprotopus raneyi (Am)		4.7			14.0
Nemertina (undet.)			4.0		16.5
Mytilidae Undet. (M)	4.0				16.5
Unknown Bivalve #1 (M)		4.0			16.5
Polydora sp. (P)		4.0			16.5
Exosphaeroma diminutum (I)	0.7	1.3	0.7	1.3	19.0
Lovenella gracilis (Cn)		3.3			21.0
Unknown Bivalve #3 (M)		3.3			21.0
Unknown Bivalve #9 (M)		3.3			21.0
Polydora sp. (P)		2.7			23.5
Magelona rosea (P)			2.0	0.7	23.5
Cumacea B (undet.)		2.0			25.5
Eulalia sanguinea (P)		2.0			25.5
Emerita talpoida (D)	1.3	0.7			27.0
Neohaustorius schmitzi (Am)	0.7	0.7			29.5
Paracaprella tenuis (Am)		0.7		0.7	29.5
Glycera dibranchiata (P)		0.7	0.7		29.5

(Continued)

Appendix C. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			S103		
Unknown Polychaete #2	0.7	0.7			29.5
Cumacea C (undet.)			1.3		35.5
Monoculodes sp. (Am)			1.3		35.5
Unciola serrata (Am)		1.3			35.5
Ampelisca sp. (Am)		1.3			35.5
Saccoglossus kowalevskii (H)				1.3	35.5
Chione cancellata (M)	1.3				35.5
Eteone heteropoda (P)		1.3			35.5
Magelona papillicornis (P)		1.3			35.5
Ogyrides alphaerostris (D)	0.7				50.5
Pinnixa cristata (D)		0.7			50.5
Gammarus sp. (Am)			0.7		50.5
Synchelidium americanum (Am)		0.7			50.5
Edotea montosa (I)		0.7			50.5
Gastrosaccus johnsoni (My)	0.7				50.5
Platyischnopidae A (Am)		0.7			50.5
Turbellaria sp.		0.7			50.5
Hemipholis elongata (E)		0.7			50.5
Glottidia pyramidata (Brach)				0.7	50.5
Nudibranchia (M)		0.7			50.5
Polinices duplicatus (M)			0.7		50.5
Unknown Bivalve #14 (M)			0.7		50.5
Unknown Bivalve #2 (M)		0.7			50.5
Unknown Bivalve #4 (M)		0.7			50.5
Lumbrineris impatiens (P)				0.7	50.5
Arenicolidae Undet. (P)				0.7	50.5
Dispio uncinata (P)		0.7			50.5
Heteromastus filiformis (P)				0.7	50.5
Unknown Polychaete #4	0.7				50.5
Maldanidae Undet. (P)		0.7			50.5
Phyllodocidae (undet.) (P)			0.7		50.5
			SS01		
Donax variabilis (M)	32.7	19.3	7.0	0.3	1.0
Parahaustorius longimerus (Am)	6.0	39.7	8.3		2.0
Acanthohaustorius millsi (Am)	3.3	8.3	25.3	7.7	3.0
Tellina sp. (M)		0.7	1.3	36.0	4.0
Scolelepis squamata (P)		4.3	29.0	0.3	5.0
Unknown Polychaete #11	0.7			19.0	6.0
Paraonis fulgens (P)	3.7	0.3	13.7		7.0

(Continued)

Appendix C. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
SS01					
Unknown Bivalve #1 (M)			10.7		8.0
Cumacea Undet.	0.3		9.0	1.0	9.0
Unknown Polychaete #15				8.3	10.0
Protohaustorius deichmannae (Am)	3.0	1.0	4.0		11.0
Nephtys picta (P)	0.7		6.0	1.3	12.0
Bathyporeia parkeri (Am)	4.3	0.3			13.0
Pagurus longicarpus (D)		0.3	2.3	0.7	14.5
Gastrosaccus johnsoni (My)			1.3	2.0	14.5
Haploscoloplos fragilis (P)			1.0	2.0	16.0
Nemertina (undet.)	0.3	0.3	2.0	0.3	17.0
Ancinus depressus (I)	1.0		1.0	0.3	18.5
Platyischnopidae A (Am)				2.3	18.5
Haustoridae Undet. (Am)	1.7				20.0
Lovenella gracilis (Cn)		1.3	0.3		21.0
Cumacea D (undet.)			1.3		22.0
Spiophanes bombyx (P)		0.3	0.3	0.3	23.0
Acanthohaustorius sp. (Am)			0.7		26.0
Leptognatha caeca (T)				0.7	26.0
Chione cancellata (M)				0.7	26.0
Eteone heteropoda (P)			0.7		26.0
Magelona papillicornis (P)				0.7	26.0
Rhepoxynius epistomus (Am)		0.3		0.3	30.0
Crassinella lunulata (M)			0.3	0.3	30.0
Glycera dibranchiata (P)			0.3	0.3	30.0
Branchiostoma caribaeum (Cc)				0.3	41.0
Ogyrides alphaerostris (D)				0.3	41.0
Neohaustorius schmitzi (Am)		0.3			41.0
Microprotopus raneyi (Am)	0.3				41.0
Oxyurostylis smithi (C)				0.3	41.0
Metamysidopsis munda (My)	0.3				41.0
Chiridotea stenops (I)		0.3			41.0
Sphaeroma quadridentatum (I)	0.3				41.0
Amphipod B	0.3				41.0
Jassa falcata (Am)				0.3	41.0
Glottidia pyramidata (Brach)				0.3	41.0
Gemma gemma (M)	0.3				41.0
Dosinia discus (M)	0.3				41.0
Mactra fragilis (M)			0.3		41.0
Unknown Polychaete #31			0.3		41.0
Tharyx marioni (P)	0.3				41.0
Dispio uncinata (P)				0.3	41.0
Unknown Polychaete #2		0.3			41.0
Cirratulidae (undet.) (P)				0.3	41.0

(Continued)

Appendix C. (continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
SS02					
Acanthohaustorius millsi (Am)	0.3	17.7	56.0	14.7	1.0
Bathyporeia parkeri (Am)		4.7	67.3	2.0	2.0
Parahaustorius longimerus (Am)		14.7	20.7	21.3	3.0
Protohaustorius deichmannae (Am)	2.7	0.3	36.3	0.3	4.0
Platyischnopidae A (Am)	8.7	0.3	4.7	14.0	5.0
Scolelepis squamata (P)		24.0		0.3	6.0
Acanthohaustorius intermedius (Am)	6.3		15.3		7.0
Leptognatha caeca (T)	5.0	7.3	2.0	3.0	8.0
Unknown Polychaete #11	4.3			9.0	9.0
Donax variabilis (M)	0.3	5.7		2.3	10.0
Magelona papillicornis (P)	5.7	1.0	1.0	0.3	11.0
Spiophanes bombyx (P)		2.7	5.0		12.0
Paraonis fulgens (P)		3.3	4.0		13.0
Rhepoxynius epistomus (Am)	1.0		3.7	2.0	14.0
Gastrosaccus johnsoni (My)	0.3		1.0	4.0	15.0
Ogyrides alphaerostris (D)	0.3			4.0	16.0
Chiridotea stenops (I)	0.7		0.7	2.3	17.0
Tellina sp. (M)	1.3	0.3		2.0	18.5
Nephtys picta (P)	1.3	0.7	0.3	1.3	18.5
Metamysidopsis munda (My)				3.3	20.0
Unknown Polychaete #2	1.0	2.0			21.0
Mellita quinquiesperforata (E)	0.3	0.3	0.3	2.0	22.0
Cumacea C (undet.)			2.7		23.5
Nemertina (undet.)	0.7		1.3	0.7	23.5
Haploscoloplos fragilis (P)		0.3	0.7	1.3	25.0
Synchelidium americanum (Am)	1.0		0.3	0.3	26.0
Mysidopsis bigelowi (My)				1.3	28.0
Cumacea Undet.		0.7	0.3	0.3	28.0
Polydora sp. (P)		1.3			28.0
Lovenella gracilis (Cn)		1.0			30.5
Echinoidea (E)	1.0				30.5
Pagurus longicarpus (D)	0.3		0.3	0.3	32.0
Callianasidae Undet. (D)				0.7	34.0
Microprotopus raneyi (Am)				0.7	34.0
Glycera dibranchiata (P)				0.7	34.0
Oxyurostylis smithi (C)		0.3	0.3		36.0
Dissodactylus mellitae (D)	0.3				42.5
Pinnixa sp. (D)				0.3	42.5
Edotea montosa (I)				0.3	42.5
Ancinus depressus (I)	0.3				42.5
Parapleustes aestuarius (Am)				0.3	42.5
Tiron tropakis (Am)				0.3	42.5
Jassa falcata (Am)				0.3	42.5
Chione cancellata (M)				0.3	42.5

(Continued)

Appendix C. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			SS02		
Sabellaria vulgaris (P)				0.3	42.5
Heteromastus filiformis (P)		0.3			42.5
Glyceridae Undet. (P)	0.3				42.5
Eteone heteropoda (P)		0.3			42.5
			SS03		
Spiophanes bombyx (P)		214.3	187.3	4.3	1.0
Tellina sp. (M)	6.0	35.0	16.7	4.0	2.0
Platyischnopidae A (Am)	2.3	21.7	7.7	7.0	3.0
Nephtys picta (P)	4.3	6.0	2.3	2.0	4.0
Rhepoxynius epistomus (Am)	2.0	6.7	2.0	2.3	5.0
Protohaustorius deichmannae (Am)	0.7	2.3	4.0	4.0	6.0
Glycera dibranchiata (P)	1.3	1.0	6.3	1.0	7.0
Caulleriella killariensis (P)		5.3	2.0		8.0
Mellita quinquiesperforata (E)	1.0	0.7	0.7	4.3	9.0
Dissodactylus mellitae (D)	1.3	0.7	1.0	3.3	10.0
Magelona papillicornis (P)		2.3	1.7	1.3	11.0
Unknown Polychaete #15	5.0				12.0
Scolelepis texana (P)	0.3	2.7	1.7		13.0
Oxyurostylis smithi (C)	1.3	2.3	1.0		14.0
Unknown Polychaete #14		1.7	2.7		15.0
Microprotopus raneyi (Am)	1.7		1.0	1.3	16.0
Haploscoloplos fragilis (P)		0.3	2.0	1.3	17.0
Synchelidium americanum (Am)	1.7	0.3	0.7	0.7	18.0
Mactra fragilis (M)	1.3		2.0		19.5
Ensis sp. (M)		2.3	1.0		19.5
Ancinus depressus (I)	0.3	0.7	0.7	1.3	21.5
Nemertina (undet.)	0.7	0.3	1.7	0.3	21.5
Renilla reniformis (Cn)	1.7		0.7	0.3	23.5
Brania clavata (P)		2.7			23.5
Acanthohaustorius intermedius (Am)			2.3		25.5
Unknown Polychaete #19	2.3				25.5
Unknown Bivalve #1 (M)		2.0			27.0
Pagurus longicarpus (D)		0.3	1.0	0.7	29.0
Crassinella lunulata (M)		1.3	0.7		29.0
Unknown Polychaete #2	0.3	0.7			29.0
Unknown Polychaete #2	1.0	0.7			29.0
Unknown Bivalve #9 (M)		1.7			31.5
Scolelepis squamata (P)		1.7			31.5
Tiron tropakis (Am)	0.3		0.3	1.0	33.0
Cumacea C (undet.)			1.3		36.5

