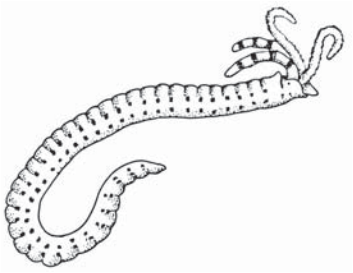
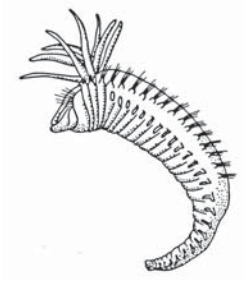
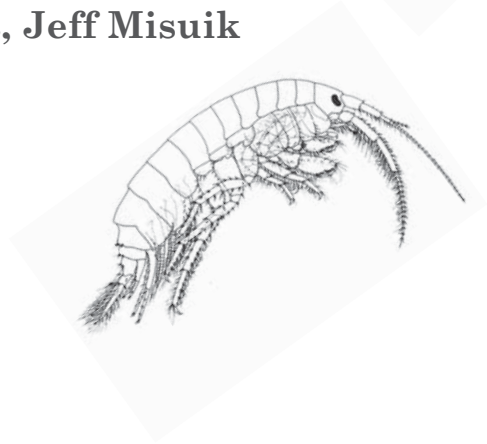




A Study of the Benthic Macroinvertebrate Community of an Urban Estuary: New Jersey's Hackensack Meadowlands

A. Brett Bragin, Craig A. Woolcott, Jeff Misuik



New Jersey Meadowlands Commission

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EXECUTIVE SUMMARY

A time span of 15 years separated two surveys of the benthic macroinvertebrate community of the Hackensack Meadowlands. During each survey, three replicate grab samples were collected using a full-sized Ponar grab at 26 sampling locations during each season over a one year period. The original survey, conducted in 1987, recovered 65,565 organisms from 52 taxa in a total of 284 benthic collections. During the 2002 survey, 215,296 organisms representing 67 taxa were identified from 312 collections. A total of 89 benthic taxa were identified during both surveys.

During the 2002 survey, the benthic community within the Hackensack Meadowlands was composed primarily of polycheate worms (22 species and 45% of the total number of organisms collected) and amphipods (10 species, with a relative abundance of 35%). The total number of taxa ranged from 43 at river mile 3.0 (location S1), to 10 at river mile 12.2 (location GN3).

In 1987, the benthic community was dominated by gastropods (primarily one species with a relative abundance of 50%) and oligocheate worms (27%). The highest number of taxa collected (n=25) was also collected at river mile 3.0 (location S1), while the lowest number of taxa (n=4) were recorded at sites between river mile 10.9 to 12.5 (locations TN5, T5-S and TN6).

Although the highest diversity (i.e., number of taxa collected) occurred at the downstream sampling locations in both survey periods, the highest density of benthic organisms (40,000 to 65,000 organisms/m^2) occurred in two tributary creeks (Mill and Cromakill) and the mainstem of the river at river mile 9.2. These high densities are primarily due to the amphipod *Apocorophium lacustre* and the polycheate worm *Hobsonia florida* that were collected during the 2002 survey.

Shannon diversity index (H′) values were calculated for each sampling location for each season, as well as for all seasons combined (i.e., a yearly total). The Shannon index values for each survey were then statistically compared using a specialized t-test. The results showed that, for all seasons combined, 19 of the 26 sampling locations had a significantly higher (p=0.05) diversity during the 2002 survey. On a seasonal basis, the H′ values were statistically higher in 2002 than in 1987 at nine locations during the winter, at 18 locations during the spring, and at 16 locations during autumn. During the summer, seven sampling locations were significantly higher in 2002, while the diversity from two locations was significantly higher in the summer of 1987.

It appears there have been significant improvements within the benthic community in the Hackensack Meadowlands in the 15 years since the original benthic survey was conducted. However, the overwhelming abundance of a few opportunistic species at several locations within the mid to upper portion of the Meadowlands provides evidence that this system is still stressed.

"The cataloguing of what we've got and how and where it occurs is the first step in any inquiry....."

Edward F. Ricketts

May 14 1897 - May 11 1948

1.0 INTRODUCTION

In 1987 the Hackensack Meadowlands Development Commission (HMDC) initiated a two-year fishery resource inventory of the lower Hackensack River (River). The purpose of the study was to collect baseline data on the fishery and benthic resources within the boundaries of the Hackensack Meadowlands District (HMD). The data was used to assess the fish and benthic macroinvertebrate populations that were using the River (i.e., "the cataloguing of what we've got and how and where it occurs", as the pioneering marine ecologist Ed Ricketts once wrote), and to determine the extent to which the River and its tributaries provided habitat and refuge for those species as part of a programmatic Draft Environmental Impact Statement for the District (the Special Area Management Plan Draft EIS; EPA, 1995). The data collected during the 1987-88 study was presented in the HMDC's 1989 fishery resource inventory report (HMDC, 1989). The 1989 report focused mainly on the fishery resources of the HMD. Although the 1987-88 benthic macroinvertebrate data were summarized in the 1989 report, there was little analysis of the benthic community data that was collected during the 1987-88 study (hereinafter referred to as the 1987 study).

The HMDC, which was renamed the New Jersey Meadowlands Commission (NJMC) on August 29, 2001, had always envisioned repeating the 1987 study periodically to determine whether the fish and benthic communities had responded to perceived water quality improvements that were occurring within the District. Therefore, in 2001, the NJMC began a new two-year fishery resource inventory of the Hackensack River, the goal of which was to repeat the earlier study and compare the results. Rather than simply repeat the fish and benthic inventories, the NJMC decided that additional studies would be beneficial. Therefore, in addition to performing the fisheries and benthic inventories, several sub-studies were added. The sub-studies included: an investigation of selected contaminants in fish tissue; a study of the reproductive health of the white perch; a food habits study of the white perch; and a chemical and textural analysis of the river bottom sediments. The results of each of these companion studies are reported under separate cover, and can be obtained from the MERI library. This report focuses solely on the benthic macroinvertebrate inventory, and includes a comparison of the benthic data collected during the 1987 study to those collected in 2002.

2.0 MATERIALS AND METHODS

A total of 21 sampling locations were established during the 1987 fisheries study (HMDC, 1989). The locations were selected with the assistance of the New Jersey Department of Environmental Protection (NJDEP) Bureau of Marine Fisheries. Sites were selected based on their spatial distribution along the River (within the HMD) and the suitability of deploying and retrieving each of the four fishery collection gear types in order to sample subtidal and shallow inshore areas of the River. The gear types were selected to match what the NJDEP Bureau of Marine Fisheries used in making collections for other fisheries studies in estuarine waters around the State (e.g., see NJDEP, 1984), and included experimental sinking gill nets (three locations), seines (three locations), bottom trawls (nine locations) and trap (fyke) nets (six locations). The same 21 fishery locations were sampled during the 2001-2003 fisheries study. However, due to changes in site conditions during the intervening years, two sampling locations (Trawl 9 [T9] and Trap Net 1 [TN1]) were moved a short distance from their original 1987 locations.

Although 21 sites were sampled for the fishery resource inventory, sampling for the benthic community inventory took place at a total of 26 sites (Figure 1). The five additional sites were due to the fact that benthic samples were collected at both the shallow and deep ends of each of the trawling sites in the mainstem of the Hackensack River (sites T1 through T5), for a total of 10 benthic sampling sites at the mainstem River trawl sites. Benthic samples from the trawl sites in the tributary creeks (T6 through T9) consisted of one location each, collected from the approximate midpoint of the area trawled (for a total of four benthic sampling sites from tributary creek trawl sites). Benthic samples collected at each of the three gill net, three seine, and six trap net sampling sites consisted of one location at each site, for the remaining 12 benthic sampling sites.

2.1 Sampling Gear and Field Collection Methods

During both studies the benthic samples were collected using a standard 316-stainless steel Ponar grab sampler (sampling area of 0.052 m^2, weight ~22.7 kg [50 lbs.]), deployed from a 21 foot Privateer work skiff via a davit equipped with a battery-operated winch. [Although the benthic samples were all collected using a Ponar grab sampler, the collection locations (i.e., the sampling sites) were all referred to by the fishery sampling gear names, an artifact of the fishery resource inventory.] The first step of the benthic collection process was to anchor the boat above the sampling location. During the 2002 collections the water depth was determined using a Garmin model 160 Blue depthfinder. During the 1987 collections, the water depths were determined using a Si-Tex model 356B recording fathometer (i.e., depthfinder).

Immediately before collecting the three replicate benthic grabs at each sampling location, conventional water quality parameters were determined. During the 2002 benthic collections, a Hydrolab multi-parameter mini-sonde with a Hydrolab Surveyor 4a data logger/display terminal was used. The following water quality parameters were measured in the field in 2002: temperature, dissolved oxygen (D.O.), conductivity, salinity, pH, total dissolved solids (T.D.S.) and oxidation-reduction potential (redox). The mini-sonde was periodically calibrated according to the manufacturers specifications. During the 1987 survey, a Yellow Springs Instruments (YSI) Model 33 S-C-T meter was used to measure the salinity, conductivity and temperature, a YSI Model 57 oxygen meter was used to measure the dissolved oxygen, and either a Beckman model 21 pH meter or a Cole-Parmer pH pen was used to measure the pH. Conductivity, T.D.S, and redox were not measured during the 1987 collections. Water clarity was measured at each sampling location during both studies using an 8-inch diameter Secchi disc.

Water quality measurements at the surface and bottom were recorded at trawl and gill net sampling locations. Samples of bottom water were collected approximately one foot off of the bottom using a 2.2 liter clear acrylic horizontal Alpha sampling bottle. Normally, only surface water quality measurements were recorded during benthic sampling at the seine and trap net sampling locations, owing to the fact that the benthic collections at these locations were normally made around the time of low water, in water depths of one to four feet. The water quality data, along with the site location, date and time of each benthic replicate collected and any other pertinent observations were noted on pre-printed benthic field data collection sheets (Figure 2).

After the water quality data was recorded, the Ponar grab was arranged in the open position and it was slowly lowered through the water column using a sufficient length of 5/8 inch line until it was in contact with the bottom. The line was allowed to go slack, and was then given a sharp tug to trip the closing mechanism. As the line became taut, the Ponar grab jaws closed, scooping up approximately 8.2 liters of sediment (i.e., for a full grab in soft sediments. At locations where the substrate was gravel, clay or hard-packed sand, the Ponar was dropped from a height of one to two feet above the sediment surface in an attempt to collect as much sediment as possible in one grab). During the 2002 collections, once the Ponar grab was out of the water the davit was swung over the deck of the boat and the Ponar grab was slowly lowered into a plastic tub (47 cm long x 36 cm wide x 18 cm high). The Ponar grab was then opened, releasing the collected sediments into the plastic tub. Any sediment adhering to the walls of the Ponar grab were hosed into the tub using Hackensack River water via a battery operated pump and a garden hose with a gentle spray nozzle. The inlet for the pump hose was screened using a 505 micron mesh filter fabric so that non-benthic organisms from the River would not be inadvertently introduced into the sample. The contents of the plastic tub were then carefully transferred to a 30.5 cm diameter (12 inch) by 20.3 cm deep (8 inch) stainless steel sieve with a 1.0 mm mesh. The sieve was placed into a large galvanized metal tub, and a gentle spray of water from the hose was used to help wash the sediments through the sieve. Once a sufficient quantity of water accumulated within the galvanized tub, the sieve was agitated within the water-filled tub in order to get as much sediment to pass through the sieve as possible. In order not to lose any of the collected specimens, great care was taken during this process so that the water/sediment slurry within the sieve was not slopped over the top of the sieve. When it was apparent that no additional sediment was passing through the sieve (i.e., the water ran clear), anything retained on the sieve (organisms, sediment, detritus, etc.) was carefully transferred into a properly labeled sample collection jar and the sample was immediately preserved using a buffered 10% formalin solution to which Rose Bengal stain had been previously added (to aid in the laboratory sorting process). The water used for sieving contained in the galvanized tub was returned to the River.

This process was repeated until three replicate samples were collected at each location. Once all three replicates were collected and preserved, the boat was moved to the next sampling location, where the entire process was repeated.

During the 1987 sample collections, the same basic methods described above were used, except that the benthic samples were not sieved on the boat. In 1987, the benthic samples were transferred from the Ponar grab sampler into five-gallon buckets, topped off with River water, and were transported back to the HMDC office in Lyndhurst, where the samples were sieved using a 1.0 mm stainless steel mesh sieve using tap water and a garden hose. Samples that could not be sieved before the end of the day were stored in the laboratory overnight and were sieved at the beginning of the next day. As with the samples collected in 2002, anything retained on the sieve was carefully transferred into a properly labeled sample collection jar and the sample was immediately preserved using a buffered 10% formalin solution to which Rose Bengal stain had been previously added. All of the sample collection jars were stored in the NJMC laboratory.

Details regarding the collection location, date and time of sample collection, water depth and observations related to the sediments collected in each replicate sample, and any other pertinent observations made during the sample collections were recorded on field data collection forms (Figure 2).

Since substrate type is an important factor related to the distribution of benthic species (Levinton, 1982, Carriker et. al., 1982), additional grab samples were collected from each site during both studies to characterize the particle size distribution (i.e., textural analysis) of the sediments and the concentrations of selected heavy metals. While the samples for benthic community analysis were collected on a seasonal basis, the sediments for the textural and metals analysis were collected once during each study period, not necessarily at the same time that the benthic collections were made.

2.2 Sampling Frequency

In an attempt to get an overall picture of the benthic community that utilizes the river within the Hackensack Meadowlands, both studies were designed to sample the benthic community across all four seasons over a one-year period. The first round of benthic samples collected during the 2002 study (winter season) were collected over eight days between January 29 to March 7. The second round of benthic samples (spring) also took eight days, and were collected between May 21 to June 17. Summer represented the third round of benthic samples collected during the 2002 study. The summer samples were collected over nine days, between August 19 to September 13. The last season of 2002 benthic samples were collected during autumn, over eight days between October 22 to December 03. A total of 78 benthic samples were collected during each season (three replicate samples were collected at each of the 26 sampling locations), for a total of 312 benthic samples collected during the 2002 study.

During the 1987 study, the first round of benthic samples were collected in the spring, over eight days, from March 30 to June 23, 1987. The second round of benthic samples collected during the 1987 study were collected over a period of five days in the summer, from August 13 to September 28, 1987. The third round of 1987 benthic samples occurred over five days in autumn, from November 16 to December 10, 1987. The fourth round of benthic samples was collected during the winter of 1987-88, over five days, from February 23, 1988 to March 24, 1988. No collections were made at site GN3 during the winter of 1987-88. Therefore, the total number of benthic grab samples collected during the 1987 benthic study was 309. Although each of the three replicate samples from eight locations (T6, TN2, TN4, T4-S, T4-D, S3, T5-S and TN6) collected during winter 1987-88 were sorted, the organisms recovered from those samples were never identified and counted. The organisms from one additional winter replicate, site T5-D (Rep. 3) were also never identified or counted. Therefore, a total of 284 benthic samples were identified and enumerated during the 1987 benthic study.

All collections were made under NJDEP scientific collection permits issued by the Division of Fish and Wildlife.

2.3 Sampling Locations

The NJMC's fishery resource inventory report (NJMC, 2005) provided a relatively detailed description of each of the 21 fishery sampling locations. Because salinity is another of the important natural factors that determine the distribution and abundance of benthic communities (Carriker et. al., 1982) consideration was given to the longitudinal distribution of the benthic sampling locations. Therefore, in this report the sampling locations are presented from south (downstream) to north (upstream) in terms of

their distance from the mouth of the Hackensack River (beginning at red nun buoy RN "2"), and are noted in river miles (RM), which were scaled (in nautical miles) from nautical chart 12337 – Passaic and Hackensack Rivers. Table 1 provides a listing of the benthic sampling locations by RM. The sampling sites covered approximately nine and a half miles of the river and five of the major tributaries that are within the Hackensack Meadowlands District.

2.5 Laboratory Sample Processing

2.5.1 Benthic Invertebrate Community Analysis

During both study periods all preserved samples were returned to the NJMC laboratory for storage and processing. In the lab, the benthic samples were sorted, a process by which any benthic organisms contained in the sample were removed from the sample matrix (i.e., the sediment and detritus that was collected and preserved). After being removed from the sample, the benthic invertebrates were identified and enumerated.

The first step of the sorting process was to rinse the sample of the formalin preservative. This was done by pouring the contents of the collection jar (or a portion of the contents, when a large amount of material was collected) onto a 1.0 mm mesh sieve, capturing the waste formalin in a bucket, and gently rinsing the sample with a gentle stream of tap water. Once the formalin was rinsed from the sample, the sample (or portion of a sample) was transferred into a shallow white enamel pan. Tap water was added to the pan until the sample was just barely covered with water. The sieve was examined to insure that no organisms were entangled in the mesh. The material in the pan was then stirred up using a pair of forceps and a dissecting probe to break up any clumps of vegetation or detritus in the sample. The sample was then carefully examined under a 3x magnified illuminator, using the forceps and dissecting probe to remove any benthic organisms from the sediment and/or detritus in the sample. A typical technique for sorting a sample would consist of moving the small bits of sediment/detritus from a clear space on one side of the tray to the other side of the clear space. Any benthic organisms encountered while moving the sediment and detritus from one side to the other were picked out of the sample and placed into Petri dishes containing a 70% isopropyl alcohol solution. In order to insure that all of the benthic organisms were recovered from the sample matrix, each sample was sorted twice. During the 1987 study, after the second sort, the sample matrix was discarded. During the 2002 study, the sediment and detritus that remained after the second sort was returned to the original sampling jar, and was preserved in a 70% isopropyl alcohol solution for subsequent quality assurance/quality control testing.

During the sorting process, the organisms recovered from the sample were placed into the Petri dishes according to the following general taxonomic categories; oligochaetes, polychaetes, amphipods, isopods, bivalves, gastropods and miscellaneous taxa. When the sorting of a sample was completed the organisms were placed (by each taxonomic category) into small alcohol filled vials, each of which were labeled with the site location, collection number, date of collection, replicate number and general taxonomic group. These small vials were stopped with cotton and all of the small vials from a particular collection (i.e., a replicate) were placed into a larger jar that was also labeled with all of the information relative to that collection (i.e., site, collection number, date, replicate number, etc.) and the large jar was filled with 70% isopropyl alcohol. These jars were then stored in the lab, awaiting final species identification and enumeration.

The objectives of the sample identification and enumeration process were to accurately identify all organisms removed from the sample to the lowest possible taxonomic level, and to accurately count the number of individuals of each taxa. Certain taxa, such as oligohcaetes and chironomid larvae are

extremely difficult to identify and no attempts were made to identify these taxa to a lower level. In order to be counted, a specimen must be whole, or have a critical part of the body present. For example, polycheate worms, gastropods, and arthropods must have the head and bivalves must have the umbo. Specimens lacking these critical parts were considered fragments and were not counted.

During the 1987 study, the benthic macroinvertebrates were identified and enumerated by NJMC staff. Identifications were done using dissecting and compound microscopes and a variety of dichotomous keys that described the various taxa recovered in the samples. Keys used during the 1987 identification process included those of Gosner (1971), Smith (1964), Gardiner (1975), Appy, et. al. (1980), Heard (1982), Day (1967), Fauchald (1976), Pettibone (1963), Gittings, et. al. (1986), Bousfield (1973), Schultz (1975), Jacobson and Emerson (1961) and Pennak (1978). As the specimens were positively identified, they were counted and the species names and associated counts were recorded on a lab data sheet. The NJMC identifications were verified by Ms. Anne Frame, a taxonomist from the National Marine Fisheries Service's Sandy Hook field office. Ms. Frame also provided identifications for any specimens that could not be identified by NJMC staff during the 1987 study. The species names and counts for each replicate from each season at each sampling location were transferred onto a large ledger sheet, and this data was typed into a tabular format on an IBM Selectric typewriter for presentation in the 1989 Fisheries Inventory report (HMDC, 1989).

During the 2002 study, the identification and enumeration of all specimens recovered by NJMC staff during the sorting process was performed by Cove Corporation, a company specializing in marine, estuarine and freshwater macrobenthic sample processing and analysis. Cove Corporation picked up the jars of sorted specimens from the NJMC offices in Lyndhurst, New Jersey and transported them to their laboratory in Lusby, Maryland for processing. Upon receipt at the Cove Corp. lab, each sample jar was given a unique serial number so that the location and status of the sample processing could be tracked at all times. At the start of the sample identification/enumeration process, the specimens from each vial from an individual collection (i.e., replicate)were rinsed into separate Petri dishes. All vials were visually inspected to be sure that all organisms were rinsed from the vials. Each taxon was identified (usually to the species level) using dissecting and compound microscopes, counted, and put into separate vials for each taxon. All vials were internally labeled with the taxomonic name, site location, date, replicate and Cove Corp. sample serial number. After being identified and counted, all vials from each sample (i.e., replicate) were pooled together into a larger sized jar filled with ethyl alcohol. All data generated during the identification/enumeration process were recorded directly onto Cove Corp. lab data sheets. The data sheets were linked to specific samples using the sample serial numbers that were assigned to each sample upon receipt at the Cove Corp. lab. Each macroinvertebrate taxon was coded with a unique National Oceanographic Data Center (NODC) numerical taxonomic code (NOAA, 1984). The abundance data was key punched into a desktop computer using a customized data entry program. All abundance data were reported on a per sample (i.e., a replicate) basis. The abundance data was provided to the NJMC in a hard copy (tabular) and an electronic format (Excel spreadsheets). All sample jars with the identified specimens in the separate vials were returned to the NJMC upon completion of the job.

2.5.2 Physical Properties of Sediment Analysis

During the 1987 study sediment texture (i.e., particle-size) was determined for each sampling location in order to characterize the sediments at each collection site. Samples used for the 1987 grain size analysis were dried to a constant weight at a temperature of 100ºC. Three 50 gram sub-samples of dried material were taken from each site and mixed with 100 ml of 0.01N sodium oxalate (a

dispersing agent) and 50 ml of distilled water. This solution was mixed in a blender for five minutes. The contents of the blender were rinsed through a #230 sieve (0.0625 mm mesh) until the water ran clear. The portion of the sample remaining on the sieve was collected and re-dried to a constant weight at 100ºC. The re-dried material was placed in a series of nested sieves (4.0mm, 2.0mm, 1.0mm, 0.5mm, 0.25mm, and 0.125mm mesh sizes) and were shaken using a Ro-Tap sieve shaker for five minutes. The fractions of material left on each sieve were collected and weighed on a Mettler P-1000 Precision balance. The percentage of material retained on each sieve was then calculated and classified according to the Wentworth Scale (Table 2).

For the 2002 study, in addition to the sediment grain size, percent moisture and percent organic matter were determined for each sediment sample. The American Society for Testing and Materials and (ASTM 2003) standard methods D 422 (particle-size) and D 2974 (moisture and organic matter) were used for the 2002 sediment analyses. The ASTM particle-size method used during the 2002 study differed from the method used in 1987 in that the silt and clay fractions (collectively referred to as percent fines) were determined using a hydrometer. This allowed for a separation of the silt and clay fractions. The silt and clay fractions were not separated by the method used for determination of the sediment texture during the 1987 study (weight of material passing through the #230 sieve). In summary, the sediment analysis for 2002 was conducted as follows:

The soil sample was dried at room temperature, and was ground using a mortar and pestle. The ground sample was sieved through a #10 mesh (2 mm) sieve using a Rotasift sieve shaker for 5 minutes. This material when weighed is the coarse fraction (i.e., gravel). The material passing through the #10 mesh sieve was mixed with a dispersing agent until homogenized. The resulting soil-water slurry (sample in dispersing agent) was transferred from its beaker into a glass sedimentation cylinder and filled to 1000mL with distilled water. Hydrometer (specific gravity) and temperature readings were recorded at intervals of 2, 5, 15, 30, 60, and 150 minutes after sedimentation began. When the hydrometer/temperature readings were finished, the contents of the cylinder were poured through a #230 mesh (0.0625 mm) sieve. The material retained on the #230 mesh sieve was dried at 105^{o} C. Once dried, any sediment clumps were broken up and the material was sieved using a nested series of #40 mesh (0.425 mm), #60 mesh (0.25 mm), and a #120 mesh (0.125 mm) sieves for 20 minutes. The weight of material retained on each sieve as well as the material that passed through all three sieves was recorded. This is the mass of sandy material.

A calculator was devised using an Excel spreadsheet to convert the hydrometer readings to grain size classifications (NJMC, 2007). This was necessary to distinguish between clay and silt sized material.

The sieve series used in the ASTM method for the determination of the sediment texture analysis during the 2002 study was slightly different that that used during the 1987 analysis (see Table 2). Although a different series of sieves was used, the important determination for the purposes of the benthic community study is the percentage of fines (silt and clay) at each location, which was determined using both methods.

ASTM Method D 2974 describes the gravimetric determination of both moisture content and organic matter. Percent moisture was determined by drying the sample for 16 hours at 105^{o} C. Organic matter (ash content) was determined by igniting the oven dried sample from moisture content in a muffle furnace at 550 °C.

2.6 Data Analysis

2.6.1 Benthic Macroinvertebrate Data Analysis

As stated above, the species identifications and counts for the 2002 benthic macroinvertebrate samples were supplied to the NJMC by Cove Corp. in Excel spreadsheets. At the time of sample collection, all of the field data related to each of the 2002 benthic collections (site location, date, time each replicate was collected, water depth, water quality data, etc.) were recorded directly onto pre-printed data forms (Figure 2). The field collection data were subsequently added to the Cove Corp. computer spreadsheets to facilitate data summary, analysis and presentation. The raw count data was used to calculate simple ecological metrics for each sampling location for each study period (by season and for all seasons combined) such as;

- Total number of organisms collected
- Mean number of organisms collected
- Total number of taxa collected
- Mean number of taxa collected
- Relative abundance of each species
- Percent frequency of occurrence of each species
- Mean number of organisms per square meter

In addition to the many data summaries included in this report, tables which contain all of the raw data for each of the 312 benthic collections made during the 2002 collections are presented in Appendix A.

One of the main goals of the parallel benthic surveys was to compare the 2002 results with those from the 1987 study. Unfortunately, the data from the 1987 study were not available in an electronic format. Therefore, all of the benthic data from the 1987 study were entered into Excel spreadsheets. Any transcription and/or typographical errors that were inadvertently published in the benthic data tables included in the 1987-88 fishery resource inventory report (HMDC, 1989) were corrected and the corrected electronic data tables were checked against the original 1987 benthic laboratory data sheets to insure accuracy. After the newly revised benthic data tables had been checked for accuracy, the numbers and identifications from the 1987 benthic samples were compiled and summarized in the same way as the data from the 2002 benthic collections. Since some of the benthic data used in these comparisons is slightly different than that which was published in the 1989 fishery resource inventory report (HMDC, 1989), the newly revised 1987 raw benthic collection data tables are included in Appendix B. Because the analysis of the 1987 benthic community data was limited to one brief paragraph in the 1989 fishery resource inventory report (along with a series of 26 summary data tables), this report will present the first in-depth analysis of this long neglected Hackensack Meadowlands benthic data.

2.6.2 Ecological Index Analysis

In addition to the simple metrics that were calculated using the 2002 and 1987 benthic community data (as discussed above), the raw benthic data was used to calculate some commonly used ecological indexes. The calculation of these ecological indexes was performed by Dr. Ken Johnson of the

Department of Mathematical Sciences at the New Jersey Institute of Technology. The manner in which the raw data was used to calculate these indexes are described below.

Prior to calculating the ecological indexes for each site, season and year, the raw observation data (i.e., the counts for each species) were checked for randomness. This was done by transforming the data for each replicate sample by taking the log of the counts and using ANOVA to determine if the data for each replicate was random within each season. All of the benthic replicates collected at each site during each season in 1987 were found to be random. For the 2002 benthic collections, the replicates at all sites during all seasons were found to be random, with the exception of site GN1 in autumn and T1-S in winter. The 2002 data for autumn at GN1 was found not to be random due to exceptionally high numbers of a polychaete worm (*Streblospio benedicti*) and the barnacle *Balanus improvisus* in replicate number 2. For the samples collected at T1-S in winter, the data were not random due to high numbers of barnacles, a polychaete worm (*Heteromastus filiformis*) and a cnidarian recovered in replicate number 3. The data for these two replicates were checked to be sure that the high numbers of these species were not the result of a typographical error. Since the count data for these species within these replicates were found to be correct, the data from these replicates were used in the subsequent analysis.

In the simplest of terms, species diversity can be expressed as species richness (S), which is the number of species in the sample or community. However, this simple measure fails to consider species evenness (the distribution of the number of individuals across all species within the sample or community). Consideration of the species richness weighted by species evenness gives a better measure, or index, of the species diversity of the sample or community. We calculated two of the most commonly used diversity indexes to compare species diversity, Simpson's Index (D) and the Shannon (sometimes referred to as the Shannon-Wiener) Index (H′). Higher values of D and H′ represent greater diversity. Both indexes are calculated using the proportions (p_i) of individuals in the total sample (N_{total}) that are represented by a given species (i), so that;

$$p_i = n_i / N_{total}$$

Simpson's Index (D) gives little weight to rare species in comparison to the abundant species. This index has a range between 0 and (1-1/S). Simpson's Index was calculated using the equation;

$$D = 1 / \Sigma\, p_i^2$$

The Shannon index (H′) takes into consideration species richness and evenness. The magnitude of H′ is affected not only by the distribution of the data but also by the number of categories (i.e., number of species). The Shannon index was calculated using the equation;

$$H' = - \Sigma\, [p_i * \log (p_i)]$$

Theoretically, the maximum possible diversity for a set of data consisting of *k* catagories (species) is H'_{max} , which equals the log of *k* (total number of species). Once H′ was known, it was used to calculate a measure of evenness, J′ (sometimes referred to as Pielou's evenness) using the equation;

$$J' = H'/H'_{max}$$

J′ expresses the observed diversity as a proportion of the maximum possible diversity (i.e., it represents the relative diversity)(Zar, 1999).

We then used an adaptation of the t-test to statistically compare the Shannon indexes calculated for the 2002 benthic community data (H'_1) to that calculated using the benthic community data collected during the 1987 study (H'_2) (Zar, 1999). The equation used for this comparison was;

$$t = (H'_1 - H'_2) / S_d$$

In order to calculate the standard deviation (S_d), the variance (s^2) of the Shannon index for each time period was first calculated using the following equation:

$$S^2 = \frac{\Sigma n_i * \log^2 n_i - (\Sigma n_i * \log (n_i)^2 / N_{total}}{N^2_{total}}$$

Then, the standard deviation was calculated using:

$$S_d = \sqrt{(S_1^2 + S_2^2)}$$

And finally, the comparison of the H′ values required calculation of specialized degrees of freedom, calculated using the following equation;

$$df = \frac{(S_1^2 + S_2^2)^2}{\frac{(S_1^2)^2}{N_1} + \frac{(S_2^2)^2}{N_2}}$$

If the calculated t-value was greater than the value found on the t-table under the specified confidence interval (95%, or p=0.05) and calculated degrees of freedom, then the diversity of the benthic communities were significantly different between the two time periods.

3.0 RESULTS

3.1 Sediment Texture

The size of sedimentary particles is of obvious importance in determining the distribution of marine benthic species (e.g., well-washed gravelly sediments will preclude species dependant on the ingestion of fine grained organic particles). The diameter of sedimentary particles is also an indicator of current strength – sediments in areas of minimal current velocity typically consist of very fine-grained sediments (Levinton, 1982). Marine benthic ecologists are typically most concerned with distinguishing fine-grained sediments, usually those finer than 1/16 of a mm (0.0625 mm or 62 microns). This fine-grained fraction of the sediment correlates well with the abundance of fine-grained organic matter in the sediment, an important source of food and an attachment substrate for the microfauna and microflora of sediments (Levinton, 1982).

Table 3 shows a comparison of the average amount of fine-grained material (i.e., silt and clay fractions) recovered from sediment samples collected at each sampling location during both studies. A plot of the data (Figure 3) shows the spatial and temporal relationship in better detail. Overall, the percentage of fines in the samples has remained relatively consistent; averaging 72% in 1987 and 69% in 2002. The comparison shows that during the 1987 study, 16 sites had a higher percentage of fines, with differences ranging from 5.3% more fine sediment at site T3-D to almost 40% more fines at site S1. The majority of the sites with a higher percentage of fine sediments in 1987 (11 of the 16) were between RM 7.0 and 10.6. During the 2002 study, six sites had a higher percentage of fines compared to 1987, ranging from 7.3% more fines at site TN1 to 69.9% more fines at site T5-D. Five of these six sites were in the lower portion of the river (from RM 3.5 to 5.2). There was little difference between the years in the amount of percent fines at four sites (T2-D, GN2, TN5, and TN6). Figure 3 also illustrates that one goal in the sampling design was met; collection sites were successfully replicated. This conclusion is supported by calculation of the population correlation coefficient between the two data sets: $r = 0.73$.

Table 4 provides a brief summary of the sediment observations made during the four seasons of benthic macroinvertebrate sampling during the 2002 study. As shown in Table 4, most of the sediments were soft black mud, grey to black clay and some brown mud. The sediments from several locations (GN1, GN2, T3-D, S2, TN4, TN5, T5-S, T5-D and TN6) gave off a chemical odor and/or sheen. Noted at several upriver sampling locations (T8, T4-S, T4-D, T9, T5-S and T5-D) was a thin, brown, oxygenated surface layer of sediment on top of soft black mud that often contained a large number of worm and/or amphipod tubes.

