U. S. Army Corps of Engineers
New York District

FINAL
BENTHIC INVERTEBRATE SURVEY: EASTERN SHORE ZONE SURVEY

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EXECUTIVE SUMMARY

This report presents the study design, methodologies and results of a survey of the ecological resources of the beach, intertidal and subtidal zones of the south shore of Long Island New York's east end from Shinnecock Inlet to Montauk Point. The U.S. Army Corps of Engineers New York District (USACOE-NYD) is conducting the survey to collect background information on the area because it has been less studied than the areas to the west and the geomorphic conditions are dissimilar to the areas to the west of Shinnecock Inlet.

The ocean beach is a dynamic transition zone between land and sea, subject to sudden disturbances. Large storm events, such as hurricanes, have the potential to cause severe erosion of the beach and impact upland communities as well as the immediate coastal area. The overall study area covers 83 linear miles from Fire Island Inlet to Montauk Point. EEA, Inc., under contract to URS Greiner/Moffatt & Nichol, JV, collected and analyzed 72 macrobenthic (organisms 0.5 mm. or larger) samples at twenty-four (24) transects along the beach at locations extending from just east of the Shinnecock Inlet to Montauk Point. Four specific study areas were surveyed for this program:

- Montauk Headlands- From Montauk Point to $1^1/_2$ miles west along the beach.
- Ditch Plains- A three-mile stretch in front of Ditch Plains.
- Coastal Ponds- The reaches in front of the three coastal ponds (Mecox Bay, Sagaponack Pond and Georgica Pond.
- East of Shinnecock Inlet- The shore zone from Shinnecock Inlet's east side to a point three miles east along the beach.

In order to build a more robust data base and for the purpose of collecting baseline information for the region, the results of this survey were compared to several studies conducted by USACOE-NYD and the Department of the Interior National Parks Service (NPS) of the beach community along Westhampton Beach and Fire Island National Seashore on Long Island, New York and three beaches on the Atlantic coast of New Jersey.

The results of the survey indicate that numerical abundance and diversity of infauna generally increase from west to east. The surf and mid-tide zones generally had higher abundances than the wrackline. The polychaete worm *Scolelepis squamata* was the most abundant species in both the spring and the fall.

U.S. ARMY CORPS OF ENGINEERS - WORK ORDER 16 –FINAL REPORT
BENTHIC INVERTEBRATE SURVEY: EAST OF SHINNECOCK INLET TO MONTAUK POINT

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BENTHIC INVERTEBRATE SURVEY

FINAL REPORT

1.0 INTRODUCTION

This report is one of a series of natural resource, physical science, and engineering studies being conducted for the U.S. Army Corps of Engineers-New York District (USACOE-NYD) as part of a Reformulation study. The overall objective of the study is to:

- Characterization of the benthic macrofauna along the beach in areas with geomorphic conditions mostly dissimilar to barrier beaches west of Shinnecock Inlet surveyed under previous studies;
- Comparison of the areas east of Shinnecock Inlet based on macroinvertebrate species composition, numerical abundance, and biomass;
- Preliminary selection of areas requiring further study; and
- Compilation of a baseline data set for future impact assessments.

The overall study area covers 83 linear miles from Fire Island Inlet to Montauk Point. In May and November/December 2000 EEA, Inc., under contract to URS Greiner/Moffatt & Nichol, JV, collected and analyzed 72 macrobenthic samples at twenty-four (24) transects along the beach at locations extending from just east of Shinnecock Inlet to Montauk Point. This report presents the methodology, findings, and a comparison to previously conducted studies off Fire Island, Shinnecock, Westhampton Beach, and the New Jersey barrier islands, as well as programs sponsored by the USACOE-NYD.

Benthic macroinvertebrate investigations are typically used in quantitative aquatic investigations. The most common approaches for assessment of benthic communities are analysis of species composition, numerical abundance and biomass. This report incorporates all three approaches into community description, however, the biomass data is not sufficiently robust to assess statistically at this time. As the data base grows with ongoing and future work, this analysis will be revisited.

2.0 STUDY AREA

The project area for the present field study includes 24 transects which extend from just east of Shinnecock Inlet to Montauk Point. These transects were representative of the various geophysical conditions of the easternmost section of the study area which, unlike Westhampton and Fire Island, is mostly non-barrier island. Features at the site locations ranged from long sandy

beaches to narrow, rocky shoreline below heavily eroded bluffs. The areas directly in front of three coastal ponds were also sampled as part of this study.

The overall Reformulation project area is located entirely within Suffolk County, along the Atlantic and bay shore towns of Babylon, Islip, Brookhaven, Southampton and East Hampton. The study area includes three large estuaries. Great South Bay is connected to the Atlantic Ocean through the Fire Island Inlet, which is a federal navigation channel. Similarly, the federal navigation channels of Moriches and Shinnecock Bays are connected to the Atlantic Ocean through the Moriches and Shinnecock Inlets, respectively. Great South Bay, Moriches Bay and Shinnecock Bay are connected by narrow channels behind the barrier islands. The westernmost portion of the study area is Fire Island Inlet, located approximately 52 miles (by water) east of the Battery, New York.

3.0 METHODOLOGY

3.1 Sample Collection

A total of 24 transects were established along a beach from east of Shinnecock Inlet, New York, to west of Montauk Point. Twenty-four samples were collected at each of the wrack line (A), the mid-tide zone (B) and the surf zone (C), for a total of 72 samples each event. The transects were established as follows: transects 1 through 7 were located from the east side of Shinnecock Inlet to 3 miles east along the beach (Figure 1). Transects were spaced 1,000 feet apart. The position of each station was fixed utilizing a Garmin GPS45XL handheld Global Positioning System (GPS) unit. Transects 8 and 9 were established on either side of the opening of Mecox Bay to the Atlantic Ocean (Figure 2). Transects 10 and 11 were established on either side of the opening of Sagaponack Pond to the Atlantic Ocean (Figure 2). Transects 12 through 14 were established west, east and directly in front of the opening of Georgica Pond to the Atlantic Ocean (Figure 2). Transects 15 through 20 were established along the 3-mile stretch in front of Ditch Plains (Figure 3). Transects 21 through 24 were established from 1.5-miles west of Montauk Point to the south west side of Montauk Point lighthouse (Figure 4). The coordinates of each sampling station are presented in Table 1.

Samples were collected during two events, in May and November/December of 2000. The fall sampling was originally scheduled to be conducted in early November. However, due to strong onshore winds during the early part of November, the sampling could not be scheduled until the end of month and continued wind events made it necessary to sample one day in early December.. Each sample was collected utilizing a three-inch diameter aluminum tube which was inserted six inches into the sediment. The core was removed from the substrate and transferred to a plastic washtub. Only full samples were utilized.

Individual samples (entire contents of the tube) were washed through on a 0.5 millimeter mesh sieve to remove fine particles. Contents were then transferred to a wide mouth one-liter sample jar which contained both an external and internal label identifying the sample. The samples were then fixed with a buffered 10 percent formalin solution.

3.2 Sample Analysis

In the laboratory, all grab samples were rinsed gently with tap water through a 0.5-mm mesh sieve to remove preservatives and sediment, stained with Rose Bengal, and stored in 70% isopropanol solution until processing. Subsequently, the organisms were carefully removed with forceps and placed in labeled plastic vials containing 70% isopropanol. After sorting, macroinvertebrates (ie. 0.5 mm. or larger) were identified to the lowest practical identification level (LPIL) which, in most cases, was to the species level unless the organism was a juvenile, damaged, or otherwise unidentifiable. The oligochaetes, chironomids, nemerteans, anthozoans, and hydrozoans were left as high taxonomic groupings because of the difficulty associated with their identification or the small size and scarcity of specimens. The number of individuals for each taxon, excluding fragments, was recorded.