(Continued)

Appendix C. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
SS03					
Metamysidopsis munda (My)				1.3	36.5
Eteone heteropoda (P)	0.3	1.0			36.5
Syllidae (undet.) (P)		0.3	1.0		36.5
Prionospio cristata (P)		1.3			36.5
Unknown Polychaete #26		1.3			36.5
Ogyrides alphaerostris (D)				1.0	42.0
Batea catharinensis (Am)	1.0				42.0
Donax variabilis (M)		1.0			42.0
Owenia fusiformis (P)			1.0		42.0
Phyllodocidae (undet.) (P)			1.0		42.0
Edotea montosa (I)	0.3		0.7		47.0
Corophium tuberculatum (Am)		0.3	0.7		47.0
Chione cancellata (M)		0.7	0.3		47.0
Onuphis eremita (P)		0.3	0.7		47.0
Polydora sp. (P)		0.3	0.7		47.0
Bathyporeia parkeri (Am)		0.3	0.3	0.3	50.0
Euceramus praelongus (D)			0.7		55.0
Acanthohaustorius millsi (Am)		0.7			55.0
Mysidopsis bigelowi (My)				0.7	55.0
Scoloplos rubra (P)	0.7				55.0
Heteromastus filiformis (P)		0.7			55.0
Travisia sp. (P)			0.7		55.0
Paraonis fulgens (P)		0.7			55.0
Oligochaeta Undet.		0.7			55.0
Ampharete americana (P)		0.7			55.0
Ogyrides limicola (D)			0.3	0.3	62.0
Parapleustes aestuarius (Am)	0.3		0.3		62.0
Terebra concava (M)		0.3	0.3		62.0
Sabellaria vulgaris (P)	0.3			0.3	62.0
Tharyx marioni (P)		0.3	0.3		62.0
Trachypeneus constrictus (D)				0.3	80.5
Leptochela serratorbita (D)	0.3				80.5
Pinnotheres ostreum (D)				0.3	80.5
Pinnixa cristata (D)	0.3				80.5
Pinnixa sayana (D)		0.3			80.5
Chiridotea stenops (I)				0.3	80.5
Unciola serrata (Am)			0.3		80.5
Ampelisca sp. (Am)			0.3		80.5
Gastrosaccus johnsoni (My)				0.3	80.5
Apanthura magnifica (I)		0.3			80.5
Cumacea B (undet.)			0.3		80.5
Ptilanthura tricarina (I)				0.3	80.5
Holothuroidea (E)		0.3			80.5

(Continued)

Appendix C. (Concluded)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
		SS03			
Nudibranchia (M)			0.3		80.5
Anadara ovalis (M)				0.3	80.5
Spisula solidissima (M)				0.3	80.5
Epitonium humphreysi (M)		0.3			80.5
Nucula sp. (M)	0.3				80.5
Terebra dislocata (M)			0.3		80.5
Unknown Bivalve #5 (M)		0.3			80.5
Dispio uncinata (P)				0.3	80.5
Armandia maculata (P)		0.3			80.5
Nereidae Undet. (P)	0.3				80.5
Orbiniidae Undet. (P)	0.3				80.5
Paraonidae Undet. (P)	0.3				80.5
Unknown Polychaete #11				0.3	80.5
Eulalia sanguinea (P)		0.3			80.5
Phyllodoce arenae (P)				0.3	80.5
Polydora sp. (P)		0.3			80.5
Terebellidae (undet.) (P)		0.3			80.5
Unknown Polychaete #27		0.3			80.5
Magelona rosea (P)			0.3		80.5

Appendix D. Ranked abundance of benthic macroinvertebrates collected during 1977-1978 at intertidal and subtidal stations on the north jetty transect (Transect III). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NI01		
Scolelepis squamata (P)		5.3			1.0
Spiophanes bombyx (P)		2.0			2.5
Polydora sp. (P)		2.0			2.5
Mytilidae undet. (M)	1.3				4.5
Polydora websteri (P)	1.3				4.5
Emerita talpoida (D)				0.7	8.0
Lepidactylus dytiscus (Am)			0.7		8.0
Metamysidopsis munda (My)	0.7				8.0
Platyischnopidae A (Am)		0.7			8.0
Unknown Bivalve #1 (M)		0.7			8.0
			NI02		
Scolelepis squamata (P)	18.7	2.0	1289.0	0.7	1.0
Donax variabilis (M)	0.7	0.7	46.0	1.3	2.0
Emerita talpoida (D)	4.7		2.7		3.0
Nemertina (undet.)				4.7	4.0
Haustorius longirostris (Am)	0.7		2.0	0.7	5.0
Neohaustorius schmitzi (Am)			0.7	0.7	6.0
Lepidactylus dytiscus (Am)				1.3	7.5
Unknown Bivalve #1 (M)		1.3			7.5
Pinnotheres ostreum (D)	0.7				13.5
Microprotopus raneyi (Am)		0.7			13.5
Caprellidae (undet.) (Am)		0.7			13.5
Ampithoidae Undet. (Am)				0.7	13.5
Mellita quinquiesperforata (E)			0.7		13.5
Mactra fragilis (M)			0.7		13.5
Mytilidae Undet. (M)		0.7			13.5
Spiophanes bombyx (P)		0.7			13.5
Hesionidae (undet.) (P)	0.7				13.5
Polydora sp. (P)		0.7			13.5
			NI03		
Scolelepis squamata (P)	14.7	6.7	491.3	6.7	1.0
Donax variabilis (M)	3.3	1.3	14.7	5.3	2.0
Emerita talpoida (D)	2.7	0.7		15.3	3.0
Exosphaeroma diminutum (I)				8.7	4.0

(Continued)

Appendix D. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NI03		
Amphiporeia virginiana (Am)	0.7	6.7			5.0
Nemertina (undet.)				2.7	6.5
Polydora sp. (P)		2.7			6.5
Erichthonius brasiliensis (Am)		2.0			8.0
Neohaustorius schmitzi (Am)		0.7	1.3		9.0
Mytilidae Undet. (M)		0.7		0.7	10.0
Haustorius sp. (Am)	1.3				11.5
Unknown Polychaete #11	1.3				11.5
Lepidactylus dytiscus (Am)			0.7		17.0
Acanthohaustorius millsi (Am)				0.7	17.0
Haustorius longirostris (Am)		0.7			17.0
Lovenella gracilis (Cn)			0.7		17.0
Unknown Bivalve #1 (M)		0.7			17.0
Unknown Bivalve #3 (M)		0.7			17.0
Unknown Polychaete #31				0.7	17.0
Nephtys picta (P)	0.7				17.0
Eteone heteropoda (P)				0.7	17.0
			NS01		
Protohaustorius deichmannae (Am)	110.7	3.7	134.3	70.3	1.0
Spiophanes bombyx (P)	0.3	46.0	36.7		2.0
Acanthohaustorius millsi (Am)	12.3	1.7	16.0	3.3	3.0
Scolelepis squamata (P)		23.3	7.7		4.0
Paraonis fulgens (P)	9.0	4.3	1.0	3.7	5.0
Tellina sp. (M)		2.0	7.7	0.7	6.0
Magelona papillicornis (P)	3.0	2.0	0.7	4.3	7.0
Leptognatha caeca (T)	0.3	3.3	1.7	2.3	8.0
Bathyporeia parkeri (Am)	6.3	0.3	0.7		9.0
Nephtys picta (P)	2.0	0.7	2.0	1.3	10.0
Pagurus longicarpus (D)	1.0		2.0	1.0	11.0
Donax variabilis (M)	1.7	1.0		0.7	12.0
Turbellaria sp.	3.0				13.5
Orbiniidae Undet. (P)				3.0	13.5
Nemertina (undet.)	1.0	1.3		0.3	15.0
Caulleriella killariensis (P)		2.0			16.0
Parahaustorius longimerus (Am)		1.7		0.3	17.0
Chiridotea stenops (I)	0.7		1.0		19.0
Gastrosaccus johnsoni (My)			0.7	1.0	19.0
Renilla reniformis (Cn)	1.7				19.0
Rhepoxynius epistomus (Am)		0.3	0.3	0.7	23.0
Platyischnopidae A (Am)		1.0	0.3		23.0
Dispio uncinata (P)				1.3	23.0
Glycera dibranchiata (P)			1.3		23.0

(Continued)

Appendix D. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
NS01					
Unknown Polychaete #2	1.3				23.0
Ogyrides alphaerostris (D)				1.0	26.5
Mactra fragilis (M)			1.0		26.5
Synchelidium americanum (Am)	0.3	0.3	0.3		28.0
Oxyurostylis smithi (C)		0.7			31.0
Lumbrineris impatiens (P)				0.7	31.0
Armandia maculata (P)	0.7				31.0
Oligochaeta Undet.		0.7			31.0
Brania clavata (P)		0.7			31.0
Unknown Bivalve #1 (M)		0.3	0.3		34.0
Dissodactylus mellitae (D)	0.3				43.0
Cumacea C (undet.)			0.3		43.0
Acanthohaustorius intermedius (Am)			0.3		43.0
Batea catharinensis (Am)			0.3		43.0
Unciola serrata (Am)		0.3			43.0
Cumacea Undet.	0.3				43.0
Caprella penantis (Am)		0.3			43.0
Pontogeneiidae Undet. (Am)				0.3	43.0
Mellita quinquiesperforata (E)	0.3				43.0
Ensis sp. (M)		0.3			43.0
Haploscoloplos fragilis (P)			0.3		43.0
Unknown Polychaete #14		0.3			43.0
Polydora sp. (P)			0.3		43.0
Eulalia sanguinea (P)		0.3			43.0
Paleanotus heteroseta (P)		0.3			43.0
Polydora sp. (P)			0.3		43.0
Unknown Polychaete #26		0.3			43.0
NS02					
Spiophanes bombyx (P)		100.7	4.3		1.0
Scolelepis squamata (P)		65.0	5.0		2.0
Platyischnopidae A (Am)	32.0	18.3	1.0	10.3	3.0
Protohaustorius deichmannae (Am)	51.7	7.0	1.3	0.3	4.0
Acanthohaustorius millsi (Am)		24.3	3.0	3.7	5.0
Rhepoxynius epistomus (Am)	9.7	10.3	0.3	0.3	6.0
Leptognatha caeca (T)		2.7	1.0	16.7	7.0
Bathyporeia parkeri (Am)	0.7	4.3	9.7	0.3	8.0
Unknown Polychaete #11				12.0	9.0
Magelona papillicornis (P)	1.7	5.0	2.3	1.7	10.0
Tellina sp. (M)		8.7	0.3		11.0
Paraonis fulgens (P)		5.0	3.7		12.0