Table 5 summarizes the average percent fines (for both studies), organic matter (OM) and percent moisture content (for 2002 only) grouped by sample location (i.e., net) type. When grouped this way, the percent fines at the gill net, trawl, and trap net sites were very similar during the two studies. The 19% difference in the amount of percent fines at the seine locations between 1987 and 2002 is mainly due to the large difference in the amount of percent fines at site S1. On average, the seine locations had the least amount of fine sediment. As discussed in Section 2.3, this is an artifact of the manner in which the sites were selected. Since the seine net was walked through the water and the net hauled up onto the shoreline at each seine location, sites that could

not be easily traversed (i.e., those with thick mud) were not selected. Areas chosen as seine collection locations generally had a firm bottom (i.e., were lacking in fines). On the other hand, the trap net sites were selected to sample nearshore areas which were too muddy to seine. The trap nets were staked into mudflats at the selected locations that were close to shore, hence the high average percentage of fine material at the trap net locations. Intermediate between the seine and trap net locations were the gill net and trawl locations, which were generally located in deeper waters of the Hackensack River, or in the tributaries. The higher energy of the flowing river at some locations does not allow for the settlement of much fine material (e.g., GN1 and T2), while other sampling locations were clearly in areas of lower energy which were depositional in nature (e.g., T1 and T5).

The surface area of a particle (i.e., sediment grains) increases as the size of the particle decreases. As organic matter is often found as coatings on particles, it is reasonable for fine material and organic matter to co-vary as demonstrated by the 2002 data where the higher percentage of organic matter is seen at sites with a higher percentage of fine material (i.e., trawl and trap net sites).

3.2 Water Quality

The water quality data recorded during each benthic collection were summarized to show both spatial and seasonal trends for each collection period. To examine spatial trends, the minimum, maximum and mean values for all surface and bottom salinity, temperature, D.O., pH, and the Secchi depth measurements were arranged by RM starting with the downstream-most site (GN1 at RM 3.0), ascending to the upstream-most site (TN6 at RM 12.5). Sampling locations that were within tributaries (T6, TN2, T7, T8, T9, and GN3) were placed according to the order of where the tributary joined the river (e.g., the mouth of Sawmill Creek, where site T6 was located, is at RM 5.1). Since the benthic sampling was conducted on a seasonal basis, the mean value for each water quality parameter at each site should be the average of four readings. This is the case for all of the 2002 surface measurements, as well as for 96% of the 1987 surface measurements. Although bottom water was not typically collected at the seine and trap net locations (since these sites were normally sampled during or near the time of low water), a few bottom measurements were made at these locations, as noted in Table 6. For ease of comparison, the data in Table 6 is arranged so that the data for each water quality parameter measured during each time period is shown side-by-side, with the 2002 data on the left. Water quality parameters that were not measured during the 1987 collections (conductivity, total dissolved solids, and redox) are not shown, however all of the raw water quality data recorded during each benthic collection is provided in Appendix A (for 2002 collections) and Appendix B (for 1987 collections). The salinity, temperature, D.O., and Secchi depth averages for each site are shown in Figures 4 through 7. It must be noted that the graphs that depict the averages for the bottom water quality parameters do not include the seine and trap net locations, since water quality data was not collected in all seasons at these sites

3.2.1 Water Quality by Site

The comparison of the average surface and bottom salinities (Figure 4) shows that the average salinity at each site (except GN3, which was not sampled during the winter of 1987-88) was higher during the 2002 study. During 2002, northern New Jersey was experiencing a drought. The lack of freshwater input resulted in higher salinities throughout the Meadowlands.

The average surface and bottom water temperature data are shown in Figure 5. From the lowermost sampling site GN1 (at RM 3.0) to RM 6.8 (at GN2), and again from site TN4 (at RM 9.2) to TN6 (at RM 12.5), average water temperatures were the same (at T4-shallow and T4-deep) or higher during the 2002 sampling. Conversely, average water temperatures were slightly higher during the 1987 benthic sampling in the Harmon Cove reach (RM 7.0 to 7.5). It must be noted that the 1987 average temperatures for site GN3 are "artificially" high as that site was not sampled during the winter of 1987.

The pattern seen in the D.O. graphs (Figure 6) is the opposite of that shown on the temperature graphs. The average D.O. was higher during the 1987 collections in the lower portion of the river, from RM 3.0 (site GN1) to RM 6.8 (site GN2). In the Harmon Cove reach, the average surface D.O. was higher during the 2002 sampling, while the average bottom D.O. was slightly higher at sites T3-shallow and T3-deep during 1987. This may be explained in part by the fact that the solubility of oxygen in water decreases with increased temperature. Upstream from the Harmon Cove reach, the D.O. pattern becomes less clear.

A comparison of the average water clarity, as measured by Secchi depths, is shown in Figure 7. The 2002 and 1987 Secchi depths are almost identical at the trap net locations, most likely because these sites were sampled at or near the time of low water, when sediments stirred up by wind or wave action were suspended in the water column. Excluding the two downstream trap net sites, the average Secchi depths in the lower five miles of the river were higher during the 2002 study. From the Harmon Cove reach, upstream for about 2.5 miles, the Secchi depths were higher during the 1987 sampling. Further upstream, Secchi depths were similar, with the exception of site T5-deep, where the 2002 water clarity was higher.

3.2.2 Seasonal Water Quality

A seasonal look at the water quality data is provided in Table 7, where the minimum, maximum and average values for each of the water quality parameters that were measured during both studies are shown. A full complement of seasonal water quality data equates to a total of 26 data points, as shown in the bottom row of each table (as the "count"). The count reveals those instances where measurements were not taken at every sampling location, most clearly seen in the data tables for the bottom water measurements. Parameters that were measured during the 2002 survey, but not during 1987 are not shown on Table 7, but are included in the raw data tables in Appendix A.

Graphical representations of the seasonal water quality data are shown in Figure 8. The seasonal salinity comparison (Figure 8A) shows that higher salinities were recorded during the 2002 sampling, again a result of a period of drought. It also shows that during 2002, the highest average salinities were during the winter and summer, with the salinity decreasing during the spring and autumn. In 2002, the average bottom salinity was always higher than the surface salinity. The average salinities measured during 1987 (a non-drought year) were always lower than the 2002 salinities, and during 1987 the salinity of the river rose slightly from winter into spring, reached its' summer maximum, and decreased into autumn. During the summer and autumn of 1987 the average bottom salinity was higher than the average surface salinity.

The seasonal temperature comparison graph (Figure 8B) shows that the average winter surface and bottom water temperatures were practically identical over both time periods. As expected, water temperatures rose through the spring, reached their maxima during summer, and decreased through the fall. Seasonal average water temperatures were higher during the 2002 benthic sample collections.

The graph of seasonal D.O. averages (Figure 8C) shows that during the 1987 benthic collections, D.O. levels on the river bottom were higher than on the surface during all seasons. This is opposite of what would normally be expected. Winter, spring and autumn D.O. averages in 1987 were either equal to or higher than the 2002 D.O. averages. Summer average D.O. at the surface and bottom were below the NJDEP water quality criteria of 4.0 mg/l during both study periods. The only instance where the average D.O. was higher during the 2002 survey occurred during the summer. As expected, the 2002 average bottom D.O. was lower than the surface averages during spring, summer and autumn. During winter 2002 the average surface and bottom D.O. levels were practically identical.

As shown on Table 7, a total of 104 surface D.O. measurements were made during the 2002 benthic collections, of which 22 (21%) were below the NJDEP water quality criteria of 4.0 mg/l. As expected, the majority of the 2002 D.O. measurements that were below 4.0 mg/l were recorded during summer, when 58% of the surface D.O. measurements were below 4.0 mg/l. The average surface D.O. for the 26 sampling locations during summer was 3.77 mg/l. Bottom water D.O. levels ranged from 1.52 mg/l (GN3, summer) to 11.62 mg/l (T7, winter). A total of 87 bottom D.O. measurements were recorded during 2002, with 37% falling below the 4.0 mg/l NJDEP criteria. Of the 21 bottom D.O. measurements made during spring, 52% were below the 4.0 mg/l criteria. During summer 2002, 91% of the 22 bottom D.O. readings were below 4.0 mg/l, with an average summer bottom D.O. of 2.95 mg/l.

During the 1987 benthic collections, 103 D.O. measurements were made at the surface, 32 of which (31%) of which were below the NJDEP 4.0 mg/l criteria. The majority of the surface D.O. measurements that were less than 4.0 mg/l were recorded in summer (89%), followed by 27% during spring and only 1% during winter and autumn. A total of 70 bottom D.O. measurements were recorded during 1987, of which 22 (31%) were below the criteria. Again, the D.O. measurements from the summer had the highest percentage of criteria exceedence (75%), followed by spring (23%), winter (4.5%) and autumn (3.8%).

Figure 8D shows the seasonal comparison of average pH values measured during both studies. As expected in an estuarine system, the pH values fluctuated in a relatively narrow range. During the winter, summer and autumn the average pH was higher in 1987 compared to 2002. The difference between the average surface and bottom pH during any season was never more than 0.10 standard units.

The comparison of the water clarity or Secchi depths is shown in Figure 8E. During 1987, the average Secchi depths were lowest during the winter, rose slightly during the spring, reached its high point in the summer, and then declined during autumn. In 2002, the highest average Secchi readings occurred during the winter. The water clarity decreased during the spring of 2002, and it stayed at roughly the same depth through the summer and autumn.

3.3 Benthic Inventory

The "baseline" benthic study, conducted in 1987, recovered 65,565 organisms from 52 taxa in a total of 284 benthic collections (an average of 231 organisms per collection). The five most abundant taxa comprised almost 92% of the total number of organisms collected. During the 2002 study, 215,296 organisms representing 67 taxa were identified from 312 collections (an average of 690 organisms per collection). This represents an increase of 15 species and a bit more than a three-fold increase in the total number of organisms collected. During the 2002 study, the nine most abundant taxa comprised just over 91% of all organisms collected. A total of 89 benthic taxa were identified across both studies. A side-by-side, phylogenetic listing of the species collected during both benthic studies is shown in Table 8, which reveals that there were 30 species in common between the two studies. Thirty seven species were only collected during 2002, and 22 species were only collected during the 1987 study. Changes in the nomenclature of seven species are also reflected on Table 8. For example, the polychaete worm known as *Nereis succinea* in 1987 is listed as *Neanthes succinea* in the 2002 species list, however, the NODC species codes are the same, denoting that they are the same species. Any species whose name changed in the time period between the two surveys are marked with an asterisk in Table 8.

3.3.1 Abundance Within the Major Taxomonic Groups

Using the NODC species codes, the individual species were separated into major taxonomic groups, such as flatworms, polychaete worms, bivalves, etc., as shown in Table 8. The abundance data for all taxa that fell within each major taxonomic group were combined in order to examine the contribution of each of the taxonomic groups to the benthic community within the Hackensack Meadowlands. Table 9 provides a side-by-side comparison of the relative abundance for each of the major taxonomic groups, along with the total number of taxa within each group, and the rank (by abundance) for each group.

As shown in Table 9, during the 1987 survey the benthic community was dominated by gastropods (primarily by one of the three species that were collected, with a relative abundance of 50.4% of all organisms collected) and oligocheate worms (26.5%). Polychaete worms (18 species) made up 8.3% of the 1987 benthic community, followed by bivalves (five species and 7.7% of the total number of organisms collected). Together, these four invertebrate groups comprised 93% of the 1987 benthic community. The groups with the highest diversity during 1987 were the polychaete worms (18 species), the amphipods (six species), and the bivalves (five species).

In contrast to the 1987 collection data, during 2002 the benthic community within the Hackensack Meadowlands was composed primarily of polycheate worms (22 species and 45% of the total number of organisms collected) and amphipods (10 species, with a relative abundance of 35.5%). Together with oligochaete worms (6%), and insects (two species, and 3.7% of the total number), these four taxonomic groups made up just over 90% of the 2002 benthic community. The groups with the highest diversity during 2002 were the polychaete worms, amphipods, bivalves (seven species) and the gastropods (six species). The overall comparison of the major groups is shown in Figure 9, which clearly shows the differences in the abundance of the various taxonomic groups over the 15 year period that elapsed between the two surveys.

The abundance data for each of the major taxonomic groups were also calculated on a seasonal basis. The total number and relative abundance for each taxonomic group are shown by season for 1987 in Table 10A, and for 2002 in Table 10B. These data are also represented graphically in Figures 10A and 10B. The figures show the seasonal fluctuations in the benthic community over a one year period, as well as over the 15 years that separated the two studies. Figure 10A shows that during the winter and spring of 1987 the oligochaete worms were the most abundant organisms found. During summer 1987, there was a more even distribution between the gastropods, oligochaetes, polychaetes and barnacles, while in autumn 1987 the gastropods were the most abundant group. During the 1987 survey, the number of benthic organisms collected increased each season, from a low of 4,713 during winter to a high of 39,321 in autumn. For comparison, the seasonal 2002 abundance data is shown in Figure 10B, which shows that in all seasons except autumn the 2002 collections produced many more organisms than in 1987. Almost twice as many individuals were counted during summer 2002 compared to summer 1987. During spring 2002 the samples produced over 19 times the number of organism collected in spring 1987. Figure 10B also shows that during winter, summer and autumn the polychaete worms were the most abundant group, followed by amphipods (winter and autumn) or cnidarians (burrowing anemones) in summer. During spring 2002, the amphipods were the most abundant invertebrate group collected, followed by the polycheates. Together, the polychaetes and amphipods made up between 74% (autumn) to 83% (winter) of the benthic community during the 2002 study.

3.3.2 Total Number of Taxa

Table 11 provides a comparison of the total number of taxa (a basic measure of diversity) collected at each site during each season for both survey periods. Seasonal fluctuations in diversity during the 2002 collections reveals that the highest number of taxa occurred at downriver sites T1-S (winter, n=28 taxa) and S1 (spring, n=29; summer, n=20 and autumn, n=25), while the sites with the lowest diversity in 2002 were found at upriver sampling sites GN3 during winter (n=5), spring (n=6) and summer (n=4) and site T4-D, where only four taxa were identified in autumn. In 1987, the highest diversity also occurred downstream, at sites T1-S (12 taxa in winter), T2-S (17 taxa in spring), S1 (16 taxa in summer) and T2-D (16 taxa in autumn). There were only a few instances where the total number of taxa collected during 1987 exceeded the number seen in the 2002 collections; during spring 1987 site T2-S had 2 more species than during the spring 2002 collections, and during summer 1987, sites T4-S and GN3 had one additional species over that collected at those sites in summer 2002.

Figure 11 shows the seasonal comparison of the total number of taxa collected from all 26 sampling locations (17 locations for winter 1987). During the 2002 survey, the number of taxa ranged from a low of 44 during the summer to a high of 54 during the spring. In 1987 the total number of taxa collected each season was always lower than in 2002, but still had a range of ten, with a low of 27 taxa identified during summer 1987 and a high of 37 during autumn 1987. During both studies the lowest number of taxa was recorded during the summer.

Figure 12 presents a spatial comparison of the total number of taxa collected at each site, with the sites arranged left to right, from downstream (GN1 at river mile 3.0) to upstream (TN6, at river mile 12.5). This chart shows that, when all seasons are combined (i.e., a yearly total), the total number of taxa collected at each sampling location was always higher during the 2002 survey. Sixteen sites had a total number of taxa that was between two to four and a half times higher than

that seen in the 1987 collections. Figure 12 also shows that as our collections moved upstream into less saline waters, there was a trend of decreasing diversity. When a linear trendline is added to the 2002 data in Figure 12 (not shown), the r^2 value is 0.69, showing a strong relationship between the total number of taxa and collection site location. The r^2 value for the 1987 data showed an even stronger relationship, with an r^2 of 0.84. The highest yearly number of taxa during the 2002 survey (n=43) was recorded at location S1, at RM 3.5. This location also produced the highest number of taxa during the 1987 survey (n=25). The lowest number of taxa collected in 2002 (n=10) was at GN3 (RM 12.2), while only four taxa were identified during the 1987 survey at upriver sites TN5, T5-S and TN6 (RM 10.9 to 12.5).

3.3.3 Benthic Density

Another way to look at the benthic data is to determine the density of the benthic organisms that inhabit the substrate. Density refers to the number of individuals per unit of area. Benthic ecologists typically use the number of organisms per square meter of river or ocean bottom. Since a standard Ponar grab samples an area of 0.052 m^2, the average abundance (i.e., the average number of organisms counted in the three replicate grab samples from each location) was converted to a density (average number per m^2) by multiplying the average number collected by 19.23. A comparison of the average density of the benthic community for both time periods is presented in Table 12, which shows the average density on both a spatial and a seasonal basis. The lowest density was recorded at site T9 (Cromakill Creek) during the summer of 1987, when no organisms were found in any of the three replicates collected that season. The highest density observed, an average of 175,006 individuals/m^2, was calculated for the three replicate samples collected at site T8 (Mill Creek) during autumn 1987.

A graphic comparison of the seasonal density is presented in Figure 13, which shows the average density for all 78 benthic collections made each season (only 50 collections during winter 1987-88). This comparison shows very large differences in the benthic density during winter and spring, when the average density calculated for the 2002 samples were 7.4 and 19.6 times higher (respectively) than those calculated for the winter and spring of 1987. A closer examination of Table 12 shows that during winter and spring, the benthic density at only three locations (TN1 and T2-D in winter, and TN1 and T2-S in spring) were higher during 1987. During summer, the 2002 average benthic density was approximately double that found during summer 1987, even though the densities at eight sites were higher in 1987 compared to the 2002 densities (see Table 12). The autumn comparison is the only season where the average benthic density was higher in 1987 than during 2002. The autumn benthic densities at 15 of the 26 sampling locations were higher during the 1987 study.

When the benthic densities from all four seasons are combined into an yearly average for each site, the comparison (Figure 14) shows that the average density of benthic organisms was higher at four locations during 1987 (S1, TN1, T2-S and T2-D). The average yearly densities calculated for the other 22 sites were higher during the 2002 study. The highest density of benthic organisms, during both time periods, occurred at site T8 (Mill Creek). Very high densities were also observed during the 2002 study at nearby sites T4-S, T4-D, and T9 (Cromakill Creek). These four locations fall between RM 9.2 and 9.4, and are located within Mill and Cromakill Creeks, and in the Hackensack River between the mouths of these creeks. Another, albeit lower peak of benthic densities occurred during the 2002 collections further upriver, around RM 11.4, the location of sites T5-S and T5-D.

3.3.4 Abundance by Species

In order to better understand the high densities of the benthic community seen at some of the sampling sites, an examination of the abundance of the individual species is needed. Therefore, the total abundance (i.e., for all seasons combined) for each species collected at each site during the 1987 study is summarized in Table 13. In addition to total abundance, Table 13 also provides a summary of the total number of taxa and total number of individuals collected at each site, as well as the overall total number and relative abundance for each species collected during the 1987 study. A similar summary of the total abundance data for each species collected at each site during the 2002 study is presented in Table 14.

Several stark differences in the distributions of certain species collected during the 1987 and 2002 studies become evident when comparing these two sets of data. For example, during 1987 relatively low numbers of three species of polychaete worms (*Hypaniola florida*, *Streblospio benedicti*, and *Laeonereis culveri*) were collected in the Hackensack River in the vicinity of Mill Creek (sites TN4, T4-S and T4-D at RM 9.2 to 9.3). No polycheate worms were collected at any upstream location (RM 9.4 to 12.5) in 1987. In contrast, very high numbers of polycheates were collected from sites T8 (at RM 9.2) through TN6 (at RM 12.5) during the 2002 study. Of the eight species of polychaetes collected at these sites during 2002 (see Table 14), the tube-building worm *Hobsonia florida* (listed as *Hypaniola florida* during the 1987 study) stands out due to the high numbers collected at these upper river sampling locations. *Hobsonia* reached its peak abundance in Cromakill Creek (site T9), where it represented 64% of all organisms collected at that site over all four seasons. In the portion of the river where no polychaetes were collected in 1987 (RM 9.4 to 12.5), *Hobsonia* comprised almost 97% of the 44,316 polycheates (and 60% of all benthic organisms) that were collected from this reach of the river during the 2002 survey.

Similarly, no isopods were collected in Mill Creek or at any site upstream of Mill Creek (RM 9.2 to 12.5) during the 1987 study. During the 2002 study, two species of isopods were collected in this reach of the river; the slender isopod (*Cyathura polita*) and *Edotea triloba*. Almost one-quarter of all the slender isopods collected during the 2002 study were recovered from the 11 sites in this upstream portion of the River, while almost half of all *Edotea triloba* collected were recovered in the upper three mile portion of our study area. When the abundances of these two species of small crustaceans are combined from the upper 11 sampling, they made up approximately one-third of all isopods collected during the 2002 study, where in the same area during 1987 no isopods were collected.

A comparison of another important group of small crustaceans, the amphipods, shows an even larger disparity between the two studies. During 1987, only two *Monoculodes edwardsi* were collected between RM 9.2 to 12.5 (see Table 13). During the 2002 study, a total of 70,002 amphipods from five different species were collected in this reach (Table 14). By far the most abundant amphipod was *Apocorophium lacustre* (listed as *Corophium lacustre* in the 1987 study), a tube-dwelling amphipod, which comprised 69% of all amphipods collected from the upper 11 collection sites (T8 to TN6). *Gammarus daiberi* was also collected in high numbers at several of these locations.

Another crustacean that follows a similar, but somewhat less striking pattern is the white-fingered mud crab (*Rhithropanopeus harrisii*). No white-fingered mud crabs were collected from the 11 sites in the upper reach of the river during 1987. However, during 2002, a total of 317 white-

fingered mud crabs were counted from the collections made in this portion of the river. This represents just over 59% of all white-fingered mud crabs collected during 2002 from all 26 sampling locations.

Given the high numbers of *Hobsonia, Apocorophium* and *Gammarus daiberi* that were recovered from several of these upper river sampling locations (T8, T4-S, T4-D, T9, T5-S and T5-D), it is easy to understand the high benthic densities that were calculated for these sites (as shown in Table 12).

An overall summary (combining all sites and seasons) of the total number collected, relative abundance (% of the total number collected), percent frequency of occurrence (number of collections that yielded a particular species divided by the total number of collections made) and abundance ranking for some of the most abundant species collected in 1987 and 2002 is presented in Table 15. Because the most abundant species were not the same during the two study periods, Table 15 presents a comparison for a total of 19 taxa, 13 of which were collected during both surveys. The species in Table 15 are arranged in order of abundance for the 2002 collection data. An examination of the data in Table 15 reveals an increase in abundance during 2002 for ten of the 13 taxa that were collected during both time periods.

A graphic comparison of the overall relative abundance for each of the species in Table 15 shows that of the 13 species that were collected during both studies, five had a higher relative abundance during the 1987 survey (Figure 15). The species in common that had a higher relative abundance during 1987 included; the Oligochaete worms (which comprised 26.5% of all organisms in 1987 compared to 6% in 2002), the platform mussel (*Mytilopsis leucophaeta*, also known as Conrad's false mussel), the polycheate worm (*Laeonereis culveri*), the white- fingered mud crab (*Rhithropanopeus harrisii*) and the bay barnacle (*Balanus improvisus*). It is interesting to note that although the polychaete *Laeonereis* and the white-fingered mud crab were collected in higher numbers during the 2002 study (i.e., their absolute abundance was higher), that their relative abundance was slightly higher during the 1987 survey. This is due to the overall lower number of invertebrates collected during the 1987 study, and the higher proportion of that lower total that these two species comprised in 1987. The most abundant species collected during the 1987 study, the snail *Hydrobia totteni*, was not identified in the 2002 collections. The polycheate worm *Polydora socialis* is another species shown on Figure 15 that was also not collected during 2002; however, its relative abundance during 1987 was relatively low (2.7%). Although ten species had a higher <u>total</u> abundance in 2002, only eight species collected during both surveys had a higher <u>relative</u> abundance during the 2002 study. These included four polycheate worms (*Hobsonia florida*, *Streblospio benedicti*, *Marenzellaria viridis* and *Heteromastus filiformis*), the isopods *Cyathura polita* and *Edotea triloba*, the amphipod *Apocorophium lacustre*, and the aquatic stages of the midge (Chironomidae). Several species that were collected in relatively high numbers in 2002 were not collected during the 1987 study, such as the amphipods *Gammarus daiberi* and *Leptocherius plumulosus*, the burrowing anemones from the family Edwardsiidae, and the snail *Littoridinops tenuipes*.

A comparison of the overall percent frequency of occurrence for each of the most abundant species collected during 1987 and 2002 is shown in Figure 16. From this chart it is easy to see the large differences in the frequency with which *Hobsonia florida*, *Apocorophium lacustre*, *Streblospio benedicti*, *Marenzellaria viridis*, *Laeonereis culveri*, *Edotea triloba*, and *Heteromastus filiformis* were collected during the 2002 collections compared to 1987. For

example, *Hobsonia* was identified in 216 of the 312 collections made during the 2002 study (a frequency of 69%), while it was present in only 21.5% of the 284 collections made during the 1987 study. The percent frequency of occurrence for a total of 11 of the 13 species shown on Table 15 that were collected during both studies was higher during the 2002 study. Only two species that were collected during both studies were collected more frequently in 1987; the oligocheates, which were present in 87% of all grab samples collected in 1987 compared to 65% during 2002, and the bay barnacle, which was present in 12% of the 1987 collections vs. 11% of the 2002 samples.

And finally, although collected in low numbers during the 2002 benthic inventory, two species deserve a special mention due to their recent discovery in the Hackensack River. A total of 11 specimens were identified by Cove Corporation as the non-indigenous marine isopod *Synidotea laevidorsalis*. These 11 individuals were collected at six locations in the lower Hackensack River (see Table 14). Chapman and Carlton (1991 and 1994) synonymized *Synidotea laticauda* (which was described based on one specimen collected from San Francisco Bay [Benedict 1897]), along with several other species of *Synidotea* under the previously described *S. laevidorsalis* (Miers, 1881), which is native to the boreal waters of the northwest Pacific (i.e., Japan). Chapman and Carlton (1991 and 1994) hypothesized that *S. laticauda* was actually *S. laevidorsalis*, which had reached Europe, Australia and North America (San Francisco Bay) as a fouling organism among hydroids and bryozoans fouling the hulls of ocean-going sailing ships. Prior to 1998, *S. laevidorsalis* was only known in the United States from California. In 1999, *S. laevidorsalis* was discovered in the waters of New Jersey's Delaware Bay (Bushek and Boyd, 2006), as well as in the Stono River in South Carolina (South Carolina Department of Natural Resources, 2008). Boyd (2008) noted that recent molecular analysis suggested that the *Synidotea* species found in the Delaware Bay (and elsewhere in the United States) is actually *S. laticauda*, proving that the taxonomic status of this isopod is still a subject of debate. Subsequent presence/absence surveys along the NJ coast by Boyd between Liberty State Park and Cape May did not reveal any *S. laevidorsalis* (or *S. laticauda*, as in Boyd, 2008), although they were identified at 34 sites within Delaware Bay. A recent search of the United States Geological Survey (USGS) Non-indigenous Aquatic Species database (http://nas.er.usgs.gov) revealed that *S. laevidorsalis* has been reported in the United States from San Francisco Bay, CA; Suisun Bay, CA; San Pablo Bay, CA; Napa River, CA; Stono River in Charlestown, SC; and in the Delaware Bay. The identification of *S. laevidorsalis* in our 2002 benthic collections represents the first record of this non-indigenous marine isopod from the Hackensack River.

Bushek and Boyd (2006) reported finding *S. laevidorsalis* in Delaware Bay waters in salinities ranging from 4 to 22 ‰. During the 2002 benthic inventory, these isopods were found in the lower to middle portion of the tidal Hackensack River, from RM 3.0 to 7.1, where salinities ranged from 6.85 to 22.98 ‰. *S. laevidorsalis* were collected during winter (n=2; at site T2-D), spring (n=6; three at T1-D, two at T3-S and one at T3-D), and autumn (n=3; one specimen each at sites T1-S, GN1 and T1-D)(see Table 17 and Appendix A). The low abundance of this isopod is likely due to the manner in which it was collected (i.e., Ponar grab sampler). It likely occurs in much higher numbers, especially on made-made structures such as marina docks, pilings, and navigational structures, as demonstrated in the Delaware Bay by Bushek and Boyd (2006). Incidental captures of relatively large isopods during the NJMC's fishery resource inventory were noted on the field data sheets (NJMC, 2005). Based on a quick on-board examination, these isopods were listed as "Idotea" (since at a glance they appeared to be the common marine isopod *Idotea baltica*) or simply as "isopods" on the fishery data sheets. A total of 13 of these isopods

were recorded during trawl and trap net collections in the lower River during October, November and December 2001 and March and July 2002. Higher numbers of similar large isopods were collected incidental to the Gill Net collections made at site GN1. During October 2001 a total of approximately 75 "isopods" were noted, and during summer 2003 a total of approximately 50 "isopods" were collected, along with clumps of bushy bryozoans that were caught in the gill net. Because these isopods had not been seen in the HMDC's 1987 fishery and benthic surveys or in any of our other 2002 fishery collections, several of them were preserved for later positive identification. An examination of these preserved specimens shows that they are all *Synidotea*. The collection of these "incidental" invertebrates during the NJMC's fishery inventory implies that there is a larger population of *Synidotea* in the Hackensack River than the few that were recovered in our benthic collections.

The other benthic species that was collected in low numbers during the 2002 benthic inventory was the common or Atlantic rangia (*Rangia cuneata*). Gosner (1978) listed the range of this brackish water clam as Maryland (northern Cheasapeake Bay) to Texas, found in tidal marshes. Although LaSalle and de la Cruz (1985) extended the range to include the Gulf of Mexico coast to Campeche, Mexico and north along the Atlantic coast including New Jersey, it appears that they included New Jersey based on a misinterpretation of the contents of a letter that was quoted in Woodburn's 1962 report on clams and oysters in Charlotte County (Florida). The discovery of *Rangia cuneata* in a tributary of the Potomac River in 1964 was noteworthy (Pfitzenmeyer and Drobeck, 1964), as living specimens were previously unknown from the Potomac and they were at the time believed to occur only in the Gulf of Mexico. Pfitzenmeyer and Drobeck speculated the *Rangia* had been introduced to the Potomac through oyster cultivation. They surmised that *Rangia* from the James River in Virginia may have been transported along with seed oysters and a few survived and successfully spawned. In 1970, Hopkins and Andrews noted that *Rangia cuneata* were developing large populations in many estuaries from Florida to Maryland. They noted that prior to 1955, *Rangia cuneata* was thought to be extinct on the east coast since the Pleistocene and to be living only in the Gulf coast estuaries (Hopkins and Andrews, 1970). They stated that *Rangia* seemed well on its way to re-occupying all of the range occupied in Pleistocene or warmer recent times. They stated that "*Rangia* populations now "pave the bottom" in many places where frequent sampling revealed none a few years ago." They noted that shellfish biologists familiar with the phenomenon had two theories as the reason for this expansion; 1) *Rangia cuneata* was a recent invader from the Gulf coast, or 2) that some unknown ecological change sparked resurgence of a small undiscovered population surviving since the Pleistocene in East Coast rivers. They stated that either explanation was hard to believe, but that it was undeniable that they were witnessing a population explosion. The first reported occurrence of *Rangia cuneata* in the Delaware River was in 1980 (Counts, 1980). In "Shells of the New York City Area", Jacobson and Emerson (1961), who examined collection locations up the Hudson River as far as Peekskill, did not include *Rangia cuneata*. The first collection of *Rangia* in the lower Hudson River was apparently by Christopher Letts in 1988 (Carlton, 1992). The Hudson River occurrence was attributed to larvae released in ballast water by Carlton (1992). The USGS considers the occurrence of *Rangia cuneata* from the east coast of Florida to the Chesapeake Bay, the James and Potomac Rivers in Virginia and the lower portion of the Hudson River in New York to be non-indigenous introductions (USGS, 2004).

In our 2002 benthic collections, a total of six *Rangia cuneata* were collected at six sampling locations (Table 14). During spring a total of two *Rangia* were recovered; one each at sites T4-S and T4-D. During summer one *Rangia* was found at site TN4, and during autumn one specimen

each was collected at sites T7 (Berry's Creek Canal), S2 and GN1. Earlier benthic collections in the Hackensack River by HMDC (1989) and PSE&G (1974, 1986 and 1998) did not report the collection of *Rangia*. Therefore, the six specimens in our 2002 collections appear to be the first record of *Rangia cuneata* expanding its range into the Hackensack River. Although collected in low numbers during our 2002 benthic inventory, the number of *Rangia* within the Hackensack River is apparently on the rise, as their occurrence as an "incidental" catch during fishery collections made by the NJMC in 2006, 2007 and 2009 will attest (NJMC, unpublished data). *Rangia* were not noted as an incidental invertebrate catch during any of the 480 fishery collections made by the NJMC during 2001-03. Fishery collections (mostly trawls) performed outside of the NJMC's regular 2001-03 fishery sampling revealed no *Rangia* in 2004 (in approximately 38 collections) or 2005 (nine collections). During 2006, one live *Rangia*, along with a few empty shells, were collected in the course of making 34 fishery collections. The live specimen (and the empty shells), collected at site T3, were thought to be so unusual that they were preserved. During 2007, when approximately 44 fishery collections were made, the valves from two different *Rangia* were trawled up from site T3. Additionally, during April 2007, large numbers of *Rangia* shells were found on the docks at the Barge Club marina in Carlstadt and at the Red Roof Inn's marina in Secaucus (undoubtedly dropped from the air by hungry gulls). Being another unusual occurrence, several of these shells were also retained for positive identification. No fishery collections were made by the NJMC in 2008, but during 2009 a total of 87 live *Rangia* were collected from 18 trawl collections. Sixty-six specimens were recovered in one trawl collection at site T9 (Cromakill Creek). Given this additional information from outside of the benthic inventory, it would appear that *Rangia cuneata* has established itself as a "new" member of the benthic community within the Hackensack Meadowlands.