3.3 Biomass Analysis

Each sample was weighed for wet weight biomass (standing stock biomass in g/square meter) for the major taxonomic groups (ie., Echinodermata, Mollusca, Polychaeta, Arthropoda and other) identified. In the laboratory, the organisms were removed from the vials and placed on a filter paper pad, gently blotted with a paper towel to remove moisture, placed in a tared weighing pan, and weighed to the nearest 0.01 g.

3.4 Quantative Data Analysis

All data generated as a result of laboratory analysis of macroinvertebrate samples were recorded in EXCEL spreadsheet format. These data sheets appear in Appendix I. The data were then evaluated for taxa diversity, composition, and abundance.

3.5 Statistical Data Analysis

Preliminary data analysis included comparing the total number of taxa, organisms, and species occurrences for each of the sampling stations. Four representative statistical measures were used to compare the sampling stations. These measures are: Abundance per Study Area, Jaccard's

Index, Shannon and Weaver Biological Diversity Indices (H') and Simpson's Indices for each sampling station . Details of these statistical metrics are listed below.

1. Abundance Per Study Area- the total number of organisms per square meter for each study area was calculated.

2. Jaccard's Index- to investigate the taxonomic similarities between sampling stations, Jaccard's Index was computed for each pair of sampling stations. This index is the proportion of the number of taxa observed in either of two sampling stations that occurred in both samples. It pertains only to the presence or absence of a species, not its abundance. The mean and the standard deviation was computed for all the Jaccard's Indices, and these were grouped into four categories, one group below the mean and three above the mean. The mean Jaccard's Index for each sampling station was then computed as an indication of its overall similarity to the other sampling stations.

   Several of the stations had only one or two taxa, which interfered with the statistical interpretations. To compensate for this, the stations were grouped together in four different reaches and Jaccard's Index was computed for the reach and compared to look for trends.

3. Shannon and Weaver Biological Diversity Index (H')

$$H' = - \sum_{i=1}^{s} (pi \ln pi)$$

   H' = average uncertainty per species in an infinite community of S species.
   $p_1, p_2, p_3 ... p_s$ = proportional abundances for each species.

   The Shannon-Weaver Index is used as a measure of community diversity. If an individual of the community is selected at random, the Shannon-Weaver Index gives a measure of the uncertainty that the selected individual will be of a particular species. The Index increases as the number of species in the sample increases. It also increases as the species populations become more alike. Both of these conditions decrease the certainty that the selected individual is a particular species. Alternatively, if there are few species in the community and most of the individuals

in the community were of the same species, there would be a more certain outcome in predicting the species of a randomly selected individual.

4. Simpson's Biological Diversity Index- $\lambda = \sum_{i=1}^{S} \frac{n_i(n_i - 1)}{n(n-1)}$

n_i = the number of individuals in the species
n = the total number of individuals in the sample

The Simpson's Index is also used as a measure of biological diversity. It gives the probability that two individuals drawn at random from a population belong to the same species. For communities with evenly distributed populations, the Simpson's Index is lowest. For those with only one or two species dominant, the Simpson's Index is highest.

The scope of the study was to profile the organisms found along the beach in an area that is predominately dissimilar to the sandy barrier beaches of Fire Island and Westhampton Beach located to the west of the study area. The blue mussel, *Mytilus edulis*, were assumed to have washed off the surrounding jetties and were not deemed true members of the sandy beach infauna in the New Jersey study by ACOE (Burlas 1998). For this reason they were excluded from the statistical analysis of the New Jersey study. They were included in the statistical analysis of this report since the beaches along the Montauk headlands and eastern Ditch Plains are comprised of very coarse sand with large stones and boulders that are habitat for organisms like the blue mussel (Gosner 1979). When the samples were collected in the two areas mentioned above, the blue mussel was recovered attached to the stones in the core sample and therefore deemed a part of the benthic community of these two areas.

Each of the four statistical tests used in the analysis evaluates the data in a different way. The Abundance Per Study Area analysis is a simple measurement of the overall concentration of organisms in a certain area. From this analysis a population dynamic can be interpreted that gives an indication of the size of the organism community in a given area. This information is useful in determining where potential food sources are most and least available. The Jaccard's Index measures similarities between sampling areas (reaches) giving an indication of how uniform, in taxonomic terms, the entire study area is overall and in particular, which sampling areas are most alike. This information is useful in ascertaining which areas have comparable resources and which do not. The Shannon-Weaver Biological Diversity Index shows the community diversity for a particular species

Simpson's Index

The Simpson's Index for biological diversity is widely used and based on information theory. The lower the value the more evenly individuals are distributed among taxa in each study area, while the higher the value the more irregular the distribution of individuals among stations. For this statistical analysis, sampling stations were grouped into four Reaches.. The results of the Simpson's Index are as follows:

Reach 1				**Reach 2**			
A	B	C	Total	A	B	C	Total
1.000	0.438	0.257	0.333	1.000	0.370	0.435	0.343
Reach 3				**Reach 4**			
A	B	C	Total	A	B	C	Total
0.264	0.589	0.818	0.700	0.524	0.822	0.759	0.546

In Reach 1 the overall distribution of species was the most even while in Reach 4 there was predominantly one species. Zone A in Reaches 1 and 2 had one dominant species while Zone C in Reach 1 had a more even distribution of species.

5.0 DISCUSSION

5.1 Previous Investigations

Although the benthic environment of the beaches on the south shore of Long Island, New York between Fire Island Inlet and Shinnecock have been sampled extensively in the past, no studies of the beaches east of Shinnecock are known to have been conducted. Sampling of the Fire Island barrier beaches was completed by Kluft for the National Park Service (1999). Westhampton Island barrier beaches were sampled by EEA, Inc. (1999) for USACOE, and the beaches along the New Jersey shoreline were sampled by B.A. Vittor (1998) for USACOE. Similar sampling techniques were used in the procedures of these studies and the results show comparable trends.

Summary of Studies Conducted by Kluft (1999)

double that of the area to its immediate west: from a total of 59 organisms at Shinnecock to 148 at the Coastal Ponds, 329 at Ditch Plains and 772 at Montauk. Adjusting for the varying number of stations per area, the ratio of organisms/station (Average Number of Organisms) for each area to that of the adjacent area on the west varies from 2.5 to 3.3: from 8.4 organisms/station at Shinnecock to 21 at the Coastal Ponds, 55 at Ditch Plains and 181 at Montauk. The number of taxa increases similarly from west to east.

Infaunal biomass totals for both seasons for individual stations ranged from .01 to 3.81 grams. Polychaete worms dominate the biomass at all sample stations with the exception of stations 21 and 23 in the Montauk Headlands reach, which has a greater biomass of molluscs. Station 4 in the Shinnecock Inlet reach had the lowest biomass (~.01 grams), while station 21 had the highest biomass (~3.81 grams). Biomass was greater in May for all taxa groups except Mollusca due to the presence of one common periwinkle (*Littorina littorea*) collected at sampling station 21 -C in November. This organism weighed 3.12 grams, accounting for 99 percent of the monthly total weight for all Mollusca. Monthly and combined biomass totals are presented in Figure 3. It should be noted that comparing wet weight polychaetes with shelled organisms may not be technically valid due to the added weight of the shells of some organisms.

4.2 Statistical Analysis

Abundance Per Study Area

A total of 1,258 individuals (3,931 per m^2) were collected from the four study areas. The first area (Shinnecock Inlet to 3 miles east) yielded a total of 59 individuals (632 per m^2) while 148 (1,586 per m^2) were present at the second area (the three coastal ponds). The third area (Ditch Plains) yielded 329 individuals (4,113 per m^2) while 722 (13,538 per m^2) were present at the fourth area (Montauk Headlands). These values are low compared to the results of the New Jersey study (Vittor, 1998) since the two investigations are not directly comparable. This study had half as many sampling stations and fall samples were collected during different months (November/December in this study and September in the New Jersey study). In addition, the New Jersey study focused on the lower intertidal area with no sampling in the wrackline. Quantitative data analysis showed that for this sampling technique, the wrack line was the least productive of the three transects for this study.