(Continued)

Appendix D. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NS02		
Nephtys picta (P)	1.3	2.0	1.0	4.0	13.0
Parahaustorius longimerus (Am)		0.7		6.3	14.5
Nemertina (undet.)	0.7	4.3	1.7	0.3	14.5
Synchelidium americanum (Am)	2.3	4.0			16.5
Ancinus depressus (I)	0.3	3.3	1.0	1.7	16.5
Tellina alternata (M)	6.0				18.0
Acanthohaustorius sp. (Am)			1.7	3.7	19.0
Renilla reniformis (Cn)	3.0	0.7			20.0
Chiridotea stenops (I)		1.7	0.7	0.7	21.0
Gastrosaccus johnsoni (My)			1.0	2.0	22.5
Ensis sp. (M)	1.0	2.0			22.5
Mellita quinquiesperforata (E)	1.3	1.0	0.3	0.3	24.0
Mactra fragilis (M)	0.3		2.0		25.0
Acanthohaustorius intermedius (Am)	1.7				26.0
Donax variabilis (M)		0.7	0.7		27.0
Microprotopus raneyi (Am)			1.0		28.0
Ogyrides alphaerostris (D)		0.3		0.7	30.0
Pagurus longicarpus (D)			0.7	0.3	30.0
Haploscoloplos fragilis (P)		0.7	0.3		30.0
Neomysis americana (My)			0.7		34.5
Mytilidae Undet. (M)			0.7		34.5
Eteone heteropoda (P)		0.7			34.5
Magelona phyllisae (P)	0.7				34.5
Unknown Polychaete #2	0.7				34.5
Scolelepis texana (P)	0.7				34.5
Dissodactylus mellitae (D)	0.3		0.3		38.0
Emerita talpoida (D)				0.3	51.0
Pinnixa cristata (D)	0.3				51.0
Lepidactylus dytiscus (Am)			0.3		51.0
Gammarus sp. (Am)			0.3		51.0
Cumacea C (undet.)			0.3		51.0
Oxyurostylis smithi (C)		0.3			51.0
Corophium tuberculatum (Am)			0.3		51.0
Lovenella gracilis (Cn)		0.3			51.0
Olivella mutica (M)			0.3		51.0
Polinices duplicatus (M)			0.3		51.0
Nassarius trivittatus (M)	0.3				51.0
Chione cancellata (M)		0.3			51.0
Spisula solidissima (M)				0.3	51.0
Pelecypoda (M)		0.3			51.0
Unknown Bivalve #11 (M)			0.3		51.0
Unknown Bivalve #1 (M)		0.3			51.0
Unknown Bivalve #8 (M)		0.3			51.0
Unknown Bivalve #9 (M)		0.3			51.0
Dispio uncinata (P)				0.3	51.0

(Continued)

Appendix D. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
NS02					
Heteromastus filiformis (P)		0.3			51.0
Glycera dibranchiata (P)				0.3	51.0
Podarke obscura (P)			0.3		51.0
Unknown Polychaete #22	0.3				51.0
Eulalia sanguinea (P)			0.3		51.0
Unknown Polychaete #26		0.3			51.0
NS03					
Spiophanes bombyx (P)		2883.0	12.7	40.7	1.0
Tellina sp. (M)		165.0		5.3	2.0
Maldanidae Undet. (P)		136.7			3.0
Ensis sp. (M)		100.3	5.0	0.3	4.0
Sabellaria vulgaris (P)				67.0	5.0
Oxyurostylis smithi (C)	3.0	24.3	0.3		6.0
Oligochaeta Undet.		0.7	26.3		7.0
Caulleriella killariensis (P)		25.3	0.3		8.0
Glycera dibranchiata (P)		3.3	19.3	1.3	9.0
Platyischnopidae A (Am)	10.3	11.3			10.0
Unknown Taxon			17.3		11.0
Nemertina (undet.)	1.7	4.7	10.0		12.0
Pagurus longicarpus (D)		5.0	0.3	11.0	13.0
Pectinaria gouldii (P)		15.0			14.0
Rhepoxynius epistomus (Am)	13.3	1.7			15.0
Unknown Polychaete #14		12.0		1.3	16.0
Nephtys picta (P)	1.7	7.7	0.3	2.0	17.0
Tharyx marioni (P)		8.3		2.3	18.0
Pilargidae (undet.) (P)			10.0	0.3	19.5
Prionospio cristata (P)		4.3	12.0		19.5
Goniadides carolinae (P)			10.0		21.0
Polydora sp. (P)		9.3			22.0
Unknown Bivalve #9 (M)		8.7			23.5
Ampharete americana (P)		8.7			23.5
Spio pettiboneae (P)		8.0			25.5
Travisia parva (P)			8.0		25.5
Chione cancellata (M)			7.7		27.0
Batea catharinensis (Am)	1.0	1.7		4.7	28.0
Scolelepis texana (P)		6.7		0.3	29.0
Hemipholis elongata (E)		2.0		4.0	30.5
Mactra fragilis (M)			6.0		30.5
Owenia fusiformis (P)		5.3		0.7	32.0
Haploscoloplos fragilis (P)		1.3	0.3	4.0	33.0

(Continued)

Appendix D. (Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NS03		
Mellita quinquiesperforata (E)	3.7		0.7	1.0	34.0
Microprotopus raneyi (Am)		5.0	0.3		35.0
Unknown Polychaete #30			5.0		36.0
Protohaustorius deichmannae (Am)	4.3			0.7	37.5
Crassinella lunulata (M)		0.3	4.7		37.5
Corophium tuberculatum (Am)		2.7		2.0	39.0
Synchelidium americanum (Am)	1.7	1.7		1.0	40.0
Dissodactylus mellitae (D)	3.3		0.3	0.7	41.0
Tellina alternata (M)	3.7				42.0
Renilla reniformis (Cn)	1.3			2.0	44.5
Unknown Bivalve #10 (M)		3.3			44.5
Heteromastus filiformis (P)		3.0		0.3	44.5
Eulalia sanguinea (P)		3.3			44.5
Magelona phyllisae (P)				3.0	48.0
Paraprionospio pinnata (P)		3.0			48.0
Nereis sp. (P)		3.0			48.0
Paraonidae Undet. (P)		1.3	1.7		50.0
Unciola serrata (Am)	0.3	1.7	0.7		53.5
Unknown Bivalve #3 (M)		2.7			53.5
Unknown Polychaete #31			2.7		53.5
Phyllodoce arenae (P)		2.7			53.5
Unknow Polychaete #26		2.7			53.5
Schistomeringos rudolphi (P)		1.7	1.0		53.5
Magelona papillicornis (P)	1.7			0.7	57.0
Unknown Bivalve #1 (M)	0.3	2.0			59.0
Parapionosyllis longicirrata (P)			2.3		59.0
Pseudeurythoe ambigua (P)			2.3		59.0
Cumacea C (undet.)			2.0		61.5
Podarke obscura (P)			2.0		61.5
Mediomastus californiensis (P)			0.7	1.3	63.0
Ampelisca verrilli (Am)		1.7			68.0
Chiridotea stenops (I)			1.7		68.0
Tiron tropakis (Am)	0.3	0.7	0.7		68.0
Polinices duplicatus (M)		1.7			68.0
Turbonilla sp. (M)		0.7		1.0	68.0
Nereis (neanthes) succinea (P)				1.7	68.0
Unknown Polychaete #2		1.7			68.0
Unknown Polychaete #15	1.7				68.0
Paleanotus heteroseta (P)		1.7			68.0
Ancinus depressus (I)	1.0		0.3		77.0
Cumacea B (undet.)		1.3			77.0
Cucumaria sp. (E)				1.3	77.0
Unknown Bivalve #13 (M)			1.3		77.0

(Continued)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NS03		
Caecum sp. (M)		1.3			77.0
Polychaeta (Undet.)		1.3			77.0
Paraonis fulgens (P)		1.3			77.0
Polydora sp. (P)				1.3	77.0
Ceratocephale sp. (P)		1.3			77.0
Trachypeneus constrictus (D)				1.0	84.0
Actinaria Undet. (Cn)			1.0		84.0
Mitrella lunata (M)				1.0	84.0
Nassarius trivittatus (M)				1.0	84.0
Magelona sp. (P)				1.0	84.0
Mysidopsis bigelowi (My)	0.3			0.7	87.5
Terebra dislocata (M)		0.7		0.3	87.5
Pinnixa retinens (D)		0.7			91.5
Cirolana polita (I)			0.7		91.5
Olivella mutica (M)			0.7		91.5
Protodorvillea kefersteini (P)			0.7		91.5
Scoloplos rubra (P)			0.7		91.5
Notocirrus spiniferus (P)		0.7			91.5
Ogyrides limicola (D)		0.3		0.3	97.5
Mercenaria mercenaria (M)	0.3			0.3	97.5
Veneridae A (undet.) (M)		0.3		0.3	97.5
Cirratulus sp. (P)			0.3	0.3	97.5
Onuphis eremita (P)		0.3		0.3	97.5
Spio setosa (P)			0.3	0.3	97.5
Branchiostoma caribaeum (Cc)			0.3		114.5
Ogyrides alphaerostris (D)		0.3			114.5
Grapsidae Undet. (D)				0.3	114.5
Ampelisca vadorum (Am)			0.3		114.5
Parametopella cypris (Am)	0.3				114.5
Edotea montosa (I)		0.3			114.5
Mysidacea				0.3	114.5
Gastrosaccus johnsoni (My)			0.3		114.5
Apanthura magnifica (I)		0.3			114.5
Amphipoda	0.3				114.5
Asterias forbesii (EO				0.3	114.5
Ophiuroidea (E)	0.3				114.5
Thyone sp. (E)				0.3	114.5
Nucula proxima (M)				0.3	114.5
Epitonium humphreysi (M)				0.3	114.5
Orbinia americana (P)			0.3		114.5
Euclymene sp. (P)				0.3	114.5
Polynoidae Undet. (P)				0.3	114.5
Travisia sp. (P)	0.3				114.5
Glyceridae Undet. (P)	0.3				114.5
Diopatra cuprea (P)				0.3	114.5