3.3.5 Seasonal Abundance by Species

Summaries of the total number, relative abundance, percent frequency of occurrence and abundance ranking for each species collected during each season are provided in Tables 16 (1987 data) and 17 (2002 data). The species in these seasonal summary tables are listed in order of abundance (i.e., by rank) rather than in phylogenetic order, which serves to illustrate the shifts in the abundance for each species across the seasons. When all sites and seasons are considered, the most abundant organism collected during the 1987 study was the snail, *Hydrobia totteni* (Table 15). However, Table 16 shows that during the winter *Hydrobia* was the second-most abundant species, making up 25% of the total number of organisms collected during that season. *Hydrobia* ranked third in abundance during the spring of 1987, making up only 2.9% of the total number of organisms collected. During both the summer and autumn of 1987, *Hydrobia* was the most abundant species collected, when it comprised 29% and 68%, respectively, of all organisms collected during those seasons.

The polychaete worm *Hobsonia florida* was the most abundant organism collected during the 2002 study (Table 15). The seasonal data in Table 17 show that during the winter of 2002 *Hobsonia* was the most abundant species collected (when it made up about 55% of all organisms collected), but during the spring it dropped to third in abundance, when it comprised only 14% of the total number of invertebrates collected during that season. *Hobsonia* was again the most abundant species collected during summer 2002 (making up 56% of the total) and autumn 2002 (46% of the total). A further examination of the data presented in Tables 16 and 17 shows the full range of fluctuations in the abundance and the frequency of occurrence for each species collected over the four seasons during both study periods. This pattern of oscillating dominance

over short periods of time is a common feature of benthic communities in marine systems (Gray, 1981).

A more detailed examination of the seasonal distribution for selected species listed in Table 15 is provided in Figures 17 through 24. Each figure provides a direct comparison of the mean number collected at each site during each of the four seasons. In each of the following figures, the upper chart shows the spatial and seasonal distribution for the selected species during the 1987 collections, and the lower chart shows the data from the 2002 collections. For each sampling site, the seasonal fluctuations in the mean number of organisms collected can be seen.

Figure 17 present the spatial and seasonal comparison for *Hobsonia florida*, a small polychaete worm that lives in tubes made of mud, sand, and bits of aminal and plant debris on the surface of the sediment. *Hobsonia* is one of the most common estuarine polychaetes, often found in high numbers in intertidal and subtidal muds from Maine to Florida. It can tolerate a wide range of salinities and is often found along with other common estuarine invertebrates. *Hobsonia* was ranked first in abundance during the 2002 study, and seventh in abundance in 1987. Figure 17 shows that the average number of *Hobsonia* collected in 2002 was, in many cases, more than an order of magnitude greater than the average number collected in 1987. In 1987, the majority of the *Hobsonia* were collected during the summer from sites S2, T1-S, TN2, S1 and T4-D, with the highest average number of 65 collected in summer at site S2. During 1987, no *Hobsonia* were collected from any location upstream of RM 9.3 (site T4-D). In 2002 very large numbers of *Hobsonia* were collected, with the highest numbers collected from the sites in and near Mill and Cromakill Creeks (T8, T4-S, T4-D, and T9), with a secondary abundance peak upstream, in the vicinity of the BCUA Little Ferry sewage treatment plant near RM 11, at sites TN5, T5-S and T5-D. This correlates well with the observations of large numbers of worm tubes on the sediment surface that were made during sample collection (see Table 4). The highest number of *Hobsonia* collected during the 2002 study was an average of 2,768 counted in the winter samples from site T4-D. Large numbers of *Hobsonia* were collected during all seasons of 2002.

Apocorophium lacustre is a surface-deposit feeding amphipod that lives in mucous-lined mud tubes built on the surface of the sediment. They are found in brackish estuaries along the Atlantic coast from the Bay of Fundy to Florida in salinities ranging from 25 ‰ to almost freshwater. *Apocorophium lacustre* was the second most abundant species collected in 2002. The spatial and seasonal comparison charts for this amphipod are shown in Figure 18. An examination of the scale on each chart reveals the two orders of magnitude difference in the average number of *Apocorophium* collected in 2002 compared to 1987. In 1987, low numbers of *Apocorophium* were collected near RM 5.1 to 5.4 in Sawmill Creek (site T6 and TN2) and the Hackensack River near Sawmill Creek (T2-S and T2-D), mainly during the autumn and spring. During 2002, the majority of *Apocorophium* were collected further upriver, near RM 9.3, in Mill Creek and the Hackensack River at the mouth of Mill Creek (sites T8 and T4-S and T-4D) during the spring and winter. Lower numbers of this amphipod were also collected during spring 2002 at site T5-S.

Streblospio benedicti is a small, tube-building spionid polychaete common in marine and estuarine muds from Maine to Florida. They are often considered indicative of stressed or polluted environments, and tend to dominate the early successional stages of a benthic community. Although *Streblospio* are common in brackish salinities (5-18 ‰), Ristich (1977) noted a decrease in abundance of *Streblospio* as salinity decreased moving up the Hudson estuary. Figure 19 presents the comparison charts for *Streblospio benedicti*. The upper chart

shows that during 1987, the majority of *Streblospio* were collected during autumn from downriver locations T2-D, GN1, S1, T1-D and TN2, where the salinities were higher than sites further upriver. A secondary peak of *Streblospio* was seen during winter 1987/88 at lower river locations TN1 and T2-D. The bottom chart shows that overall, many more *Streblospio* were collected during the 2002 collections, with the majority of these worms being collected in the middle portion of the Meadowlands District, from the sampling sites between Berry's Creek and Berry's Creek Canal. During 2002, the salinities in this area were similar to those seen in the lower portion of the river in 1987. In 2002, the majority of *Streblospio* were collected during the spring and summer.

Oligochaetes (aquatic earthworms) are basically a freshwater group of annelid worms, but there are species which live in brackish waters. Oligochaetes are non-selective deposit feeders. They are able to thrive in areas with low concentrations of D.O., often occur in great numbers, and are often considered as indicators of organic pollution. The seasonal comparison for the oligochaete worms is shown in Figure 20. Overall, the oligochaetes were the second most abundant organism in 1987, and ranked fifth in abundance in 2002. During 1987, oligochaetes were collected throughout the study area, with the majority being collected in autumn, followed by summer, spring and winter. In 2002, very few oligochaetes were collected in the lower portion of the river. This is likely due to the higher salinity at the downriver sampling locations in 2002. The majority of the oligocheates recovered in 2002 were collected during the spring from Cromakill and Mill Creeks.

Although the midge flies of the family Chironomidae have more marine representatives than any other species of aquatic insects (Pennak, 1978), their aquatic larvae are mainly oligohaline to freshwater organisms. Many chironomid larvae (like those seen in our collections) construct mucous tubes on the surface of the mud. Like the oligochaetes, chironomids are capable of surviving at very low oxygen levels, and often occur in great abundance. The comparison charts for the chironomids are shown in Figure 21. The number of chironomids collected in 1987 were an order of magnitude lower than 2002. Chironomids were more widely distributed throughout the river in 1987 (due to lower salinities throughout the river), when the majority of the chironomids were collected during the spring. In the 2002 collections, almost all of the chironomids were collected in the upper three miles of the study area (where salinities were lower), with large numbers collected during the spring from Mill and Cromakill Creeks, summer at site S3 and winter in the Cromakill Creek.

Cyathura polita is the only isopod in the river with a long, cylindrical body; for this reason it is often called the slender isopod. *Cyathura* prefers mud and muddy sand substrate in oligohaline to mesohaline waters (salinities up to about 18 to 20 ‰), where they make simple, unlined burrows that may extend to a depth of 8 cm. The slender isopod was ranked 12th in abundance during both study periods. However, it occurred in only 22% of the 1987 collections, while during the 2002 study it was found in 74% of all collections. The wider distribution and greater abundance of this isopod within the study area during the 2002 collections is evident in the comparison charts in Figure 22. The upper chart shows that during 1987, very few slender isopods were collected in the river near Harmon Cove (RM 7.1 to 7.4) and none were collected at any of the sampling locations upstream of Berry's Creek Canal (RM 7.5). The majority of the slender isopods collected during 1987 were in the lower portion of the river during summer and autumn. The lower chart shows that during 2002, many more slender isopods were collected

during all seasons of the year, at almost all of the sampling stations from the area of RM 5.1 (Sawmill Creek) upstream to RM 11.4 (site T5-S).

Rhithropanopeus harrisii is a small, brown xanthid crab with light or white colored "fingers" on its claws (hence its common name, the white-fingered mud crab) that lives in mud, on pilings, among shells, or other areas that afford it some shelter. They can be found in tidal freshwater to salinities approaching 20 ‰ in estuaries from Canada to Mexico. In the Hackensack River, the white-fingered mud exhibited a similar spatial distribution pattern as the slender isopod. The upper chart in Figure 23 shows that during the 1987 collections, no white-fingered mud crabs were collected upstream of Berry's Creek Canal. The peak of abundance during 1987 was in the vicinity of RM 5.1 (Sawmill Creek), while the seasonal distribution shows the highest numbers of white-fingered mud crabs were collected during the summer. The abundance was progressively lower during the spring and autumn, with the lowest numbers collected during the winter of 1987. The chart showing the distribution of white-fingered mud crabs during the 2002 study shows that the majority of the mud crabs were also collected during the summer, with a slightly lower number collected during autumn, declining further in winter and spring. During the 2002 study, about 41% of all the white-fingered mud crabs collected were from the sites in and adjacent to Mill Creek near RM 9.3 (i.e., T8, T4-S and T4-D), an upstream shift from the 1987 abundance peak of approximately four miles.

Hydrobia totteni and *Littoridinops tenuipes* are members of the gastropod family Hydrobiidae. They are often found in very high numbers (but are often overlooked because of their very small size) in estuarine tidal marsh pools and in detritus on the bottom of creeks, rivers and mudflats, where they feed on the microflora and other organic matter on the substrate surface. The spatial and seasonal distribution for the small deposit-feeding hydrobid snail *Hydrobia totteni*, which was the most abundant species collected during the 1987 study, is shown on the upper chart in Figure 24. This chart clearly shows the very high mean number of *Hydrobia* that were collected in Mill Creek during the autumn of 1987. The scale on this chart may obscure the fact that the site with the second highest abundance of *Hydrobia*, (also collected in autumn) in 1987 was T7, in Berry's Creek Canal. Since no *Hydrobia* were identified in any of the 2002 benthic samples, the lower chart on Figure 24 presents the mean numbers of an analogous hydrobid snail, *Littoridinops tenuipes,* which ranked ninth in abundance during the 2002 study. During the 2002 study, the highest numbers of *Littoridinops* were collected during the spring from Overpeck Creek (site GN3) and the Hackensack River in the vicinity of the BCUA Little Ferry treatment plant (sites T5-S and T5-D). Smaller numbers of this snail were also collected during the winter and spring in Mill Creek.

3.3.6 Comparison of Diversity Indexes

As discussed in Section 2.6.2, the raw benthic data (i.e., the total number of individuals of each species collected at each site) was used to calculate a few commonly used ecological indexes; the Shannon diversity index (H′), Simpson's diversity index (D), and Evenness (J′). For each site an overall or yearly value (i.e., all seasons combined) for each index was calculated in addition to calculating each index value for each season. Table 18 provides a comparison for the yearly index values calculated for each site. For ease of comparison, this table also shows the averages calculated for salinity, dissolved oxygen, percent fines, and total organic carbon at each site, along with the total number of collections, the total number of organisms and the total number of taxa collected at each site for each study period. At a glance Table 18 shows that;

- The average salinity was higher at each site during the 2002 study.
- The average dissolved oxygen was higher at 21 of the 26 sampling sites during 1987. Sites with a higher average D.O. in 2002 included TN3, T7, T4-S, T9 and GN3.
- Sixteen sites had a higher percentage of fine sediments in 1987.
- The total number of organisms collected was higher at 22 sites in 2002. The four sites that had a higher number of organisms in 1987 included down river sites S1, TN1, T2-S and T2-D.
- The total number of taxa collected at each site was higher at all sites in 2002, and the number of taxa decreased moving upstream.

The comparison of the calculated indexes on Table 18 shows that the yearly Shannon index was higher at each of the 26 sampling locations during the 2002 study. Generally, during both study periods, the highest diversity was calculated for the downstream sites (from RM 3.0 to 5.4). Diversity decreased in an upstream direction. The highest H′ for 2002 (1.153) was calculated for site T1-D, while the lowest yearly H′ in 2002 (0.443) was calculated for site TN5. In 1987, the highest yearly H′ was at T2-S (0.846), while the yearly low H′ of 0.212 was calculated for site GN2. The results of the t-test comparison of the 2002 and 1987 Shannon indexes revealed that, when all seasons were combined, 19 of the 26 sampling locations (73%) had a significantly higher (p=0.05) Shannon index during the 2002 study (shown as bold numbers within shaded cells on Table 18. A graphic comparison of the yearly Shannon index values is provided in Figure 25).

Comparisons of the seasonal H′ calculated for each site in 2002 and 1987 are shown in Table 19. As with Table 18, any seasonal H′ values that are bold and shaded were significantly different than the corresponding Shannon index for that site (p=0.05). A graphic representation of the seasonal H′ data is shown in Figure 26, where the index values that were significantly different are denoted with an arrow. A synopsis of this data reveals that during the winter, the Shannon index was higher during the 2002 study at all sites where a comparison could be made (i.e., at 17 sites. Nine sites could not be compared because there were no abundance data from the 1987 study). Of these 17 sites, the Shannon index was significantly higher at ten sites. During winter 2002, the highest H′ of 1.162 was at site S1, while the lowest winter H′ in 2002 of 0.214 was calculated for site T5-D. In the winter of 1987, the highest H′ was at GN1 (0.960) and a 1987 winter H′ of 0.000 was calculated for site T8 in Mill Creek.

During the spring of 2002, the Shannon index was higher at all sites when compared to spring 1987, and H′ was significantly higher at 18 of the 26 sampling locations. In the spring of 2002, site T1-D had the highest H′ (1.112), while the lowest H′ (0.264) in spring 2002 was at site GN3. The highest H′ of 0.791 in the spring of 1987 was at site T2-S, while sites TN5 and TN6 had a H′ of 0.000.

During the summer, the Shannon index at 17 of the 26 sites was higher in 2002; and seven sites had a significantly higher H′ when compared to summer 1987. Of the nine sites where the Shannon index was higher during the summer of 1987, only two sites (TN2 and T4-S) had a significantly higher Shannon index during summer 1987. In the summer of 2002, the highest H′ of 0.990 was at site T2-S, while the lowest H′ (0.047) was at site T4-S. The Shannon indexes during the summer of 1987 ranged from 0.754 at site TN2 to 0.000 at site T9 (Cromakill Creek).

The comparison of the autumn data showed that the Shannon index was higher at 24 of the 26 sites in 2002, 16 of which were significantly higher than the 1987 Shannon index. Two sites (TN1 and T5-S) had a higher Shannon index during autumn of 1987, but they were not significantly different than the autumn 2002 Shannon index. The highest H′ calculated in autumn 2002 was 1.070 at site S1, while the lowest was 0.351 at T5-S. In 1987, the Shannon indexes ranged from 0.841 at site TN1 to a low of 0.112 at site T7 (in Berry's Creek Canal).

Similar to the Shannon index, the yearly Simpson diversity indexes that were calculated for each site were always higher in 2002 (Table 18); however, the 1987 Simpson diversity index values calculated for up-river sites TN5, T5-S, and GN3 were very close to the 2002 values. No statistical comparison was performed for the Simpson diversity indexes. A graphic representation of the yearly Simpson diversity index values is provided in Figure 27. As would be expected, when the Shannon and Simpson diversity indexes calculated for each site are compared, they mirror each other. The Simpson diversity index values calculated for each site during each season are shown in Table 20, which shows that during the winter, the Simpson diversity index was higher in 2002 for 16 of the 17 sites where a comparison could be made. In the spring of 2002, the Simpson diversity index at 25 of the 26 sites was higher than during spring 1987. The Simpson diversity index calculated at site T1-S was higher in both winter and spring 1987. When the Simpson's diversity index values for summer are compared, 12 sites had a higher diversity in 2002, while during the 1987 study 14 sites (GN1, TN1, T1-D, TN2, S2, T8, T4-S, T4-D, S3, TN5, T5-S, T5-D, GN3, and TN6) had a higher diversity. During the autumn sampling, 23 of the 26 sites had a higher Simpson's diversity index in 2002, with sites TN1, T9 and T5-S having a higher Simpson's diversity in autumn 1987.

The yearly evenness indexes calculated for each site during each study period are compared in Table 18 and Figure 28. The evenness was higher during the 2002 study at a total of 21 of the 26 sites (19 of those sites were from RM 3.0 to RM 9.3). From RM 9.4 to 12.5, five of the sites (out of the remaining seven) had a higher yearly evenness index during 1987. The seasonal evenness indexes calculated for each site are provided in Table 21. The evenness comparisons for the winter collections revealed that the evenness was higher at 13 sites during the 2002 study, while the evenness during winter 1987 was higher at four sites (GN1, T1-S, T1-D, and T9). In spring 2002, the evenness was higher at 19 sites. The spring evenness was exactly the same during both years at site S1, and the remaining six sites (T1-S, T1-D, S2, T7, TN4, and T9) had a higher evenness during spring 1987. During the summer, only 11 sites had a higher evenness in 2002; the evenness indexes for the remaining 15 sites were higher in 1987. The autumn comparison was similar to that found in spring, as the evenness calculated at 20 sites was higher during 2002, with the evenness higher at the remaining six sites (TN1, T9, S3, TN5, T5-S, and T5-D) in 1987.

4.0 DISCUSSION

As discussed in Section 3.0, the benthic community within the Hackensack Meadowlands in 2002 was dominated by polychaete worms and amphipods, with lower numbers of oligochaete worms and insects (mainly the larvae and pupae of midge flies). Although this represented a shift from a benthic community that was dominated by gastropods and oligocheate worms, followed by polychaetes and bivalves (clams) during the 1987 study, it is evident that during both studies the benthic community in the Hackensack River and its tributaries was typical of what would be expected in a mesohaline (5-18 ‰) to oligohaline (0.5-5 ‰) estuary (Tiner, 1985) with a substrate of predominately fine-grained sediments (i.e., mud). Shallow-burrowing deposit feeding annelid worms (oligocheates and polychaetes) that construct tubes on the sediment surface, tube dwelling amphipods that also live on the surface of the mud, along with snails and clams are typically the dominant benthic organisms found in soft-bottomed estuarine habitats (Posey and Alphin, 2001). As would also be expected, the 2002 benthic community in the Hackensack Meadowlands was dominated by only a few species, several of which occurred in very high numbers (e.g., the polychaetes *Hobsonia florida*, and *Streblospio benedicti* and the amphipods *Apocorophium lacustre*, and *Gammarus daiberi*, which together comprised 74% of all organisms collected*)*. These species, often referred to as opportunistic (or pollution-tolerant), reproduce quickly, rapidly colonize areas of suitable habitat after a disturbance, and have a high rate of mortality (Grassle and Grassle, 1974; McCall 1977; Whitlatch and Zajac, 1985). Disturbance of the benthic community can result from natural processes, such as sediment erosion and re-deposition after a storm, changes in sediment chemistry, and predator foraging, as well as from human activities like dredging, thermal effluent from power plants, bottom trawling, pollution from industrial discharges or spills, and excessive organic loading (which can lead to hypoxia). These opportunistic species are common in a variety of estuarine, river-dominated systems, especially those with anthropogenic impacts (Grizzle, 1984; Whitlatch and Zajac, 1985; Posey and Alphin, 2001).

When compared to the 1987 study, the 2002 benthic community data show large increases in abundance, percent frequency of occurrence, and expanded distributions for many of the benthic species that were collected during both studies. The overall diversity of the benthic community has also increased throughout the Meadowlands. The distribution and abundance of the benthos is determined by many natural and human factors. Among the most important natural factors are salinity and sediment composition (Carriker, et. al. 1982). Human factors include both physical and chemical (noted above). Because of the complex interactions of environmental factors that can influence the distributions of the benthos, it is difficult to say exactly why the benthic community has shown the improvements noted in this study, and it is virtually impossible to relate alterations to any specific natural or anthropogenic stressor (Boesch, 1982). However, the general perception is that the water quality within not only the Hackensack Meadowlands, but within much of the NY/NJ Harbor estuary has been steadily improving (Dean and Haskin, 1964; Berg and Levinton, 1985; PSE&G, 1998). An examination of the water quality data collected during the benthic invertebrate sampling has shown that in many cases, one important water quality parameter, the bottom D.O. levels were higher during the 1987 study (see Section 3.2 and Figures 6 and 8C). However, this snapshot view of the D.O. measurements can not discern the steady increase in the levels of D.O. that have been measured during seasonal water quality monitoring that has occurred in the Hackensack River since 1993. This seasonal water quality

monitoring has detected an increase in the D.O. levels within the Hackensack River over the 15 years that this data has been collected (Figure 29; NJMC, 2008).

Benthic invertebrate sampling conducted by PSE&G as part of regulatory studies related to the operations of the Kearny, Hudson and Bergen power generating stations have also show an increase in the abundance and diversity of the benthic community in the Hackensack River. During 1972-73, a total of only 13 benthic taxa were identified in samples collected from approximately RM 3 to 15 (PSE&G, 1974). In similar sampling conducted by PSE&G in 1986 a total of 27 different taxa were collected, and the densities were typically an order of magnitude higher than that seen during the 1972-73 collections (PSE&G, 1986). Benthic sampling conducted by PSE&G again in 1996-97 found a total of 37 taxa. PSE&G attributed the improvements they observed in the benthic community over the years to improved water quality; more specifically to increasing levels of D.O. measured in the Hackensack River (PSE&G, 1998).

An analysis of the sediment samples collected at all of the benthic invertebrate sampling locations for selected heavy metals has shown that the levels of cadmium, chromium, copper, lead, and nickel have decreased from 1987 to 2002 (NJMC, 2007). The NJMC sediment analysis noted a reduction in average concentrations of 22% for lead, 61% for nickel, 63% for chromium, 71% for cadmium and 73% for copper in sediments collected in 2002 at the 26 benthic community sampling locations. A t-test determined that the average sediment concentrations of cadmium, chromium, copper and lead were significantly lower during the 2002 benthic study. It appears that natural attenuation may be responsible for this decrease in metals contamination, where older, more contaminated sediments are being buried by newer, less contaminated sediments. The process of natural attenuation in Meadowlands sediments has been confirmed by other researchers (Goeller, 1989; Weis, et. al., 2005). Although the sediments now contain lower concentrations of these metals than in the past, they are far from “clean”. There are no absolute chemical concentrations that correspond to sediment toxicity, but “Effects Range Low” (ER-L) and “Effects Range Median” (ER-M) values are used as guidelines in assessing marine and estuarine sediment contamination. ER-M is the median concentration of a contaminant observed to have adverse biological effects in the literature studies examined by Long et. al. (1995). A more protective indicator of contaminant concentration is the ER-L criteria, which is the 10th percentile concentration of a contaminant represented by studies demonstrating adverse biological effects in the literature. The NJMC sediment analysis found that sediments at 60% of the benthic sampling locations exceeded more than five of the ER-L sediment guidelines, indicating that the estuary continues to exhibit metals contamination (NJMC, 2007). No data on sediment concentrations of organic contaminants such as pesticides or PCB’s were collected during the 1987 study. However, during the 2002 study, low levels of pesticides and PCB’s were detected in the limited number of sediment samples analyzed for these chemicals. The bioavailability of the metals and organic contaminants within the sediments, and the potential synergistic effects of these and other sediment constituents not measured during our studies (such as the levels of sulfide and ammonia) to the benthic invertebrates are unknown.

Although Levinton (1982) stated that the substrate type is the major controlling factor in the distribution of benthic species, Carriker (1967) noted that benthic communities in estuaries are primarily determined by salinity, which he felt was the major factor controlling regional distribution. In our study, the highest numbers of taxa were found in the downstream portions of the Hackensack River, where the salinity is typically highest. The relationship between the

average salinity and the RM where the benthic collections were made are shown in Figure 30. The Pearson product-moment coefficient (R^2), which depicts the strength of the correlation of the values of these two variables, is shown on each chart in Figure 30. The top chart shows the strong relationship between salinity and RM for the 2002 collections (R^2=0.93), while the bottom chart shows that the R^2 for 1987 was 0.87. Levinton (1982) also noted that species richness (i.e., diversity) generally diminishes moving up-estuary and reaches a minimum at a critical salinity. Species richness then increases again in freshwater (Dean and Haskin, 1964; Levinton, 1982). The steady decrease in diversity moving up into the estuary is related to the steady reduction of species that are capable of dealing with the stress that an ever changing salinity presents to them. This pattern was seen in our Meadowlands benthic data. When the yearly Shannon diversity index values calculated for each site were plotted against the average salinity (Figure 31), the highest Shannon index values are associated with the highest salinities. The R^2 value for the 2002 data (top chart on Figure 31) is 0.88, showing a strong relationship between diversity and salinity. A similar plot using the 1987 Shannon index values vs. the average salinity shows that there was a somewhat weaker relationship between these two variables in 1987 (when the average salinities were lower), with an R^2 value of 0.59 (bottom chart on Figure 31). When a similar comparison was made between the sediment texture (amount of percent fines at each site) and the Shannon diversity indexes (shown in Figure 32), the R^2 value for the 1987 data was 0.16 and for the 2002 data the R^2 value was 0.58. Therefore, of these two important natural variables, salinity appears to be a stronger influence on the diversity of the benthic community in the Hackensack River. The shifts in the distribution of some of the species collected during both studies is likely due to the differences in salinities measured during the two time periods. The lower salinities seen throughout the river in 1987 would have precluded species that prefer more marine and mesohaline salinities from successfully colonizing in areas of low salinity. During the 2002 collections, salinities measured throughout the Meadowlands were higher (due to a drought and the associated lack of freshwater input from the upper part of the system). This allowed species that prefer higher salinities to colonize and exploit areas further upriver than would have been possible in 1987.

This strong relationship between salinity and the diversity of the benthic community was confirmed in another recent benthic study commissioned by the Army Corps of Engineers, New York District (ACOE). They performed limited benthic grab sampling, along with a more extensive Sediment Profile Imaging (SPI) study in the mainstem of the Hackensack River in 2007 (ACOE, 2007). Using non-metric multi-dimensional scaling (nMDS) to analyze the benthic invertebrate community identified in 33 grab samples collected from the mouth of the river to approximately RM 10 during May 2007, the ACOE found that there were no consistent trends or patterns in community similarity among their 33 sampling stations that might be explained by similarities or differences in habitat types (i.e., stations with sandy vs. muddy substrate). Stations that were grouped together during the ACOE's analysis showed that the community structure was gradually changing from upstream to downstream, and the most likely explanation given was a salinity gradient to which the benthic community was responding (ACOE, 2007).

The higher densities of polychaete worm and amphipods in the vicinity of Mill and Cromakill Creeks, and upriver near the Little Ferry sewage treatment plant in 2002 may seem to indicate that the health of the benthic community has improved in those areas. They are an important part of the food web, and provide a good source of prey for fish, shrimp and crabs. Dr. Judith Weis (2005) found that the diet of white perch, the second most abundant fish species found during the NJMC fisheries resource inventory, was dominated by gammaridian amphipods. Ristich (1977)

seemed to equate very high benthic densities in the lower Hudson River as evidence of the "health" of that estuary. However, since cultural eutrophication is often reflected by enhanced productivity of relatively few tolerant species, high densities by themselves may not indicate a "healthy" or "normal" benthic community (Franz, 1982). The overwhelming dominance of the benthic community in Mill and Cromakill Creeks, in the Hackensack River between those tributaries, and further upstream near the Little Ferry treatment plant by the three most abundant species (*Hobsonia*, *Apocorophium*, and *Gammarus*) suggests that these areas are subject to some kind of periodic disturbance that has not allowed a more advanced successional stage of the benthic community to develop. Both Mill and Cromakill Creeks receive the effluent discharged from separate sewage treatment plants. Mill Creek receives a discharge of approximately 3.5 million gallons per day (mgd), while Cromakill Creek is the recipient of approximately 6 mgd. At Little Ferry, the Hackensack River receives approximately 76 mgd of treated sewage effluent. The large volumes of freshwater discharged by these facilities, and the additional organic loading from the sewage effluent are a "disturbance" that likely exerts a strong influence on the benthic community in these areas. Gray (1981) stated that probably the most universal pollutant affecting marine benthic communities is excess organic matter, which occurs principally as sewage. Sewage discharged into confined bodies of water frequently leads to eutrophication, resulting in decreased oxygen and the presence of hydrogen sulfide in the sediment, with a corresponding absence of fauna. As one moves away from the source of pollution there is typically a sudden and rapid increase in biomass and abundance of the fauna. Observations made during the collection of the 2002 benthic samples confirmed that there was a thin brown oxygenated surface layer (where the numerous worm and amphipod tubes were located), underlain by a soft, black anoxic mud at sampling locations T4-S and D, T5-S and D, T8 and T9.

Another potential source of disturbance could have been the disruption of the river bottom by the trawling conducted as part of the concurrent NJMC fishery resource inventory (NJMC, 2005). Since the trawling was conducted monthly during the first year of the fishery collections, the benthic habitat at all of the trawl stations was repeatedly disturbed. As discussed in Section 2.0, the seasonal benthic grab samples were collected from the same sampling locations. The benthic sampling sites in Mill and Cromakill Creeks and in the Hackensack River where the high densities of *Hobsonia*, *Apocorophium*, and *Gammarus* were encountered correspond to trawl sites T8, T9, T4 and T5. A review of the dates when trawling was conducted relative to when the seasonal benthic grab samples were collected showed that during the winter of 2001-02 (which represented the first round of 2002 benthic sampling), the time between trawling and benthic sample collections ranged from 11 to 24 days. The time between trawling and the spring benthic collections ranged from 2 to 22 days; during summer the time difference ranged from 42 to 66 days. During the final round of benthic sampling in autumn 2002 (when trawling was being done on a quarterly, rather than a monthly basis), the difference in time between trawling and benthic sampling ranged from 21 to 106 days (with a span of 103 days at site T5, 106 days for T4 and T8 and a span of 35 days for T9). In his classic study of the role of bottom disturbance and its effect on the infaunal benthos in Long Island Sound, McCall (1977) found that pioneering (i.e., opportunistic) species settling in trays of defaunated mud reached their maximum abundance in 10 to 50 days. Another conclusion reached by the ACOE's Hackensack River benthic study was that physical disturbance (from cycles of deposition and erosion) as well as salinity fluctuations appeared to be the main environmental factors that have resulted in the numerical dominance of the stress/disturbance tolerant species in the Hackensack River benthic community (ACOE, 2007).

It is unlikely that any single factor is responsible for the high densities of opportunistic species seen at these sampling locations, but rather there are a complex combination of factors (including, but not limited to fluctuations in temperature, salinity, the quality and quantity of food items available, competition between species, predation – especially by blue crabs, impacts of parasites, disease, etc.) that are responsible for the patterns of distribution and abundance in the benthic community that were seen in the 2002 study.

In summary, there appear to have been significant increases in the abundance of many species and in the overall diversity of the benthic community in the Hackensack Meadowlands in the 15 years since the original 1987 benthic survey was conducted. However, the overwhelming dominance of a few opportunistic species at several locations within the mid to upper portion of the Meadowlands provides evidence that this system is subject to periodic disturbances that, in localized areas, may retard the development of more advanced successional stages of the benthic community.

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TABLES

TABLE 1
Site Names/Locations by River Mile
NMJC/MERI Hackensack River Benthic Inventory

Approximate River Mile	Sample Location Name	Abbreviation in Report	Notes
3.00	Gill Net 1	GN1	
3.50	Seine 1	S1	
3.70	Trap Net 1	TN1	TN1 was situated closer to the mouth of Penhorn Creek during the 1987 study
3.71	Trawl 1 - Shallow	T1-S	
3.72	Trawl 1 - Deep	T1-D	
5.10	Trawl 6	T6	in Sawmill Creek
5.20	Trap Net 2	TN2	in Sawmill Creek
5.40	Trawl 2 - Shallow	T2-S	
5.41	Trawl 2 - Deep	T2-D	
6.80	Gill Net 2	GN2	
7.00	Trawl 3 - Shallow	T3-S	
7.01	Trawl 3 - Deep	T3-D	
7.10	Trap Net 3	TN3	
7.40	Seine 2	S2	
7.50	Trawl 7	T7	in Berry's Creek Canal
9.20	Trap Net 4	TN4	
9.21	Trawl 8	T8	in Mill Creek
9.25	Trawl 4 - Shallow	T4-S	
9.31	Trawl 4 - Deep	T4-D	
9.40	Trawl 9	T9	in Cromakill Creek, T9 was located further upstream during the 1987 study
10.60	Seine 3	S3	
10.90	Trap Net 5	TN5	
11.40	Trawl 5 - Shallow	T5-S	
11.41	Trawl 5 - Deep	T5-D	
12.20	Gill Net 3	GN3	in Overpeck Creek
12.50	Trap Net 6	TN6	just north of HMD boundary

Note: Figures for approximate River Mile are in nautical miles.