Jaccard's Index

For the twenty-four sampling stations, 552 Jaccard's Indices were computed and arranged in a matrix as Table 3. The indices are deliberately repeated in the table, resulting in a mirror image

reflected across the diagonal. The effect makes for easier comparison of the sampling stations since the table can be read form either horizontally or vertically. A Jaccard's Index of zero would mean the sampling stations are completely dissimilar, having no species in common. An index of one would mean the sampling stations are exactly alike, having all the same species.

The computed indices range from 0.000 to 1.000, with a mean of 0.2129 and a standard deviation of 0.18131. There are 73 pairs with an index of below 0.030. There are 91 pairs with an index from 0.030 to 0.210. There are 70 pairs with an index from 0.210 to 0.390 and 35 pairs with an index from 0.390 to 0.580. The remaining 7 pairs have an index greater than 0.580, and 3 of these pairs have an index of 1.000. Over half of the stations have indices below the mean Jaccard's Index indicating dissimilarity between stations in general. The results shown in Table 3 show that organisms in stations in reach 3 and 4 are dissimilar from stations in reach 1 and 2. Organisms from stations in reaches 1 and 2 have a higher degree of similarity to each other while organisms from stations in reach 3 and 4 have a higher degree of similarity to each other..

Distinctive Sampling Stations:

The mean Jaccard's Index for each sampling station indicates the overall similarity of that sampling station to the others. Four sampling stations stand out: sampling station 10, located on the west side of Sagaponack Pond, with the highest average index, 0.328, sampling station 16 with the lowest average index, 0.018, and sampling stations 18 and 19, all located in front of Ditch Plains, with the second highest average index, 0.316. The other sampling stations have approximately the same average index, ranging from 0.089 to 0.294. This suggests that sampling station 10 has the highest proportion of species in common with other sampling stations, sampling station 16 has the lowest proportion of species in common with other sampling stations, and sampling stations 18 and 19 the second highest proportion. The other sampling stations have about the same proportion of species in common. Note that sampling station 13 has two of the 7 indices in the highest category and sampling station 16 has twenty of the 164 indices in the lowest category.

Mean Jaccard's Index	.2129675
Number of pairs from 1 to 0 s below the mean	164
Number of pairs from 0 to 1 s above the mean	70
Number of pairs from 1 to 2 s above the mean	35
Number of pairs above 2s above the mean	7

For the four reaches, 16 Jaccard's Indices were computed and arranged in a matrix in the table below. The results indicate that Reach 2 (Coastal Ponds) has more taxa in common with the other reaches- 50% with Reach 3 (Ditch Plains) and 42% with Reach 1 (Shinnecock Inlet East). There are some close similarities between the group results and the station results. Sampling station 10 has the highest index in the station analysis and is in Reach 2 (Coastal Ponds), the area with the highest group index. Reach 4 (Montauk Headlands) ranked lowest in the group analysis and had two of the three lowest indices by station.

	Shinnecock 1-7	Ponds 8-14	Ditch Plains 15-20	Montauk 21-24
Shinnecock 1-7		0.417	0.176	0.158
Ponds 8-14	0.417		0.500	0.150
Ditch Plains 15-20	0.176	0.500		0.300
Montauk 21-24	0.158	0.150	0.300	

Shannon-Weaver Index

The Shannon-Weaver Index (H) for biological diversity was calculated for each sample station and for the four reaches. This index is widely used and based on information theory. A higher value of H indicates a greater diversity. After calculating H, the borrow areas were ranked accordingly. Table 4 presents the results of the Shannon-Weaver Index by sampling station.

The results of H by station for the May data ranged from 0.000 to 1.330. The November/December data ranged from 0.000 to 1.386. The ranges for both collection events are very similar showing a relatively narrow range. Sampling station 7, the easternmost station of the Shinnecock Inlet stations, was the most diverse in May, while sampling station 18, in the Ditch Plains reach was the most diverse in November/December. Sampling station 15 was also the most diverse for May and November/December combined totals.

The results of H by Reach for May and November/December ranged from 0.665 to 1.336 for all zones combined. The two western reaches, 1 and 2, had similar indices, 1.34 and 1.29, respectively, while the eastern reaches, 3 and 4 also had similar indices, .69 and .66, respectively. This indicates that taxa are more evenly distributed in the west than in the east. Zone A (wrack line) in Reaches 1 and 2 had the lowest indices while Zone C (surf zone) in Reach 1 had the highest index.

Simpson's Index

The Simpson's Index for biological diversity is widely used and based on information theory. The lower the value the more evenly individuals are distributed among taxa in each study area, while the higher the value the more irregular the distribution of individuals among stations. For this statistical analysis, sampling stations were grouped into four Reaches.. The results of the Simpson's Index are as follows:

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In Reach 1 the overall distribution of species was the most even while in Reach 4 there was predominantly one species. Zone A in Reaches 1 and 2 had one dominant species while Zone C in Reach 1 had a more even distribution of species.

5.0 DISCUSSION

5.1 Previous Investigations

Although the benthic environment of the beaches on the south shore of Long Island, New York between Fire Island Inlet and Shinnecock have been sampled extensively in the past, no studies of the beaches east of Shinnecock are known to have been conducted. Sampling of the Fire Island barrier beaches was completed by Kluft for the National Park Service (1999). Westhampton Island barrier beaches were sampled by EEA, Inc. (1999) for USACOE, and the beaches along the New Jersey shoreline were sampled by B.A. Vittor (1998) for USACOE. Similar sampling techniques were used in the procedures of these studies and the results show comparable trends.

Summary of Studies Conducted by Kluft (1999)

Kluft- Steinbeck sampled the beaches of Fire Island from September 1995 to July 1996. The study was multi-faceted with a core sampling effort similar to the technique used by EEA for the current study. Notable differences in the sampling technique were that the core sampler used by Kluft was twice the diameter of the EEA core sampler, and the sieve in the Kluft study had a 1mm-mesh screen.

Sampling events were conducted seasonally during the one-year study. Four of the 14 species collected were caught strictly in the lower intertidal zone, three near the dunes, and the remainder around the wrackline. The average number of species per sample ranged from a low of 0.1 in the fall and winter to a high of 0.5 in the summer. Species richness was lowest in winter with only one species collected from the easternmost site at Smith Point while in the spring a total of 11 and in the summer a total of 9 species were collected, respectively.

The results of the fall and winter sampling averaged significantly lower than spring and summer sampling in terms of average number of individuals and species richness. The most common species in the transect cores were found in the intertidal area and consisted of the amphipods *A. virginiana* and *Haustorius canadensis*, the polychaete *Scolelepis squamata*, and the mole crab *Emerita talpoida*.

Summary of Studies Conducted by E.E.A., Inc. (1999)

EEA, Inc. conducted a single sampling event along the ocean and bay beaches of Westhampton barrier island in the spring of 1998. The objective of the study was to compare the benthic community of an area of beach that has been relatively stable for a period of years to an area of beach recently created following a breach. The field techniques of this study were identical to those used in the study of this report. Station locations were distributed across four different areas: the placement location, a groin field, an updrift control area and the bay side of the breach area.

The bayside samples contained a significantly higher number of organisms per sample than any of the ocean sample areas by a partial order of magnitude. Mollusks comprised the greatest portion of organisms with nematodes and oligochaetes following closely. Polychaete worms and crustaceans accounted for the lowest percentage of organisms collected. The surf zone contained the highest percentage of all the organisms collected while the mid-tide zone contained the lowest percentage of organisms collected.

Summary of Studies Conducted by B.A. Vittor Associates (1994-1996)

Sampling of intertidal benthos was conducted at 10 sites within each of three areas along the beaches from Asbury to Manasquan by B.A. Vittor & Associates during May and September of 1994, 1995, and 1996 for pre-construction baseline information. Each sampling station was located between the groins on the beaches. Samples were taken at mean low water (MLW) and -1 m MLW, no sampling was done at the wrackline. A total of 360 samples were collected each year.