(Continued)

Appendix D. (Concluded)

SPECIES	FALL 1977	WINTER 1978	SPRING 1978	SUMMER 1978	OVERALL RANK
			NS03		
Exogone heteropoda (P)		0.3			114.5
Poecilochaetus sp. (P)			0.3		114.5
Eunicidae Undet. ( )	0.3				114.5
Unknown Polychaete #11	0.3				114.5
Brania clavata (P)		0.3			114.5
Phyllodocidae (undet.) (P)			0.3		114.5
Clymenella torquata (P)			0.3		114.5

Appendix E. Ranked abundance of benthic macroinvertebrates collected during 1982 at intertidal and subtidal stations on the south jetty transect (Transect II). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	SUMMER 1982		FALL 1982		OVERALL RANK
	$\bar{x}$	SE	$\bar{x}$	SE	
SI01					
NO ANIMALS COLLECTED					
SI02					
Emerita talpoida (D)	77.3	19.7	5.3	2.7	1.0
Nematoda	56.0	7.2			2.0
Scolelepis squamata (P)	39.3	10.5	0.7	0.7	3.0
Crassinella lunulata (M)	1.3	0.7			4.0
SI03					
Nematoda			12.7	7.7	1.0
Emerita talpoida (D)			10.7	3.5	2.0
Scolelepis squamata (P)	3.3	0.7	3.3	1.8	3.0
Tellina sp. (M)	4.7	1.8			4.0
Parahaustorius longimerus (Am)	2.0	1.1			6.0
Bowmaniella sp. (My)	2.0	2.0			6.0
Donax variabilis (M)	0.7	0.7	1.3	1.3	6.0
Crassinella lunulata (M)			1.3	1.3	8.0
SS01					
Nematoda	28.7	13.4	11.3	5.2	1.0
Paraonis fulgens (P)	3.7	2.7	4.7	4.7	2.0
Bowmaniella sp. (My)	5.7	1.8			3.0
Crassinella lunulata (M)	1.3	0.9	1.3	0.3	4.0
Petricola pholadiformis (M)	1.0	1.0	0.7	0.3	5.0
Platyischnopidae A (Am)	1.3	0.3			6.0
Bowmaniella floridana (My)	1.0	1.0			8.0
Tellina texana (M)	1.0	0.6			8.0
Crassostrea virginica (M)	1.0	1.0			8.0
Donax variabilis (M)			0.7	0.3	11.5
Lumbrineris impatiens (P)	0.7	0.3			11.5
Scolelepis squamata (P)			0.7	0.3	11.5
Nephtys picta (P)			0.7	0.3	11.5
Emerita talpoida (D)	0.3	0.3			17.5
Pagurus sp. (D)	0.3	0.3			17.5

(Continued)

Appendix E. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
SS01					
Paguridae (D)	0.3	0.3			17.5
Acanthohaustorius millsi (Am)	0.3	0.3			17.5
Ancinus depressus (I)	0.3	0.3			17.5
Mysidae (My)	0.3	0.3			17.5
Bowmaniella brasiliensis (Am)	0.3	0.3			17.5
Eunicidae (P)			0.3	0.3	17.5
SS02					
Nematoda	108.3	26.2	13.0	7.1	1.0
Hemipodus roseus (P)	17.0	6.0	5.3	1.4	2.0
Tellina texana (M)	6.0	1.0			3.0
Paraonis fulgens (P)	4.0	1.5	0.3	0.3	4.5
Oligochaeta			4.3	4.3	4.5
Nephtys picta (P)	0.7	0.3	3.3	1.2	6.0
Spiophanes bombyx (P)	1.7	0.9	0.7	0.3	7.0
Branchiostoma caribaeum (Cc)	1.3	0.3	0.3	0.3	9.0
Ancinus depressus (I)	0.7	0.7	1.0	0.6	9.0
Cumacea B	1.7	0.9			9.0
Platyischnopidae A (Am)	0.7	0.7	0.7	0.7	12.0
Chione grus (M)	1.3	0.9			12.0
Sabellaria vulgaris (P)	1.3	1.3			12.0
Corophium sp. C (Am)	1.0	1.0			15.5
Tiron tropakis (Am)	1.0	1.0			15.5
Orbiniidae (P)			1.0	0.6	15.5
Haploscoloplos foliosus (P)			1.0	1.0	15.5
Trachypenaeus constrictus (D)	0.7	0.3			21.5
Synchelidium americanum (Am)	0.7	0.7			21.5
Acanthohaustorius intermedius (Am)			0.7	0.7	21.5
Erichthonius brasiliensis (Am)	0.7	0.7			21.5
Caprella penantis (Am)	0.7	0.7			21.5
Spisula solidissima (M)	0.7	0.3			21.5
Crassinella lunulata (M)	0.7	0.7			21.5
Glycera sp. C (P)	0.7	0.3			21.5
Pinnixa cristata (D)			0.3	0.3	36.5
Xanthidae (D)	0.3	0.3			36.5
Portunus sp. (D)	0.3	0.3			36.5
Paguridae (D)			0.3	0.3	36.5
Rhepoxynius epistomus (Am)	0.3	0.3			36.5
Metharpinia floridana (Am)	0.3	0.3			36.5
Paracaprella tenuis (Am)	0.3	0.3			36.5
Chiridotea stenops (I)	0.3	0.3			36.5

(Continued)

Appendix E. (Continued)

SPECIES	SUMMER 1982 x	SUMMER 1982 SE	FALL 1982 x	FALL 1982 SE	OVERALL RANK
			SS02		
Bowmaniella sp. (My)	0.3	0.3			36.5
Jassa falcata (Am)	0.3	0.3			36.5
Amphipoda	0.3	0.3			36.5
Renilla reniformis (Cn)			0.3	0.3	36.5
Actiniaria (Cn)	0.3	0.3			36.5
Olivella mutica (M)			0.3	0.3	36.5
Petricola pholadiformis (M)	0.3	0.3			36.5
Sipunculida	0.3	0.3			36.5
Harmothoe sp. (P)	0.3	0.3			36.5
Drilonereis magna (P)			0.3	0.3	36.5
Magelona papillicornis (P)	0.3	0.3			36.5
Nereidae (P)	0.3	0.3			36.5
Cirratulidae (P)			0.3	0.3	36.5
Polydora caeca (P)	0.3	0.3			
			SS03		
Crassinella martinicensis (M)			378.0	81.4	1.0
Podarke obscura (P)			195.7	146.8	2.0
Turbellaria A			82.3	63.8	3.0
Crassinella lunulata (M)	19.3	5.0	7.7	6.2	4.0
Nematoda	14.3	6.1	10.7	8.7	5.0
Turbellaria	0.3	0.3	21.3	21.3	6.0
Hemipodus roseus (P)	8.3	4.5	12.7	9.8	7.0
Sabellaria vulgaris (P)	2.3	1.3	9.0	2.1	8.0
Turbellaria B			10.0	5.0	9.0
Chione grus (M)	2.7	1.3			10.0
Ophiuroidea A (E)			1.7	0.9	11.5
Pseudeurythoe ambigua (P)	1.0	1.0	0.7	0.7	11.5
Microprotopus raneyi (Am)	1.0	1.0			15.0
Chiridotea stenops (I)	0.3	0.3	0.7	0.7	15.0
Pisione remota (P)			1.0	1.0	15.0
Autolytus sp. (P)			1.0	0.6	15.0
Hydroides protulicola (P)			1.0	0.6	15.0
Branchiostoma caribaeum (Cc)	0.3	0.3	0.3	0.3	20.5
Emerita talpoida (D)	0.3	0.3	0.3	0.3	20.5
Pinnotheres sp. (D)	0.7	0.7			20.5
Ancinus depressus (I)	0.7	0.3			20.5
Corophium sp. C (Am)	0.7	0.3			20.5
Turbellaria C			0.7	0.7	20.5
Bathyporeia parkeri (Am)	0.3	0.3			31.5
Ampelisca vadorum (Am)	0.3	0.3			31.5

(Continued)

Appendix E. (Concluded)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
			SS03		
Protohaustorius deichmannae (Am)	0.3	0.3			31.5
Batea catharinensis (Am)	0.3	0.3			31.5
Edotea montosa (I)	0.3	0.3			31.5
Exosphaeroma diminutum (I)			0.3	0.3	31.5
Bowmaniella floridana (My)	0.3	0.3			31.5
Platyischnopidae A (Am)	0.3	0.3			31.5
Actiniaria (Cn)			0.3	0.3	31.5
Turbellaria D			0.3	0.3	31.5
Olivella mutica (M)			0.3	0.3	31.5
Petricola pholadiformis (M)			0.3	0.3	31.5
Arcidae B (M)	0.3	0.3			31.5
Hydroides uncinata (P)			0.3	0.3	31.5
Hydroides sp. (P)			0.3	0.3	31.5
Nephtys picta (P)	0.3	0.3			31.5

Appendix F. Ranked abundance of benthic macroinvertebrates collected during 1982 at intertidal and subtidal stations on the north jetty transect (Transect III). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
NI01					
Nematoda	6.0	2.0	16.0	16.0	1.0
Oligochaeta			1.3	1.3	2.0
Pinnotheres sp. (D)	0.7	0.7			3.0
NI02					
Oligochaeta			424.0	164.1	1.0
Nematoda			170.7	21.8	2.0
Scolelepis squamata (P)	16.0	5.3	1.3	1.3	3.0
Emerita talpoida (D)	0.7	0.7	6.0	3.0	4.0
Crassinella lunulata (M)	4.0	1.1	2.0	1.1	5.0
Donax variabilis (M)			1.3	1.3	6.0
NI03					
Scolelepis squamata (P)	227.3	91.1	1.3	0.7	1.0
Donax variabilis (M)			32.7	4.0	2.0
Nematoda			28.0	26.0	3.0
Emerita talpoida (D)	8.7	1.3	2.0	1.1	4.0
Amphiporeia virginiana (Am)	6.0	3.5			5.0
Protohaustorius deichmannae (Am)	2.7	2.7			6.0
Batea catharinensis (Am)	1.3	1.3			7.0
Rhepoxynius epistomus (Am)	0.7	0.7			9.0
Corophium sp. A (Am)	0.7	0.7			9.0
Oligochaeta			0.7	0.7	9.0
NS01					
Bathyporeia parkeri (Am)	50.7	12.2			1.0
Leptognatha caeca (T)	26.7	13.3	2.0	2.0	2.0
Protohaustorius deichmannae (Am)	22.0	10.5	3.0	3.0	3.0
Ogyrides hayi (D)	9.3	2.9			4.0
Nematoda	6.0	1.1	4.5	2.5	5.0
Platyischnopidae A (Am)	7.0	2.6	2.5	2.5	6.0
Parahaustorius longimerus (Am)	8.0	2.6			7.0
Bowmaniella sp. (My)	5.7	2.2			8.0
Rhepoxynius epistomus (Am)	5.0	2.5			9.0