TABLE 2
Sieve Series Used for Sediment Texture Analysis and Wentworth Particle Size Classification
NMJC/MERI Hackensack River Benthic Inventory

1987 Sieve Series

Sieve Mesh #	Grain Size (mm)	Wentworth Scale	Class
5	4.0	pebble	Gravel
10	2.0	granule	
18	1.0	very coarse sand	Sand
35	0.5	coarse sand	
60	0.25	medium sand	
120	0.125	fine sand	
230	0.0625	very fine sand	
<230	<0.0625	silt & clay	Mud

2002 Sieve Series

Sieve Mesh #	Grain Size (mm)	Wentworth Scale	Class
4	4.75	pebble	Gravel
10	2.00	granule	
40	0.425	coarse sand	Sand
60	0.250	medium sand	
120	0.125	fine sand	
230	0.0625	very fine sand	
<230	0.005	silt	Mud
(by hydrometer)	<0.005	clay	

TABLE 3
Average Percentage of Fine Material (Silt & Clay)
From Sediment Samples Collected During the
2002 and 1987 Hackensack River
Benthic Macroinvertebrate Inventories

River Mile	SITE	2002	1987
3.00	**GN1**	19.1	11.5
3.50	**S1**	1.9	41.5
3.70	**TN1**	83.6	76.3
3.70	**T1-S**	74.6	56.4
3.71	**T1-D**	70.6	55.1
5.10	**T6**	76.6	94.8
5.20	**TN2**	86.5	94.8
5.40	**T2-S**	40.2	11.0
5.41	**T2-D**	19.5	17.6
6.80	**GN2**	73.7	73.0
7.00	**T3-S**	81.2	91.0
7.01	**T3-D**	87.5	92.8
7.10	**TN3**	78.6	96.0
7.40	**S2**	27.7	40.3
7.50	**T7**	84.6	94.6
9.20	**TN4**	76.7	89.4
9.20	**T8**	84.0	91.4
9.25	**T4-S**	68.6	93.9
9.31	**T4-D**	60.9	88.9
9.40	**T9**	86.4	92.5
10.60	**S3**	91.3	97.3
10.90	**TN5**	80.0	77.6
11.40	**T5-S**	79.6	96.7
11.41	**T5-D**	84.7	14.8
12.20	**GN3**	89.0	98.2
12.50	**TN6**	85.6	84.8
	AVERAGE	**69.0**	**72.0**

TABLE 4
Visual Description of Sediments Collected During 2002
NMJC/MERI Hackensack River Benthic Inventory

River Mile	Sample Location	Summary of Visual Descriptions of Sediments Collected Across All Four Seasons
3.00	GN1	sticky black mud with some sand & gravel. chemical odor & sheen often noted
3.50	S1	grey/brown mud with a lot of sand & gravel, occassional glass
3.70	TN1	grey clay with a thin brown surface layer, with fine organic detritus
3.71	T1-S	grey/black sticky clay with some sand
3.72	T1-D	grey/black sticky clay with shell fragments & some sand. Little organic detritus
5.10	T6	sticky grey & brown clay with some shells, gravel & sand. Hard bottom prevents obtaining a full grab.
5.20	TN2	sticky grey clay with a lot of organic detritus
5.40	T2-S	greyish-brown hard packed sand with some black/grey mud
5.41	T2-D	brown & grey sand with some organic detritus
6.80	GN2	grey clay & black mud with a lot of organic detritus. Occassional chemical odor & sheen.
7.00	T3-S	grey mud with a thin brown surface layer. Little organic debris
7.01	T3-D	soft blackish/grey mud with a thin brown surface layer. Occassional sheen
7.10	TN3	soft black mud
7.40	S2	black mud & grey clay with a lot of sand. Occassional chemical odor & sheen
7.50	T7	very soft black mud with a lot of organic detritus (Phragmites leaves & stalks). anaerobic odor
9.20	TN4	soft black mud with a thin brown surface layer. Occasional chemical odor & sheen
9.21	T8	black mud with a thin grey-brown surface layer with many worm/amphipod tubes
9.25	T4-S	soft black mud with a thin brown surface layer & many worm/amphipod tubes. Abundant organic detritus
9.31	T4-D	soft black mud with a thin brown surface layer & many worm/amphipod tubes. Abundant organic detritus
9.40	T9	soft black mud with a thin brown surface layer & many worm/amphipod tubes.
10.60	S3	soft black mud with a thin brown surface layer, some sand & gravel
10.90	TN5	soft black mud with a small amount of organic detritus. Occassional sheen.
11.40	T5-S	soft black mud with a thin brown surface layer & worm/amphipod tubes on the surface. Chemical odor & sheen.
11.41	T5-D	soft black mud with some sand with a thin brown surface layer & worm/amphipod tubes on the surface. Chemical odor & sheen.
12.20	GN3	very soft black mud with very little organic detritus.
12.50	TN6	soft dark grey-black mud with very fine organic detritus. Chemical odor & sheen often noted.

TABLE 5
Average Percent Fines, Grouped By Location Type, in Sediments Collected During the 1987 and 2002 Benthic Invertebrate Inventories NMJC/MERI Hackensack River Benthic Inventory

1987 AVERAGES

Net Type	# of sites	% Fines	% OM	% Moisture
Seines	3	59	--	--
Gill Nets	3	61	--	--
Trawls	14	71	--	--
Trap Nets	6	86	--	--

NOTE: Sediment samples were not analyzed for Organic Matter (OM) or Percent Moisture in 1987.

2002 AVERAGES

Net Type	# of sites	% Fines	% OM	% Moisture
Seines	3	40	7.7	50
Gill Nets	3	61	7.9	51
Trawls	14	70	9.8	60
Trap Nets	6	82	12.0	65

TABLE 6

Summary of Surface and Bottom Water Quality Measurements by Site Location

NMJC/MERI Hackensack River Benthic Inventory

January to December 2002 and March 1987 to March 1988

Approx River Mile	Surface Salinity (0/00) 2002				
	Surf Sal	n=	Min	Max	Mean
3.00	**GN1**	4	8.96	22.55	**15.89**
3.50	**S1**	4	8.52	20.11	**14.58**
3.70	**TN1**	4	7.72	21.26	**14.54**
3.70	**T1-shallow**	4	9.16	22.88	**14.90**
3.71	**T1-deep**	4	8.90	22.32	**14.65**
5.10	**T6**	4	8.10	19.22	**13.93**
5.20	**TN2**	4	8.16	17.44	**12.93**
5.40	**T2-shallow**	4	9.13	19.30	**14.16**
5.41	**T2-deep**	4	7.14	20.61	**13.77**
6.80	**GN2**	4	6.99	14.46	**10.62**
7.00	**T3-shallow**	4	7.10	14.50	**10.96**
7.01	**T3-deep**	4	6.85	13.81	**10.02**
7.10	**TN3**	4	5.25	16.84	**10.21**
7.40	**S2**	4	6.00	15.62	**11.34**
7.50	**T7**	4	4.00	13.81	**8.90**
9.20	**TN4**	4	5.28	14.02	**9.28**
9.20	**T8**	4	5.66	9.94	**7.46**
9.25	**T4-shallow**	4	4.04	11.77	**8.09**
9.31	**T4-deep**	4	3.85	13.70	**8.61**
9.40	**T9**	4	2.33	10.27	**5.41**
10.60	**S3**	4	3.12	9.79	**6.55**
10.90	**TN5**	4	1.95	8.91	**5.89**
11.40	**T5-shallow**	4	3.25	8.25	**5.72**
11.41	**T5-deep**	4	3.06	8.05	**5.18**
12.20	**GN3**	4	1.24	7.70	**4.43**
12.50	**TN6**	4	0.74	8.40	**5.05**

Surface Salinity (0/00) 1987-88				
Surf Sal	n=	Min	Max	Mean
GN1	4	4.0	15.0	**9.0**
S1	4	8.0	17.0	**11.3**
TN1	4	8.0	17.0	**10.8**
T1-shallow	4	4.0	17.0	**9.8**
T1-deep	4	4.0	17.0	**9.8**
T6	4	3.0	15.0	**7.3**
TN2	4	3.0	13.0	**6.8**
T2-shallow	4	6.0	15.5	**8.9**
T2-deep	4	6.0	15.5	**8.9**
GN2	4	2.0	11.0	**5.8**
T3-shallow	4	2.0	8.0	**5.3**
T3-deep	4	2.0	8.0	**5.3**
TN3	4	2.0	11.0	**6.0**
S2	4	3.0	12.0	**7.8**
T7	4	2.0	8.0	**4.8**
TN4	4	0.0	5.0	**3.0**
T8	4	0.0	5.0	**3.3**
T4-shallow	4	0.0	6.0	**4.0**
T4-deep	4	0.0	6.0	**4.0**
T9	4	0.0	4.0	**1.6**
S3	4	0.0	4.5	**1.1**
TN5	4	0.0	3.0	**1.5**
T5-shallow	4	0.0	4.0	**1.0**
T5-deep	4	0.0	3.5	**0.9**
GN3	3	2.0	7.0	**4.3**
TN6	4	0.0	4.0	**1.5**

	Bottom Salinity (0/00) 2002				
	Bottom Sal	n=	Max	Mean	Mean
3.00	**GN1**	4	8.97	22.98	**15.98**
3.50	**S1**	1	21.17	21.17	**21.17**
3.70	**TN1**	1	21.45	21.45	**21.45**
3.70	**T1-shallow**	4	10.32	23.27	**15.41**
3.71	**T1-deep**	4	8.93	23.52	**15.04**
5.10	**T6**	4	8.13	20.13	**14.24**
5.20	**TN2**	1	17.55	17.55	**17.55**
5.40	**T2-shallow**	4	9.86	19.91	**14.73**
5.41	**T2-deep**	4	10.76	21.10	**15.07**
6.80	**GN2**	4	7.27	14.44	**10.93**
7.00	**T3-shallow**	4	7.85	15.34	**11.76**
7.01	**T3-deep**	4	7.71	14.32	**11.22**
7.10	**TN3**	3	8.20	17.37	**12.47**
7.40	**S2**	3	8.58	15.71	**13.33**
7.50	**T7**	4	3.98	15.18	**9.34**
9.20	**TN4**	3	5.96	15.27	**9.42**
9.20	**T8**	4	5.80	10.02	**7.52**
9.25	**T4-shallow**	4	4.27	12.83	**8.82**
9.31	**T4-deep**	4	4.48	15.35	**9.79**
9.40	**T9**	4	2.40	10.73	**6.42**
10.60	**S3**	2	4.97	11.90	**8.44**
10.90	**TN5**	2	8.83	9.08	**8.96**
11.40	**T5-shallow**	4	3.73	9.33	**6.35**
11.41	**T5-deep**	4	4.14	10.69	**6.61**
12.20	**GN3**	4	1.26	7.76	**5.29**
12.50	**TN6**	3	3.73	9.04	**6.87**

Bottom Salinity (0/00) 1987-88				
Bottom Sal	n=	Min	Max	Mean
GN1	4	4.0	16.0	**9.8**
S1	1	8.0	8.0	**8.0**
TN1	2	8.0	10.0	**9.0**
T1-shallow	4	5.0	17.0	**10.3**
T1-deep	4	5.0	17.0	**10.3**
T6	4	3.0	16.0	**8.0**
TN2	4	3.0	13.5	**6.9**
T2-shallow	4	6.0	16.0	**9.3**
T2-deep	4	6.0	16.0	**9.3**
GN2	4	2.0	12.5	**6.4**
T3-shallow	4	2.0	9.0	**6.0**
T3-deep	4	2.0	9.0	**6.0**
TN3	2	2.0	5.0	**3.5**
S2	2	5.0	11.0	**8.0**
T7	4	2.0	9.0	**6.3**
TN4	4	0.0	7.0	**3.5**
T8	4	0.0	6.0	**3.5**
T4-shallow	4	0.0	7.0	**4.5**
T4-deep	4	0.0	7.0	**4.5**
T9	4	0.0	3.0	**1.5**
S3	2	0.0	1.0	**0.5**
TN5	4	0.0	3.0	**1.0**
T5-shallow	3	0.0	1.0	**0.3**
T5-deep	4	0.0	3.5	**1.1**
GN3	3	2.0	8.0	**4.7**
TN6	4	0.0	4.0	**1.3**

TABLE 6 (continued)
Summary of Surface and Bottom Water Quality Measurements by Site Location
NMJC/MERI Hackensack River Benthic Inventory
January to December 2002 and March 1987 to March 1988

Approx River Mile	Surface Temperature (°C) 2002				
	Surf Temp	n=	Min	Max	Mean
3.00	**GN1**	4	6.84	31.23	**16.47**
3.50	**S1**	4	7.40	32.24	**18.79**
3.70	**TN1**	4	7.05	39.08	**21.33**
3.70	**T1-shallow**	4	10.65	28.15	**17.24**
3.71	**T1-deep**	4	10.29	27.13	**16.69**
5.10	**T6**	4	10.30	25.55	**16.65**
5.20	**TN2**	4	9.96	29.06	**17.46**
5.40	**T2-shallow**	4	9.24	26.02	**17.16**
5.41	**T2-deep**	4	9.63	25.91	**17.63**
6.80	**GN2**	4	9.25	28.19	**17.67**
7.00	**T3-shallow**	4	7.84	24.07	**16.18**
7.01	**T3-deep**	4	7.82	23.25	**15.93**
7.10	**TN3**	4	6.46	28.58	**16.74**
7.40	**S2**	4	6.34	27.98	**16.26**
7.50	**T7**	4	1.60	27.74	**14.84**
9.20	**TN4**	4	8.13	27.51	**17.94**
9.20	**T8**	4	6.34	23.19	**16.33**
9.25	**T4-shallow**	4	7.59	23.46	**16.93**
9.31	**T4-deep**	4	7.96	23.07	**16.76**
9.40	**T9**	4	2.72	23.38	**14.10**
10.60	**S3**	4	3.26	26.24	**14.38**
10.90	**TN5**	4	8.48	26.40	**16.50**
11.40	**T5-shallow**	4	9.17	23.93	**17.20**
11.41	**T5-deep**	4	8.33	23.54	**16.90**
12.20	**GN3**	4	5.98	24.08	**14.45**
12.50	**TN6**	4	7.79	26.73	**16.30**

Surface Temperature (°C) 1987-88				
Surf Temp	n=	Min	Max	Mean
GN1	4	6.5	25.5	**14.0**
S1	4	6.7	25.0	**14.0**
TN1	4	6.1	25.0	**15.4**
T1-shallow	4	7.6	27.0	**16.0**
T1-deep	4	7.6	27.0	**16.0**
T6	4	6.6	25.5	**14.9**
TN2	4	7.9	25.5	**15.5**
T2-shallow	4	7.0	26.0	**15.2**
T2-deep	4	7.0	25.0	**14.9**
GN2	4	6.6	25.0	**14.9**
T3-shallow	4	6.7	25.0	**16.4**
T3-deep	4	6.7	25.0	**16.4**
TN3	4	6.7	26.5	**17.1**
S2	4	6.7	25.5	**16.8**
T7	4	5.6	24.0	**15.5**
TN4	4	6.9	26.0	**13.5**
T8	4	8.8	21.0	**15.1**
T4-shallow	4	9.0	26.0	**16.7**
T4-deep	4	9.0	26.0	**16.7**
T9	4	6.4	20.0	**12.6**
S3	4	6.0	24.0	**13.1**
TN5	4	6.0	21.0	**13.2**
T5-shallow	4	6.0	27.0	**15.2**
T5-deep	4	6.0	22.0	**13.9**
GN3	3	7.5	28.5	**21.0**
TN6	4	7.0	21.0	**13.7**

	Bottom Temperature (C) 2002				
	Bottom Temp	n=	Min	Max	Mean
3.00	**GN1**	4	6.08	31.14	**16.18**
3.50	**S1**	1	7.66	7.66	**7.66**
3.70	**TN1**	1	7.02	7.02	**7.02**
3.70	**T1-shallow**	4	10.23	24.43	**15.62**
3.71	**T1-deep**	4	10.19	24.27	**15.58**
5.10	**T6**	4	9.78	25.21	**16.42**
5.20	**TN2**	1	29.15	29.15	**29.15**
5.40	**T2-shallow**	4	9.15	25.40	**16.91**
5.41	**T2-deep**	4	8.84	25.43	**16.97**
6.80	**GN2**	4	7.78	28.66	**17.25**
7.00	**T3-shallow**	4	7.77	24.05	**16.13**
7.01	**T3-deep**	4	8.05	23.95	**16.06**
7.10	**TN3**	3	6.54	28.59	**19.30**
7.40	**S2**	3	6.69	28.44	**19.07**
7.50	**T7**	3	7.56	28.22	**19.21**
9.20	**TN4**	3	7.34	23.01	**14.66**
9.20	**T8**	4	5.08	23.18	**16.23**
9.25	**T4-shallow**	4	7.64	23.29	**16.69**
9.31	**T4-deep**	4	7.12	23.12	**16.63**
9.40	**T9**	4	2.68	22.18	**13.54**
10.60	**S3**	2	6.80	20.53	**13.67**
10.90	**TN5**	2	7.87	26.57	**17.22**
11.40	**T5-shallow**	4	7.59	23.40	**16.36**
11.41	**T5-deep**	4	6.54	23.25	**15.99**
12.20	**GN3**	4	5.66	23.38	**14.21**
12.50	**TN6**	3	7.32	26.62	**16.01**

Bottom Temperature (C) 1987-88				
Bottom Temp	n=	Min	Max	Mean
GN1	4	6.7	25.5	**13.9**
S1	1	6.6	6.6	**6.6**
TN1	2	5.8	6.6	**6.2**
T1-shallow	4	6.8	25.5	**14.1**
T1-deep	4	6.8	25.5	**14.1**
T6	4	6.6	25.0	**14.7**
TN2	4	7.6	25.5	**15.1**
T2-shallow	4	7.1	25.5	**15.0**
T2-deep	4	7.1	25.5	**15.0**
GN2	4	6.0	25.0	**14.6**
T3-shallow	4	6.1	25.0	**16.3**
T3-deep	4	6.1	25.0	**16.3**
TN3	2	6.1	10.0	**8.1**
S2	2	10.0	25.0	**17.5**
T7	4	5.4	24.0	**15.4**
TN4	4	6.4	25.0	**13.1**
T8	4	8.7	20.5	**14.9**
T4-shallow	4	8.7	25.0	**15.5**
T4-deep	4	8.7	25.0	**15.5**
T9	4	6.5	20.0	**12.7**
S3	3	6.0	13.0	**9.3**
TN5	3	6.0	16.5	**10.5**
T5-shallow	3	6.0	13.1	**10.7**
T5-deep	4	6.0	22.0	**13.5**
GN3	3	7.3	28.0	**20.8**
TN6	3	6.0	16.5	**10.9**

TABLE 6 (continued)
Summary of Surface and Bottom Water Quality Measurements by Site Location
NMJC/MERI Hackensack River Benthic Inventory
January to December 2002 and March 1987 to March 1988

Approx River Mile	Surface Dissolved Oxygen (mg/L) 2002					Surface Dissolved Oxygen (mg/L) 1987-88				
	Surf DO	n=	Min	Max	Mean	Surf DO	n=	Min	Max	Mean
3.00	**GN1**	4	2.78	9.83	**6.77**	**GN1**	4	3.1	11.4	**7.9**
3.50	**S1**	4	4.06	9.33	**6.54**	**S1**	4	2.8	11.1	**7.1**
3.70	**TN1**	4	2.99	9.78	**6.34**	**TN1**	4	2.8	10.6	**6.8**
3.70	**T1-shallow**	4	3.60	7.55	**5.80**	**T1-shallow**	4	3.1	12.0	**8.0**
3.71	**T1-deep**	4	3.52	7.17	**5.80**	**T1-deep**	4	3.1	12.0	**8.0**
5.10	**T6**	4	2.85	9.70	**6.70**	**T6**	3	8.0	13.0	**10.5**
5.20	**TN2**	4	4.45	10.30	**7.49**	**TN2**	4	3.6	13.0	**9.1**
5.40	**T2-shallow**	4	3.05	7.28	**5.60**	**T2-shallow**	4	3.8	10.2	**6.7**
5.41	**T2-deep**	4	3.23	6.73	**5.70**	**T2-deep**	4	3.8	10.2	**6.7**
6.80	**GN2**	4	3.29	6.65	**5.36**	**GN2**	4	4.2	8.6	**5.5**
7.00	**T3-shallow**	4	3.21	7.15	**4.95**	**T3-shallow**	4	2.5	6.2	**4.0**
7.01	**T3-deep**	4	4.37	7.35	**5.61**	**T3-deep**	4	2.5	8.2	**4.5**
7.10	**TN3**	4	4.82	6.28	**5.65**	**TN3**	4	2.5	8.2	**4.7**
7.40	**S2**	4	2.87	6.73	**5.04**	**S2**	4	3.2	8.0	**4.8**
7.50	**T7**	4	3.72	11.75	**7.38**	**T7**	4	2.2	9.2	**5.2**
9.20	**TN4**	4	2.20	5.60	**4.55**	**TN4**	4	2.9	8.2	**6.2**
9.20	**T8**	4	3.42	6.15	**4.80**	**T8**	4	2.2	4.2	**3.3**
9.25	**T4-shallow**	4	4.81	7.19	**5.84**	**T4-shallow**	4	2.9	6.2	**4.6**
9.31	**T4-deep**	4	4.01	5.84	**4.68**	**T4-deep**	4	2.9	6.2	**4.6**
9.40	**T9**	4	2.62	6.22	**4.55**	**T9**	4	1.0	6.4	**3.0**
10.60	**S3**	4	2.96	7.11	**5.12**	**S3**	4	3.2	7.3	**5.9**
10.90	**TN5**	4	4.33	5.28	**4.96**	**TN5**	4	5.8	9.0	**7.0**
11.40	**T5-shallow**	4	2.91	5.60	**4.84**	**T5-shallow**	4	2.5	8.2	**5.9**
11.41	**T5-deep**	4	4.10	5.69	**5.03**	**T5-deep**	4	2.7	8.2	**5.9**
12.20	**GN3**	4	4.83	8.64	**7.00**	**GN3**	3	1.8	6.8	**3.5**
12.50	**TN6**	4	3.28	5.69	**4.53**	**TN6**	4	3.0	7.2	**5.6**

	Bottom Dissolved Oxygen (mg/L) 2002					Bottom Dissolved Oxygen (mg/L) 1987-88				
	Bottom DO	n=	Min	Max	Mean	Bottom DO	n=	Min	Max	Mean
3.00	**GN1**	4	3.01	8.78	**6.41**	**GN1**	4	3.5	11.2	**8.1**
3.50	**S1**	1	8.76	8.76	**8.76**	**S1**	1	9.5	9.5	**9.5**
3.70	**TN1**	1	9.21	9.21	**9.21**	**TN1**	2	9.5	10.4	**10.0**
3.70	**T1-shallow**	4	3.38	7.58	**5.58**	**T1-shallow**	4	3.7	11.6	**8.3**
3.71	**T1-deep**	4	3.68	7.22	**5.80**	**T1-deep**	4	3.7	11.6	**8.3**
5.10	**T6**	4	2.80	9.07	**6.59**	**T6**	4	4.1	13.0	**9.1**
5.20	**TN2**	1	3.57	3.57	**3.57**	**TN2**	4	4.3	13.0	**9.1**
5.40	**T2-shallow**	4	3.17	7.11	**5.27**	**T2-shallow**	4	4.5	10.1	**6.8**
5.41	**T2-deep**	4	3.13	6.96	**5.28**	**T2-deep**	4	4.5	10.1	**6.8**
6.80	**GN2**	4	3.15	6.82	**5.05**	**GN2**	4	3.6	9.2	**5.8**
7.00	**T3-shallow**	4	3.09	7.09	**4.95**	**T3-shallow**	4	2.5	9.6	**5.2**
7.01	**T3-deep**	4	3.53	7.11	**4.97**	**T3-deep**	4	2.5	9.6	**5.2**
7.10	**TN3**	3	4.27	6.31	**5.10**	**TN3**	2	5.2	9.6	**7.4**
7.40	**S2**	3	2.88	6.09	**4.04**	**S2**	2	3.9	5.2	**4.6**
7.50	**T7**	4	2.13	11.62	**6.38**	**T7**	4	2.2	9.2	**5.2**
9.20	**TN4**	3	2.15	6.45	**4.59**	**TN4**	4	2.4	8.6	**6.3**
9.20	**T8**	4	2.51	6.52	**4.51**	**T8**	4	2.4	9.0	**5.5**
9.25	**T4-shallow**	4	3.86	6.11	**4.99**	**T4-shallow**	4	2.4	5.8	**4.5**
9.31	**T4-deep**	4	2.08	6.82	**4.25**	**T4-deep**	4	2.4	5.8	**4.5**
9.40	**T9**	4	2.13	6.55	**4.09**	**T9**	4	1.7	6.4	**3.3**
10.60	**S3**	2	3.33	5.14	**4.24**	**S3**	3	6.1	7.3	**6.8**
10.90	**TN5**	2	3.24	5.64	**4.44**	**TN5**	3	6.1	9.0	**7.3**
11.40	**T5-shallow**	4	2.20	5.37	**3.81**	**T5-shallow**	3	6.1	7.3	**6.8**
11.41	**T5-deep**	4	2.01	6.54	**3.83**	**T5-deep**	4	3.8	7.3	**6.1**
12.20	**GN3**	4	1.52	8.42	**5.83**	**GN3**	3	1.9	7.3	**4.0**
12.50	**TN6**	3	2.01	4.88	**3.56**	**TN6**	3	6.4	7.2	**6.9**

TABLE 6 (continued)
Summary of Surface and Bottom Water Quality Measurements by Site Location
NMJC/MERI Hackensack River Benthic Inventory
January to December 2002 and March 1987 to March 1988

Approx River Mile	Surface pH 2002					Surface pH 1987-88				
	Surf. pH	n=	Min	Max	Mean	Surf. pH	n=	Min	Max	Mean
3.00	**GN1**	4	7.47	8.22	**7.82**	**GN1**	4	7.4	8.3	**7.8**
3.50	**S1**	4	7.56	8.26	**7.84**	**S1**	4	7.3	8.0	**7.6**
3.70	**TN1**	4	7.37	7.92	**7.70**	**TN1**	4	7.3	7.7	**7.5**
3.70	**T1-shallow**	4	7.27	8.13	**7.72**	**T1-shallow**	3	7.3	8.1	**7.6**
3.71	**T1-deep**	4	6.95	8.16	**7.58**	**T1-deep**	4	7.3	8.1	**7.6**
5.10	**T6**	4	7.09	8.21	**7.66**	**T6**	4	7.3	8.5	**7.8**
5.20	**TN2**	4	7.36	8.18	**7.76**	**TN2**	4	7.5	8.5	**7.8**
5.40	**T2-shallow**	4	7.23	7.85	**7.60**	**T2-shallow**	4	7.5	7.8	**7.7**
5.41	**T2-deep**	4	7.14	7.91	**7.53**	**T2-deep**	4	7.5	7.8	**7.7**
6.80	**GN2**	4	7.13	8.15	**7.68**	**GN2**	4	7.5	8.8	**8.0**
7.00	**T3-shallow**	4	7.25	7.76	**7.50**	**T3-shallow**	4	7.5	8.8	**7.9**
7.01	**T3-deep**	4	7.12	7.70	**7.43**	**T3-deep**	4	7.5	8.8	**7.9**
7.10	**TN3**	4	6.99	8.08	**7.61**	**TN3**	4	7.5	8.8	**7.9**
7.40	**S2**	4	6.90	7.57	**7.17**	**S2**	4	7.5	8.8	**7.9**
7.50	**T7**	4	7.08	8.20	**7.46**	**T7**	4	7.4	7.9	**7.6**
9.20	**TN4**	4	7.06	7.72	**7.44**	**TN4**	4	7.4	7.7	**7.5**
9.20	**T8**	4	7.03	7.67	**7.36**	**T8**	4	7.3	7.6	**7.5**
9.25	**T4-shallow**	4	7.08	8.08	**7.42**	**T4-shallow**	4	7.4	7.6	**7.5**
9.31	**T4-deep**	4	7.09	7.87	**7.35**	**T4-deep**	4	7.4	7.6	**7.5**
9.40	**T9**	4	7.12	8.24	**7.41**	**T9**	4	6.8	7.7	**7.4**
10.60	**S3**	4	7.07	7.87	**7.36**	**S3**	4	7.5	7.7	**7.6**
10.90	**TN5**	4	7.17	7.69	**7.37**	**TN5**	4	7.5	7.6	**7.5**
11.40	**T5-shallow**	4	7.15	7.88	**7.38**	**T5-shallow**	4	7.4	7.6	**7.5**
11.41	**T5-deep**	4	7.09	7.85	**7.41**	**T5-deep**	4	7.4	7.6	**7.5**
12.20	**GN3**	4	7.13	7.83	**7.49**	**GN3**	3	7.4	7.6	**7.5**
12.50	**TN6**	4	7.04	7.74	**7.34**	**TN6**	4	7.5	8.2	**7.8**

	Bottom pH 2002					Bottom pH 1987-88				
	Bottom pH	n=	Min	Max	Mean	Bottom pH	n=	Min	Max	Mean
3.00	**GN1**	4	7.53	8.15	**7.89**	**GN1**	4	7.4	8.2	**7.8**
3.50	**S1**	1	7.75	7.75	**7.75**	**S1**	1	7.5	7.5	**7.5**
3.70	**TN1**	1	7.74	7.74	**7.74**	**TN1**	2	7.5	7.7	**7.6**
3.70	**T1-shallow**	4	7.29	8.13	**7.72**	**T1-shallow**	4	7.3	8.1	**7.7**
3.71	**T1-deep**	4	7.07	8.15	**7.62**	**T1-deep**	4	7.3	8.1	**7.7**
5.10	**T6**	4	7.01	8.23	**7.68**	**T6**	4	7.3	8.5	**7.8**
5.20	**TN2**	1	7.43	7.43	**7.43**	**TN2**	4	7.5	8.5	**7.8**
5.40	**T2-shallow**	4	7.36	7.87	**7.62**	**T2-shallow**	4	7.4	7.8	**7.6**
5.41	**T2-deep**	4	7.18	7.90	**7.57**	**T2-deep**	4	7.4	7.8	**7.6**
6.80	**GN2**	4	7.23	8.14	**7.69**	**GN2**	4	7.4	9.0	**7.9**
7.00	**T3-shallow**	4	7.38	7.73	**7.52**	**T3-shallow**	4	7.4	9.0	**7.9**
7.01	**T3-deep**	4	7.16	7.63	**7.44**	**T3-deep**	4	7.4	9.0	**7.9**
7.10	**TN3**	3	7.14	8.10	**7.66**	**TN3**	2	7.6	9.0	**8.3**
7.40	**S2**	3	6.90	7.21	**7.09**	**S2**	2	7.5	9.0	**8.3**
7.50	**T7**	4	7.02	8.23	**7.45**	**T7**	4	7.4	7.8	**7.5**
9.20	**TN4**	3	7.08	7.62	**7.36**	**TN4**	4	7.4	7.7	**7.6**
9.20	**T8**	4	7.11	7.65	**7.37**	**T8**	4	7.3	7.5	**7.4**
9.25	**T4-shallow**	4	7.20	8.06	**7.45**	**T4-shallow**	4	7.4	7.5	**7.5**
9.31	**T4-deep**	4	7.11	7.83	**7.37**	**T4-deep**	4	7.4	7.5	**7.5**
9.40	**T9**	4	7.14	8.23	**7.43**	**T9**	4	7.1	7.7	**7.4**
10.60	**S3**	2	7.21	7.88	**7.55**	**S3**	3	7.5	7.7	**7.6**
10.90	**TN5**	2	7.19	7.30	**7.25**	**TN5**	3	7.5	7.6	**7.5**
11.40	**T5-shallow**	4	7.16	7.82	**7.36**	**T5-shallow**	3	7.5	7.6	**7.5**
11.41	**T5-deep**	4	7.16	7.85	**7.39**	**T5-deep**	4	7.5	7.6	**7.5**
12.20	**GN3**	4	7.11	7.85	**7.53**	**GN3**	3	7.5	7.6	**7.5**
12.50	**TN6**	3	7.06	7.28	**7.20**	**TN6**	3	7.5	7.7	**7.6**

TABLE 6 (continued)
Summary of Surface and Bottom Water Quality Measurements by Site Location
NMJC/MERI Hackensack River Benthic Inventory
January to December 2002 and March 1987 to March 1988

Approx River Mile	Secchi (cm) 2002					Secchi (cm) 1987-88				
	Secchi	n=	Min	Max	Mean	Secchi	n=	Min	Max	Mean
3.00	**GN1**	4	60	115	**81.3**	**GN1**	4	60	80	**72.5**
3.50	**S1**	4	65	125	**88.8**	**S1**	4	70	80	**72.5**
3.70	**TN1**	4	65	100	**78.8**	**TN1**	4	70	90	**77.5**
3.70	**T1-shallow**	4	70	95	**78.8**	**T1-shallow**	4	70	70	**70.0**
3.71	**T1-deep**	4	60	130	**86.3**	**T1-deep**	4	70	70	**70.0**
5.10	**T6**	4	60	85	**70.0**	**T6**	4	40	90	**66.3**
5.20	**TN2**	4	60	60	**60.0**	**TN2**	4	40	80	**60.0**
5.40	**T2-shallow**	4	55	100	**76.3**	**T2-shallow**	4	60	90	**70.0**
5.41	**T2-deep**	4	65	85	**75.0**	**T2-deep**	4	60	90	**70.0**
6.80	**GN2**	4	50	80	**63.8**	**GN2**	4	70	70	**70.0**
7.00	**T3-shallow**	4	50	70	**61.3**	**T3-shallow**	4	70	100	**77.5**
7.01	**T3-deep**	4	55	60	**56.3**	**T3-deep**	4	70	100	**77.5**
7.10	**TN3**	4	40	120	**73.8**	**TN3**	4	60	100	**75.0**
7.40	**S2**	3	55	60	**58.3**	**S2**	4	60	70	**67.5**
7.50	**T7**	4	40	70	**51.3**	**T7**	4	60	80	**70.0**
9.20	**TN4**	4	30	85	**57.5**	**TN4**	3	40	100	**63.3**
9.20	**T8**	4	35	65	**55.0**	**T8**	4	50	90	**72.5**
9.25	**T4-shallow**	4	50	85	**61.3**	**T4-shallow**	4	70	80	**75.0**
9.31	**T4-deep**	4	45	85	**62.5**	**T4-deep**	4	70	80	**75.0**
9.40	**T9**	4	37	50	**43.0**	**T9**	4	50	70	**60.0**
10.60	**S3**	4	45	85	**62.5**	**S3**	4	50	90	**60.0**
10.90	**TN5**	4	50	75	**61.3**	**TN5**	4	50	90	**62.5**
11.40	**T5-shallow**	4	35	80	**56.3**	**T5-shallow**	4	40	80	**55.0**
11.41	**T5-deep**	4	50	80	**66.3**	**T5-deep**	4	40	80	**55.0**
12.20	**GN3**	4	40	65	**53.8**	**GN3**	3	50	65	**58.3**
12.50	**TN6**	4	30	60	**45.0**	**TN6**	4	40	70	**50.0**