The dominant species at the sampling stations were Rhynchocoels (LPIL) The next most abundant taxa were the spionid polychaete *Scolelepis squamata* and Oligochaeta (LPIL). Biomass was dominated by *S. squamata* and the mole crab *Emerita talpoida*. The numbers of organisms collected were significantly higher than the other studies cited or the study of this report, however the number of samples collected is also much higher. In addition, and there were no samples taken at the wrackline in this study, a zone that was less productive in most of the other studies.

5.2 Comparison of Previous Investigations to EEA's 2000 Study

Assessment of the Study Area Comparisons

The results of EEA's study differ from those of the studies conducted on New Jersey beaches but show some similarities with studies on other Long Island barrier beaches. Abundances were low compared to the New Jersey study (Vittor 1998), but consistent with the results of the studies conducted on Fire Island and Westhampton Beach (Kluft 1999 and EEA 1999). The total lack of mole crabs (*Emerita talpoida*) in this study and EEA's Westhampton Beach study may be due to the early spring and late fall sampling dates.

There was a large number of Rhyncocoela or Nemertean worms collected in both the Westhampton Beach and New Jersey studies. No nemerteans were reported in the Fire Island study and very few were collected in the present study. Nemerteans are flat worms commonly known as proboscis worms because of the presence of a large tongue like apparatus used in capturing food. Most nemerteans are benthic, living under rocks or in burrows in soft substrates or crawling among algae, hydroids, or in bottom debris. The reason they were found in some studies in large numbers and not others is unclear.

Discussion of Studies Conducted by EEA (2000)

The physical characteristics of the shoreline of the eastern portion of the study area are very different from the characteristics of the western portion and that of the other studies. The shoreline of the Montauk Headlands is armored with stones and boulders with a mix of coarse sand and clay where beach is exposed. A large portion of the beaches along Ditch Plains are also characterized by

large stones and coarse sand. The beach community in these areas has a different habitat and profile than the sandy beaches in other areas.

The western beaches of the study area are open to vehicular traffic by permit and ruts caused by 4-wheel drive vehicle tires were observed across the beaches during both sampling events. This may account in part for the extremely low number of organisms collected in the wrackline zone. The three dominant organisms collected during the May sampling event were *Scolelepis squamata*, *Mytilus edulis*, and *Gammarus oceanicus* at the western reaches and *Mytilus edulis*, *Scolelepis squamata* and *Jassa falcata* at the eastern reaches in that order. The three most dominant organisms collected during the November sampling event were *Scolelepis squamata*, *Gammarus oceanicus* and Nematoda.

The study area is has unique features in comparison to the other studies cited. Both Mecox Bay and Sagaponic Pond were open to the ocean at the time of the fall sampling and Mecox Bay was open during the spring. The beach in front of Georgica Pond showed evidence of recent washouts at the time of both sampling events. The Montauk headlands and Ditch Plains areas are predominately rocky beaches with boulders on the beach and in the surf zone. The sandy beaches of the beaches immediately east of Shinnecock Inlet do not have protective groins.

6.0 CONCLUSIONS

The results of the May and November/December 2000 benthic sampling and analyses program are reasonably consistent with earlier programs given the inherent variability of biological organisms over time and distance. Considering the results of the above program, the following conclusions were drawn and supported by statistical analysis:

- **Numerical abundance and diversity of infauna generally increased from west to east. One of the possible reasons for this could be the difference in grain size from west to east. Samples were not required to be analyzed for grain size under the work order for the project due to budget restraints.**
- **Biomass values were generally similar with most of the biomass attributable to the polychaete worms *Scolelepis squamata*. This was true of all sampling stations except sampling stations 21 and 23 located on the Montauk Headlands which were dominated by the mollusks *Mytilius edulis* and *Littorina littorea*.**

- **Sampling stations in the surf and mid-tide zones generally had higher abundances of organisms than stations in the wrackline.**
- **A total of twenty-three taxons were collected from 24 stations from Shinnecock to Montauk Point. This included one Nematoda species, one Archiannelid, six Annelida, one Rhynchocoela, four Mollusca, and ten species of Arthopoda.**
- **The results of this program were comparable to the programs conducted by Kluft (1999) and EEA (1999), but were noticeably different than those conducted by Vittor & Associates (1998).**
- **There were 1198 organisms of 18 taxa collected in May and 60 organisms of 11 taxa collected in November/December.**

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TABLE 1
Station Locations

Station	Site Description	Latitude	Longitude
ESZ-01A,B,&C		40.84011	72.47360
ESZ-02A,B,&C	Reach 1	40.84367	72.46422
ESZ-03A,B,&C		40.84715	72.45530
ESZ-04A,B,&C	Shinnecock Inlet	40.85017	72.44643
ESZ-05A,B,&C	to three-miles east	40.85291	72.43725
ESZ-06A,B,&C		40.85603	72.42806
ESZ-07A,B,&C		40.85924	72.41956
	Reach 2		
ESZ-08A,B,&C		40.89145	72.32824
ESZ-09A,B,&C	Mecox Bay	40.89260	72.32659
ESZ-10A,B,&C		40.90614	72.29044
ESZ-11A,B,&C	Sagaponack Pond	40.90682	72.28882
ESZ-12A,B,&C		40.92937	72.23197
ESZ-13A,B,&C	Georgica Pond	40.92985	72.23043
ESZ-14A,B,&C		40.93052	72.22847
ESZ-15A,B,&C	Reach 3	41.02569	71.96288
ESZ-16A,B,&C		41.02881	71.95361
ESZ-17A,B,&C	3-mile stretch in	41.03169	71.94466
ESZ-18A,B,&C	front of Ditch Plains	41.03456	71.93501
ESZ-19A,B,&C		41.03723	71.92382
ESZ-20A,B,&C		41.03980	71.91454
ESZ-21A,B,&C	Reach 4	41.05325	71.87340
ESZ-22A,&B*		41.05738	71.87075
ESZ-23A,B,&C	Montauk Point	41.06320	71.86357
ESZ-24A,B,&C	to 1.5 miles west	41.07001	71.85768

A-high-tide line
B-mid-tide line
C-low-tide surf zone

*the team was unable to obtain a low-tide surf zone sample at this location in May due to the predominance of large stones in the sample area.

TABLE 2
List of Benthic Invertebrate Species by Season

May			**November/December**	
Species	Total Number		Species	Total Number
Mytilus edulis	916		*Scolelepis squamata*	24
Scolelepis squamata	102		*Gammarus oceanicus*	13
Unidentified Nematoda sp.	58		*Unidentified Nematoda sp.*	9
Amphipoda sp. (Unidentified)	20		*Ophelia bicornis*	4
Trichophoxus epistomus	20		*Protohaustorius wigleyi*	3
Jassa falcata	17		*Mytilus edulis*	2
Calliopius laeviusculus	16		*Polygordiidae*	1
Littorina littorea	15		*Glycera sp.*	1
Gammarus oceanicus	10		*Turbellaria*	1
Lumbrineris tenuis	5		*Lacuna vincta*	1
Nemertean sp. (Unidentified)	4		*Littorina littorea*	1
Acanthohaustorius millsi	4		Totals	60
Idotea baltica	3			
Syllidae	2			
Erichthonius rubricornis	2			
Gammarus annulatus	2			
Terebellidae	1			
Ampithoe rubricata	1			
Totals	1198			