(Continued)

Appendix F. (Continued)

SPECIES	SUMMER 1982 x	SUMMER 1982 SE	FALL 1982 x	FALL 1982 SE	OVERALL RANK
NS01					
Acanthohaustorius intermedius (Am)	3.3	0.9	1.0	1.0	10.5
Mageiona papillicornis (P)	3.7	1.2	0.5	0.5	10.5
Mellita quinquesperforata (E)	2.0	1.5	1.5	0.5	12.0
Bowmaniella floridana (My)	1.3	0.9			13.5
Scolelepis squamata (P)	1.3	0.9			13.5
Chiridotea stenops (I)	0.7	0.7	0.5	0.5	15.5
Lumbrineris impatiens (P)	1.0				15.5
Pagurus longicarpus (D)	0.7	0.7			19.5
Synchelidium americanum (Am)	0.7	0.3			19.5
Acanthohaustorius millsi (Am)	0.7	0.3			19.5
Nemertinea	0.7	0.3			19.5
Olivella mutica (M)	0.3	0.3	0.5	0.5	19.5
Nephtys picta (P)	0.7	0.3			19.5
Pinnixa sp. (D)	0.3	0.3			25.5
Pinnotheres sp. (D)	0.3	0.3			25.5
Lysianassidae (Am)	0.3	0.3			25.5
Tellina sp. (M)	0.3	0.3			25.5
Dispio uncinata (P)			0.5	0.5	25.5
Nereidae (P)	0.3	0.3			25.5
NS02					
Platyischnopidae A	20.7	3.3	4.0	1.0	1.0
Acanthohaustorius intermedius (Am)	10.3	1.8	5.3	3.9	2.0
Leptognatha caeca (T)	9.7	4.3	3.7	2.2	3.0
Rhepoxynius epistomus (Am)	13.0	5.0			4.0
Ogyrides hayi (D)	9.3	3.2	0.3	0.3	5.0
Chiridotea stenops (I)	8.0	1.5	1.0		6.0
Protohaustorius deichmannae (Am)	3.0	0.6	5.0	1.7	7.0
Nematoda	6.7	3.2	1.0	0.6	8.0
Bathyporeia parkeri (Am)	5.3	2.4			9.0
Magelona papillicornis (P)	2.7	1.8	1.3	0.3	10.0
Acanthohaustorius millsi (Am)	1.0	1.0	2.3	2.3	11.0
Bowmaniella sp. (My)	3.0	1.5			12.0
Nephtys picta (P)	1.0	0.6	1.7	0.7	13.0
Parahaustorius longimerus (Am)	2.3	2.3			14.0
Mellita quinquesperforata (E)	1.3	0.3	0.7	0.7	15.5
Echinoidea (E)	2.0	1.1			15.5
Bodotriidae A (C)	1.3	1.3			17.0
Ancinus depressus (I)	1.0	1.0			19.5
Bowmaniella floridana (My)	1.0	0.6			19.5
Haustoriidae (Am)	1.0	1.0			19.5

(Continued)

Appendix F. (Continued)

SPECIES	SUMMER 1982 x	SUMMER 1982 SE	FALL 1982 x	FALL 1982 SE	OVERALL RANK
NS02					
Paraonis fulgens (P)			1.0	1.0	19.5
Pinnixa cristata (D)			0.7	0.7	23.0
Tellina texana (M)	0.3	0.3	0.3	0.3	23.0
Scolelepis squamata (P)	0.7	0.7			23.0
Pagurus longicarpus (D)	0.3	0.3			32.0
Albunea paretti (D)	0.3	0.3			32.0
Paguridae (D)			0.3	0.3	32.0
Pinnotheres sp. (D)	0.3	0.3			32.0
Synchelidium americanum (Am)	0.3	0.3			32.0
Erichsonella filiformis (I)	0.3	0.3			32.0
Amphipoda	0.3	0.3			32.0
Nucula proxima (M)			0.3	0.3	32.0
Spisula solidissima (M)	0.3	0.3			32.0
Lumbrineris impatiens (P)			0.3	0.3	32.0
Glycera oxycephala (P)	0.3	0.3			32.0
Dispio uncinata (P)			0.3	0.3	32.0
Travisia sp. A (P)	0.3	0.3			32.0
Nephtyidae (P)	0.3	0.3			32.0
Travisia parva (P)	0.3	0.3			32.0
NS03					
Platyischnopidae A (Am)	29.7	5.3	3.0	1.0	1.0
Rhepoxynius epistomus (Am)	20.7	2.3			2.0
Protohaustorius deichmannae (Am)	17.3	5.0	0.3	0.3	3.0
Nematoda	7.7	5.8	5.0	4.0	4.0
Nephtys picta (P)	4.0	0.6	4.0		5.0
Acanthohaustorius intermedius (Am)	6.3	1.8	0.7	0.7	6.0
Renilla reniformis (Cn)	5.0	1.0	0.7	0.3	7.5
Mellita quinquesperforata (E)	1.0	0.6	4.7	1.4	7.5
Bathyporeia parkeri (Am)	4.0	1.7			9.5
Tellina texana (M)	3.3	0.9	0.7	0.7	9.5
Magelona papillicornis (P)	1.3	0.9	1.3	0.9	11.0
Olivella mutica (M)	2.0	0.6			13.0
Tellina probrina (M)	2.0	1.0			13.0
Sabellaria vulgaris (P)			2.0	1.5	13.0
Ogyrides hayi (D)	1.7	0.3			16.5
Acanthohuastorius millsi (Am)	0.7	0.3	1.0	0.6	16.5
Bowmaniella sp. (My)	1.3	0.9	0.3	0.3	16.5
Metamysidopsis swifti (My)	1.7	1.7			16.5
Mysidopsis bigelowi (My)	1.3	1.3			20.5
Chiridotea stenops (I)	1.0	0.6	0.3	0.3	20.5

(Continued)

Appendix F. (Concluded)

SPECIES	SUMMER 1982 x	SUMMER 1982 SE	FALL 1982 x	FALL 1982 SE	OVERALL RANK
			NS03		
Ancinus depressus (I)	0.3	0.3	1.0	0.6	20.5
Leptognatha caeca (T)			1.3	0.7	20.5
Lepidopa websteri (D)	1.0				24.5
Emerita talpoida (D)			1.0	1.0	24.5
Tiron tropakis (Am)			1.0	1.0	24.5
Nemertinea	1.0	0.6			24.5
Synchelidium americanum (Am)	0.7	0.3			28.0
Parahaustorius longimerus (Am)	0.7	0.3			28.0
Hemipodus roseus (P)			0.7	0.7	28.0
Pagurus longicarpus (D)	0.3	0.3			38.5
Automate sp. (D)	0.3	0.3			38.5
Paguridae (D)			0.3	0.3	38.5
Pinnixa sp. (D)			0.3	0.3	38.5
Batea catharinensis (Am)	0.3	0.3			38.5
Oxyurostylis smithi (C)	0.3	0.3			38.5
Bowmaniella floridana (My)	0.3	0.3			38.5
Strigilla mirabilis (M)	0.3	0.3			38.5
Tellina iris (M)	0.3	0.3			38.5
Oliva sayana (M)			0.3	0.3	38.5
Petricola pholadiformis (M)			0.3	0.3	38.5
Solen viridis (M)	0.3	0.3			38.5
Spisula solidissima (M)	0.3	0.3			38.5
Terebra dislocata (M)	0.3	0.3			38.5
Armina tigrina (M)	0.3	0.3			38.5
Glycera oxycephala (P)	0.3	0.3			38.5
Spionidae A (P)	0.3	0.3			38.5
Paraonis fulgens (P)	0.3	0.3			38.5

Appendix G. Ranked abundance of benthic macroinvertebrates collected during 1982 at intertidal and subtidal stations on the south control transect (Transect IV). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CI01					
Nematoda	1.3	0.7	408.0	162.2	1.0
Oligochaeta			110.0	88.0	2.0
Donax variabilis (M)	1.3	1.3	2.0	1.1	3.0
Emerita talpoida (D)			1.3	0.7	4.5
Talorchestia megalophthalma (Am)	1.3	1.3			4.5
Pinnotheres sp. (D)	0.7	0.7			6.0
CI02					
Nematoda	10.7	7.0	88.7	61.5	1.0
Donax variabilis (M)	55.3	7.7	6.0	2.0	2.0
Scolelepis squamata (P)	40.0	5.3	8.0	2.3	3.0
Emerita talpoida (D)	2.7	0.7	35.3	9.9	4.0
Haustorius longirostris (Am)			1.3	1.3	5.0
Amphiporeia virginiana (Am)			0.7	0.7	7.0
Exogone dispar (P)	0.7	0.7			7.0
Syllis spongicola (P)	0.7	0.7			7.0
CI03					
Emerita talpoida (D)	315.3	134.4			1.0
Donax variabilis (M)	169.3	3.3	18.0	7.0	2.0
Scolelepis squamata (P)	181.3	6.8	1.3	0.7	3.0
Amphiporeia virginiana (Am)	10.0	1.1	1.3	0.7	4.0
Haustorius longirostris (Am)			6.0	5.0	5.0
Nematoda			4.0	3.0	6.0
Haustoriidae (Am)			2.7	2.7	7.0
Parahaustorius longimerus (Am)			1.3	0.7	8.0
Acanthohaustorius millsi (Am)	0.7	0.7			10.0
Renilla reniformis (Cn)			0.7	0.7	10.0
Crassinella lunulata (M)	0.7	0.7			10.0
CS01					
Donax variabilis (M)	52.7	28.5	1.7	1.2	1.0
Parahaustorius longimerus (Am)	25.0	20.1			2.0
Magelona papillicornis (P)	0.3	0.3	20.0	3.0	3.0

(Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CS01					
Nematoda			15.7	12.8	4.0
Emerita talpoida (D)	14.0	14.0			5.0
Scolelepis squamata (P)	13.7	5.2			6.0
Bowmaniella sp. (My)	7.3	5.9	0.3	0.3	7.0
Protohaustorius deichmannae (Am)			5.0	2.0	8.0
Metamysidopsis swifti (My)	1.7	1.7			9.0
Bathyporeia parkeri (Am)	0.7	0.3	0.7	0.3	10.0
Ogyrides hayi (D)	1.0	1.0			11.5
Chiridotea stenops (I)			1.0	0.6	11.5
Albunea paretti (D)	0.7	0.3			14.5
Nemertinea			0.7	0.7	14.5
Lumbrineris impatiens (P)	0.3	0.3	0.3	0.3	14.5
Dispio uncinata (P)			0.7	0.7	14.5
Pinnixa cristata (D)	0.3	0.3			21.0
Pinnotheres sp. (D)	0.3	0.3			21.0
Lepidactylus dytiscus (Am)			0.3	0.3	21.0
Oxyurostylis smithi (C)			0.3	0.3	21.0
Mysidacea A	0.3	0.3			21.0
Paradella quadripunctata (I)			0.3	0.3	21.0
Nephtys picta (P)			0.3	0.3	21.0
Spionidae (P)	0.3	0.3			21.0
Paraonis fulgens (P)			0.3	0.3	21.0
CS02					
Protohaustorius deichmannae (Am)	89.3	6.1	19.5	5.5	1.0
Magelona papillicornis (P)	18.3	4.2	10.5	3.5	2.0
Bowmaniella sp. (My)	10.3	4.4	4.5	2.5	3.0
Rhepoxynius epistomus (Am)	7.3	2.2			4.0
Chiridotea stenops (I)	2.3	0.3	3.0	1.0	5.0
Sabellaria vulgaris (P)	4.0	4.0			6.0
Ogyrides hayi (D)	3.7	0.7			7.0
Nematoda	1.0	0.6	3.5	3.5	8.0
Pagurus longicarpus (D)	2.7	2.7			9.0
Renilla reniformis (Cn)	1.3	0.3	1.5	0.5	10.0
Dispio uncinata (P)			3.0	3.0	11.0
Paraonis fulgens (P)	1.3	0.9	0.5	0.5	12.0
Pagurus sp. (D)	1.3	0.7			15.0
Pagurus hendersoni (D)	1.3	1.3			15.0
Bowmaniella floridana (My)	1.3	0.9			15.0
Tellina texana (M)	1.0	0.6	0.5	0.5	15.0
Nephtys picta (P)	1.3	0.9			15.0

(Continued)

Appendix G. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CS02					
Bowmaniella brasiliensis (My)	1.0	1.0			18.5
Tellina iris (M)	1.0	0.6			18.5
Bathyporeia parkeri (Am)	0.7	0.3			20.0
Trachypenaeus constrictus (D)	0.3	0.3			26.0
Albunea paretti (D)	0.3	0.3			26.0
Pinnixa cristata (D)	0.3	0.3			26.0
Portunus sp. (D)			0.5	0.5	26.0
Paguridae (D)			0.5	0.5	26.0
Ancinus depressus (I)	0.3	0.3			26.0
Platyischnopidae A (Am)	0.3	0.3			26.0
Nemertinea			0.5	0.5	26.0
Mellita quinquesperforata (E)			0.5	0.5	26.0
Lumbrineris impatiens (P)	0.3	0.3			26.0
Polydora commensalis (P)	0.3	0.3			26.0
CS03					
Nematoda	71.3	29.4	32.7	23.3	1.0
Sabellaria vulgaris (P)	88.7	28.0	4.0	3.5	2.0
Batea catharinensis (Am)	32.7	12.2	0.3	0.3	3.5
Corophium sp. (Am)	33.0	32.0			3.5
Corophium sp. C (Am)	20.3	20.3			5.0
Oligochaeta	0.7	0.7	18.3	17.3	6.0
Elasmopus levis (Am)	16.3	8.7	0.3	0.3	7.0
Unciola serrata (Am)	12.0	6.6	0.7	0.7	8.0
Leptochela serratorbita (D)	0.3	0.3			9.0
Ogyrides alphaerostris (D)	0.3	0.3			9.0
Upogebia affinis (D)	0.3	0.3			9.0
Pagurus longicarpus (D)	0.3	0.3			9.0
Pagurus pollicaris (D)	0.3	0.3			9.0
Pelia mutica (D)	0.3	0.3			9.0
Majidae (D)	0.3	0.3			9.0
Brachyura B (D)	0.3	0.3			9.0
Penaeidae (D)	0.3	0.3			9.0
Ogyrides hayi (D)	0.3	0.3			9.0
Pinnixa floridana (D)	0.3	0.3			9.0
Ostracoda	0.3	0.3			9.0
Chiridotea stenops (I)	0.3	0.3			9.0
Elasmopus sp. D (Am)	0.3	0.3			9.0
Platyischnopidae A (Am)	0.7	0.7	11.3	7.8	9.0
Turbellaria	0.3	0.3			9.0
Nemertinea	0.3	0.3			9.0

(Continued)

Appendix G. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CS03					
Asterias forbesii (E)	0.3	0.3			9.0
Parvilucina multilineata (M)			0.3	0.3	9.0
Crepidula plana (M)	0.3	0.3			9.0
Ensis directus (M)	0.3	0.3			9.0
Arcidae B (M)	0.3	0.3			9.0
Ilyanassa obsoleta (M)	0.3	0.3			9.0
Polychaeta	0.3	0.3			9.0
Goniada sp. (P)	0.3	0.3			9.0
Phyllodoce sp. (P)	0.3	0.3			9.0
Cirriformia grandis (P)	0.3	0.3			9.0
Onuphis microcephala (P)	0.3	0.3			9.0
Pista sp. (P)	0.3	0.3			9.0
Glycera americana (P)	0.3	0.3			9.0
Sigambra tentaculata (P)	0.3	0.3			9.0
Glycera dibranchiata (P)	0.3	0.3			9.0
Polydora ligni (P)	0.3	0.3			9.0
Goniada maculata (P)	0.3	0.3			9.0
Pista quadrilobata (P)	0.3	0.3			9.0
Nereidae (P)	0.3	0.3			9.0
Ampharetidae (P)	0.3	0.3			9.0
Terebellidae (P)	0.3	0.3			9.0
Magelona rosea (P)	0.3	0.3			9.0
Schistomeringos rudolphi (P)	0.3	0.3			9.0
Hemipholis elongata (E)	10.3	6.1	1.3	0.3	10.0
Ampelisca vadorum (Am)	10.7	5.4			11.0
Pinnixa sp. A (D)	8.0	4.3			12.0
Xanthidae (D)	5.7	3.8	0.3	0.3	13.5
Spiophanes bombyx (P)	5.7	5.2	0.3	0.3	13.5
Owenia fusiformis (P)	5.0	3.5			15.0
Nephtys picta (P)	1.0	1.0	3.3	1.4	16.0
Tellina texana (M)	3.0	1.5	1.0	0.6	17.5
Hydroides protulicola (P)	4.0	3.5			17.5
Maldanidae (P)	3.3	2.4			19.5
Amphare te americana (P)	3.3	2.0			19.5
Nucula proxima (M)	1.0	1.0	2.0	2.0	22.5
Nereis succinea (P)	3.0	2.1			22.5
Diopatra cuprea (P)	2.7	1.3	0.3	0.3	22.5
Magelona phyllisae (P)	3.0	1.5			22.5
Erichthonius brasiliensis (Am)	2.7	2.2			26.5
Arcidae A (M)	2.7	1.4			26.5
Nereis sp. (P)	2.7	1.4			26.5
Clymenella torquata (P)	2.7	2.7			26.5
Sabella sp. (P)	2.3	1.2			30.5

(Continued)

Appendix G. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CS03					
Pseudeurythoe ambigua (P)	2.3	2.3			30.5
Arabella iricolor (P)	2.0	1.5	0.3	0.3	30.5
Drilonereis magna (P)	2.0	1.1	0.3	0.3	30.5
Metamysidopsis swifti (My)	1.7	0.9	0.3	0.3	34.5
Crassinella lunulata (M)	0.3	0.3	1.7	1.7	34.5
Glycera sp. C (P)	1.0	0.6	1.0	1.0	34.5
Hemipodus roseus (P)	1.3	0.9	0.7	0.7	34.5
Trachypenaeus constrictus (D)	1.7	1.2			39.0
Latreutes parvulus (D)	1.7	0.9			39.0
Pagurus hendersoni (D)	1.7	1.7			39.0
Callianassa biformis (D)	1.7	1.7			39.0
Eobrolgus spinosus (Am)	1.7	1.2			39.0
Euceramus praelongus (D)	1.3	0.9			46.0
Paguridae (D)			1.3	0.7	46.0
Listriella clymenellae (Am)	1.3	1.3			46.0
Unciola sp. (Am)			1.3	1.3	46.0
Crepidula fornicata (M)	0.7	0.7	0.7	0.7	46.0
Sthenelais boa (P)	1.0	0.6	0.3	0.3	46.0
Ancistrosyllis hartmanae (P)	1.3	1.3			46.0
Magelona papillicornis (P)			1.3	1.3	46.0
Chrysopetalidae B (P)	1.3	1.3			46.0
Pinnixa sp. B (D)	1.0	0.6			56.5
Listriella barnardi (Am)	1.0	1.0			56.5
Oxyurostylis smithi (C)	1.0	0.6			56.5
Ophiuroidea B (E)	1.0	0.6			56.5
Glottidia pyramidata (Brach)	1.0	0.6			56.5
Astyris lunata (M)	1.0	0.6			56.5
Pelecypoda A (M)	1.0	1.0			56.5
Pherusa ehlersi (P)	1.0	1.0			56.5
Onuphis jenneri (P)	1.0	1.0			56.5
Onuphidae (P)	1.0	1.0			56.5
Armandia agilis (P)	0.3	0.3	0.7	0.7	56.5
Hydroides dianthus (P)	1.0	1.0			56.5
Panopeus herbstii (D)	0.7	0.7			76.0
Heterocrypta granulata (D)	0.7	0.7			76.0
Portunus sp. (D)	0.7	0.7			76.0
Pinnotheres sp. (D)	0.7	0.3			76.0
Synchelidium americanum (Am)			0.7	0.7	76.0
Lembos smithi (Am)	0.7	0.7			76.0
Paracaprella tenuis (Am)	0.7	0.7			76.0
Ancinus depressus (I)			0.7	0.3	76.0
Tiron tropakis (Am)			0.7	0.7	76.0
Actiniaria (Cn)	0.7	0.3			76.0

(Continued)

Appendix C. (Concluded)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
CS03					
Olivella mutica (M)			0.7	0.7	76.0
Spisula solidissima (M)			0.7	0.7	76.0
Sipunculida	0.7	0.7			76.0
Polychaeta A	0.7	0.7			76.0
Amastigos caperatus (P)			0.7	0.7	76.0
Ancistrosyllis jonesi (P)	0.7	0.7			76.0
Spiochaetopterus costarum oculatus (P)	0.7	0.3			76.0
Arabella mutans (P)	0.7	0.3			76.0
Cistenides gouldii (P)	0.7	0.3			76.0
Exogone dispar (P)	0.3	0.3	0.3	0.3	76.0
Spionidae (P)	0.7	0.7			76.0
Hesionidae (P)	0.7	0.3			76.0
Caulleriella killariensis (P)			0.7	0.3	76.0
Mediomastus californiensis (P)	0.7	0.3			76.0
Syllidae (P)	0.3	0.3	0.3	0.3	76.0
Polydora caeca (P)	0.3	0.3			76.0
Sabella microphthalma (P)	0.7	0.7			76.0