	AIR Temperature (°C) 2002					AIR Temperature (°C) 1987-88				
	AIR Temp	n=	Min	Max	Mean	AIR Temp	n=	Min	Max	Mean
3.00	**GN1**	4	4	31	**16.5**	**GN1**	3	5.0	28.0	**18.0**
3.50	**S1**	4	5	33	**18.3**	**S1**	4	6.0	23.0	**16.8**
3.70	**TN1**	4	6	33	**19.0**	**TN1**	4	6.0	23.0	**14.3**
3.70	**T1-shallow**	4	12	30	**20.5**	**T1-shallow**	4	7.0	24.0	**17.4**
3.71	**T1-deep**	4	10	30	**20.0**	**T1-deep**	4	12.0	28.5	**21.1**
5.10	**T6**	4	9	29	**20.5**	**T6**	4	6.0	21.0	**14.0**
5.20	**TN2**	3	15	28	**23.0**	**TN2**	4	7.0	21.0	**14.1**
5.40	**T2-shallow**	3	9	20	**14.7**	**T2-shallow**	4	8.0	21.0	**15.0**
5.41	**T2-deep**	4	7	32	**18.5**	**T2-deep**	3	8.0	21.0	**16.0**
6.80	**GN2**	3	12	28	**20.3**	**GN2**	3	5.0	22.0	**16.3**
7.00	**T3-shallow**	4	9	25	**15.8**	**T3-shallow**	3	5.0	21.0	**15.7**
7.01	**T3-deep**	4	10	25	**16.3**	**T3-deep**	3	5.0	21.0	**15.7**
7.10	**TN3**	4	3	28	**15.3**	**TN3**	3	5.0	33.0	**19.7**
7.40	**S2**	4	3	27	**15.8**	**S2**	4	5.0	33.0	**17.5**
7.50	**T7**	4	7	27	**16.8**	**T7**	4	5.0	21.0	**14.5**
9.20	**TN4**	4	14	28	**18.9**	**TN4**	4	5.0	21.0	**12.1**
9.20	**T8**	4	10	24	**17.8**	**T8**	4	-1.0	27.0	**15.0**
9.25	**T4-shallow**	4	9	26	**17.8**	**T4-shallow**	4	-1.0	29.0	**15.3**
9.31	**T4-deep**	4	9	25	**17.8**	**T4-deep**	4	-1.0	29.0	**14.8**
9.40	**T9**	4	6	28	**18.6**	**T9**	4	-1.0	20.0	**9.1**
10.60	**S3**	4	3	25	**14.8**	**S3**	4	8.5	22.0	**12.9**
10.90	**TN5**	3	15	20	**17.8**	**TN5**	4	0.5	20.0	**10.4**
11.40	**T5-shallow**	4	15	28	**22.3**	**T5-shallow**	4	8.5	20.0	**12.4**
11.41	**T5-deep**	4	12	28	**21.5**	**T5-deep**	4	8.5	20.0	**12.4**
12.20	**GN3**	4	11	26	**17.5**	**GN3**	3	8.5	28.0	**19.5**
12.50	**TN6**	4	12	25	**17.8**	**TN6**	4	10.0	20.0	**14.5**

TABLE 7
Comparison of Seasonal Surface and Bottom Water Quality Parameters
NMJC/MERI Hackensack River Benthic Inventory
January to December 2002 and March 1987 to March 1988

2002 Seasonal Surface Salinity (0/00)				
Surf Sal	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**13.68**	**6.11**	**13.55**	**7.13**
Min	7.70	0.74	5.44	2.33
Max	22.55	9.16	22.88	12.87
Count	26	26	26	26

1987 Seasonal Surface Salinity (0/00)				
Surf Sal	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**3.96**	**4.96**	**8.52**	**4.58**
Min	0.00	0.00	2.00	0.00
Max	17.00	12.00	17.00	8.00
Count	25	26	26	26

2002 Seasonal Bottom Salinity (0/00) (No bottom measurements at TN & S locations)				
Bottom Sal	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**14.24**	**7.05**	**14.02**	**7.72**
Min	7.76	1.26	6.72	2.40
Max	22.98	10.76	23.52	12.81
Count	25	21	22	19

1987 Seasonal Bottom Salinity (0/00) (No bottom measurements at TN & S locations)				
Bottom Sal	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**3.52**	**4.55**	**9.26**	**4.92**
Min	0.00	0.00	0.00	1.00
Max	12.00	9.00	17.00	9.00
Count	23	22	21	26

2002 Seasonal Surface Temperature (^{o}C)				
Surf Temp	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**8.26**	**21.31**	**26.68**	**10.64**
Min	5.98	15.78	21.59	1.60
Max	12.63	25.20	39.08	15.33
Count	26	26	26	26

1987 Seasonal Surface Temperature (^{o}C)				
Surf Temp	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**8.03**	**19.52**	**24.65**	**8.48**
Min	5.60	12.00	20.00	6.00
Max	12.70	28.50	27.00	12.10
Count	25	26	26	26

2002 Seasonal Bottom Temperature (^{o}C) (No bottom measurements at TN & S locations)				
Bottom Temp	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.63**	**21.27**	**25.42**	**11.15**
Min	5.08	16.25	20.88	2.68
Max	10.23	24.05	31.14	14.08
Count	25	21	22	18

1987 Seasonal Bottom Temperature (^{o}C) (No bottom measurements at TN & S locations)				
Bottom Temp	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.73**	**18.25**	**24.53**	**8.07**
Min	5.40	12.00	20.00	6.00
Max	13.10	28.00	27.00	12.10
Count	23	22	19	26

2002 Seasonal Surface Dissolved Oxygen (mg/L)				
Surf DO	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.04**	**5.54**	**3.77**	**6.20**
Min	5.16	2.20	2.62	3.93
Max	11.75	10.30	5.25	10.07
Count	26	26	26	26
# < 4.0 mg/l	0	6	15	1

1987 Seasonal Surface Dissolved Oxygen (mg/L)				
Surf DO	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**8.52**	**6.06**	**3.02**	**6.25**
Min	2.40	1.90	1.00	2.20
Max	12.00	13.00	5.80	9.80
Count	25	26	26	26
# < 4.0 mg/l	1	7	23	1

2002 Seasonal Bottom Dissolved Oxygen (mg/L) (No bottom measurements at TN & S locations)				
Bottom DO	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.03**	**4.27**	**2.95**	**5.82**
Min	4.88	2.15	1.52	3.79
Max	11.62	9.07	4.27	8.84
Count	25	21	22	19
# < 4.0 mg/l	0	11	20	1

1987 Seasonal Bottom Dissolved Oxygen (mg/L) (No bottom measurements at TN & S locations)				
Bottom DO	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**8.75**	**6.37**	**3.37**	**6.90**
Min	1.70	2.80	1.90	2.80
Max	11.60	13.00	6.90	9.80
Count	22	22	20	26
# < 4.0 mg/l	1	5	15	1

2002 Seasonal Surface pH measurements				
Surf. pH	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.28**	**7.86**	**7.31**	**7.60**
Min	6.99	6.90	6.95	7.07
Max	8.20	8.26	7.75	8.16
Count	26	26	26	26

1987 Seasonal Surface pH measurements				
Surf. pH	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.75**	**7.64**	**7.45**	**7.77**
Min	7.50	7.30	7.30	6.80
Max	8.30	8.50	7.80	8.80
Count	25	25	26	26

2002 Seasonal Bottom pH measurements				
Bottom pH	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.35**	**7.83**	**7.28**	**7.60**
Min	7.06	6.90	7.01	7.18
Max	8.23	8.23	7.73	8.15
Count	25	21	22	19

1987 Seasonal Bottom pH measurements				
Bottom pH	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.65**	**7.60**	**7.47**	**7.84**
Min	7.40	7.30	7.30	7.10
Max	8.20	7.70	7.83	9.00
Count	23	22	19	26

2002 Seasonal Secchi Disk Depths (cm)				
Secchi	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**78.1**	**59.5**	**58.8**	**62.8**
Min	40	30	30	40
Max	130	100	90	85
Count	26	26	26	25

1987 Seasonal Secchi Disk Depths (cm)				
Secchi	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**62.4**	**63.6**	**76.9**	**66.9**
Min	40	40	50	40
Max	90	90	100	90
Count	25	25	26	26

2002 Air Temperature measurements (^{o}C)				
Air Temp.	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**12.5**	**22.1**	**27.5**	**10.9**
Min	3	15	22	6
Max	21	28	33	19
Count	24	26	24	26

1987 Air Temperature measurements (^{o}C)				
Air Temp.	**Winter**	**Spring**	**Summer**	**Autumn**
MEAN	**7.7**	**19.6**	**21.7**	**9.3**
Min	-1	1	20	5
Max	20	33	28	12
Count	24	26	26	21

TABLE 8
Phylogenetic Listing of Benthic Invertebrates
Identified During the 2002 and 1987 Hackensack River Benthic Inventories

	2002 Benthic Species List		1987 Benthic Species List	
Major Groups	**NODC Code**	**Species**	**NODC Code**	**Species**
Cnidarians/Coelenterates			3758000000	Actinaria sp.
	3759010000	Edwardsiidae sp.		
	3760080103	Diadumene leucolena		
Flatworms	3906030101	Stylochus ellipticus		
	3906050601	Euplana gracilis		
Ribbon/Proboscis Worms			4300000000	Nemertea
	4302020101	Carinoma tremaphorus		
	4306050110	Amphiporus bioculatus		
Nematodes			4700000000	Nematoda
Polycheates			5001130200	Eteone sp. +
			5001130205	Eteone longa
	5001130207	Eteone heteropoda	5001130207	Eteone heteropoda
	5001130211	Eteone foliosa		
	5001210102	Podarkeopsis levifuscina		
	5001210201	Microphthalmus sczelkowii		
	5001240410	Neanthes succinea	5001240410	Nereis succinea *
			5001240411	Nereis diversicolor
	5001240801	Laeonereis culveri	5001240801	Laeoneries culveri
	5001250117	Nephtys picta		
	5001270104	Glycera americana		
			5001270105	Glycera dibranchiata
			5001400100	Haploscoloplos sp.
	5001400104	Leitoscoloplos robustus	5001400104	Leitoscoloplos robustus
			5001400105	Leitoscoloplos fragilis
			5001430000	Spionidae sp. +
			5001430400	Polydora sp. +
			5001430402	Polydora socialis
	5001430411	Polydora cornuta	5001430411	Polydora ligni *
	5001430602	Marenzelleria viridis	5001430602	Scolecolepides viridis *
	5001430704	Spio setosa		
			5001430808	Boccardia ligerica
	5001431801	Streblospio benedicti	5001431801	Streblospio benedicti
	5001432802	Boccardiella ligerica		
	5001500399	Tharyx sp. A		
	5001600101	Capitella capitata		
	5001600201	Heteromastus filiformis	5001600201	Heteromastus filliformis
	5001600401	Mediomastus ambiseta		
	5001650202	Sabellaria vulgaris		
	5001660302	Pectinaria gouldii	5001660302	Pectinaria gouldii
	5001670309	Hobsonia florida	5001670309	Hypaniola florida *
	5001701502	Manayunkia aestuarina	5001701502	Manayunkia aesturina
Oligocheates	5004000000	Oligochaeta	5004000000	Oligochaeta
Gastropods			51031301__	Hydrobia totteni
			5105010601	Eupleura caudata
			5114040201	Melampus bidentatus
	5103130501	Littoridinops tenuipes		
	5103500108	Epitonium rupicola		
	5110120102	Haminoea solitaria		
	5123030102	Elysia chlorotica		
	5123060301	Alderia modesta		
	5131070201	Doridella obscura		
Bivalves	5510020102	Crassostrea virginica		
			5507011501	Geukensia demissus
	5515250301	Mulinia lateralis	5515250301	Mulinia lateralis
	5515250401	Rangia cuneata		
	5515310116	Macoma balthica	5515310116	Macoma balthica
	5515310119	Macoma mitchelli		
	5515370201	Mytilopsis leucophaeata	5515370101	Congeria leucophaeta *
	5517010201	Mya arenaria	5517010201	Mya arenaria
Water mites			5922000000	Hydracarina
Sea Spiders	6001060206	Anoplodactylus petiolatus		
Harpacticoid Copepods			6119000000	Harpacticoida
Barnacles	6134020114	Balanus improvisus	6134020114	Balanus improvisus
Oppossum Shrimp	6153011508	Neomysis americana	6153011508	Neomysis americana
Cumaceans	6154040110	Leucon americanus	6154040110	Leucon americanus
	6154050801	Oxyurostylis smithi		
Isopods	6160010201	Cyathura polita	6160010201	Cyathura polita
	6162020299	Synidotea laevidorsalis		
	6162020703	Edotea triloba	6162020703	Edotea triloloba
Amhipods	6169020108	Ampelisca abdita		
	6169060701	Leptocheirus plumulosus		
			6169150200	Corophium sp. +
	6169150205	Apocorophium lacustre	6169150205	Corophium lacustre *
	6169150211	Monocorophium insidiosum		
	6169210705	Gammarus daiberi		
			6169210707	Gammarus tigrinus
	6169210708	Gammarus palustris		
	6169210709	Mucrogammarus mucronatus	6169210709	Gammarus mucronatus *
			6169211003	Melita dentata
	6169211006	Melita nitida	6169211006	Melita nitida
			6169370820	Monoculodes edwardsi
	6169371800	Ameroculodes spp. complex		
	6169430306	Incisocalliope aestuarius		
Caridean Shrimp	6179110303	Palaemonetes pugio	6179110303	Palaemonetes pugio
	6179220103	Crangon septemspinosa	6179220103	Crangon septemspinosa
True Crabs	6189010301	Callinectes sapidus	6189010301	Callinectus sapidus
	6189020901	Rhithropanopeus harrisii	6189020901	Rithropanopeus harrisii
Insect Larvae			6302000000	Coleoptera
	6505030100	Chaoborus sp.	6505030100	Chaoborus sp.
	6505080000	Chironomidae	6505080000	Chironomidae
			6516010000	Tabanidae
Echinoderms			8170000000	Holothuroidea
Sea Squirts	8406030108	Molgula manhattensis		

NOTES: Total number of taxa = 89

22 taxa collected only in 1987

37 taxa collected only in 2002

30 taxa collected in both 2002 and 1987

+ Eteone sp., Spionidae sp., Polydora sp. & Corophium sp. not counted as separate taxa

*** denotes a change in nomenclature from 1987 to 2002**

TABLE 9
Comparison of Rank and Relative Abundance by Major Taxonomic Groups
NJMC/MERI Hackensack River Benthic Inventory

2002 Collections ALL SEASONS (n=312)				1987 Collections ALL SEASONS (n=284)		
Total # of Taxa	**Relative Abundance**	**Overall Rank**	**Major Taxonomic Groups**	**Overall Rank**	**Relative Abundance**	**Total # of Taxa**
2	**3.11%**	5	**Cnidarians/Coelenterates**	11	**0.07%**	1
2	**0.00%**	14	**Flatworms**			0
2	**0.25%**	9	**Ribbon/Proboscis Worms**	12	**0.06%**	1
0			**Nematodes**	16	**0.01%**	1
22	**45.00%**	1	**Polychaetes**	3	**8.30%**	18
1	**6.02%**	3	**Oligochaetes**	2	**26.54%**	1
6	**2.12%**	6	**Gastropods**	1	**50.42%**	3
7	**2.07%**	7	**Bivalves**	4	**7.74%**	5
0			**Water Mites**	17	**0.00%**	1
1	**0.00%**	14	**Sea Spiders**			0
0			**Harpacticoid Copepods**	15	**0.01%**	1
1	**0.18%**	10	**Barnacles**	5	**4.02%**	1
1	**0.02%**	12	**Oppossum shrimp**	14	**0.02%**	1
2	**0.02%**	12	**Cumaceans**	12	**0.06%**	1
3	**1.78%**	8	**Isopods**	8	**0.45%**	2
10	**35.45%**	2	**Amphipods**	9	**0.41%**	6
2	**0.05%**	11	**Caridean Shrimp**	13	**0.04%**	2
2	**0.25%**	9	**True Crabs**	7	**0.66%**	2
2	**3.65%**	4	**Insect Larvae**	6	**0.81%**	4
0			**Echinoderms**	10	**0.38%**	1
1	**0.01%**	13	**Sea squirts**			0
67			**Total # of Taxa**			**52**

TABLE 10A
Summary of 1987 Abundance Data by Major Taxomonic Groups
NJMC/MERI Hackensack River Benthic Inventory

Major Taxonomic Groups	WINTER 1987-88		SPRING 1987		SUMMER 1987		AUTUMN 1987		ALL SEASONS (n=284)	
	TOTAL # COLLECTED (n=50 reps)	Relative Abundance	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	Total # Collected	Relative Abundance
Cnidarians/Coelenterates	0	0.00%	0	0.00%	49	0.30%	0	0.00%	49	0.07%
Flatworms										
Ribbon/Proboscis Worms	9	0.19%	6	0.12%	7	0.04%	16	0.04%	38	0.06%
Nematodes	0	0.00%	6	0.12%	0	0.00%	1	0.00%	7	0.01%
Polychaetes	459	9.74%	212	4.18%	2,440	14.82%	2,328	5.92%	5,439	8.30%
Oligochaetes	2,870	60.90%	4,015	79.25%	4,329	26.29%	6,185	15.73%	17,399	26.54%
Gastropods	1,196	25.38%	147	2.90%	4,825	29.30%	26,887	68.38%	33,055	50.42%
Bivalves	42	0.89%	69	1.36%	2,719	16.51%	2,248	5.72%	5,078	7.74%
Water Mites	0	0.00%	1	0.02%	0	0.00%	0	0.00%	1	0.00%
Sea Spiders										
Harpacticoid Copepods	0	0.00%	6	0.12%	0	0.00%	2	0.01%	8	0.01%
Barnacles	17	0.36%	24	0.47%	1,650	10.02%	943	2.40%	2,634	4.02%
Oppossum Shrimp	1	0.02%	1	0.02%	0	0.00%	11	0.03%	13	0.02%
Cumaceans	31	0.66%	0	0.00%	0	0.00%	7	0.02%	38	0.06%
Isopods	45	0.95%	40	0.79%	97	0.59%	110	0.28%	292	0.45%
Amphipods	16	0.34%	82	1.62%	6	0.04%	166	0.42%	270	0.41%
Caridean shrimp	4	0.08%	4	0.08%	14	0.09%	6	0.02%	28	0.04%
True Crabs	13	0.28%	104	2.05%	229	1.39%	88	0.22%	434	0.66%
Insects	9	0.19%	349	6.89%	99	0.60%	75	0.19%	532	0.81%
Echinoderms	1	0.02%	0	0.00%	1	0.01%	248	0.63%	250	0.38%
Sea Squirts										
total # of individuals	**4,713**	**100%**	**5,066**	**100%**	**16,465**	**100%**	**39,321**	**100%**	**65,565**	**100%**
Total # of Taxa	**32**		**33**		**27**		**37**		**52**	

TABLE 10B
Summary of 2002 Abundance Data by Major Taxomonic Groups
NJMC/MERI Hackensack River Benthic Inventory

Major Taxonomic Groups	WINTER 2001/02		SPRING 2002		SUMMER 2002		AUTUMN 2002		ALL SEASONS (n=312)	
	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	Total # Collected	Relative Abundance
Cnidarians/Coelenterates	778	**1.33%**	1,629	**1.64%**	2,823	**8.65%**	1,464	**5.94%**	6,694	**3.11%**
Flatworms	3	**0.01%**	5	**0.01%**	1	**0.00%**			9	**0.00%**
Ribbon/Proboscis Worms	114	**0.19%**	71	**0.07%**	167	**0.51%**	193	**0.78%**	545	**0.25%**
Nematodes										
Polychaetes	36,338	**61.96%**	22,609	**22.75%**	23,622	**72.41%**	14,309	**58.03%**	96,878	**45.00%**
Oligochaetes	1,121	**1.91%**	8,608	**8.66%**	1,333	**4.09%**	1,904	**7.72%**	12,966	**6.02%**
Gastropods	430	**0.73%**	4,094	**4.12%**	25	**0.08%**	10	**0.04%**	4,559	**2.12%**
Bivalves	3,443	**5.87%**	295	**0.30%**	325	**1.00%**	397	**1.61%**	4,460	**2.07%**
Water Mites										
Sea Spiders			1	**0.00%**					1	**0.00%**
Harpacticoid Copepods										
Barnacles	68	**0.12%**	82	**0.08%**	155	**0.48%**	87	**0.35%**	392	**0.18%**
Oppossum shrimp	9	**0.02%**	7	**0.01%**	4	**0.01%**	30	**0.12%**	50	**0.02%**
Cumaceans	14	**0.02%**	6	**0.01%**			20	**0.08%**	40	**0.02%**
Isopods	1,168	**1.99%**	728	**0.73%**	775	**2.38%**	1,157	**4.69%**	3,828	**1.78%**
Amphipods	12,421	**21.18%**	58,170	**58.54%**	1,770	**5.43%**	3,969	**16.10%**	76,330	**35.45%**
Caridean Shrimp	4	**0.01%**	92	**0.09%**	10	**0.03%**	7	**0.03%**	113	**0.05%**
True Crabs	80	**0.14%**	78	**0.08%**	252	**0.77%**	138	**0.56%**	548	**0.25%**
Insect Larvae	2,644	**4.51%**	2,899	**2.92%**	1,358	**4.16%**	960	**3.89%**	7,861	**3.65%**
Echinoderms										
Sea squirts	8	**0.01%**			1	**0.00%**	13	**0.05%**	22	**0.01%**
Total # of Individuals	**58,643**	**100%**	**99,374**	**100%**	**32,621**	**100%**	**24,658**	**100%**	**215,296**	**100%**
Total # of Species	**47**		**54**		**44**		**51**		**67**	

TABLE 11
Comparison of Total Number of Taxa by Site and Season
NJMC/MERI Hackensack River Benthic Inventory

Approximate River Mile	SEASON:	WINTER		SPRING		SUMMER		AUTUMN		All Seasons Combined	
	YEAR:	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
	Total # of Collections	**78**	**50**	**78**	**78**	**78**	**78**	**78**	**78**	**312**	**284**
3.00	GN1	21	11	12	9	20	8	16	13	32	23
3.50	S1	27	8	29	12	20	16	25	15	43	25
3.70	TN1	19	8	14	10	12	8	18	14	27	21
3.71	T1-S	28	12	27	8	15	15	14	13	41	24
3.72	T1-D	21	10	23	7	14	10	17	13	34	17
5.10	(T6)	23		13	4	20	4	22	11	34	11
5.20	(TN2)	15		16	9	14	10	16	11	22	16
5.40	T2-S	10	7	15	17	15	2	11	7	23	19
5.41	T2-D	18	8	21	11	14	9	20	16	34	21
6.80	GN2	17	8	20	5	13	7	17	10	27	19
7.00	T3-S	19	6	22	4	13	6	18	6	29	12
7.01	T3-D	17	9	18	5	10	10	16	8	25	18
7.10	TN3	11	2	15	6	13	3	14	8	19	11
7.40	S2	14	5	13	5	15	9	22	8	28	13
7.50	T7	12	7	15	5	14	6	16	3	24	12
9.20	(TN4)	16		15	4	11	5	15	5	21	8
9.21	T8	14	1	15	6	17	9	14	8	22	10
9.25	(T4-S)	19		21	5	4	5	13	5	25	9
9.31	(T4-D)	18		19	5	6	5	4	3	22	8
9.40	T9	14	3	14	2	16	0	18	2	22	5
10.60	(S3)	8		8	3	11	5	11	4	18	6
10.90	TN5	8	2	7	1	13	3	10	4	17	4
11.40	(T5-S)	9		11	2	17	4	15	3	18	4
11.41	*T5-D	9	6	13	2	14	4	14	2	20	6
12.20	(GN3)	5		6	3	4	5	9	4	10	5
12.50	(TN6)	8		7	1	10	3	7	4	14	4
	Total # of Taxa	**47**	**32**	**54**	**33**	**44**	**27**	**51**	**37**	**67**	**52**

NOTES: Site names in parentheses [e.g., (T6)] indicate that no winter comparisons could be made due to the lack of winter 1987 data.
***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.

TABLE 12

Comparison of Benthic Density (Average # of organisms per M^2) by Site and Season

NJMC/MERI Hackensack River Benthic Inventory

Approximate River Mile	SEASON:	WINTER		SPRING		SUMMER		AUTUMN		All Seasons Combined	
	YEAR:	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
	Total # of Collections	**78**	**50**	**78**	**78**	**78**	**78**	**78**	**78**	**312**	**284**
3.00	GN1	1,525.6	198.7	435.9	326.9	3,647.3	730.7	692.3	3,647.3	1,575.3	1,225.9
3.50	S1	2,134.5	269.2	2,903.7	897.4	3,775.5	8,807.3	2,371.7	2,512.7	2,796.4	3,121.7
3.70	TN1	1,076.9	1,852.5	756.4	2,538.4	1,576.9	628.2	1,974.3	1,000.0	1,346.1	1,504.7
3.71	T1-S	2,237.1	365.4	2,775.5	455.1	724.3	2,634.5	788.4	1,499.9	1,631.3	1,238.7
3.72	T1-D	794.8	224.4	826.9	109.0	1,205.1	237.2	378.2	2,019.2	801.3	647.4
5.10	(T6)	2,121.7		871.8	346.1	794.8	442.3	1,108.9	3,737.0	1,224.3	1,131.4
5.20	(TN2)	6,845.9		7,839.4	3,660.1	6,102.3	2,448.6	2,474.3	6,102.3	5,815.5	3,052.8
5.40	T2-S	173.1	115.4	269.2	1,692.2	423.1	128.2	692.3	205.1	389.4	535.2
5.41	T2-D	1,378.2	2,070.4	1,762.8	615.4	1,070.5	724.3	2,749.9	3,929.3	1,740.3	1,834.9
6.80	GN2	3,660.1	1,314.1	8,333.0	1,141.0	3,705.0	410.2	1,294.8	4,326.8	4,248.2	1,798.0
7.00	T3-S	4,801.1	2,307.6	7,230.5	359.0	1,179.4	750.0	3,660.1	3,698.6	4,217.8	1,778.8
7.01	T3-D	5,326.7	3,993.4	30,678.3	1,307.6	339.7	1,628.1	5,711.3	2,423.0	10,514.0	2,338.0
7.10	TN3	4,410.1	1,685.8	15,659.6	634.6	2,743.5	1,346.1	1,089.7	1,205.1	5,975.7	1,217.9
7.40	S2	1,967.9	942.3	13,550.7	1,653.8	11,653.4	4,102.4	5,910.0	2,198.6	8,270.5	2,224.3
7.50	T7	8,044.6	4,275.5	18,364.7	1,621.7	7,640.7	3,589.6	1,878.1	11,467.5	8,982.0	5,238.6
9.20	(TN4)	11,294.4		6,448.5	102.6	2,390.9	4,487.0	4,467.8	1,935.8	6,150.4	1,631.3
9.21	T8	63,933.3	3,929.3	136,494.5	1,173.0	21,826.1	41,652.2	35,703.7	175,005.8	64,489.4	55,440.1
9.25	(T4-S)	53,786.3		125,584.7	4,422.9	5,102.4	11,903.4	3,961.4	6,704.9	47,108.7	5,757.8
9.31	(T4-D)	79,830.1		126,110.3	1,685.8	6,403.6	6,980.5	487.2	4,493.4	53,207.8	3,289.9
9.40	T9	45,568.7	160.3	50,158.3	38.5	42,613.7	0.0	23,646.5	25.6	40,496.8	56.1
10.60	(S3)	2,916.6		1,160.2	147.4	11,743.1	352.6	3,480.6	692.3	4,825.1	298.1
10.90	TN5	2,640.9	551.3	4,846.0	25.6	16,787.8	506.4	13,070.0	269.2	9,336.2	338.1
11.40	(T5-S)	33,896.1		18,576.2	109.0	27,088.7	185.9	18,762.1	416.7	24,580.7	177.9
11.41	*T5-D	21,306.8	8,932.3	32,255.1	2,615.3	15,730.1	7,961.2	18,326.2	1,160.2	21,904.6	4,825.0
12.20	(GN3)	1,871.7		14,384.0	4,480.6	1,025.6	1,185.9	1,128.2	9,903.5	4,602.4	3,892.5
12.50	(TN6)	12,358.5		8,711.2	314.1	11,807.2	1,717.9	2,249.9	1,467.9	8,781.7	875.0
	Seasonal AVG #/m^2	**14,457.8**	**1,952.2**	**24,499.5**	**1,249.0**	**8,042.3**	**4,059.3**	**6,079.1**	**9,694.1**	**13,269.7**	**4,056.5**

NOTES: Site names in parentheses [e.g., (T6)] indicate that no winter comparisons could be made due to the lack of winter 1987 data.

***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.

TABLE 13
Total Number of Organisms Collected Across Four Seasons Using a Full-Sized Ponar Grab Sampler - 1987
NJMC/MERI Hackensack River Benthic Inventory

	RIVER MILE:	3.0	3.5	3.7	3.705	3.71	5.1	5.2	5.4	5.41	6.8	7.0	7.01	7.1	7.4	7.5	9.2	9.2	9.3	9.31	9.4	10.6	10.9	11.4	11.41	12.2	12.5	All Sites All Seasons	
	# OF COLLECTIONS:	12	12	12	12	12	9	9	12	12	12	12	12	12	12	12	9	12	9	9	12	9	12	9	11	9	9	284	Relative
Taxonomic Group	**SPECIES SITE:**	**GN1**	**S1**	**TN1**	**T1-S**	**T1-D**	***T6**	***TN2**	**T2-S**	**T2-D**	**GN2**	**T3-S**	**T3-D**	**TN3**	**S2**	**T7**	***TN4**	**T8**	***T4-S**	***T4-D**	**T9**	***S3**	**TN5**	***T5-S**	**#T5-D**	***GN3**	***TN6**	**TOTAL #**	**Abundance**
Cnidarians/Coelenterates	Actinaria sp.				1			48																				**49**	**0.07%**
Ribbon/Proboscis Worms	Nemertea	1	2	5	20	8				2																		**38**	**0.06%**
Nematodes	Nematoda		1	4						2																		**7**	**0.01%**
Polychaetes	Eteone sp.				2	1				1																		**4**	**0.01%**
	Eteone longa	1																										**1**	**0.00%**
	Eteone heteropoda	2	7	1		3				2																		**15**	**0.02%**
	Nereis succinea	4	31	18					3	3	1																	**60**	**0.09%**
	Nereis diversicolor		1																									**1**	**0.00%**
	Laeoneries culveri		38	51	34	2		166			1		2	41	124			4	1									**464**	**0.71%**
	Glycera dibranchiata	1			1																							**2**	**0.00%**
	Haploscoloplos sp.					2																						**2**	**0.00%**
	Leitoscoloplos robustus		1																									**1**	**0.00%**
	Leitoscoloplos fragilis				1	1																						**2**	**0.00%**
	Spionidae sp.		3							1																		**4**	**0.01%**
	Polydora sp.	1		8						1	2																	**12**	**0.02%**
	Polydora socialis		1	14			12		47	2					2			1,717										**1,795**	**2.74%**
	Polydora ligni		16		1																							**17**	**0.03%**
	Boccardia ligerica			19			27																					**46**	**0.07%**
	Streblospio benedicti	361	304	273	131	205	6	96	27	633	23	27	9	1	24	11	6		7	8								**2,152**	**3.28%**
	Marenzellaria viridis	4	2		11	24			1	20	4		1															**67**	**0.10%**
	Heteromastus filliformis				9																							**9**	**0.01%**
	Pectinaria gouldii				3																							**3**	**0.00%**
	Hypaniola florida		57	2	188			170	1	1		7	9	8	211	29	3	23	17	52								**778**	**1.19%**
	Manayunkia aesturina								3									1										**4**	**0.01%**
Oligochaetes	Oligochaeta	291	313	454	220	56	35	1,012	123	327	1,023	831	701	512	502	532	412	3,921	1,518	841	28	88	157	74	2,212	771	445	**17,399**	**26.54%**
Gastropods	Hydrobia totteni							56		8	5	200	624	141	420	2,617	575	22,928	2,010	1,132	3	73	38	24	517	1,588	94	**33,053**	**50.41%**
	Eupleura caudata	1																										**1**	**0.00%**
	Melampus bidentatus																				1							**1**	**0.00%**
Bivalves	Geukensia demissus				7				1																			**8**	**0.01%**
	Mulinia lateralis	1		1																								**2**	**0.00%**
	Macoma balthica	42	15	7	54	8		8	6	24	6	4	12	1	5	1												**193**	**0.29%**
	Congeria leucophaeta		152	2		9	25			1			23			3	1	4,584	4	1		3		1	21	23	1	**4,854**	**7.40%**
	Mya arenaria	4	6	3	6	2																						**21**	**0.03%**
Water Mites	Hydracarina																					1						**1**	**0.00%**
Harpacticoid Copepods	Harpacticoida			1					2		1		1		1				1	1								**8**	**0.01%**
Barnacles	Balanus improvisus	9	841			54	301		1	54	1							1,367							3	3		**2,634**	**4.02%**
Oppossum Shrimp	Neomysis americana		1	3						1	2		2				1		3									**13**	**0.02%**
Cumaceans	Leucon americanus	4	4	16					2		5	4	2							1								**38**	**0.06%**
Isopods	Cyathura polita	8	81	30	65	11	3	12		17	1	3	3		11	1												**246**	**0.38%**
	Edotea triloloba	2	1	6	3		3	14	4	3			9		1													**46**	**0.07%**
Amphipods	Corophium sp.						117																					**117**	**0.18%**
	Corophium lacustre		1		2		35	14	34	3																		**89**	**0.14%**
	Gammarus mucronatus													1														**1**	**0.00%**
	Gammarus tigrinus										1																	**1**	**0.00%**
	Melita dentata	1														1												**2**	**0.00%**
	Melita nitida		12			4	21	1	4	1	4	1	1															**49**	**0.07%**
	Monoculodes edwardsi	1				3					1	1	1			2									2			**11**	**0.02%**
Caridean Shrimp	Palaemonetes pugio	3			1			1	1		7	1	2	3		2	1	1										**23**	**0.04%**
	Crangon septemspinosa	1			1	1			1	1																		**5**	**0.01%**
True Crabs	Callinectus sapidus	1																										**1**	**0.00%**
	Rithropanopeus harrisii	21	56	18	9	10	121	9	59	37	33	22	34	1	2	1												**433**	**0.66%**
Insecta	Coleoptera				2										1						2							**5**	**0.01%**
	Chaoborus sp.																					1	1					**2**	**0.00%**
	Chironomidae			3	1			56	14			9	23	44	84	69	19	50	32	17		20	15	12	5	44	6	**523**	**0.80%**
	Tabanidae							1													1							**2**	**0.00%**
Echinoderms	Holothuroidea		1					241			1			7														**250**	**0.38%**
	TOTAL # COLLECTED	**765**	**1,948**	**939**	**773**	**404**	**706**	**1,905**	**334**	**1,145**	**1,122**	**1,110**	**1,459**	**760**	**1,388**	**3,269**	**1,018**	**34,596**	**3,593**	**2,053**	**35**	**186**	**211**	**111**	**2,760**	**2,429**	**546**	**65,565**	**100.00%**
	TOTAL # OF TAXA	**23**	**25****	**21****	**24**	**17****	**11****	**16**	**19**	**21****	**19**	**12**	**18**	**11**	**13**	**12**	**8**	**10**	**9**	**8**	**5**	**6**	**4**	**4**	**6**	**5**	**4**	**52****	