TABLE 3
Jaccard's Index by Station

JACCARD'S INDEX - measure of similarity of species

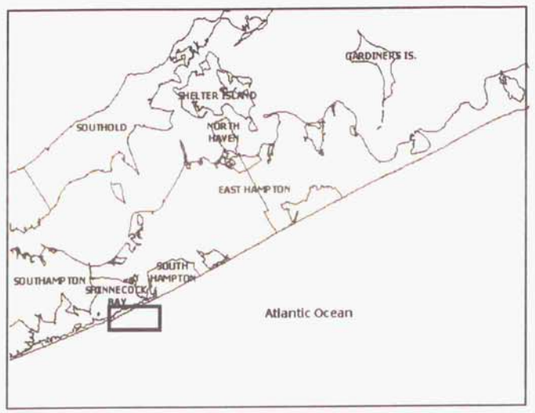
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Station
1		0.333	0.250	0.500	0.333	0.250	0.200	0.400	0.200	0.333	0.200	0.000	0.250	0.500	0.000	0.000	0.000	0.200	0.200	0.143	0.000	0.000	0.000	0.000	1
2	0.333		0.250	0.500	0.333	0.250	0.500	0.167	0.200	0.333	0.200	0.000	0.250	0.500	0.000	0.000	0.000	0.200	0.200	0.143	0.000	0.000	0.111	0.000	2
3	0.250	0.250		0.333	0.667	0.200	0.167	0.143	0.400	0.250	0.167	0.200	0.200	0.333	0.167	0.000	0.000	0.167	0.167	0.125	0.091	0.000	0.000	0.000	3
4	0.500	0.500	0.333		0.500	0.333	0.250	0.200	0.250	0.500	0.250	0.000	0.333	1.000	0.000	0.000	0.000	0.250	0.250	0.167	0.000	0.000	0.000	0.000	4
5	0.333	0.333	0.667	0.500		0.250	0.200	0.167	0.200	0.333	0.200	0.000	0.250	0.500	0.000	0.000	0.000	0.200	0.200	0.143	0.100	0.000	0.000	0.000	5
6	0.250	0.250	0.200	0.333	0.250		0.400	0.143	0.167	0.250	0.167	0.200	0.500	0.333	0.000	0.000	0.000	0.167	0.167	0.125	0.000	0.000	0.000	0.000	6
7	0.200	0.500	0.167	0.250	0.200	0.400		0.286	0.143	0.500	0.143	0.167	0.750	0.250	0.143	0.000	0.250	0.333	0.333	0.250	0.083	0.250	0.200	0.200	7
8	0.400	0.167	0.143	0.200	0.167	0.143	0.286		0.286	0.400	0.286	0.143	0.333	0.200	0.286	0.000	0.200	0.500	0.500	0.571	0.167	0.200	0.182	0.400	8
9	0.200	0.200	0.400	0.250	0.200	0.167	0.143	0.286		0.200	0.600	0.400	0.167	0.250	0.333	0.167	0.000	0.333	0.333	0.250	0.083	0.000	0.000	0.200	9
10	0.333	0.333	0.250	0.500	0.333	0.250	0.500	0.400	0.200		0.200	0.000	0.667	0.500	0.200	0.000	0.500	0.500	0.500	0.333	0.100	0.500	0.111	0.333	10
11	0.200	0.200	0.167	0.250	0.200	0.167	0.143	0.286	0.600	0.200		0.167	0.167	0.250	0.143	0.167	0.000	0.333	0.333	0.429	0.083	0.000	0.000	0.200	11
12	0.000	0.000	0.200	0.000	0.000	0.200	0.167	0.143	0.400	0.000	0.167		0.200	0.000	0.400	0.000	0.000	0.167	0.167	0.125	0.091	0.000	0.000	0.250	12
13	0.250	0.250	0.200	0.333	0.250	0.500	0.750	0.333	0.167	0.667	0.167	0.200		0.333	0.167	0.000	0.333	0.400	0.400	0.286	0.091	0.333	0.100	0.250	13
14	0.500	0.500	0.333	1.000	0.500	0.333	0.250	0.200	0.250	0.500	0.250	0.000	0.333		0.000	0.000	0.000	0.250	0.250	0.167	0.000	0.000	0.000	0.000	14
15	0.000	0.000	0.167	0.000	0.000	0.000	0.143	0.286	0.333	0.200	0.143	0.400	0.167	0.000		0.000	0.250	0.333	0.333	0.250	0.182	0.250	0.091	0.500	15
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.000	0.167	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.091	0.000	0.000	0.000	16
17	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.200	0.000	0.500	0.000	0.000	0.333	0.000	0.250	0.000		0.250	0.250	0.167	0.111	1.000	0.125	0.500	17
18	0.200	0.200	0.167	0.250	0.200	0.167	0.333	0.500	0.333	0.500	0.333	0.167	0.400	0.250	0.333	0.000	0.250		1.000	0.429	0.300	0.250	0.200	0.500	18
19	0.200	0.200	0.167	0.250	0.200	0.167	0.333	0.500	0.333	0.500	0.333	0.167	0.400	0.250	0.333	0.000	0.250	1.000		0.429	0.300	0.250	0.200	0.500	19
20	0.143	0.143	0.125	0.167	0.143	0.125	0.250	0.571	0.250	0.333	0.429	0.125	0.286	0.167	0.250	0.000	0.167	0.429	0.429		0.154	0.167	0.273	0.333	20
21	0.000	0.000	0.091	0.000	0.100	0.000	0.083	0.167	0.083	0.100	0.083	0.091	0.091	0.000	0.182	0.091	0.111	0.300	0.300	0.154		0.111	0.214	0.222	21
22	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.200	0.000	0.500	0.000	0.000	0.333	0.000	0.250	0.000	1.000	0.250	0.250	0.167	0.111		0.125	0.500	22
23	0.000	0.111	0.000	0.000	0.000	0.000	0.200	0.182	0.000	0.111	0.000	0.000	0.100	0.000	0.091	0.000	0.125	0.200	0.200	0.273	0.214	0.125		0.111	23
24	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.400	0.200	0.333	0.200	0.250	0.250	0.000	0.500	0.000	0.500	0.500	0.500	0.333	0.222	0.500	0.111		24
Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
average JI for	0.187	0.194	0.186	0.244	0.199	0.170	0.261	0.268	0.224	**0.328**	0.204	0.116	0.294	0.244	0.175	0.018	0.171	**0.316**	**0.316**	0.237	0.112	0.171	0.089	0.217	
rank	15	14	16	7.5	13	20	6	5	10	1	12	21	4	7.5	17	24	18.5	2.5	2.5	9	22	18.5	23	11	
<0.03	8	7	5	8	7	7	1	1	3	2	3	10	1	8	7	20	11	1	1	1	5	11	10	8	146
0.03< <0.21	6	7	11	2	8	8	10	11	10	5	13	10	7	2	7	3	4	7	7	11	14	4	11	4	182
0.21< <0.39	6	6	5	8	5	6	8	5	7	7	5	1	10	8	7	0	5	9	9	7	4	5	2	5	140
0.39< <0.58	3	3	1	4	2	2	3	6	2	8	1	2	3	4	2	0	2	5	5	4	0	2	0	6	70
>0.58	0	0	1	1	1	0	1	0	1	1	1	0	2	1	0	0	1	1	1	0	0	1	0	0	14
	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	552

<0.03
0.03< <0.21
0.21< <0.39
0.39< <0.58
>0.58

0.21297 Mean JI
0.18131 std ji
0.03166 1 s below mean
0.39428 1 s above mean
0.57559 2 s above mean

TABLE 4
Shannon-Weaver Index by Station

	SHANNON-WEAVER VALUE			
STATION				Combined
	May	Nov/Dec	May+Nov/Dec	Rank
1	0.000	0.000	0.410	17
2	0.693	0.000	0.500	15
3	0.956	0.000	0.900	7
4	0.000	0.000	0.000	21
5	0.637	0.000	0.637	12
6	0.685	0.693	0.868	9
7	1.330	0.000	0.916	6
8	0.463	0.673	1.062	3
9	0.797	0.000	0.785	11
10	0.000	0.000	0.305	20
11	0.660	0.000	0.610	13
12	0.168	0.000	0.325	19
13	0.637	0.000	1.040	4
14	0.000	0.000	0.000	22
15	1.119	0.000	1.119	1
16	0.000	0.693	1.099	2
17	0.000	0.000	0.000	23
18	0.691	1.386	1.028	5
19	0.562	1.055	0.799	10
20	0.351	0.000	0.386	18
21	0.646	1.332	0.872	8
22	0.000	0.000	0.000	24
23	0.514	0.000	0.525	14
24	0.500	0.000	0.500	16
Total	1.031	1.767	1.160	