Appendix H. Ranked abundance of benthic macroinvertebrates collected during 1982 at intertidal and subtidal stations on the north control transect (Transect V). Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	SUMMER 1982		FALL 1982		OVERALL RANK
	$\bar{x}$	SE	$\bar{x}$	SE	
GI01					
Nematoda	0.7	0.7	104.0	6.0	1.0
Oligochaeta			7.0	5.0	2.0
Talorchestia megalophthalma (Am)	2.0	1.1			3.0
Tellina sp. (M)	0.7	0.7			4.0
GI02					
Oligochaeta	861.3	731.4	1.3	0.7	1.0
Emerita talpoida (D)	54.7	19.9	18.7	5.4	2.0
Nematoda	46.7	36.7	25.3	11.1	3.0
Donax variabilis (M)	50.7	4.0	0.7	0.7	4.0
Scolelepis squamata (P)	32.0	12.8			5.0
Haustorius longirostris (Am)	2.7	0.7			6.0
Crassinella lunulata (M)	0.7	0.7			7.0
GI03					
Donax variabilis (M)	244.0	28.4	14.0	10.3	1.0
Emerita talpoida (D)	244.7	38.0	0.7	0.7	2.0
Amphiporeia virginiana (Am)	14.0	6.0	1.3	0.7	3.5
Scolelepis squamata (P)	14.7	2.9	0.7	0.7	3.5
Nematoda			8.0	4.0	5.0
Haustorius longirostris (Am)			5.3	5.3	6.0
Bowmaniella sp. (My)	2.0	2.0			7.0
Parahaustorius longimerus (Am)	0.7	0.7	0.7	0.7	8.5
Paradella quadripunctata (I)			1.3	1.3	8.5
Lepidactylus dytiscus (Am)			0.7	0.7	12.0
Gammaropsis sp. (Am)	0.7	0.7			12.0
Bodotriidae A (C)	0.7	0.7			12.0
Tellina sp. (M)			0.7	0.7	12.0
Crassinella lunulata (M)	0.7	0.7			12.0
GS01					
Donax variabilis (M)	76.0	41.6			1.0
Protohaustorius leighmannae (Am)	2.7	1.8	17.7	3.4	2.0
Scolelepis squamata (P)	13.0	6.2			3.0

(Continued)

SPECIES	SUMMER 1982 x̄	SUMMER 1982 SE	FALL 1982 x̄	FALL 1982 SE	OVERALL RANK
GS01					
Magelona papillicornis (P)	0.7	0.7	8.3	0.7	4.0
Nematoda			6.3	3.0	5.0
Bowmaniella sp. (My)	3.7	1.2	2.0	0.6	6.0
Parahaustorius longimerus (Am)	2.0	1.0			7.0
Chiridotea stenops (I)	0.7	0.7	0.7	0.3	8.5
Dispio uncinata (P)			1.3	0.9	8.5
Nemertinea			1.0	1.0	10.0
Pinnixa cristata (D)	0.7	0.3			12.0
Ogyrides hayi (D)	0.7	0.7			12.0
Metamysidopsis swifti (My)			0.7	0.7	12.0
Albunea paretti (D)	0.3	0.3			18.0
Acanthohaustorius millsi (Am)	0.3	0.3			18.0
Photis sp. (Am)			0.3	0.3	18.0
Bowmaniella floridana (My)	0.3	0.3			18.0
Leptognatha caeca (T)			0.3	0.3	18.0
Cumacea A	0.3	0.3			18.0
Nephtys picta (P)			0.3	0.3	18.0
Glycera dibranchiata (P)			0.3	0.3	18.0
Paraonis fulgens (P)	0.3	0.3			18.0
GS02					
Protohaustorius deichmannae (Am)	49.7	13.5	5.0	3.6	1.0
Magelona papillicornis (P)	12.7	2.0	4.0	3.0	2.0
Bowmaniella sp. (My)	9.7	4.0	4.0	3.5	3.0
Nematoda	0.7	0.7	9.7	3.4	4.0
Renilla reniformis (Cn)	5.3	1.8	0.7	0.7	5.0
Rhepoxynius epistomus (Am)	5.3	1.4			6.0
Donax variabilis (M)	2.7	0.3			7.0
Pagurus longicarpus (D)	2.3	2.3			8.0
Pinnotheres sp. (D)	1.3	0.7	0.3	0.3	9.0
Chiridotea stenops (I)	1.0		0.3	0.3	10.0
Ogyrides hayi (D)	1.0	0.6			13.5
Bowmaniella floridana (My)	0.7	0.3	0.3	0.3	13.5
Nemertinea	0.3	0.3	0.7	0.7	13.5
Tellina texana (M)	0.7	0.3	0.3	0.3	13.5
Nephtys picta (P)	1.0	0.6			13.5
Paraonis fulgens (P)	1.0	1.0			13.5
Mellita quinquiesperforata (E)			0.7	0.3	17.5
Aricidea mauguezensis (P)	0.7	0.7			17.5
Dissodactylus mellitae (D)			0.3	0.3	25.5
Pinnixa cristata (D)	0.3	0.3			25.5

(Continued)

AD-A149 211 ECOLOGICAL EFFECTS OF RUBBLE WEIR JETTY CONSTRUCTION AT MURRELLS INLET SO..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS D M KNOTT ET AL. 2/2

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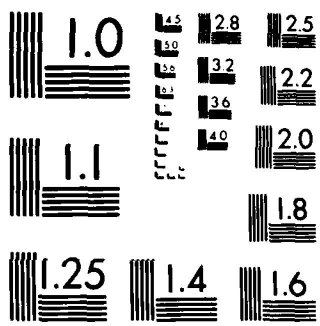

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Appendix H. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
GS02					
Synchelidium americanum (Am)	0.3	0.3			25.5
Microprotopus raneyi (Am)			0.3	0.3	25.5
Batea catharinensis (Am)	0.3	0.3			25.5
Caprella equilibra (Am)			0.3	0.3	25.5
Edotea montosa (I)			0.3	0.3	25.5
Cumacea B	0.3	0.3			25.5
Caprella penantis (Am)			0.3	0.3	25.5
Pelecypoda B (M)			0.3	0.3	25.5
Spiophanes bombyx (P)	0.3	0.3			25.5
Scolelepis squamata (P)	0.3	0.3			25.5
Scolelepis texana (P)	0.3	0.3			25.5
Phyllodocidae (P)	0.3	0.3			25.5
GS03					
Sabellaria vulgaris (P)	32.3	21.4	3.7	0.9	1.0
Corophium sp. C (Am)	34.0	19.6			2.0
Batea catharinensis (Am)	24.3	6.2	3.7	1.8	3.0
Unciola serrata (Am)	3.3	0.9	20.0	6.3	4.0
Crassinella lunulata (M)	21.7	7.8			5.0
Nematoda	10.7	4.2	8.3	2.9	6.0
Nucula proxima (M)	11.0	1.5	7.7	2.6	7.0
Amastigos caperatus (P)			15.3	12.4	8.0
Elasmopus levis (Am)	10.3	3.9	0.7	0.7	9.0
Mediomastus californiensis (P)	10.0	10.0			10.0
Crepidula fornicata (M)	8.0	7.0			11.0
Xanthidae (D)	7.3	7.3	0.3	0.3	12.0
Platyischnopidae A (Am)			6.0	3.8	13.5
Spiophanes bombyx (P)	1.3	0.9	4.7	2.7	13.5
Polychaeta B			5.7	2.8	15.0
Corophium sp. (Am)	3.7	3.7			16.0
Magelona papillicornis (P)	0.3	0.3	2.7	0.9	17.0
Ampelisca vadorum (Am)	2.0	1.0	0.7	0.7	21.0
Paracaprella tenuis (Am)	2.7	1.8			21.0
Ancinus depressus (I)	0.3	0.3	2.3	1.4	21.0
Arcidae A (M)	2.7	1.8			21.0
Nereis falsa (P)	2.7	1.2			21.0
Arabella iricolor (P)	1.3	1.3	1.3	0.3	21.0
Caulleriella killariensis (P)			2.7	1.3	21.0
Tellina texana (M)			2.3	1.2	26.0
Glycera sp. C (P)	2.3	1.2			26.0
Oligochaeta			2.3	2.3	26.0
Neopanope sayi (D)	2.0	1.1			29.0

(Continued)

Appendix H. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
		GS03			
Diopatra cuprea (P)	1.7	0.3	0.3	0.3	29.0
Syllidae (P)	0.3	0.3	1.7	1.2	29.0
Tiron tropakis (Am)	1.7	0.9			33.0
Astyris lunata (M)	1.7	0.7			33.0
Pseudeurythoe ambigua (P)			1.7	0.9	33.0
Podarke obscura (P)	1.7	1.7			33.0
Exogone dispar (P)	1.7	1.7			33.0
Trachypenaeus constrictus (D)	1.0	0.6	0.3	0.3	39.0
Protohaustorius deichmannae (Am)	1.3	1.3			39.0
Nemertinea	0.7	0.3	0.7	0.7	39.0
Sphaerodoridae A (P)			1.3	1.3	39.0
Glycera americana (P)	1.3	0.9			39.0
Nephtys picta (P)	1.3	0.9			39.0
Chrysopetalidae B (P)	1.3	0.7			39.0
Alpheus normanni (D)	1.0				48.0
Latreutes parvulus (D)	1.0	0.6			48.0
Panopeus herbstii (D)	1.0	1.0			48.0
Paguridae (D)	1.0	0.6			48.0
Pinnixa sp. A (D)			1.0	1.0	48.0
Erichthonius brasiliensis (Am)	1.0	0.6			48.0
Cumacea B	0.3	0.3	0.7	0.3	48.0
Nudibranchia (M)	1.0	1.0			48.0
Brania sp. (P)			1.0	1.0	48.0
Arabella mutans (P)	1.0	1.0			48.0
Nereis lamellosa (P)	1.0	1.0			48.0
Heterocrypta granulata (D)	0.7	0.7			62.0
Pagurus sp. (D)	0.7	0.3			62.0
Penaeidae (D)	0.7	0.3			62.0
Synchelidium americanum (Am)			0.7	0.3	62.0
Eobrolgus spinosus (Am)	0.7	0.7			62.0
Listriella barnardi (Am)			0.7	0.7	62.0
Cerapus tubularis (Am)	0.7	0.7			62.0
Stenothoe sp. (Am)	0.7	0.7			62.0
Metamysidopsis swifti (My)			0.7	0.3	62.0
Hemipholis elongata (E)			0.7	0.3	62.0
Anomia simplex (M)	0.7	0.3			62.0
Petricola pholadiformis (M)	0.3	0.3	0.3	0.3	62.0
Pilargidae (P)			0.7	0.7	62.0
Glycera capitata (P)	0.3	0.3	0.3	0.3	62.0
Spionidae (P)	0.7	0.7			62.0
Polydora caeca (P)	0.7	0.7			62.0
Schistomeringos rudolphi (P)	0.3	0.3	0.3	0.3	62.0
Leptochela serratorbita (D)			0.3	0.3	62.0