NOTES: * denotes that no collections were made at this site during winter 1987-88.
 # denotes that the Winter collection at T5 Deep consisted of only 2 replicates.
****denotes that Eteone sp., Spionidae sp., Polydora sp., and Corophium sp. were not counted as a separate taxa.**

TABLE 14
Total Number of Organisms Collected Across Four Seasons Using a Full-Sized Ponar Grab Sampler - 2002
NJMC/MERI Hackensack River Benthic Inventory

	RIVER MILE:	3.0	3.5	3.7	3.705	3.71	5.1	5.2	5.4	5.41	6.8	7.0	7.01	7.1	7.4	7.5	9.2	9.2	9.3	9.31	9.4	10.6	10.9	11.4	11.41	12.2	12.5	All Sites All Seasons	
	# OF COLLECTIONS:	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	312	Relative
Taxonomic Group	**SPECIES SITE:**	**GN1**	**S1**	**TN1**	**T1-S**	**T1-D**	**T6**	**TN2**	**T2-S**	**T2-D**	**GN2**	**T3-S**	**T3-D**	**TN3**	**S2**	**T7**	**TN4**	**T8**	**T4-S**	**T4-D**	**T9**	**S3**	**TN5**	**T5-S**	**T5-D**	**GN3**	**TN6**	**TOTAL #**	**Abundance**
Cnidaria/	Edwardsiidae sp.			20				119			14	153	1,267	175	176	14	563	828	1,404	1,222	149	34	23	81	289		5	**6,536**	**3.04%**
Coelenterates	Diadumene leucolena				155	2									1													**158**	**0.07%**
Flatworms	Stylochus ellipticus	1																	2	2								**5**	**0.00%**
	Euplana gracilis																	1		3								**4**	**0.00%**
Ribbon/	Carinoma tremaphorus	9	21	41	32	24	38	6	27	71	51	42	20	23	36	33	10	6	17	10	1	3	5	10	3	2	1	**542**	**0.25%**
Proboscis Worms	Amphiporus bioculatus		1	1		1																						**3**	**0.00%**
Polychaete Worms	Eteone heteropoda	18	46	10	13	3	7	2	3	33	6	14	30	1	1													**187**	**0.09%**
	Eteone foliosa		2						1	2																		**5**	**0.00%**
	Podarkeopsis levifuscina									2																		**2**	**0.00%**
	Microphthalmus sczelkowii		1																									**1**	**0.00%**
	Neanthes succinea	18	18	4	16	6	2			4		1			2			1			22			4	5			**103**	**0.05%**
	Laeonereis culveri	2	224	315			5	348	1	1		19			20		90	158	3		36	109	42					**1,373**	**0.64%**
	Nephtys picta		2																									**2**	**0.00%**
	Glycera americana	4	2	3	4	6																						**19**	**0.01%**
	Leitoscoloplos robustus	33	118	49	53	49	18		19	58		1																**398**	**0.18%**
	Polydora cornuta	88	29		7	16	24			10																		**174**	**0.08%**
	Marenzelleria viridis		9	21	4	12	17	47	35	94	99	117	153	239	525	33	438	53	972	991	1	3	1	25	9	5	8	**3,911**	**1.82%**
	Spio setosa				2	3				1																		**6**	**0.00%**
	Streblospio benedicti	328	537	14	287	6	158	943	6	150	1,331	604	3,454	570	1,379	2,148	91	167	135	49	530	72	27	25	76	3		**13,090**	**6.08%**
	Boccardiella ligerica						10										1	46	28	29	319		2	97	11			**543**	**0.25%**
	Tharyx sp. A		1		2																							**3**	**0.00%**
	Capitella capitata		16							1					1													**18**	**0.01%**
	Heteromastus filiformis	15	191	125	80	39	26	27	36	188	69	67	20	22	152	17	4	1	3	2					1			**1,085**	**0.50%**
	Mediomastus ambiseta		1		2																							**3**	**0.00%**
	Sabellaria vulgaris				1																							**1**	**0.00%**
	Pectinaria gouldii	10	17		18	23	6		1	4	1																	**80**	**0.04%**
	Hobsonia florida	10	10	5	5		10	521	1	3	319	573	507	737	105	2,130	1,450	8,844	7,971	9,771	16,216	1,183	4,163	10,064	7,753	228	3,274	**75,853**	**35.23%**
	Manayunkia aestuarina																	7	2	10	2							**21**	**0.01%**
Oligochaete Worms	Oligochaeta	12	71		5		9	128	4	57	196	262	363	289	508	415	75	2,014	271	259	3,321	179	793	467	1,590	220	1,458	**12,966**	**6.02%**
Gastropods (snails)	Littoridinops tenuipes											1					1	313		36	27	1	95	781	1,222	1,900	164	**4,541**	**2.11%**
	Epitonium rupicola									1																		**1**	**0.00%**
	Haminoea solitaria		3																									**3**	**0.00%**
	Elysia chlorotica							3													1							**4**	**0.00%**
	Alderia modesta							3																				**3**	**0.00%**
	Doridella obscura	2			1	1	3																					**7**	**0.00%**
Bivalves (clams)	Crassostrea virginica		1				1																					**2**	**0.00%**
	Mulinia lateralis	62	80	15	94	147	3		3	62	3	5	4	1	3	2												**484**	**0.22%**
	Rangia cuneata										1				1	1	1		1	1								**6**	**0.00%**
	Macoma balthica	10	12	31	4	8	1	1	8	39	50	52	28	41	18	5			1	2								**311**	**0.14%**
	Macoma mitchelli		21	13	5	2	1	5	11	23	12	58	26	21	20	12	4		1			1						**236**	**0.11%**
	Mytilopsis leucophaeata						2			1					1	2	5	732	266	1,045	645	1	1	466	37		7	**3,211**	**1.49%**
	Mya arenaria	61	32	7	10	26	16		3	48	2		2			3												**210**	**0.10%**
Sea Spiders	Anoplodactylus petiolatus				1																							**1**	**0.00%**
Barnacles	Balanus improvisus	187	67		37	5	18		1	19			1		19	1		1	36									**392**	**0.18%**
Oppossum Shrimp	Neomysis americana		3		2	2	1		2	1	1	14	18		1		1		1						2	1		**50**	**0.02%**
Cumaceans	Oxyurostylis smithi			1	1																							**2**	**0.00%**
	Leucon americanus	2	22	2							5	7																**38**	**0.02%**
Isopods	Cyathura polita	18	51	118	57	52	194	162	56	150	263	174	74	157	309	153	142	56	149	125	85	1	14	57	1		1	**2,619**	**1.22%**
	Synidotea laevidorsalis	1			1	4				2		2	1															**11**	**0.01%**
	Edotea triloba	10	11	2	10	10	24	26		7	68	93	214	35	36	59	49	163	152	17	107		22	68	15			**1,198**	**0.56%**
Amphipods	Ampelisca abdita	3	25	20	59	11	3			4	5		1															**131**	**0.06%**
	Leptocheirus plumulosus	18	41	16	7	9	37	1,105	7	42	45	269	302	806	412	28	130	1,682	8	4	16	152	125	194	12		6	**5,473**	**2.54%**
	Apocorophium lacustre	6			4	2	69	8		1	5	3	17	8	1	7	125	20,278	13,691	11,534	657	12	6	1,761	207	3	15	**48,420**	**22.49%**
	Monocorophium insidiosum	31	9		5	1																						**46**	**0.02%**
	Gammarus daiberi		3		1	14		100		1	5	63	14	557	1,384	516	624	2,972	4,164	7,662	1,435	6	5	653	1,812	22	24	**22,037**	**10.24%**
	Gammarus palustris																				2							**2**	**0.00%**
	Mucrogammarus mucronatus		6	2	1	4	19	58	9			8									2	1						**110**	**0.05%**
	Melita nitida	2	5	1	4		3	1			1																	**17**	**0.01%**
	Ameroculodes spp. complex		1		3	2			1		30	7	22	8	12	1												**87**	**0.04%**
	Incisocalliope aestuarius	3	2				2																					**7**	**0.00%**
Carridean Shrimp	Palaemonetes pugio	1												1	1	3						2				1		**9**	**0.00%**
	Crangon septemspinosa	4	22	2	11	6	16	5	6	3	4	8	13		1	2								1				**104**	**0.05%**
True Crabs	Callinectes sapidus	2	4	1	1	2	1				1	2							1									**15**	**0.01%**
	Rhithropanopeus harrisii		5	1	11	1	16	11	2		64	12	3	38	36	16	29	58	56	105	13	2	4	40	4		6	**533**	**0.25%**
Insect larvae	Chaoborus sp.																								1			**1**	**0.00%**
	Chironomidae									2		1	7			4	5	1,862	62	324	1,684	1,249	498	545	619	488	510	**7,860**	**3.65%**
Sea Squirts	Molgula manhattensis	12	2		2	1	4			1																		**22**	**0.01%**
	TOTAL # COLLECTED	**983**	**1,745**	**840**	**1,018**	**500**	**764**	**3,629**	**243**	**1,086**	**2,651**	**2,632**	**6,561**	**3,729**	**5,161**	**5,605**	**3,838**	**40,243**	**29,397**	**33,203**	**25,271**	**3,011**	**5,826**	**15,339**	**13,669**	**2,872**	**5,480**	**215,296**	**100.00%**
	TOTAL # OF SPECIES	**32**	**43**	**27**	**41**	**34**	**34**	**22**	**23**	**34**	**27**	**29**	**25**	**19**	**28**	**24**	**21**	**22**	**25**	**22**	**22**	**18**	**17**	**18**	**20**	**10**	**14**	**67**	

TABLE 15
Ranked Summary of the Relative Abundance and Percent Frequency of Occurrence for the Top 10 Species Collected During the 1987 and 2002 Benthic Studies
NJMC/MERI Hackensack River Benthic Inventory

	ALL SITES & SEASONS COMBINED							
Species	**2002 TOTAL # COLLECTED**	1987 TOTAL # COLLECTED	**2002 Relative Abundance**	1987 Relative Abundance	**2002 % Freq Occur**	1987 % Freq Occur	**2002 RANK**	1987 RANK
Hobsonia florida	**75,853**	778	**35.23%**	1.19%	**69.23%**	21.48%	**1**	7
Apocorophium lacustre	**48,420**	206	**22.49%**	0.31%	**42.95%**	5.99%	**2**	13
Gammarus daiberi	**22,037**		**10.24%**		**39.10%**		**3**	
Streblospio benedicti	**13,090**	2,152	**6.08%**	3.28%	**61.86%**	35.56%	**4**	5
Oligochaeta	**12,966**	17,399	**6.02%**	26.54%	**65.38%**	87.32%	**5**	2
Chironomidae	**7,860**	523	**3.65%**	0.80%	**39.42%**	28.52%	**6**	8
Edwardsiidae sp.	**6,536**		**3.04%**		**45.83%**		**7**	
Leptocheirus plumulosus	**5,473**		**2.54%**		**54.17%**		**8**	
Littoridinops tenuipes	**4,541**		**2.11%**		**13.46%**		**9**	
Marenzelleria viridis	**3,911**	67	**1.82%**	0.10%	**56.73%**	10.56%	**10**	15
Mytilopsis leucophaeata	**3,211**	4,854	**1.49%**	7.40%	**15.06%**	14.44%	**11**	3
Cyathura polita	**2,619**	246	**1.22%**	0.38%	**74.04%**	21.83%	**12**	12
Laeonereis culveri	**1,373**	464	**0.64%**	0.71%	**27.88%**	15.49%	**13**	9
Edotea triloba	**1,198**	46	**0.56%**	0.07%	**50.96%**	7.04%	**14**	20
Heteromastus filiformis	**1,085**	9	**0.50%**	0.01%	**46.15%**	1.06%	**15**	31
Rhithropanopeus harrisii	**533**	433	**0.25%**	0.66%	**35.26%**	23.94%	**18**	10
Hydrobia totteni		33,053		50.41%		47.18%		1
Balanus improvisus	**392**	2,634	**0.18%**	4.02%	**11.22%**	12.32%	**21**	4
Polydora socialis		1,795		2.74%		8.10%		6

TABLE 16
Ranked Seasonal Total Number, Relative Abundance and Percent Frequency of Occurrence for All Benthic Invertebrates Collected During 1987
NJMC/MERI Hackensack River Benthic Inventory

	WINTER 1987-88			
Species	TOTAL # COLLECTED (n=50 reps)	Relative Abundance	% Freq Occur	RANK
Oligochaeta	2,870	60.90%	84.0%	1
Hydrobia totteni	1,195	25.36%	40.0%	2
Streblospio benedicti	398	8.44%	28.0%	3
Cyathura polita	32	0.68%	24.0%	4
Leucon americanus	31	0.66%	24.0%	5
Polydora socialis	20	0.42%	8.0%	6
Balanus improvisus	17	0.36%	10.0%	7
Macoma balthica	17	0.36%	18.0%	7
Marenzellaria viridis	15	0.32%	10.0%	9
Congeria leucophaeta	14	0.30%	4.0%	10
Laeoneries culveri	13	0.28%	10.0%	11
Edotea triloloba	13	0.28%	12.0%	11
Rithropanopeus harrisii	12	0.25%	12.0%	13
Monoculodes edwardsi	10	0.21%	14.0%	14
Nereis succinea	9	0.19%	10.0%	15
Nemertea	9	0.19%	10.0%	15
Geukensia demissus	7	0.15%	2.0%	17
Chironomidae	4	0.08%	2.0%	18
Corophium lacustre	4	0.08%	4.0%	18
Palaemonetes pugio	4	0.08%	4.0%	18
Mya arenaria	4	0.08%	6.0%	18
Coleoptera	4	0.08%	4.0%	18
Haploscoloplos sp.	2	0.04%	2.0%	23
Hypaniola florida	1	0.02%	2.0%	24
Holothuroidea	1	0.02%	2.0%	24
Melita nitida	1	0.02%	2.0%	24
Eteone heteropoda	1	0.02%	2.0%	24
Neomysis americana	1	0.02%	2.0%	24
Melita dentata	1	0.02%	2.0%	24
Tabanidae	1	0.02%	2.0%	24
Eupleura caudata	1	0.02%	2.0%	24
Callinectus sapidus	1	0.02%	2.0%	24
Total # of individuals	**4,713**	**100%**		
Total # of Taxa	**32**			

	SPRING 1987			
Species	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	% Freq Occur	RANK
Oligochaeta	4,015	79.08%	87.2%	1
Chironomidae	347	6.83%	43.6%	2
Hydrobia totteni	146	2.88%	34.6%	3
Rithropanopeus harrisii	104	2.05%	17.9%	4
Corophium lacustre	68	1.34%	10.3%	5
Streblospio benedicti	65	1.28%	14.1%	6
Hypaniola florida	63	1.24%	24.4%	7
Macoma balthica	63	1.24%	29.5%	7
Polydora socialis	35	0.69%	6.4%	9
Cyathura polita	33	0.65%	14.1%	10
Balanus improvisus	24	0.47%	10.3%	11
Laeoneries culveri	22	0.43%	7.7%	12
Nereis succinea	12	0.24%	7.7%	13
Melita nitida	11	0.22%	7.7%	14
Marenzellaria viridis	7	0.14%	6.4%	15
Edotea triloloba	7	0.14%	3.8%	15
Nemertea	6	0.12%	5.1%	17
Harpacticoida	6	0.12%	6.4%	17
Nematoda	6	0.12%	3.8%	17
Spionidae sp. *	4	0.08%	2.6%	20
Manayunkia aesturina	4	0.08%	2.6%	20
Mya arenaria	3	0.06%	3.8%	22
Crangon septemspinosa	3	0.06%	3.8%	22
Congeria leucophaeta	2	0.04%	2.6%	24
Palaemonetes pugio	1	0.02%	1.3%	25
Neomysis americana	1	0.02%	1.3%	25
Monoculodes edwardsi	1	0.02%	1.3%	25
Geukensia demissus	1	0.02%	1.3%	25
Coleoptera	1	0.02%	1.3%	25
Tabanidae	1	0.02%	1.3%	25
Melampus bidentatus	1	0.02%	1.3%	25
Hydracarina	1	0.02%	1.3%	25
Gammarus mucronatus	1	0.02%	1.3%	25
Gammarus tigrinus	1	0.02%	1.3%	25
Total # of individuals	**5,066**	**100%**		
Total # of Taxa	**33***			

	SUMMER 1987			
Species	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	% Freq Occur	RANK
Hydrobia totteni	4,825	29.30%	47.4%	1
Oligochaeta	4,329	26.29%	84.6%	2
Congeria leucophaeta	2,616	15.88%	28.2%	3
Balanus improvisus	1,650	10.02%	10.3%	4
Polydora socialis	1,120	6.80%	9.0%	5
Hypaniola florida	646	3.92%	37.2%	6
Laeoneries culveri	344	2.09%	26.9%	7
Streblospio benedicti	269	1.63%	50.0%	8
Rithropanopeus harrisii	229	1.39%	39.7%	9
Macoma balthica	103	0.63%	23.1%	10
Chironomidae	98	0.60%	32.1%	11
Cyathura polita	94	0.57%	28.2%	12
Actinaria sp.	49	0.30%	5.1%	13
Marenzellaria viridis	21	0.13%	11.5%	14
Polydora ligni	15	0.09%	1.3%	15
Palaemonetes pugio	14	0.09%	12.8%	16
Nereis succinea	13	0.08%	1.3%	17
Nemertea	7	0.04%	6.4%	18
Melita nitida	5	0.03%	2.6%	19
Eteone sp. *	4	0.02%	5.1%	20
Edotea triloloba	3	0.02%	2.6%	21
Polydora sp. *	2	0.01%	1.3%	22
Pectinaria gouldii	2	0.01%	2.6%	22
Holothuroidea	1	0.01%	1.3%	24
Eteone heteropoda	1	0.01%	1.3%	24
Spionidae sp. *	1	0.01%	1.3%	24
Glycera dibranchiata	1	0.01%	1.3%	24
Melita dentata	1	0.01%	1.3%	24
Chaoborus sp.	1	0.01%	1.3%	24
Eteone longa	1	0.01%	1.3%	24
Total # of individuals	**16,465**	**100%**		
Total # of Taxa	**27***			

	AUTUMN 1987			
Species	TOTAL # COLLECTED (n=78 reps)	Relative Abundance	% Freq Occur	RANK
Hydrobia totteni	26,887	68.38%	64.1%	1
Oligochaeta	6,185	15.73%	92.3%	2
Congeria leucophaeta	2,222	5.65%	19.2%	3
Streblospio benedicti	1,420	3.61%	47.4%	4
Balanus improvisus	943	2.40%	17.9%	5
Polydora socialis	620	1.58%	9.0%	6
Holothuroidea	248	0.63%	5.1%	7
Corophium sp. *	117	0.30%	3.8%	8
Rithropanopeus harrisii	88	0.22%	21.8%	9
Cyathura polita	87	0.22%	21.8%	10
Laeoneries culveri	85	0.22%	15.4%	11
Chironomidae	74	0.19%	26.9%	12
Hypaniola florida	68	0.17%	15.4%	13
Boccardia ligerica	46	0.12%	3.8%	14
Melita nitida	32	0.08%	12.8%	15
Nereis succinea	26	0.07%	7.7%	16
Marenzellaria viridis	24	0.06%	14.1%	17
Edotea triloloba	23	0.06%	11.5%	18
Corophium lacustre	17	0.04%	5.1%	19
Nemertea	16	0.04%	9.0%	20
Mya arenaria	14	0.04%	10.3%	21
Eteone heteropoda	13	0.03%	12.8%	22
Neomysis americana	11	0.03%	7.7%	23
Macoma balthica	10	0.03%	10.3%	24
Polydora sp. *	9	0.02%	2.6%	25
Heteromastus filliformis	9	0.02%	3.8%	25
Leucon americanus	7	0.02%	7.7%	27
Palaemonetes pugio	4	0.01%	5.1%	28
Polydora ligni	2	0.01%	2.6%	29
Harpacticoida	2	0.01%	2.6%	29
Crangon septemspinosa	2	0.01%	2.6%	29
Leitoscoloplos fragilis	2	0.01%	2.6%	29
Mulinia lateralis	2	0.01%	2.6%	29
Nematoda	1	0.00%	1.3%	34
Pectinaria gouldii	1	0.00%	1.3%	34
Glycera dibranchiata	1	0.00%	1.3%	34
Chaoborus sp.	1	0.00%	1.3%	34
Nereis diversicolor	1	0.00%	1.3%	34
Leitoscoloplos robustus	1	0.00%	1.3%	34
Total # of individuals	**39,321**	**100%**		
Total # of Taxa	**37***			

NOTE: * denotes that Eteone sp., Spionidae sp., Polydora sp., and Corophium sp. were not counted as a separate taxa

TABLE 17
Ranked Seasonal Total Number, Relative Abundance and Percent Frequency of Occurrence for All Benthic Invertebrates Collected During 2002
NJMC/MERI Hackensack River Benthic Inventory

	WINTER 2001/02			
Species	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	% Freq Occur	RANK
Hobsonia florida	32,087	**54.72%**	**74.4%**	1
Apocorophium lacustre	10,924	**18.63%**	**46.2%**	2
Mytilopsis leucophaeata	3,125	**5.33%**	**30.8%**	3
Chironomidae	2,644	**4.51%**	**44.9%**	4
Marenzelleria viridis	1,780	**3.04%**	**71.8%**	5
Streblospio benedicti	1,561	**2.66%**	**53.8%**	6
Oligochaeta	1,121	**1.91%**	**62.8%**	7
Gammarus daiberi	840	**1.43%**	**48.7%**	8
Cyathura polita	759	**1.29%**	**70.5%**	9
Edwardsiidae sp.	638	**1.09%**	**25.6%**	10
Leptocheirus plumulosus	537	**0.92%**	**69.2%**	11
Littoridinops tenuipes	422	**0.72%**	**20.5%**	12
Edotea triloba	407	**0.69%**	**51.3%**	13
Laeonereis culveri	323	**0.55%**	**21.8%**	14
Heteromastus filiformis	216	**0.37%**	**47.4%**	15
Mya arenaria	160	**0.27%**	**29.5%**	16
Diadumene leucolena	140	**0.24%**	**3.8%**	17
Carinoma tremaphorus	114	**0.19%**	**50.0%**	18
Mulinia lateralis	114	**0.19%**	**24.4%**	18
Boccardiella ligerica	95	**0.16%**	**19.2%**	20
Polydora cornuta	83	**0.14%**	**16.7%**	21
Rhithropanopeus harrisii	72	**0.12%**	**25.6%**	22
Balanus improvisus	68	**0.12%**	**6.4%**	23
Leitoscoloplos robustus	67	**0.11%**	**23.1%**	24
Eteone heteropoda	60	**0.10%**	**29.5%**	25
Ameroculodes spp. complex	51	**0.09%**	**15.4%**	26
Macoma balthica	43	**0.07%**	**25.6%**	27
Ampelisca abdita	32	**0.05%**	**14.1%**	28
Neanthes succinea	32	**0.05%**	**14.1%**	28
Monocorophium insidiosum	31	**0.05%**	**5.1%**	30
Pectinaria gouldii	22	**0.04%**	**11.5%**	31
Leucon americanus	12	**0.02%**	**7.7%**	32
Glycera americana	10	**0.02%**	**9.0%**	33
Neomysis americana	9	**0.02%**	**10.3%**	34
Molgula manhattensis	8	**0.01%**	**6.4%**	35
Callinectes sapidus	8	**0.01%**	**10.3%**	35
Melita nitida	6	**0.01%**	**3.8%**	37
Crangon septemspinosa	4	**0.01%**	**2.6%**	38
Elysia chlorotica	4	**0.01%**	**3.8%**	38
Euplana gracilis	3	**0.01%**	**2.6%**	40
Alderia modesta	3	**0.01%**	**2.6%**	40
Synidotea laevidorsalis	2	**0.00%**	**1.3%**	42
Oxyurostylis smithi	2	**0.00%**	**2.6%**	42
Manayunkia aestuarina	1	**0.00%**	**1.3%**	44
Doridella obscura	1	**0.00%**	**1.3%**	44
Crassostrea virginica	1	**0.00%**	**1.3%**	44
Sabellaria vulgaris	1	**0.00%**	**1.3%**	44
Total # of Individuals	**58,643**	**100.00%**		
Total # of Species	**47**			

	SPRING 2002			
Species	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	% Freq Occur	RANK
Apocorophium lacustre	34,455	**34.67%**	**46.2%**	1
Gammarus daiberi	20,797	**20.93%**	**66.7%**	2
Hobsonia florida	14,192	**14.28%**	**71.8%**	3
Oligochaeta	8,608	**8.66%**	**67.9%**	4
Streblospio benedicti	5,814	**5.85%**	**53.8%**	5
Littoridinops tenuipes	4,093	**4.12%**	**28.2%**	6
Chironomidae	2,899	**2.92%**	**42.3%**	7
Leptocheirus plumulosus	2,745	**2.76%**	**55.1%**	8
Edwardsiidae sp.	1,612	**1.62%**	**41.0%**	9
Marenzelleria viridis	1,566	**1.58%**	**70.5%**	10
Cyathura polita	514	**0.52%**	**62.8%**	11
Boccardiella ligerica	304	**0.31%**	**20.5%**	12
Laeonereis culveri	228	**0.23%**	**23.1%**	13
Edotea triloba	208	**0.21%**	**51.3%**	14
Macoma balthica	207	**0.21%**	**37.2%**	15
Heteromastus filiformis	204	**0.21%**	**46.2%**	16
Leitoscoloplos robustus	155	**0.16%**	**23.1%**	17
Mucrogammarus mucronatus	107	**0.11%**	**20.5%**	18
Crangon septemspinosa	91	**0.09%**	**33.3%**	19
Balanus improvisus	82	**0.08%**	**17.9%**	20
Rhithropanopeus harrisii	74	**0.07%**	**32.1%**	21
Carinoma tremaphorus	70	**0.07%**	**41.0%**	22
Mytilopsis leucophaeata	66	**0.07%**	**14.1%**	23
Polydora cornuta	49	**0.05%**	**14.1%**	24
Ameroculodes spp. complex	35	**0.04%**	**17.9%**	25
Eteone heteropoda	29	**0.03%**	**19.2%**	26
Neanthes succinea	25	**0.03%**	**19.2%**	27
Manayunkia aestuarina	19	**0.02%**	**6.4%**	28
Mulinia lateralis	18	**0.02%**	**9.0%**	29
Diadumene leucolena	17	**0.02%**	**3.8%**	30
Monocorophium insidiosum	14	**0.01%**	**7.7%**	31
Ampelisca abdita	7	**0.01%**	**6.4%**	32
Neomysis americana	7	**0.01%**	**5.1%**	32
Melita nitida	7	**0.01%**	**5.1%**	32
Leucon americanus	6	**0.01%**	**5.1%**	35
Synidotea laevidorsalis	6	**0.01%**	**5.1%**	35
Spio setosa	6	**0.01%**	**5.1%**	35
Pectinaria gouldii	5	**0.01%**	**5.1%**	38
Stylochus ellipticus	5	**0.01%**	**3.8%**	38
Glycera americana	4	**0.00%**	**3.8%**	40
Callinectes sapidus	4	**0.00%**	**2.6%**	40
Incisocalliope aestuarius	3	**0.00%**	**2.6%**	42
Tharyx sp. A	3	**0.00%**	**3.8%**	42
Rangia cuneata	2	**0.00%**	**2.6%**	44
Mediomastus ambiseta	2	**0.00%**	**2.6%**	44
Nephtys picta	2	**0.00%**	**2.6%**	44
Mya arenaria	1	**0.00%**	**1.3%**	47
Palaemonetes pugio	1	**0.00%**	**1.3%**	47
Doridella obscura	1	**0.00%**	**1.3%**	47
Eteone foliosa	1	**0.00%**	**1.3%**	47
Amphiporus bioculatus	1	**0.00%**	**1.3%**	47
Crassostrea virginica	1	**0.00%**	**1.3%**	47
Microphthalmus sczelkowii	1	**0.00%**	**1.3%**	47
Anoplodactylus petiolatus	1	**0.00%**	**1.3%**	47
Total # of Individuals	**99,374**	**100.00%**		
Total # of Species	**54**			

	SUMMER 2002			
Species	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	% Freq Occur	RANK
Hobsonia florida	18,203	**55.80%**	**67.9%**	1
Streblospio benedicti	4,015	**12.31%**	**67.9%**	2
Edwardsiidae sp.	2,823	**8.65%**	**62.8%**	3
Chironomidae	1,358	**4.16%**	**34.6%**	4
Apocorophium lacustre	1,341	**4.11%**	**32.1%**	5
Oligochaeta	1,333	**4.09%**	**64.1%**	6
Cyathura polita	668	**2.05%**	**80.8%**	7
Laeonereis culveri	505	**1.55%**	**35.9%**	8
Marenzelleria viridis	387	**1.19%**	**39.7%**	9
Rhithropanopeus harrisii	252	**0.77%**	**47.4%**	10
Mulinia lateralis	222	**0.68%**	**33.3%**	11
Gammarus daiberi	204	**0.63%**	**21.8%**	12
Leptocheirus plumulosus	203	**0.62%**	**23.1%**	13
Heteromastus filiformis	185	**0.57%**	**46.2%**	14
Carinoma tremaphorus	165	**0.51%**	**52.6%**	15
Balanus improvisus	155	**0.48%**	**7.7%**	16
Edotea triloba	107	**0.33%**	**38.5%**	17
Leitoscoloplos robustus	98	**0.30%**	**26.9%**	18
Boccardiella ligerica	88	**0.27%**	**9.0%**	19
Eteone heteropoda	55	**0.17%**	**24.4%**	20
Macoma balthica	42	**0.13%**	**28.2%**	21
Macoma mitchelli	39	**0.12%**	**10.3%**	22
Pectinaria gouldii	37	**0.11%**	**15.4%**	23
Littoridinops tenuipes	21	**0.06%**	**2.6%**	24
Mytilopsis leucophaeata	19	**0.06%**	**14.1%**	25
Ampelisca abdita	19	**0.06%**	**11.5%**	25
Capitella capitata	16	**0.05%**	**3.8%**	27
Polydora cornuta	14	**0.04%**	**10.3%**	28
Neanthes succinea	14	**0.04%**	**7.7%**	28
Palaemonetes pugio	6	**0.02%**	**5.1%**	30
Crangon septemspinosa	4	**0.01%**	**3.8%**	31
Neomysis americana	4	**0.01%**	**3.8%**	31
Glycera americana	4	**0.01%**	**3.8%**	31
Haminoea solitaria	3	**0.01%**	**1.3%**	34
Mya arenaria	2	**0.01%**	**2.6%**	35
Amphiporus bioculatus	2	**0.01%**	**2.6%**	35
Mucrogammarus mucronatus	1	**0.00%**	**1.3%**	37
Monocorophium insidiosum	1	**0.00%**	**1.3%**	37
Molgula manhattensis	1	**0.00%**	**1.3%**	37
Melita nitida	1	**0.00%**	**1.3%**	37
Rangia cuneata	1	**0.00%**	**1.3%**	37
Eteone foliosa	1	**0.00%**	**1.3%**	37
Euplana gracilis	1	**0.00%**	**1.3%**	37
Epitonium rupicola	1	**0.00%**	**1.3%**	37
Total # of Individuals	**32,621**	**100.00%**		
Total # of Species	**44**			