2000 0 2000 4000 Feet

Key to Features

Station Locations

N

Shinnecock Indian Reservation

Shinnecock Bay

ESZ-07A,B,&C

ESZ-06A,B,&C

ESZ-05A,B,&C

ESZ-04A,B,&C

ESZ-03A,B,&C

Hampton Beach

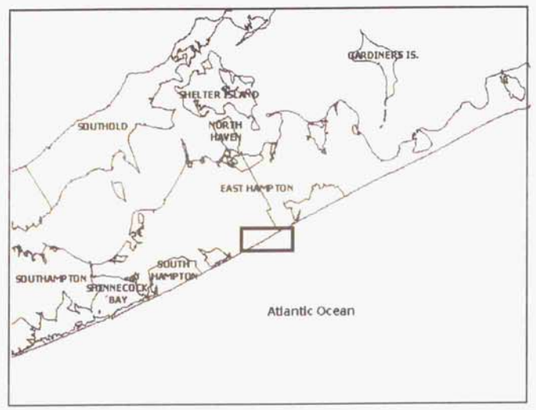
ESZ-02A,B,&C

Shinnecock Inlet

ESZ-01A,B,&C

Reach 1

FIGURE 1

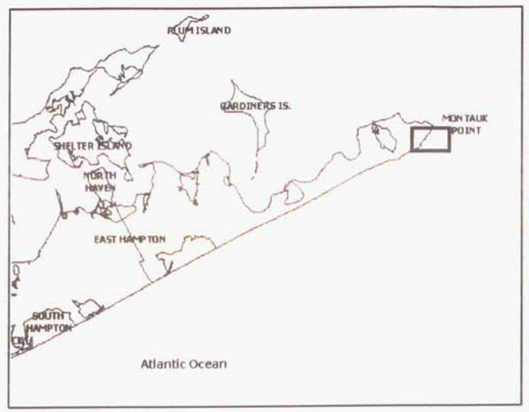


2500 0 2500 Feet

Key to Features

Station Locations

FIGURE 2



1000 0 1000 2000 Feet

Key to Features

Station Locations

MONTAUK POINT

ESZ-24A,B,&C

ESZ-23A,B,&C

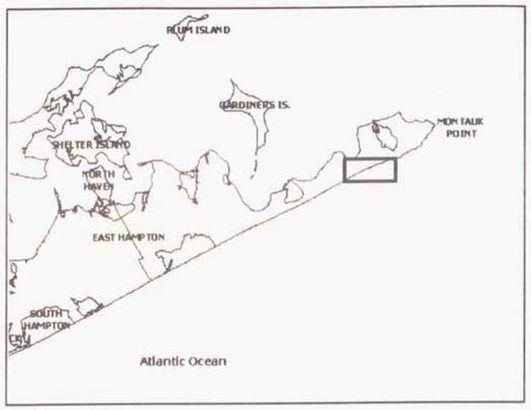
ESZ-22A,&B

ESZ-21A,B,&C

Reach 4

N

FIGURE 4



1000 0 1000 2000 Feet

Key to Features

Station Locations

DITCH PLAINS

ESZ-20A,B,&C

ESZ-19A,B,&C

ESZ-18A,B,&C

ESZ-17A,B,&C

ESZ-16A,B,&C

ESZ-15A,B,&C

Reach 3

FIGURE 3

Figure 6
Monthly and Combined Biomass Totals

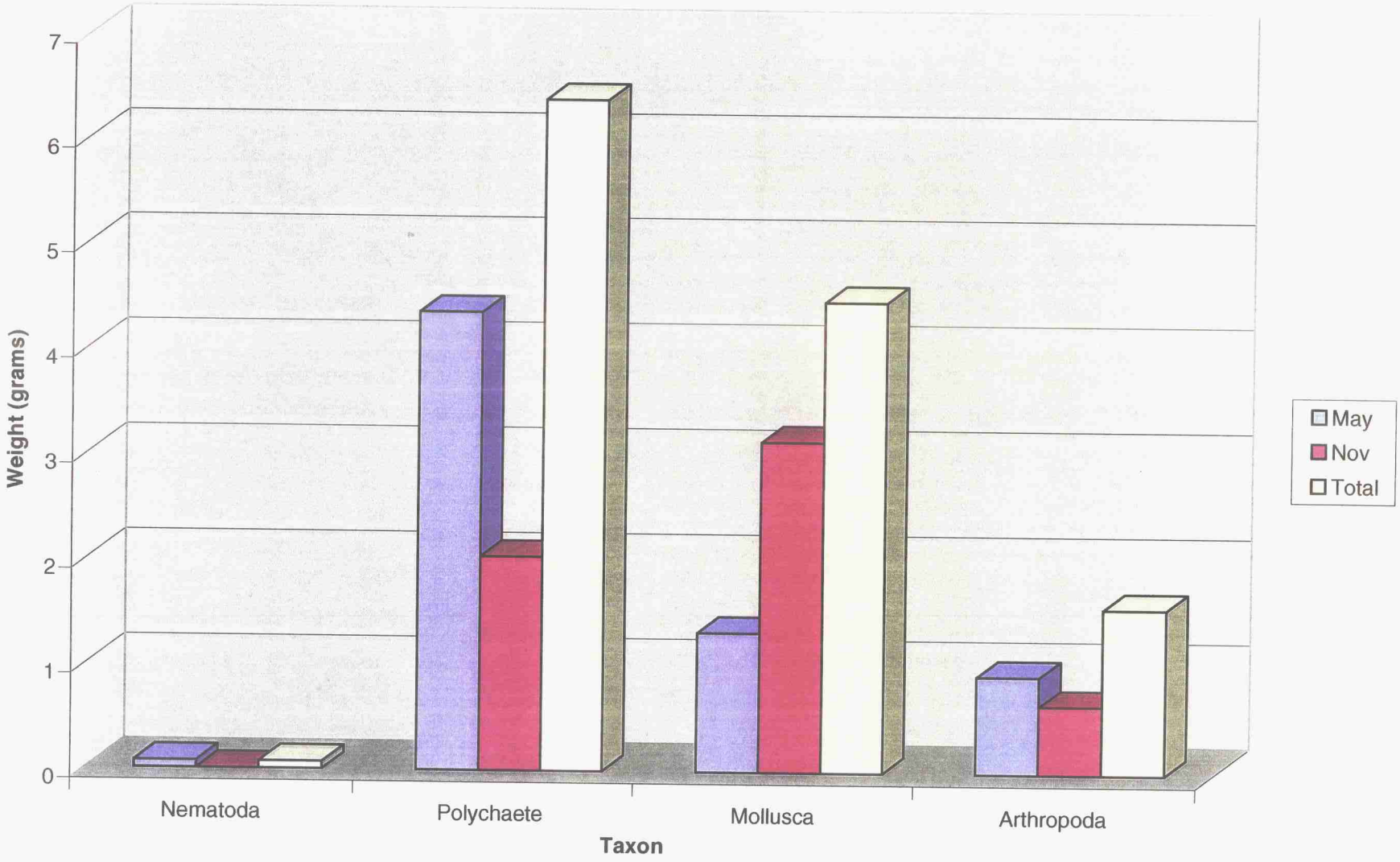
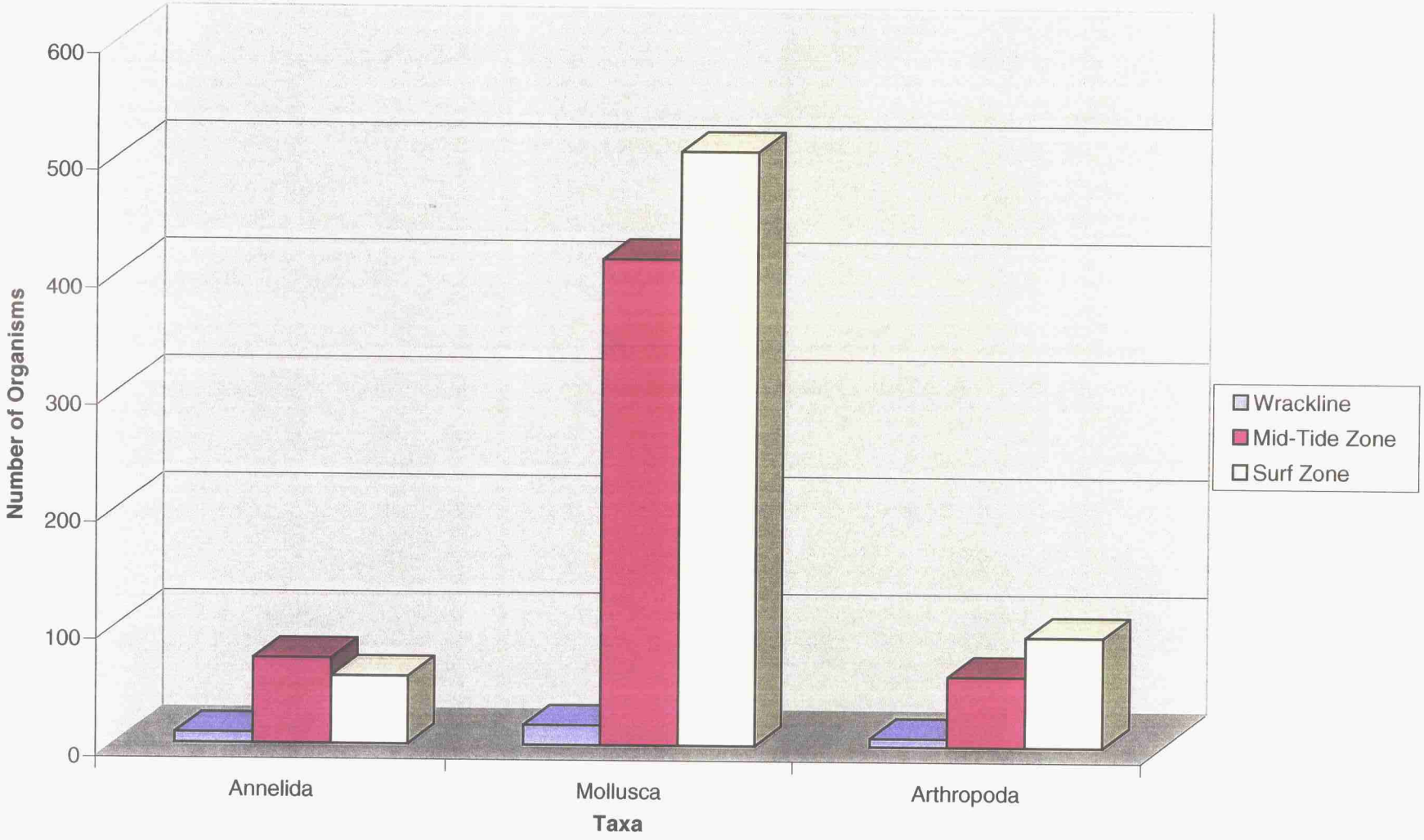