(Continued)

Appendix H. (Concluded)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
		GS03			
Pagurus longicarpus (D)	0.3	0.3			92.5
Portunus gibbesii (D)	0.3	0.3			92.5
Portunus sp. (D)	0.3	0.3			92.5
Automate sp. (D)			0.3	0.3	92.5
Pinnixa sp. (D)			0.3	0.3	92.5
Callianassidae (D)	0.3	0.3			92.5
Pinnotheres sp. (D)	0.3	0.3			92.5
Rhepoxynius epistomus (Am)	0.3	0.3			92.5
Microprotopus raneyi (Am)	0.3	0.3			92.5
Oxyurostylis smithi (C)	0.3	0.3			92.5
Listriella clymenellae (Am)			0.3	0.3	92.5
Bowmaniella floridana (My)	0.3	0.3			92.5
Caprella penantis (Am)			0.3	0.3	92.5
Bowmaniella sp. (My)			0.3	0.3	92.5
Actiniaria (Cn)	0.3	0.3			92.5
Ophiothrix angulata (E)			0.3	0.3	92.5
Holothuroidea (E)	0.3	0.3			92.5
Crepidula plana (M)	0.3	0.3			92.5
Urosalpinx cinerea (M)	0.3	0.3			92.5
Ensis directus (M)	0.3	0.3			92.5
Spisula solidissima (M)	0.3	0.3			92.5
Abra aequalis (M)	0.3	0.3			92.5
Mulinia lateralis (M)	0.3	0.3			92.5
Tellina sp. (M)	0.3	0.3			92.5
Harmothoe sp. A (P)	0.3	0.3			92.5
Pista palmata (P)			0.3	0.3	92.5
Chone americana (P)	0.3	0.3			92.5
Pherusa ehlersi (P)	0.3	0.3			92.5
Cirriformia sp. (P)			0.3	0.3	92.5
Onuphis nebulosa (P)	0.3	0.3			92.5
Loimia medusa (P)	0.3	0.3			92.5
Axiothella mucosa (P)			0.3	0.3	92.5
Hydroides protulicola (P)	0.3	0.3			92.5
Polycirrus eximius (P)	0.3	0.3			92.5
Spiochaetopterus costarum oculatus (P)			0.3	0.3	92.5
Owenia fusiformis (P)	0.3	0.3			92.5
Ancistrosyllis hartmanae (P)	0.3	0.3			92.5
Drilonereis magna (P)			0.3	0.3	92.5
Lepidonotus sublevis (P)	0.3	0.3			92.5
Pista quadrilobata (P)			0.3	0.3	92.5
Nereidae (P)	0.3	0.3			92.5
Phyllodocidae (P)	0.3	0.3			92.5
Chrysopetalidae (P)			0.3	0.3	92.5

Appendix I. Ranked abundance of benthic macroinvertebrates collected during 1982 at the additional offshore control stations. Estimates represent the mean number per 0.1 m^2 and A = Ascidiacea, Am = Amphipoda, Brach = Brachiopoda, C = Cumacea, Cc = Cephalochordata, Cn = Cnidaria, D = Decapoda, E = Echinodermata, H = Hemichordata, I = Isopoda, M = Mollusca, My = Mysidacea, P = Polychaeta, T = Tanaidacea.

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
XS03					
Platyischnopidae A (Am)	30.0	6.4	43.0	7.0	1.0
Rhepoxynius epistomus (Am)	13.7	4.9	5.0	1.1	2.0
Nephtys picta (P)	8.3	3.3	3.3	0.9	3.0
Protohaustorius deichmannae (Am)	0.7	0.7	4.0	2.5	4.0
Ogyrides alphaerostris (D)	4.3	0.7			5.0
Nematoda	0.7	0.7	2.7	2.2	6.5
Onuphis eremita (P)	2.0		1.3	0.9	6.5
Renilla reniformis (Cn)	1.3	0.9	1.7	0.7	8.5
Magelona papillicornis (P)	2.3	1.4	0.7	0.7	8.5
Tellina texana (M)	1.7	0.7	1.0	0.6	10.5
Glycera sp. C (P)	2.0	1.0	0.7	0.7	10.5
Dissodactylus mellitae (D)			2.3	2.3	12.5
Synchelidium americanum (Am)	2.0	1.0	0.3	0.3	12.5
Microprotopus raneyi (Am)	1.7	1.2	0.3	0.3	15.5
Batea catharinensis (Am)	1.0	0.6	1.0	1.0	15.5
Turbellaria			2.0	2.0	15.5
Armandia agilis (P)	1.3	0.9	0.7	0.3	15.5
Olivella mutica (M)			1.3	0.7	18.0
Trachypenaeus constrictus (D)	1.0	0.6			21.0
Mellita quinquesperforata (E)			1.0	1.0	21.0
Parvilucina multilineata (M)	0.7	0.7	0.3	0.3	21.0
Spiophanes bombyx (P)			1.0		21.0
Goniada maculata (P)	0.3	0.3	0.7	0.3	21.0
Ancinus depressus (I)			0.7	0.7	25.5
Nemertinea			0.7	0.7	25.5
Nudibranchia (M)	0.7	0.7			25.5
Glycera capitata (P)			0.7	0.7	25.5
Gammaropsis sp. (Am)			0.3	0.3	38.0
Listriella barnardi (Am)	0.3	0.3			38.0
Oxyurostylis smithi (C)	0.3	0.3			38.0
Chiridotea stenops (I)			0.3	0.3	38.0
Leucothoe spinicarpa (Am)			0.3	0.3	38.0
Cumacea B			0.3	0.3	38.0
Apanthura magnifica (I)			0.3	0.3	38.0
Protohaustorius sp. (Am)	0.3	0.3			38.0
Tellina iris (M)	0.3	0.3			38.0
Astyris lunata (M)	0.3	0.3			38.0
Petricola pholadiformis (M)	0.3	0.3			38.0
Arcidae A (M)	0.3	0.3			38.0
Terebra dislocata (M)	0.3	0.3			38.0

(Continued)

Appendix I. (Continued)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
			XS03		
Scolelepis squamata (P)	0.3	0.3			38.0
Glyceridae (P)			0.3	0.3	38.0
Drilonereis magna (P)			0.3	0.3	38.0
Spionidae (P)			0.3	0.3	38.0
Scolelepis texana (P)	0.3	0.3			38.0
Haploscoloplos sp. (P)	0.3	0.3			38.0
Phyllodocidae (P)	0.3	0.3			38.0
			YS03		
Platyischnopidae A (Am)	20.3	5.0	44.7	2.6	1.0
Protohaustorius deichmannae (Am)	23.0	5.0	4.3	0.9	2.0
Rhepoxynius epistomus (Am)	7.0	1.1	7.0	2.1	3.0
Nematoda	5.7	3.5	4.0	3.5	4.0
Tellina texana (M)	8.3	4.7			5.0
Nephtys picta (P)	3.7	1.2	2.0	0.6	6.0
Olivella mutica (M)	1.0	0.6	2.7	1.8	7.0
Mellita quinquesperforata (E)	2.0	0.6	1.0	1.0	8.5
Magelona papillicornis (P)	1.3	0.3	1.7	0.9	8.5
Dissodactylus mellitae (D)	2.0	0.6	0.3	0.3	10.0
Batea catharinensis (Am)	1.7	0.9			11.5
Bowmaniella sp. (My)	1.7	0.7			11.5
Pinnotheres sp. (D)	1.0	1.0	0.3	0.3	14.5
Synchelidium americanum (Am)	1.0	0.6	0.3	0.3	14.5
Acanthohaustorius intermedius (Am)	0.3	0.3	1.0	0.6	14.5
Parvilucina multilineata (M)	1.0		0.3	0.3	14.5
Emerita talpoida (D)	1.0	0.6			18.5
Ancinus depressus (I)	0.3	0.3	0.7	0.3	18.5
Metamysidopsis swifti (My)			1.0	1.0	18.5
Bemipodus roseus (P)	1.0	0.6			18.5
Pinnixa sp. A (D)	0.7	0.7			24.5
Oxyurostylis smithi (C)			0.7	0.3	24.5
Chiridotea stenops (I)			0.7	0.7	24.5
Cumacea B	0.7	0.3			24.5
Ptilanthura tricarina (I)	0.3	0.3	0.3	0.3	24.5
Renilla reniformis (Cn)	0.7	0.7			24.5
Glycera sp. C (P)	0.7	0.3			24.5
Armandia agilis (P)			0.7	0.7	24.5
Branchiostoma caribaeum (Cc)	0.3	0.3			38.0
Trachypenaeus constrictus (D)	0.3	0.3			38.0
Ogyrides alphaerostris (D)	0.3	0.3			38.0
Paguridae (D)			0.3	0.3	38.0

(Continued)

Appendix I. (Concluded)

SPECIES	SUMMER 1982 $\bar{x}$	SUMMER 1982 SE	FALL 1982 $\bar{x}$	FALL 1982 SE	OVERALL RANK
			<u>YS03</u>		
Pinnixa sp. (D)			0.3	0.3	38.0
Ogyrides hayi (D)	0.3	0.3			38.0
Paracaprella tenuis (Am)	0.3	0.3			38.0
Tiron tropakis (Am)			0.3	0.3	38.0
Tiron triocellatus (Am)	0.3	0.3			38.0
Tellina iris (M)	0.3	0.3			38.0
Nucula proxima (M)	0.3	0.3			38.0
Nereis falsa (P)	0.3	0.3			38.0
Glycera capitata (P)			0.3	0.3	38.0
Nephtys incisa (P)			0.3	0.3	38.0
Dispio uncinata (P)	0.3	0.3			38.0
Goniada maculata (P)			0.3	0.3	38.0
Spionidae (P)			0.3	0.3	38.0
Capitellidae (P)	0.3	0.3			38.0
Paraonis fulgens (P)			0.3	0.3	38.0

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