	AUTUMN 2002			
Species	TOTAL # COLLECTED (n = 78 reps)	Relative Abundance	% Freq Occur	RANK
Hobsonia florida	11,371	**46.11%**	**62.8%**	1
Leptocheirus plumulosus	1,988	**8.06%**	**69.2%**	2
Oligochaeta	1,904	**7.72%**	**66.7%**	3
Apocorophium lacustre	1,700	**6.89%**	**47.4%**	4
Streblospio benedicti	1,700	**6.89%**	**71.8%**	4
Edwardsiidae sp.	1,463	**5.93%**	**53.8%**	6
Chironomidae	959	**3.89%**	**35.9%**	7
Cyathura polita	678	**2.75%**	**82.1%**	8
Heteromastus filiformis	480	**1.95%**	**44.9%**	9
Edotea triloba	476	**1.93%**	**62.8%**	10
Laeonereis culveri	317	**1.29%**	**30.8%**	11
Macoma mitchelli	197	**0.80%**	**50.0%**	12
Gammarus daiberi	196	**0.79%**	**19.2%**	13
Carinoma tremaphorus	193	**0.78%**	**61.5%**	14
Marenzelleria viridis	178	**0.72%**	**44.9%**	15
Rhithropanopeus harrisii	135	**0.55%**	**35.9%**	16
Mulinia lateralis	130	**0.53%**	**24.4%**	17
Balanus improvisus	87	**0.35%**	**12.8%**	18
Leitoscoloplos robustus	78	**0.32%**	**21.8%**	19
Ampelisca abdita	73	**0.30%**	**17.9%**	20
Boccardiella ligerica	56	**0.23%**	**6.4%**	21
Mya arenaria	47	**0.19%**	**23.1%**	22
Eteone heteropoda	43	**0.17%**	**14.1%**	23
Neanthes succinea	32	**0.13%**	**20.5%**	24
Neomysis americana	30	**0.12%**	**10.3%**	25
Polydora cornuta	28	**0.11%**	**10.3%**	26
Leucon americanus	20	**0.08%**	**5.1%**	27
Macoma balthica	19	**0.08%**	**16.7%**	28
Pectinaria gouldii	16	**0.06%**	**12.8%**	29
Molgula manhattensis	13	**0.05%**	**6.4%**	30
Littoridinops tenuipes	5	**0.02%**	**2.6%**	31
Crangon septemspinosa	5	**0.02%**	**6.4%**	31
Doridella obscura	5	**0.02%**	**3.8%**	31
Incisocalliope aestuarius	4	**0.02%**	**3.8%**	34
Melita nitida	3	**0.01%**	**3.8%**	35
Callinectes sapidus	3	**0.01%**	**3.8%**	35
Synidotea laevidorsalis	3	**0.01%**	**3.8%**	35
Rangia cuneata	3	**0.01%**	**3.8%**	35
Eteone foliosa	3	**0.01%**	**3.8%**	35
Mucrogammarus mucronatus	2	**0.01%**	**1.3%**	40
Capitella capitata	2	**0.01%**	**2.6%**	40
Palaemonetes pugio	2	**0.01%**	**2.6%**	40
Podarkeopsis levifuscina	2	**0.01%**	**1.3%**	40
Gammarus palustris	2	**0.01%**	**1.3%**	40
Mytilopsis leucophaeata	1	**0.00%**	**1.3%**	45
Diadumene leucolena	1	**0.00%**	**1.3%**	45
Ameroculodes spp. complex	1	**0.00%**	**1.3%**	45
Manayunkia aestuarina	1	**0.00%**	**1.3%**	45
Glycera americana	1	**0.00%**	**1.3%**	45
Mediomastus ambiseta	1	**0.00%**	**1.3%**	45
Chaoborus sp.	1	**0.00%**	**1.3%**	45
Total # of Individuals	**24,658**	**100.00%**		
Total # of Species	**51**			

TABLE 18

Comparison of Overall (i.e., Yearly) Shannon Diversity Index, Simpson Diversity Index and Evenness Calculated for Each Sampling Location, NJMC/MERI Hackensack River Benthic Inventory

SITE	GN1		S1		TN1		T1-S		T1-D		(T6)		(TN2)	
RIVER MILE	3.0		3.5		3.7		3.7		3.71		5.1		5.2	
YEAR	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
Avg. Salinity (0/00)	15.98	9.75	14.58	11.25	14.54	10.75	15.41	10.25	15.04	10.25	14.24	8.00	12.93	6.88
Avg. D.O. (mg/l)	6.41	8.05	6.54	7.13	6.34	6.80	5.58	8.25	5.80	8.25	6.59	9.13	7.49	9.13
Avg. % Fines (silt + clay)	19.1	11.5	1.9	41.5	83.6	76.3	74.6	56.4	70.6	55.1	76.6	94.8	86.5	94.8
Avg. T.O.C. (%)	4.1		5.54		10.10		6.90		5.60		5.66		9.76	
TOTAL # OF ORGANISMS	983	765	1,745	1,948	840	939	1,018	773	500	404	764	706	3,629	1,905
TOTAL # OF COLLECTIONS	12	12	12	12	12	12	12	12	12	12	12	9	12	9
TOTAL # OF TAXA	32	22	43	25	27	21	41	23	34	17	34	11	22	16
Shannon Diversity Index (H')	1.024	0.577	1.131	0.798	0.946	0.697	1.115	0.875	1.153	0.755	1.129	0.767	0.850	0.713
Simpson Diversity Index (D)	5.953	2.691	7.299	4.046	5.184	3.085	7.673	5.418	8.006	3.313	7.832	4.040	5.111	3.136
Evenness (J')	0.295	0.184	0.301	0.245	0.287	0.226	0.300	0.279	0.327	0.256	0.320	0.309	0.275	0.257

SITE	T2-S		T2-D		GN2		T3-S		T3-D		TN3	
RIVER MILE	5.4		5.41		6.8		7.0		7.01		7.1	
YEAR	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
Avg. Salinity (0/00)	14.73	9.25	15.07	9.25	10.93	6.38	11.76	6.00	11.22	6.00	10.66	6.00
Avg. D.O. (mg/l)	5.27	6.83	5.28	6.83	5.05	5.75	4.95	5.20	4.97	5.20	5.39	4.65
Avg. % Fines (silt + clay)	40.2	11.0	19.5	17.6	73.7	73.0	81.2	91.0	87.5	92.8	78.6	96.0
Avg. T.O.C. (%)	2.36		2.39		5.64		10.0		10.16		9.38	
TOTAL # OF ORGANISMS	243	334	1,086	1,145	2,651	1,122	2,632	1,110	6,561	1,459	3,729	760
TOTAL # OF COLLECTIONS	12	12	12	12	12	12	12	12	12	12	12	12
TOTAL # OF TAXA	24	19	34	21	29	18	29	12	25	18	19	11
Shannon Diversity Index (H')	1.063	0.846	1.143	0.570	0.802	0.212	1.029	0.365	0.698	0.494	0.928	0.456
Simpson Diversity Index (D)	8.212	4.850	10.485	2.541	3.492	1.201	7.468	2.410	3.054	1.683	6.851	2.021
Evenness (J')	0.339	0.287	0.324	0.187	0.243	0.072	0.306	0.147	0.217	0.171	0.315	0.190

TABLE 18 (continued)
Comparison of Overall (i.e., Yearly) Shannon Diversity Index, Simpson Diversity Index and Evenness Calculated for Each Sampling Location, for Benthic Macroinverteberate Samples Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory

SITE	S2		T7		(TN4)		T8		(T4-S)		(T4-D)		T9	
RIVER MILE	7.4		7.5		9.2		9.2		9.25		9.31		9.4	
YEAR	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
Avg. Salinity (0/00)	11.50	7.75	9.34	6.25	9.88	3.50	7.52	3.50	8.82	4.50	9.79	4.50	6.42	1.50
Avg. D.O. (mg/l)	4.71	4.78	6.38	5.15	4.76	6.25	4.51	5.50	4.99	4.45	4.25	4.45	4.09	3.28
Avg. % Fines (silt + clay)	27.7	40.3	84.6	94.6	76.7	89.4	84.0	91.4	68.6	93.9	60.9	88.9	86.4	92.5
Avg. T.O.C. (%)	4.81		13.51		13.29		19.01		12.82		6.38		16.36	
TOTAL # OF ORGANISMS	**5,161**	**1,388**	**5,605**	**3,269**	**3,838**	**1,018**	**40,243**	**34,596**	**29,397**	**3,593**	**33,203**	**2,053**	**25,271**	**35**
TOTAL # OF COLLECTIONS	**12**	**12**	**12**	**12**	**12**	**9**	**12**	**12**	**12**	**9**	**12**	**9**	**12**	**12**
TOTAL # OF TAXA	**29**	**13**	**24**	**12**	**22**	**8**	**23**	**10**	**26**	**9**	**23**	**8**	**23**	**5**
Shannon Diversity Index (H')	**0.894**	0.680	**0.645**	0.279	**0.844**	0.361	**0.691**	0.469	**0.634**	0.342	**0.677**	0.373	0.584	0.328
Simpson Diversity Index (D)	5.683	3.883	3.266	1.497	4.784	2.069	3.175	2.111	3.184	2.034	3.789	2.116	2.283	1.533
Evenness (J')	0.268	0.265	0.203	0.112	0.277	0.174	0.224	0.204	0.197	0.155	0.219	0.179	0.179	0.204

SITE	(S3)		TN5		(T5-S)		T5-D*		(GN3)		(TN6)	
RIVER MILE	10.6		10.9		11.4		11.41		12.2		12.5	
YEAR	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
Avg. Salinity (0/00)	6.55	1.13	5.89	1.00	6.35	0.33	6.61	1.13	5.29	4.67	5.34	1.25
Avg. D.O. (mg/l)	5.12	5.88	4.96	6.95	3.81	6.80	3.83	6.05	5.83	4.03	4.09	5.60
Avg. % Fines (silt + clay)	91.3	97.3	80.0	77.6	79.6	96.7	84.7	14.8	89.0	98.2	85.6	84.8
Avg. T.O.C. (%)	12.66		12.60		13.41		15.37		12.55		15.29	
TOTAL # OF ORGANISMS	**3,011**	**186**	**5,826**	**211**	**15,339**	**111**	**13,669**	**2,760**	**2,872**	**2,429**	**5,480**	**546**
TOTAL # OF COLLECTIONS	**12**	**9**	**12**	**12**	**12**	**9**	**12**	**11**	**12**	**9**	**12**	**9**
TOTAL # OF TAXA	**19**	**6**	**18**	**4**	**19**	**4**	**21**	**6**	**11**	**5**	**14**	**4**
Shannon Diversity Index (H')	0.600	0.471	0.443	0.322	0.584	0.384	**0.617**	0.240	0.453	0.313	0.465	0.230
Simpson Diversity Index (D)	2.989	2.566	1.861	1.692	2.215	1.988	2.750	1.476	2.089	1.892	2.287	1.441
Evenness (J')	0.208	0.263	0.156	0.232	0.202	0.277	0.206	0.134	0.197	0.207	0.176	0.166

NOTES: Site names in parentheses [e.g., (T6)] indicate that the 1987 yearly Shannon diversity index did not include winter data.
Shannon diversity Index values that are bold and shaded were significantly different (p=0.05) from their corresponding Shannon index value.
***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.
No Total Organic Carbon (T.O.C.) determinations were made during the 1987 study.

TABLE 19
Comparison of the Seasonal Shannon Diversity Index Values (H') Calculated For Each Site
NJMC/MERI Hackensack River Benthic Inventory

Approximate River Mile	SEASON:	WINTER		SPRING		SUMMER		AUTUMN		All Seasons Combined	
	YEAR:	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
	Total # of Collections:	78	50	78	78	78	78	78	78	312	284
3.00	GN1	1.068	0.960	0.791	0.671	0.671	0.634	**0.962**	0.398	**1.024**	0.577
3.50	S1	**1.162**	0.714	**0.985**	0.728	0.773	0.649	**1.070**	0.656	**1.131**	0.798
3.70	TN1	**1.061**	0.449	**0.942**	0.243	0.669	0.636	0.692	0.841	**0.946**	0.697
3.71	T1-S	0.997	0.924	0.730	0.589	0.874	0.743	0.890	0.694	**1.115**	0.875
3.72	T1-D	1.082	0.907	**1.112**	0.705	0.739	0.807	**1.010**	0.574	**1.153**	0.755
5.10	(T6)	0.973		**0.887**	0.344	**0.987**	0.143	**0.978**	0.678	**1.129**	0.767
5.20	(TN2)	0.762		**0.650**	0.332	0.463	**0.754**	**0.854**	0.643	0.850	0.713
5.40	T2-S	0.925	0.735	**1.024**	0.791	**0.990**	0.217	0.793	0.590	**1.063**	0.846
5.41	T2-D	**1.014**	0.384	**0.878**	0.593	0.857	0.639	**0.948**	0.500	**1.143**	0.570
6.80	GN2	**0.858**	0.178	**0.597**	0.174	**0.761**	0.473	**0.992**	0.154	**0.802**	0.212
7.00	T3-S	**0.772**	0.312	**0.974**	0.367	**0.979**	0.397	**0.886**	0.271	**1.029**	0.365
7.01	T3-D	**0.895**	0.288	**0.580**	0.222	0.667	0.462	**0.797**	0.382	**0.698**	0.494
7.10	TN3	0.491	0.081	**0.821**	0.527	0.814	0.436	**0.958**	0.236	**0.928**	0.456
7.40	S2	**0.909**	0.394	0.502	0.378	0.672	0.667	**0.819**	0.413	**0.894**	0.680
7.50	T7	**0.518**	0.289	0.576	0.375	**0.486**	0.247	**0.936**	0.112	**0.645**	0.279
9.20	(TN4)	0.630		0.627	0.399	**0.666**	0.291	**0.669**	0.229	**0.844**	0.361
9.21	T8	**0.509**	0.000	0.583	0.363	0.666	0.681	**0.793**	0.325	**0.691**	0.469
9.25	(T4-S)	0.613		**0.481**	0.103	0.047	**0.317**	**0.785**	0.212	**0.634**	0.342
9.31	(T4-D)	0.493		**0.517**	0.214	0.138	0.385	0.456	0.242	**0.677**	0.373
9.40	T9	0.340	0.193	**0.607**	0.196	**0.350**	0.000	0.399	0.244	0.584	0.328
10.60	(S3)	0.298		0.552	0.243	0.519	0.494	0.628	0.454	0.600	0.471
10.90	TN5	**0.524**	0.028	**0.411**	0.000	0.184	0.434	0.392	0.265	0.443	0.322
11.40	(T5-S)	0.475		**0.754**	0.097	0.333	0.403	0.351	0.389	0.584	0.384
11.41	***T5-D**	0.214	0.096	**0.651**	0.007	0.381	0.305	0.582	0.229	**0.617**	0.240
12.20	(GN3)	0.283		0.264	0.135	0.310	0.321	**0.555**	0.122	0.453	0.333
12.50	(TN6)	0.384		**0.395**	0.000	0.160	0.268	0.526	0.203	0.465	0.230
	# of H' Significantly Different:	**10**	**0**	**18**	**0**	**7**	**2**	**16**	**0**	**19**	**0**

NOTES: Shannon diversity Index values that are bold and shaded were significantly different (p=0.05) from their corresponding Shannon index value.
Site names in parentheses [e.g., (T6)] indicate that the 1987 yearly Shannon diversity index did not include winter data.
***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.

TABLE 20
Comparison of the Seasonal Simpson Diversity Index Values (D) Calculated For Each Site
NJMC/MERI Hackensack River Benthic Inventory

Approximate River Mile	SEASON:	WINTER		SPRING		SUMMER		AUTUMN		All Seasons Combined	
	YEAR:	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
	Total # of Collections:	78	50	78	78	78	78	78	78	312	284
3.00	GN1	8.842	7.688	4.266	2.979	2.852	3.682	6.869	2.153	5.953	2.691
3.50	S1	9.886	4.121	5.251	3.544	3.918	2.664	8.038	2.704	7.299	4.046
3.70	TN1	8.415	2.030	7.282	1.255	2.746	3.197	3.123	4.510	5.184	3.085
3.71	T1-S	5.161	6.358	2.565	2.652	4.266	3.728	5.568	3.619	7.673	5.418
3.72	T1-D	8.240	6.921	8.495	3.959	3.311	5.226	7.267	2.419	8.006	3.313
5.10	(T6)	5.702		5.367	1.923	6.380	1.159	5.270	3.121	7.832	4.040
5.20	(TN2)	4.505		2.571	1.495	1.783	4.784	5.454	3.192	5.111	3.136
5.40	T2-S	7.364	4.500	8.167	3.971	7.669	1.471	4.528	2.926	8.212	4.850
5.41	T2-D	8.443	2.122	4.205	2.551	5.850	3.276	6.298	2.119	10.485	2.541
6.80	GN2	5.080	1.175	2.271	1.215	3.645	1.943	7.684	1.153	3.492	1.201
7.00	T3-S	3.914	1.551	7.218	1.335	8.008	1.872	5.102	2.052	7.468	2.410
7.01	T3-D	6.107	1.787	2.490	1.825	2.929	1.844	4.006	1.507	3.054	1.683
7.10	TN3	1.906	1.095	5.236	2.812	5.223	2.508	7.059	1.277	6.851	2.021
7.40	S2	6.667	1.912	2.262	2.065	3.120	4.199	4.219	2.259	5.683	3.883
7.50	T7	2.543	1.720	3.139	1.955	2.104	1.349	6.283	1.151	3.266	1.497
9.20	(TN4)	2.654		2.637	1.939	3.304	1.621	3.318	1.363	4.784	2.069
9.21	T8	2.317	1.000	2.645	1.761	3.019	4.231	4.993	1.535	3.175	2.111
9.25	(T4-S)	2.834		2.404	1.114	1.041	1.932	4.281	1.397	3.184	2.034
9.31	(T4-D)	2.083		2.597	1.296	1.156	2.190	2.433	1.568	3.789	2.116
9.40	T9	1.572	1.278	3.458	1.385	1.475	0.000	1.570	1.600	2.283	1.533
10.60	(S3)	1.517		2.593	1.426	2.612	2.665	3.554	2.616	2.989	2.566
10.90	TN5	3.110	1.024	1.895	1.000	1.186	2.563	1.646	1.416	1.861	1.692
11.40	(T5-S)	1.919		4.449	1.125	1.405	2.219	1.442	2.082	2.215	1.988
11.41	*T5-D	1.232	1.084	4.125	1.005	1.588	1.908	2.426	1.525	2.750	1.476
12.20	(GN3)	1.585		1.385	1.166	1.725	1.757	2.822	1.141	2.089	1.892
12.50	(TN6)	1.903		1.797	1.000	1.166	1.634	3.002	1.324	2.287	1.441
	# Higher Than Other Year:	16	1	25	1	12	14	23	3	26	0

NOTES: Site names in parentheses [e.g., (T6)] indicate that no winter comparisons could be made due to the lack of winter 1987 data.
***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.

TABLE 21
Comparison of the Seasonal Evenness Index Values (J') Calculated For Each Site
NJMC/MERI Hackensack River Benthic Inventory

Approximate River Mile	SEASON:	WINTER		SPRING		SUMMER		AUTUMN		All Seasons Combined	
	YEAR:	2002	1987	2002	1987	2002	1987	2002	1987	2002	1987
	Total # of Collections:	78	50	78	78	78	78	78	78	312	284
3.00	GN1	0.351	0.401	0.318	0.305	0.224	0.305	0.347	0.155	0.295	0.184
3.50	S1	0.352	0.343	0.293	0.293	0.258	0.234	0.332	0.242	0.301	0.245
3.70	TN1	0.360	0.216	0.357	0.106	0.269	0.306	0.239	0.319	0.287	0.226
3.71	T1-S	0.299	0.372	0.222	0.283	0.323	0.282	0.337	0.271	0.300	0.279
3.72	T1-D	0.355	0.394	0.355	0.362	0.280	0.367	0.357	0.224	0.327	0.256
5.10	(T6)	0.310		0.342	0.248	0.329	0.103	0.316	0.283	0.320	0.309
5.20	(TN2)	0.281		0.234	0.151	0.176	0.328	0.308	0.268	0.275	0.257
5.40	T2-S	0.402	0.378	0.378	0.279	0.365	0.314	0.331	0.303	0.339	0.287
5.41	T2-D	0.351	0.197	0.288	0.239	0.325	0.328	0.316	0.180	0.324	0.187
6.80	GN2	0.303	0.086	0.199	0.108	0.297	0.243	0.350	0.067	0.243	0.072
7.00	T3-S	0.262	0.174	0.315	0.265	0.382	0.222	0.306	0.151	0.306	0.147
7.01	T3-D	0.316	0.131	0.201	0.138	0.290	0.201	0.287	0.184	0.217	0.171
7.10	TN3	0.205	0.116	0.303	0.294	0.317	0.397	0.363	0.114	0.315	0.190
7.40	S2	0.344	0.245	0.196	0.235	0.248	0.303	0.265	0.199	0.268	0.265
7.50	T7	0.209	0.148	0.213	0.233	0.184	0.138	0.338	0.102	0.203	0.112
9.20	(TN4)	0.227		0.231	0.288	0.278	0.181	0.247	0.142	0.277	0.174
9.21	T8	0.193	+	0.215	0.203	0.235	0.310	0.301	0.156	0.224	0.204
9.25	(T4-S)	0.208		0.158	0.064	0.034	0.197	0.306	0.131	0.197	0.155
9.31	(T4-D)	0.171		0.176	0.133	0.077	0.239	0.329	0.220	0.219	0.179
9.40	T9	0.129	0.175	0.230	0.282	0.124	^	0.135	0.352	0.179	0.204
10.60	(S3)	0.143		0.266	0.221	0.217	0.307	0.262	0.327	0.208	0.263
10.90	TN5	0.252	0.040	0.211	+	0.072	0.395	0.170	0.191	0.156	0.232
11.40	(T5-S)	0.216		0.314	0.140	0.118	0.291	0.130	0.354	0.202	0.277
11.41	*T5-D	0.097	0.053	0.254	0.011	0.144	0.220	0.220	0.331	0.206	0.134
12.20	(GN3)	0.176		0.147	0.123	0.223	0.199	0.253	0.088	0.197	0.207
12.50	(TN6)	0.185		0.203	+	0.070	0.244	0.270	0.146	0.176	0.166
	# Higher Than Other Year:	13	4	19	6	11	15	20	6	21	5

NOTES: Site names in parentheses [e.g., (T6)] indicate that no winter comparisons could be made due to the lack of winter 1987 data.

***** Values calculated for T5-D during winter 1987 are based on only 2 replicates.

\+ Evenness not calculated for these sites, as only one species was collected

^ No organisms collected in three replicates at this site.

FIGURES

Figure 1. NJMC Benthic Inventory Sampling Locations

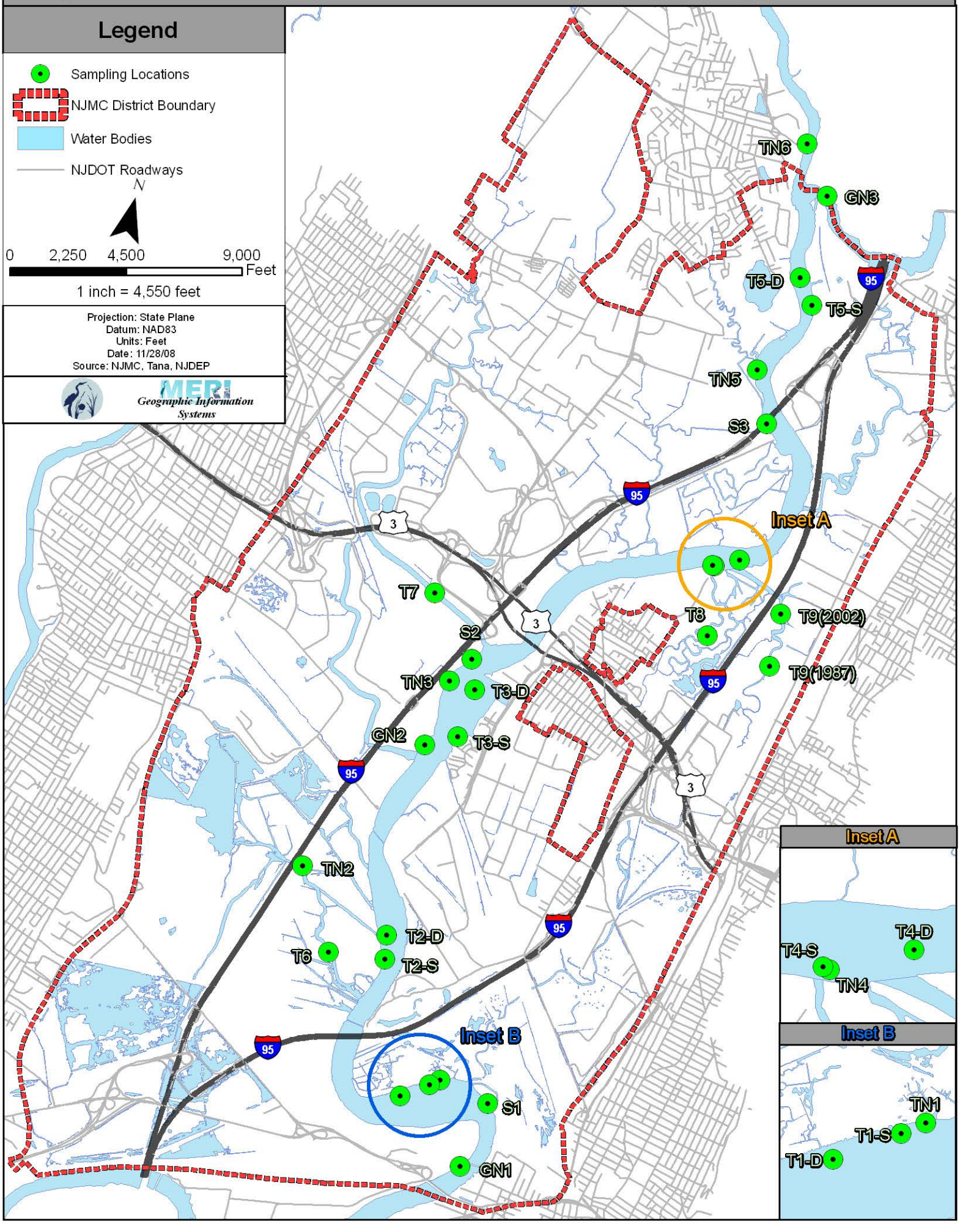


FIGURE 2

NJMC HACKENSACK RIVER FISHERIES RESOURCE INVENTORY
Benthic Collection Field Data Sheet

Station/Location: _____ Gear: **Full Size Ponar Grab Sampler**

Collection No.: _____ Rep. No.: _____ Date/Time: _____

Tide: High / Low

Depth: _____

Moon Phase: _____

Weather: wind: Calm, Breezy, Windy, Other: _____
sea: Calm, Choppy, Rough, Other: _____
atmosphere: Clear, Overcast, Fog, Drizzle, Rain, Sleet, Snow, Other: _____

Temp. : air: _____
(^{0}C) surface: _____ Crew: _____
bottom: _____ Remarks: _____

D.O. surface: _____
(mg/L) bottom: _____

Cond : surface: _____
(umhos) bottom: _____

Salinity surface: _____
(0/00) bottom: _____

Turb: surface: _____
(NTU) bottom: _____

pH: surface: _____
bottom: _____

T.D.S.: surface: _____
bottom: _____

Redox : surface: _____
(mV) bottom: _____

Secchi (cm): _____

FIGURE 3
Comparison of Sediment Texture (Percent Fines)
NJMC/MERI Hackensck River Benthic Inventory

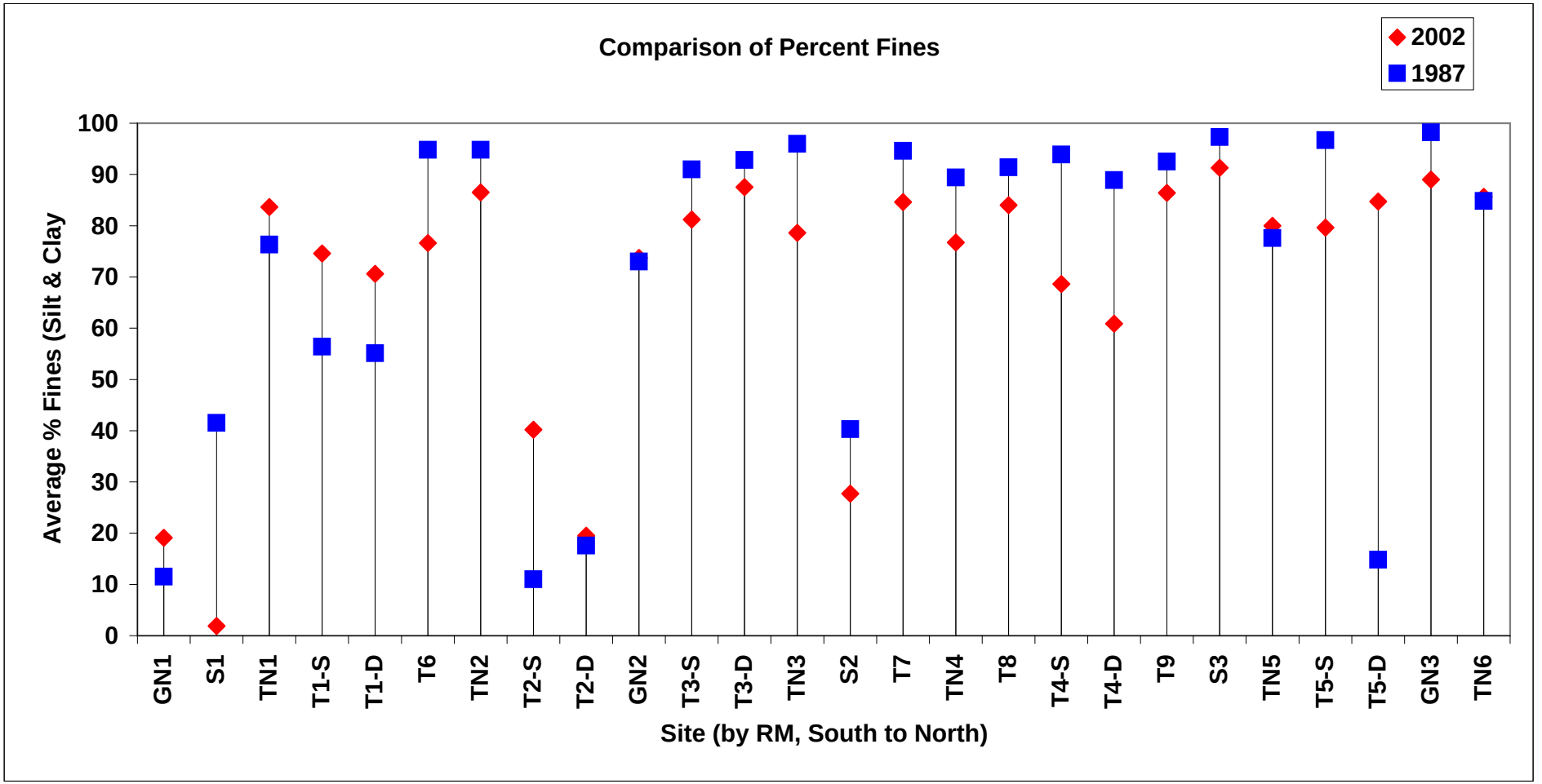
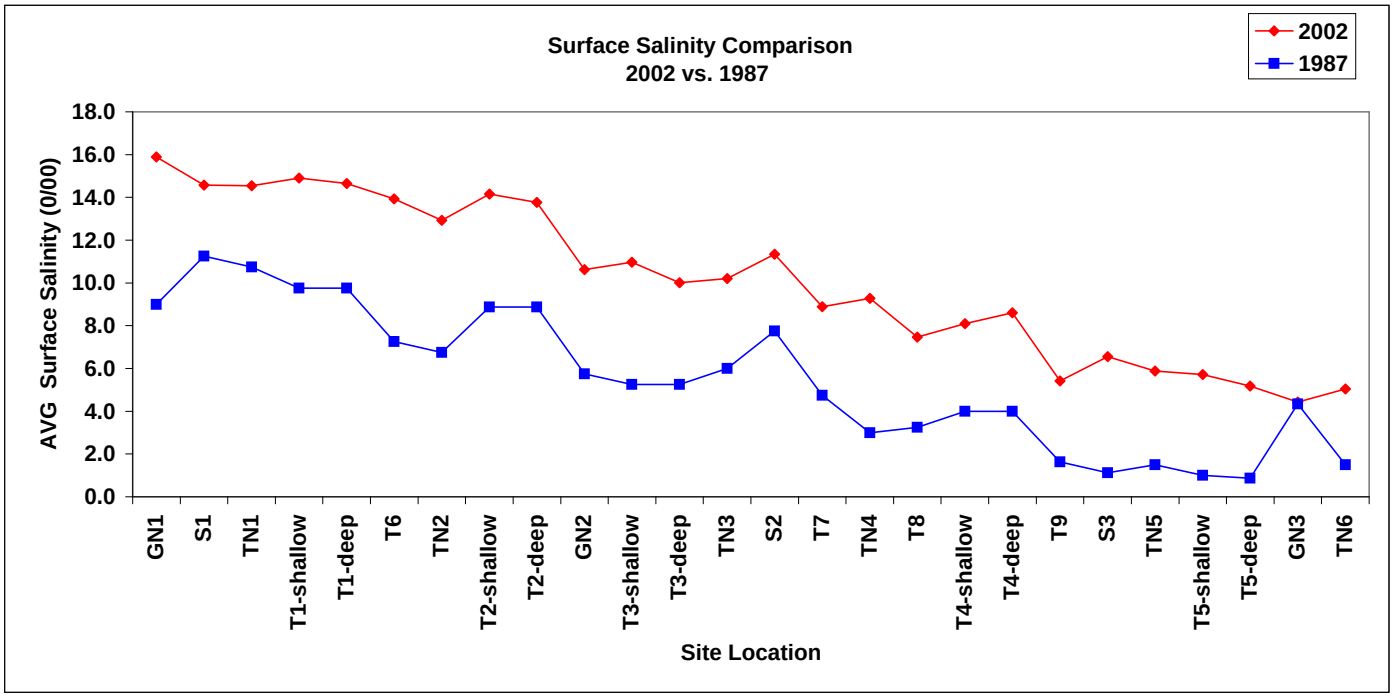


FIGURE 4
Surface and Bottom Salinity Comparison by Site
NJMC/MERI Hackensck River Benthic Inventory