Figure 5.
Three Most Abundant Taxa By Zone



APPENDIX I
MACROBENTHIC INVERTEBRATE DATA SHEETS
SPRING 2000

Sampling Dates																						
5/15/00-5/16/00	Eastern Shore Zone Survey																					
	Reach 1																					
Station No.	01-A	01-B	01-C	02-A	02-B	02-C	03-A	03-B	03-C	04-A	04-B	04-C	05-A	05-B	05-C	06-A	06-B	06-C	07-A	07-B	07-C	Totals
Taxa																						
Nematoda																						
Unidentified Nematoda sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida																						
POLYCHAETE WORMS																						
Lumbrineris tenuis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scolelepis squamata	3	0	3	0	1	0	0	3	1	0	1	0	0	1	0	0	6	1	0	1	1	22
Syllidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terebellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	3	0	3	0	1	0	0	3	1	0	1	0	0	1	0	0	6	1	0	1	1	22
Rhynchocoela																						
Nemertean sp. (Unidentified)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca																						
BIVALVES																						
Mytilus edulis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
GASTROPODA																						0
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda																						
AMPHIPODS																						
Acanthohaustorius millsi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Amphipoda sp. (Unidentified)	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	4
Ampithoe rubricata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calliopius laeviusculus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erichthonius rubricornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus annulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	1	0	10
Jassa falcata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichophoxus epistomus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
ISOPODS																						
Idotea baltica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	1	0	0	0	3	0	0	0	0	0	2	0	9	0	0	1	2	18
Grand Totals	**3**	**0**	**3**	**0**	**2**	**0**	**0**	**3**	**4**	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**15**	**1**	**0**	**3**	**3**	**41**

Sampling Dates																						
5/15/00-5/16/00	Eastern Shore Zone Survey																					
	Reach 2																					
Station No.	08-A	08-B	08-C	09-A	09-B	09-C	10-A	10-B	10-C	11-A	11-B	11-C	12-A	12-B	12-C	13-A	13-B	13-C	14-A	14-B	14-C	Totals
Taxa																						
Nematoda																						
Unidentified Nematoda sp.	0	0	0	29	0	0	0	0	0	0	1	0	0	24	0	0	0	0	0	0	0	54
Totals	0	0	0	29	0	0	0	0	0	0	1	0	0	24	0	0	0	0	0	0	0	54
Annelida																						
POLYCHAETE WORMS																						
Lumbrineris tenuis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Scolelepis squamata	0	1	0	0	1	7	0	10	0	0	0	14	0	0	0	0	2	0	0	15	0	50
Syllidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terebellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	1	0	0	1	7	0	10	0	0	0	15	0	0	0	0	2	0	0	15	0	51
Rhynchocoela																						
Nemertean sp. (Unidentified)	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Totals	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
Mollusca																						
BIVALVES																						
Mytilus edulis	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	15
Totals	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	15
GASTROPODA																						
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda																						
AMPHIPODS																						
Acanthohaustorius millsi	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Amphipoda sp. (Unidentified)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampithoe rubricata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calliopius laeviusculus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Erichthonius rubricornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus annulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jassa falcata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichophoxus epistomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ISOPODS																						0
Idotea baltica	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
Grand Totals	**0**	**15**	**1**	**29**	**1**	**10**	**0**	**10**	**0**	**0**	**1**	**16**	**0**	**24**	**1**	**0**	**3**	**0**	**0**	**15**	**0**	**126**

Sampling Dates																			
5/15/00-5/16/00	Eastern Shore Zone Survey																		
	Reach 3																		
Station No.	15-A	15-B	15-C	16-A	16-B	16-C	17-A	17-B	17-C	18-A	18-B	18-C	19-A	19-B	19-C	20-A	20-B	20-C	Totals
Taxa																			
Nematoda																			
Unidentified Nematoda sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Totals	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Annelida																			
POLYCHAETE WORMS																			
Lumbrineris tenuis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
Scolelepis squamata	0	0	0	0	0	0	0	0	0	1	0	6	1	4	8	0	10	0	30
Syllidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terebellidae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	1	0	6	1	4	8	0	14	0	34
Rhynchocoela																			
Nemertean sp. (Unidentified)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mollusca																			
BIVALVES																			
Mytilus edulis	6	1	0	0	0	0	1	6	0	2	5	1	2	12	25	0	37	174	272
Totals	6	1	0	0	0	0	1	6	0	2	5	1	2	12	25	0	37	174	272
GASTROPODA																			
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda																			
AMPHIPODS																			
Acanthohaustorius millsi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Amphipoda sp. (Unidentified)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampithoe rubricata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calliopius laeviusculus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Erichthonius rubricornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus annulatus	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jassa falcata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichophoxus epistomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ISOPODS																			
Idotea baltica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Totals	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5
Grand Totals	**11**	**1**	**0**	**0**	**1**	**0**	**1**	**6**	**0**	**3**	**5**	**7**	**3**	**16**	**33**	**1**	**51**	**176**	**315**

Sampling Dates														
5/15/00-5/16/00	Eastern Shore Zone Survey													
	Reach 4													
Station No.	21-A	21-B	21-C	22-A	22-B	22-C	23-A	23-B	23-C	24-A	24-B	24-C	Totals	Grand Totals
Taxa														
Nematoda														
Unidentified Nematoda sp.	0	0	0	0	0	N/A	0	0	0	0	1	0	1	58
Totals	0	0	0	0	0	N/A	0	0	0	0	1	0	1	58
Annelida														
POLYCHAETE WORMS														
Lumbrineris tenuis	0	0	0	0	0	N/A	0	0	0	0	0	0	0	5
Scolelepis squamata	0	0	0	0	0	N/A	0	0	0	0	0	0	0	102
Syllidae	0	0	0	0	0	N/A	2	0	0	0	0	0	2	2
Terebellidae sp.	0	0	1	0	0	N/A	0	0	0	0	0	0	1	1
Totals	0	0	1	0	0	N/A	2	0	0	0	0	0	3	110
Rhynchocoela														
Nemertean sp. (Unidentified)	0	0	0	0	0	N/A	0	0	0	0	0	0	0	4
Totals	0	0	0	0	0	N/A	0	0	0	0	0	0	0	4
Mollusca														
BIVALVES														
Mytilus edulis	0	0	79	1	0	N/A	3	320	221	1	3	0	628	916
Totals	0	0	79	1	0	N/A	3	320	221	1	3	0	628	916
GASTROPODA														
Littorina littorea	0	0	0	0	0	N/A	0	15	0	0	0	0	15	15
Totals	0	0	0	0	0	N/A	0	15	0	0	0	0	15	15
Arthropoda														
AMPHIPODS														
Acanthohaustorius millsi	0	0	0	0	0	N/A	0	0	0	0	0	0	0	4
Amphipoda sp. (Unidentified)	0	0	16	0	0	N/A	0	0	0	0	0	0	16	20
Ampithoe rubricata	0	0	1	0	0	N/A	0	0	0	0	0	0	1	1
Calliopius laeviusculus	0	0	0	0	0	N/A	0	0	15	0	0	0	15	16
Erichthonius rubricornis	0	0	2	0	0	N/A	0	0	0	0	0	0	2	2
Gammarus annulatus	0	0	0	0	0	N/A	0	0	0	0	0	0	0	2
Gammarus oceanicus	0	0	0	0	0	N/A	0	0	0	0	0	0	0	10
Jassa falcata	0	0	0	0	0	N/A	0	17	0	0	0	0	17	17
Trichophoxus epistomus	0	0	0	0	0	N/A	0	0	17	0	0	0	17	20
ISOPODS														
Idotea baltica	0	0	0	0	0	N/A	0	1	0	0	0	0	1	3
Totals	0	0	19	0	0	N/A	0	18	32	0	0	0	69	95
Grand Totals	**0**	**0**	**99**	**1**	**0**	N/A	**5**	**353**	**253**	**1**	**4**	**0**	**716**	**1198**

APPENDIX II
MACROBENTHIC INVERTEBRATE DATA SHEETS
FALL 2000

Sampling Dates																						
11/22/00-12/11/00	Eastern Shore Zone Survey																					
	Reach 1																					
Station No.	01-A	01-B	01-C	02-A	02-B	02-C	03-A	03-B	03-C	04-A	04-B	04-C	05-A	05-B	05-C	06-A	06-B	06-C	07-A	07-B	07-C	Totals
Taxa																						
Nematoda																						
Unidentified Nematoda sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Archiannelid																						
Polygordiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Platyhelminthes																						
Turbellaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida																						
POLYCHAETE WORMS																						
Glycera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophelia bicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scolelepis squamata	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5
Totals	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	5
Mollusca																						
BIVALVES																						
Mytilus edulis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GASTROPODA																						
Lacuna vincta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda																						
AMPHIPODS																						
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	11
Protohaustorius wigleyi	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	3	12
Grand Totals	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**8**	**3**	**18**

Sampling Dates																						
11/22/01-12/11/01	Eastern Shore Zone Survey																					
	Reach 2																					
Station No.	08-A	08-B	08-C	09-A	09-B	09-C	10-A	10-B	10-C	11-A	11-B	11-C	12-A	12-B	12-C	13-A	13-B	13-C	14-A	14-B	14-C	Totals
Taxa																						
Nematoda																						
Unidentified Nematoda sp.	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Totals	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Archiannelid																						
Polygordiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes																						
Turbellaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annelida																						
POLYCHAETE WORMS																						
Glycera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophelia bicornis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scolelepis squamata	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	11	0	13
Totals	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	11	0	13
Mollusca																						
BIVALVES																						
Mytilus edulis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
GASTROPODA																						0
Lacuna vincta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropoda																						
AMPHIPODS																						
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Protohaustorius wigleyi	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Totals	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	4
Grand Totals	**0**	**3**	**2**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**11**	**0**	**22**

Sampling Dates																			
11/22/01-12/11/01	Eastern Shore Zone Survey																		
	Reach 3																		
Station No.	15-A	15-B	15-C	16-A	16-B	16-C	17-A	17-B	17-C	18-A	18-B	18-C	19-A	19-B	19-C	20-A	20-B	20-C	Totals
Taxa																			
Nematoda																			
Unidentified Nematoda sp.	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	3
Totals	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	3
Archiannelid																			
Polygordiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platyhelminthes																			
Turbellaria	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida																			
POLYCHAETE WORMS																			
Glycera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ophelia bicornis	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2
Scolelepis squamata	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	3	6
Totals	0	0	0	0	0	0	0	0	0	1	0	1	1	2	0	0	0	3	8
Mollusca																			
BIVALVES																			
Mytilus edulis	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Totals	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
GASTROPODA																			
Lacuna vincta	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Littorina littorea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Arthropoda																			
AMPHIPODS																			
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protohaustorius wigleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Totals	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**2**	**0**	**0**	**0**	**3**	**14**

Sampling Dates														
11/22/01-12/11/01	Eastern Shore Zone Survey													
	Reach 4													
Station No.	21-A	21-B	21-C	22-A	22-B	22-C	23-A	23-B	23-C	24-A	24-B	24-C	Totals	Grand Totals
Taxa														
Nematoda														
Unidentified Nematoda sp.	0	0	2	0	0	0	0	0	0	0	0	0	2	9
Totals	0	0	2	0	0	0	0	0	0	0	0	0	2	9
Archiannelid														
Polygordiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Platyhelminthes														
Turbellaria	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annelida														
POLYCHAETE WORMS														
Glycera sp.	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Ophelia bicornis	0	0	1	0	0	0	0	0	1	0	0	0	2	4
Scoleoepis squamata	0	0	0	0	0	0	0	0	0	0	0	0	0	24
Totals	0	0	2	0	0	0	0	0	1	0	0	0	3	29
Mollusca														
BIVALVES														
Mytilus edulis	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	2
GASTROPODA														
Lacuna vincta	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Littorina littorea	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Totals	0	0	1	0	0	0	0	0	0	0	0	0	1	2
Arthropoda														
AMPHIPODS														
Gammarus oceanicus	0	0	0	0	0	0	0	0	0	0	0	0	0	13
Protohaustorius wigleyi	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Grand Totals	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**6**	**60**