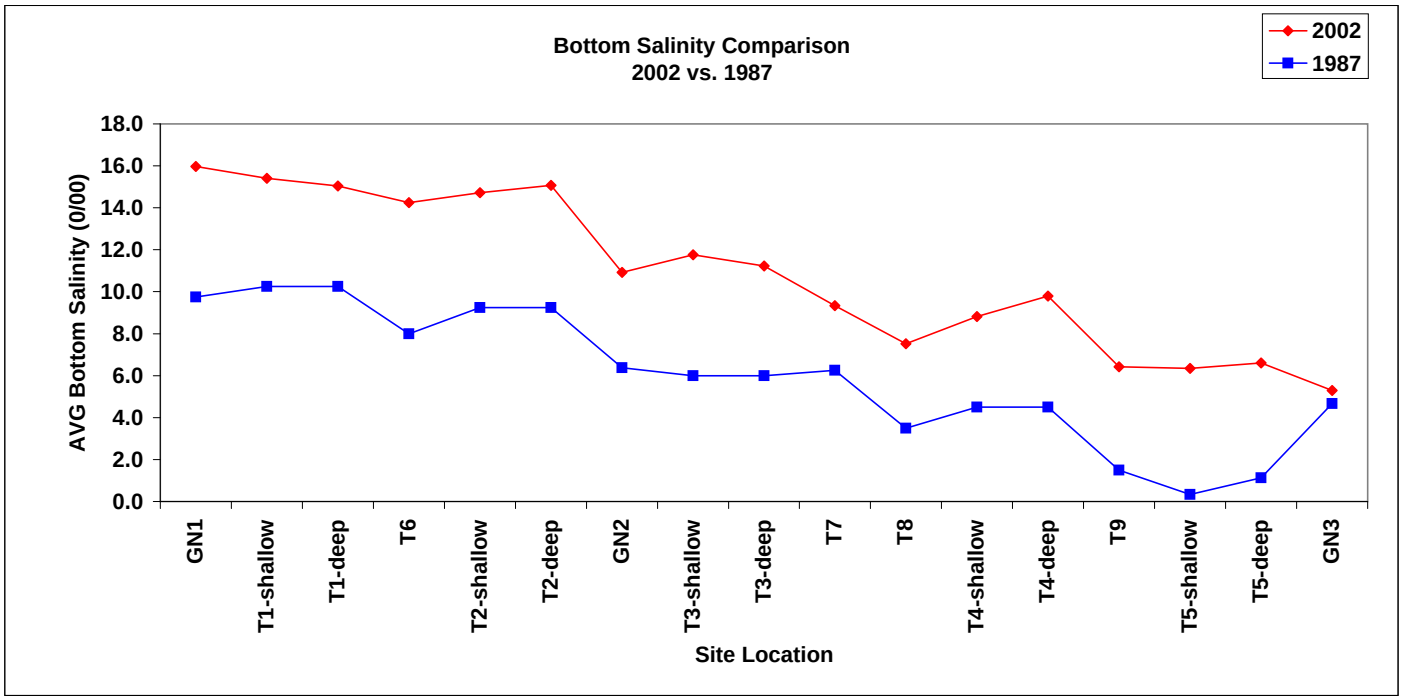
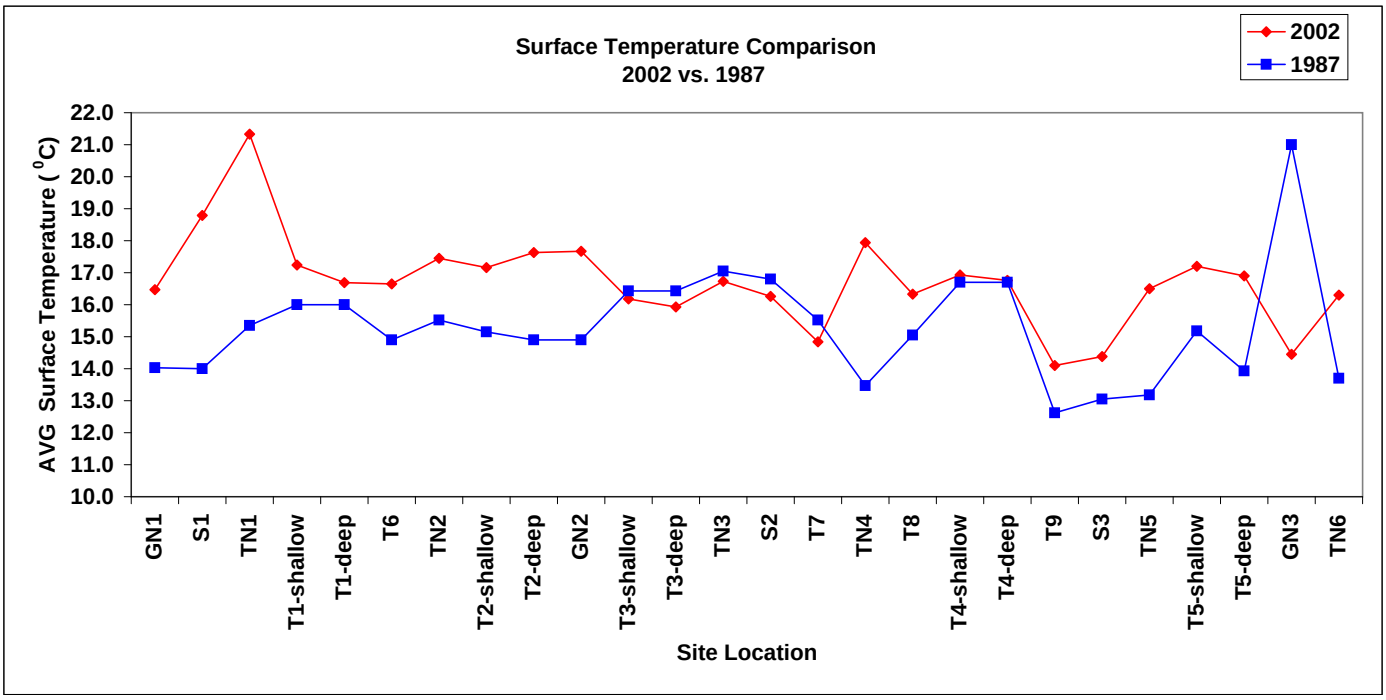


FIGURE 5
Surface and Bottom Temperature Comparison by Site
NJMC/MERI Hackensck River Benthic Inventory



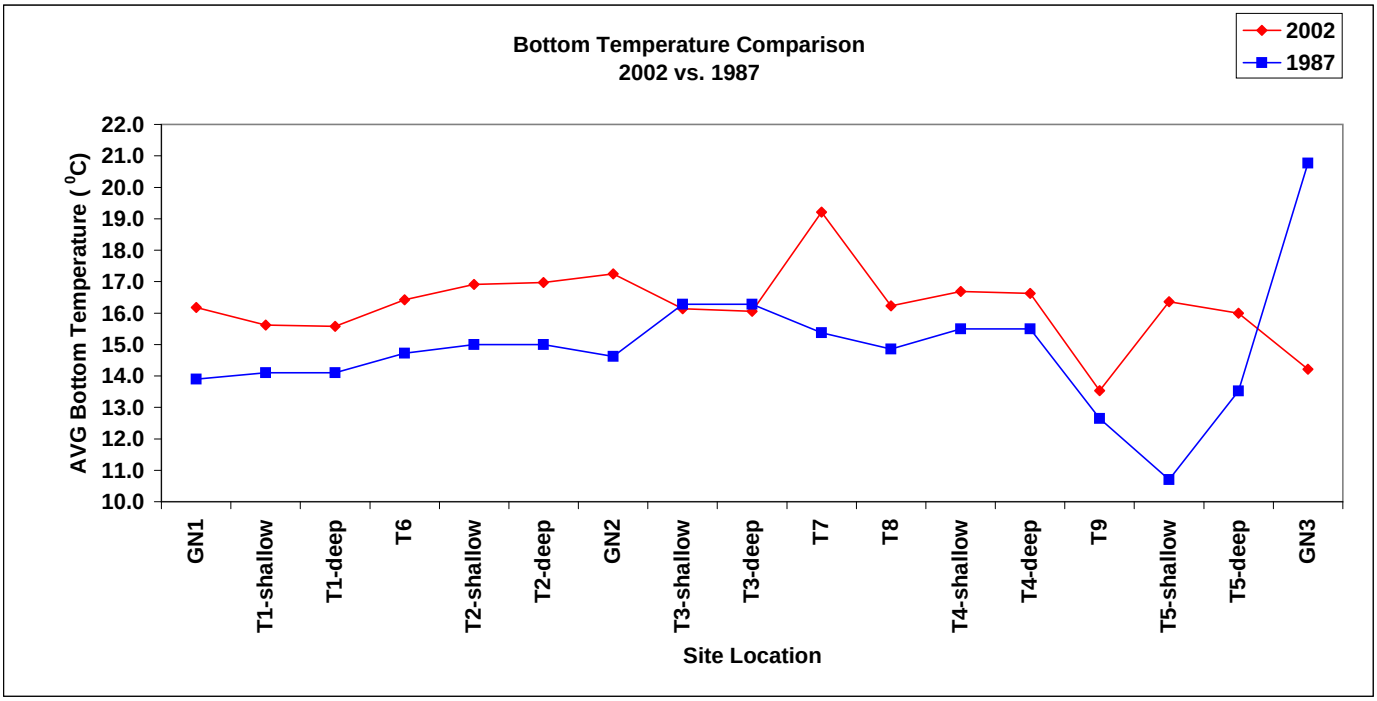
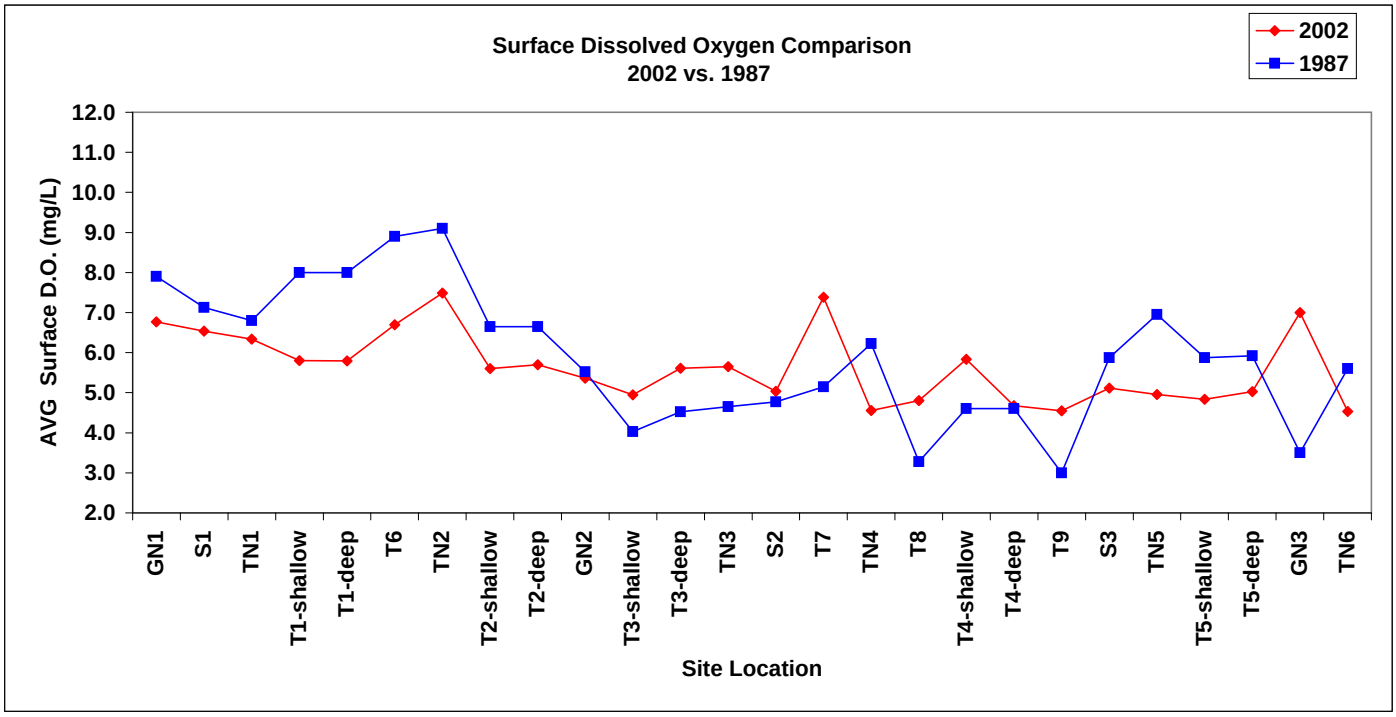


FIGURE 6
Surface and Bottom Dissolved Oxygen Comparison by Site
NJMC/MERI Hackensck River Benthic Inventory



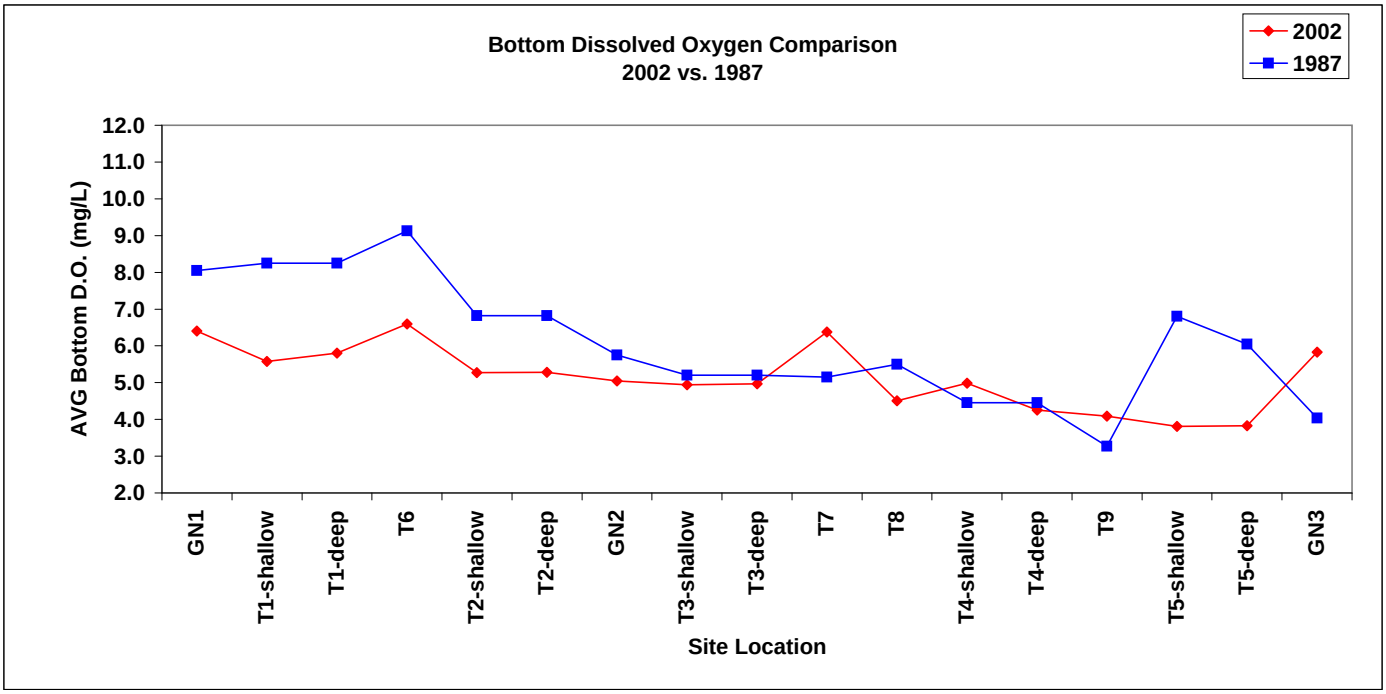


FIGURE 7
Secchi Depth Comparison by Site
NJMC/MERI Hackensck River Benthic Inventory

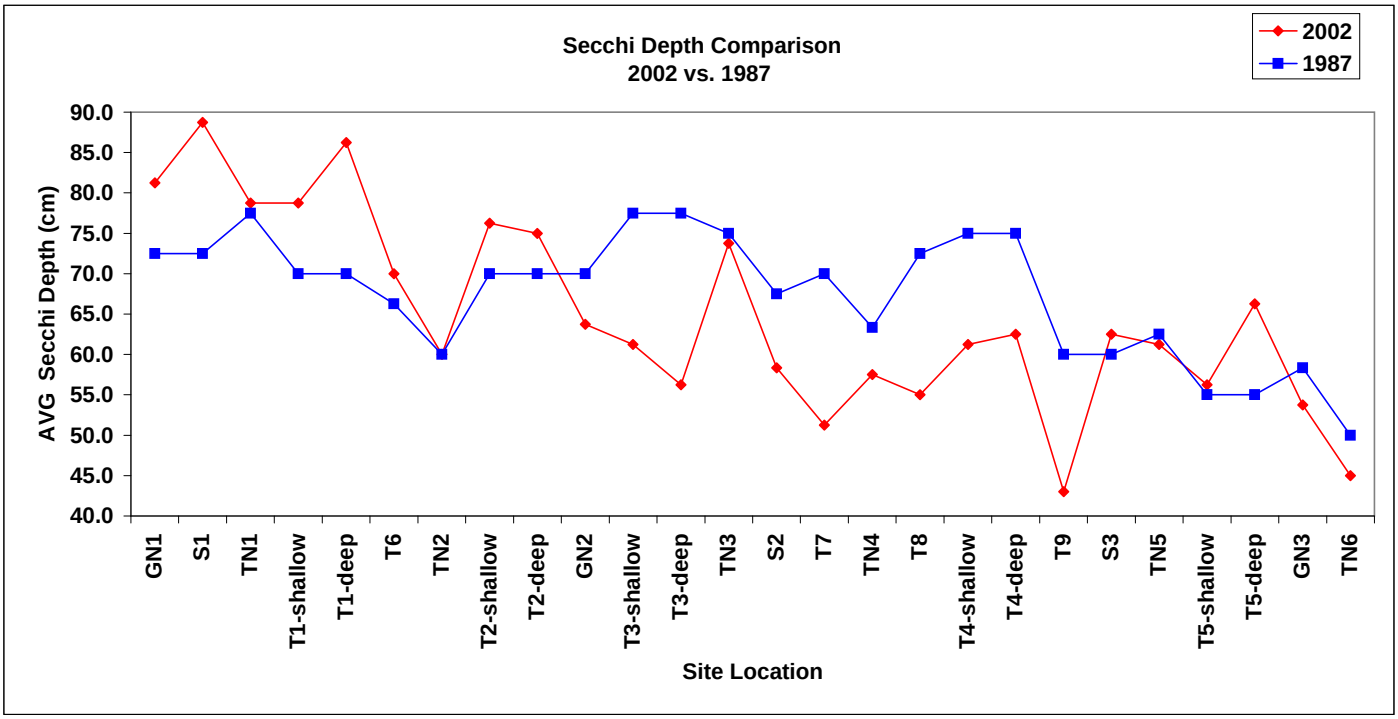
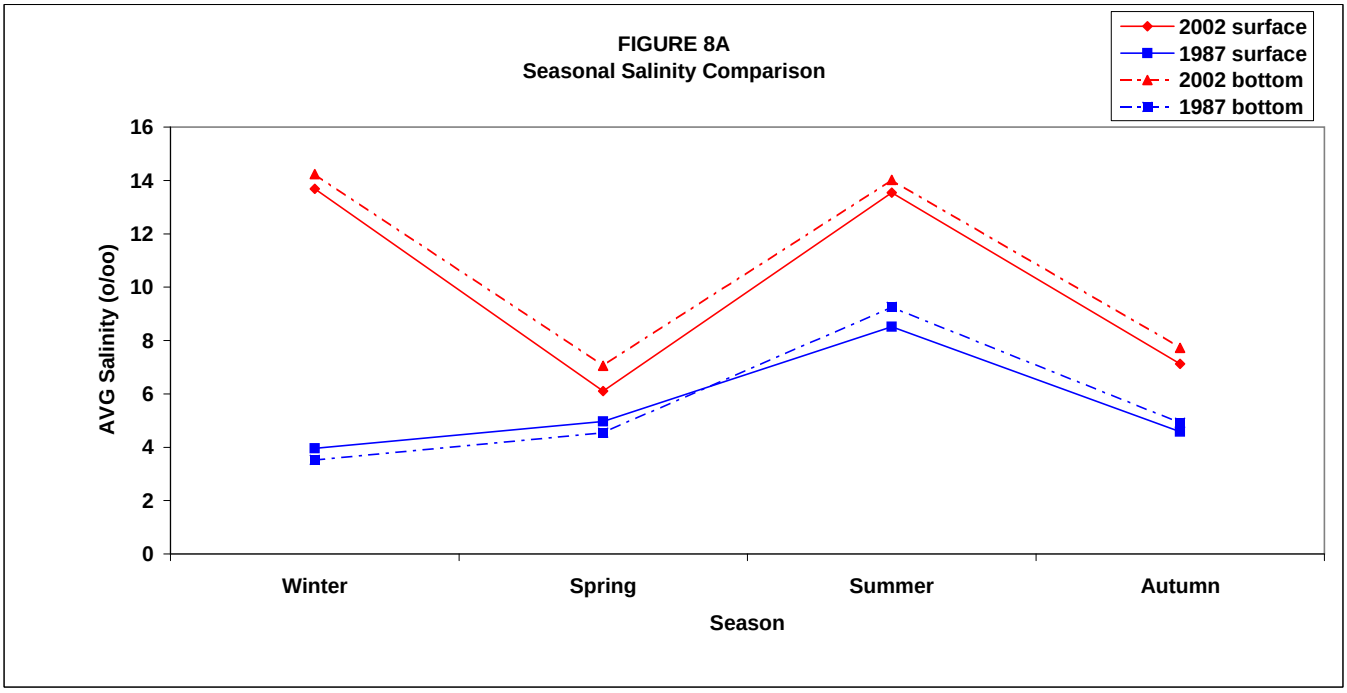


FIGURE 8
Seasonal Water Quality Comparisons
NJMC/MERI Hackensack River Benthic Inventory



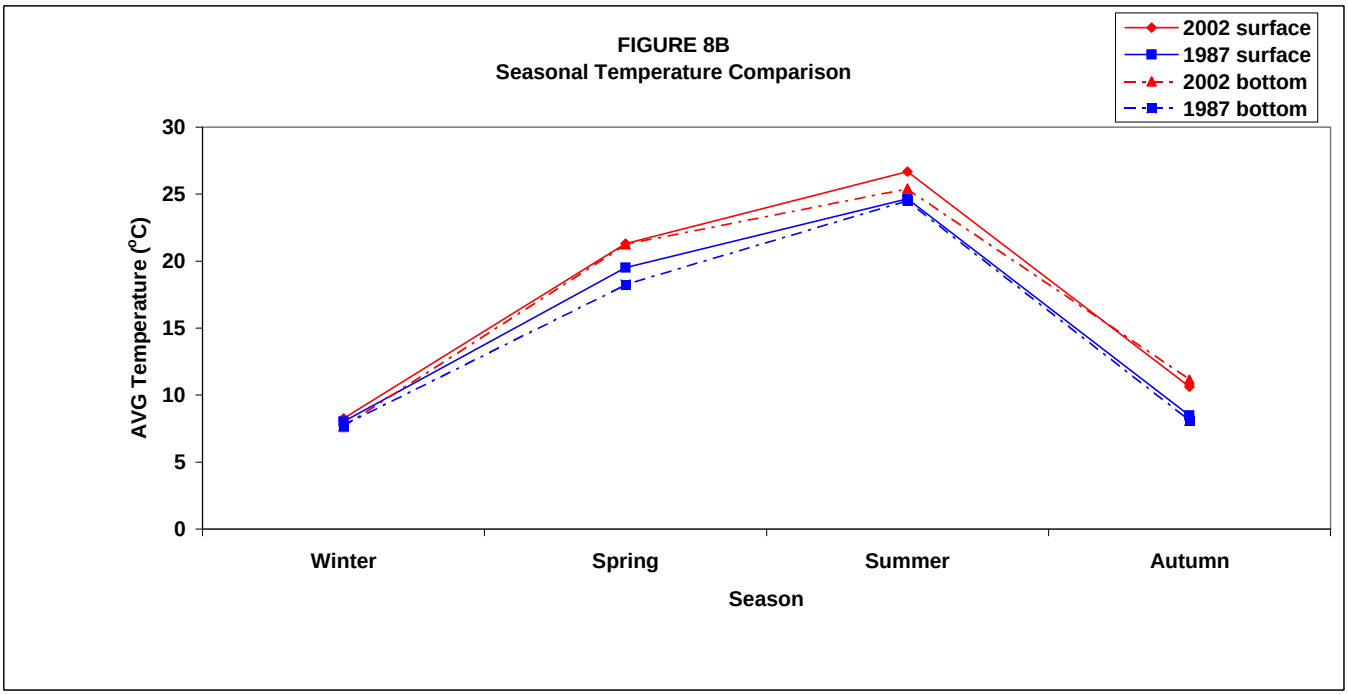
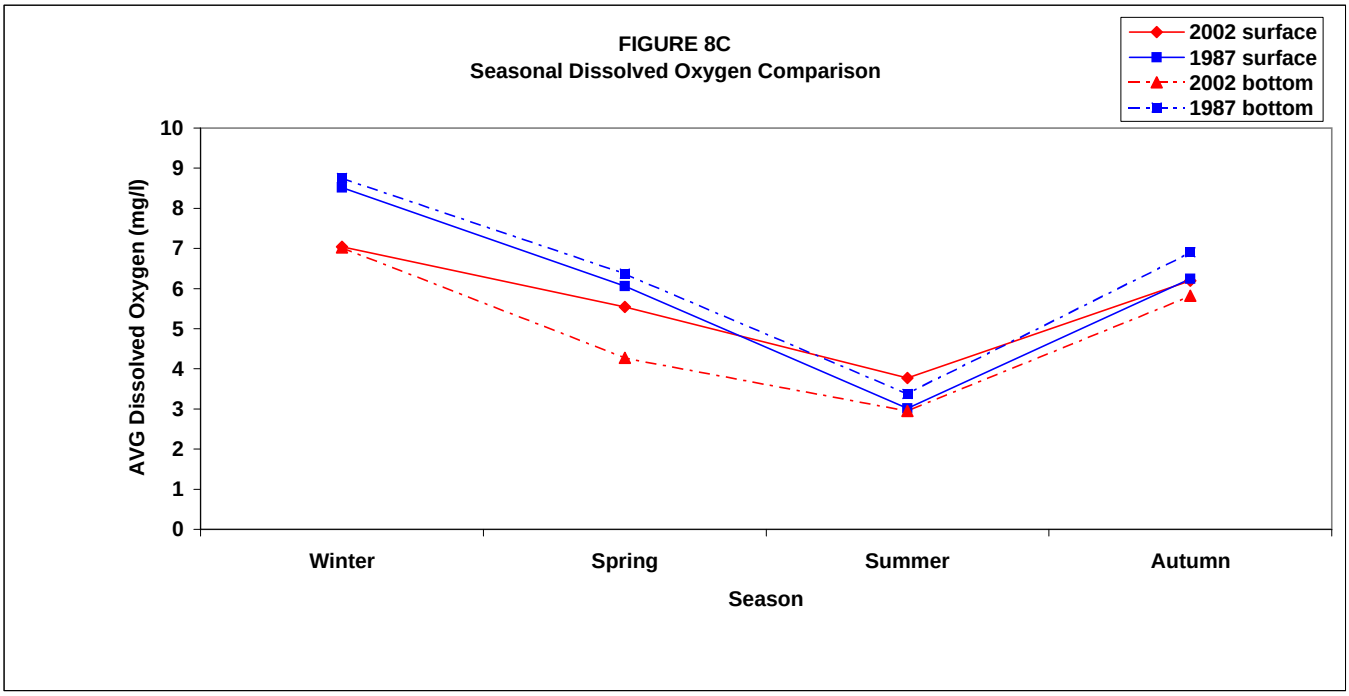


FIGURE 8 (continued)
Seasonal Water Quality Comparisons
NJMC/MERI Hackensack River Benthic Inventory



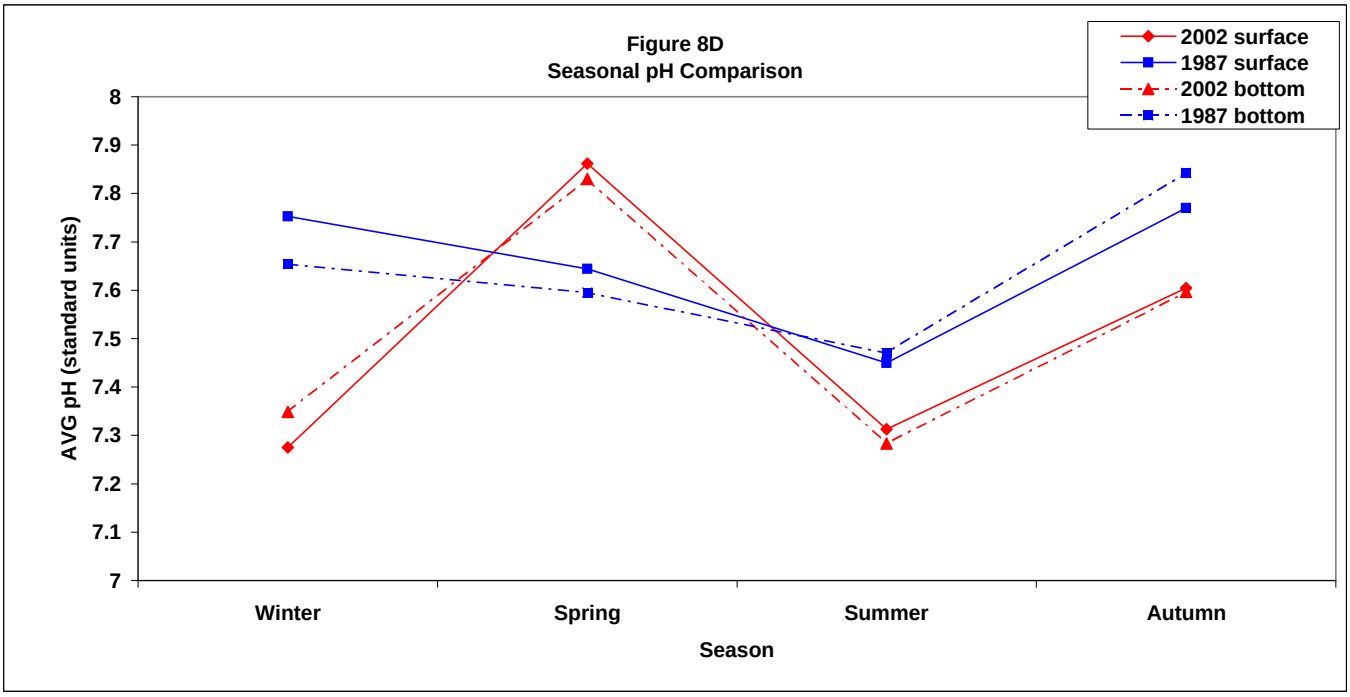


FIGURE 8 (continued)
Seasonal Water Quality Comparisons
NJMC/MERI Hackensack River Benthic Inventory

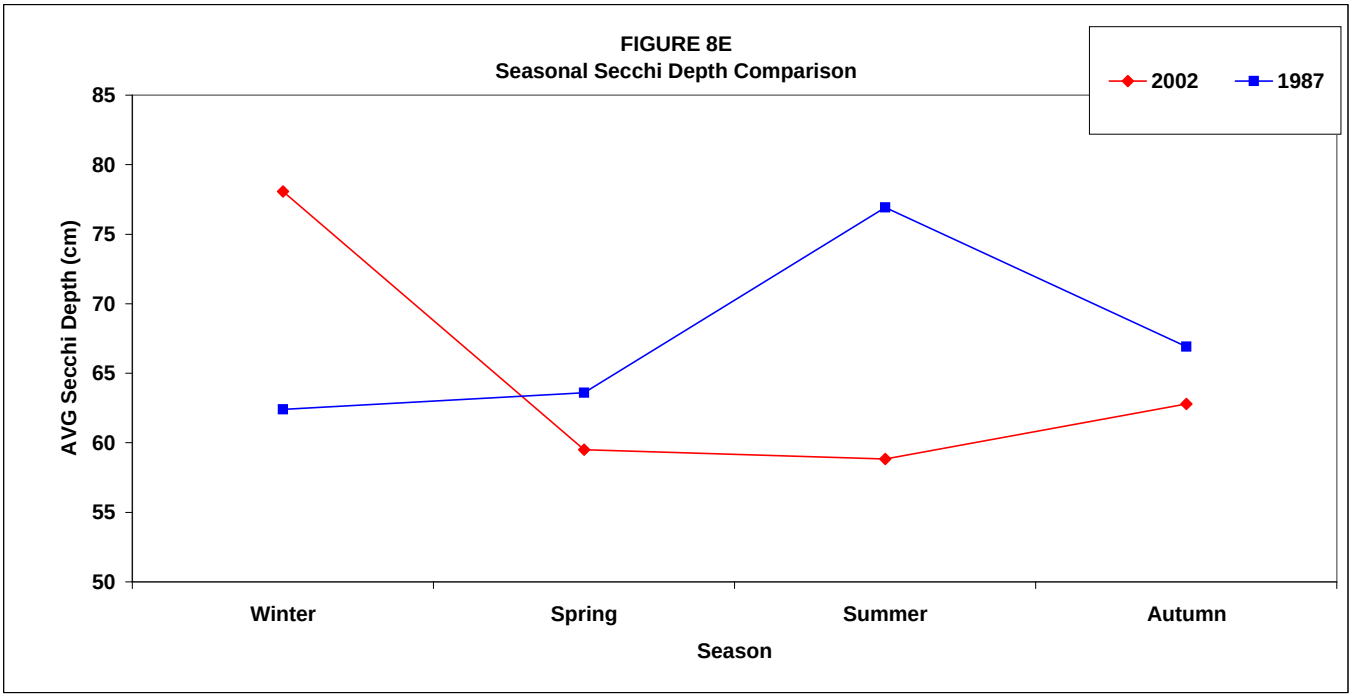


FIGURE 9
Overall Comparison of Relative Abundance of the Major Taxonomic Groups
NJMC/MERI Hackensack River Benthic Inventory

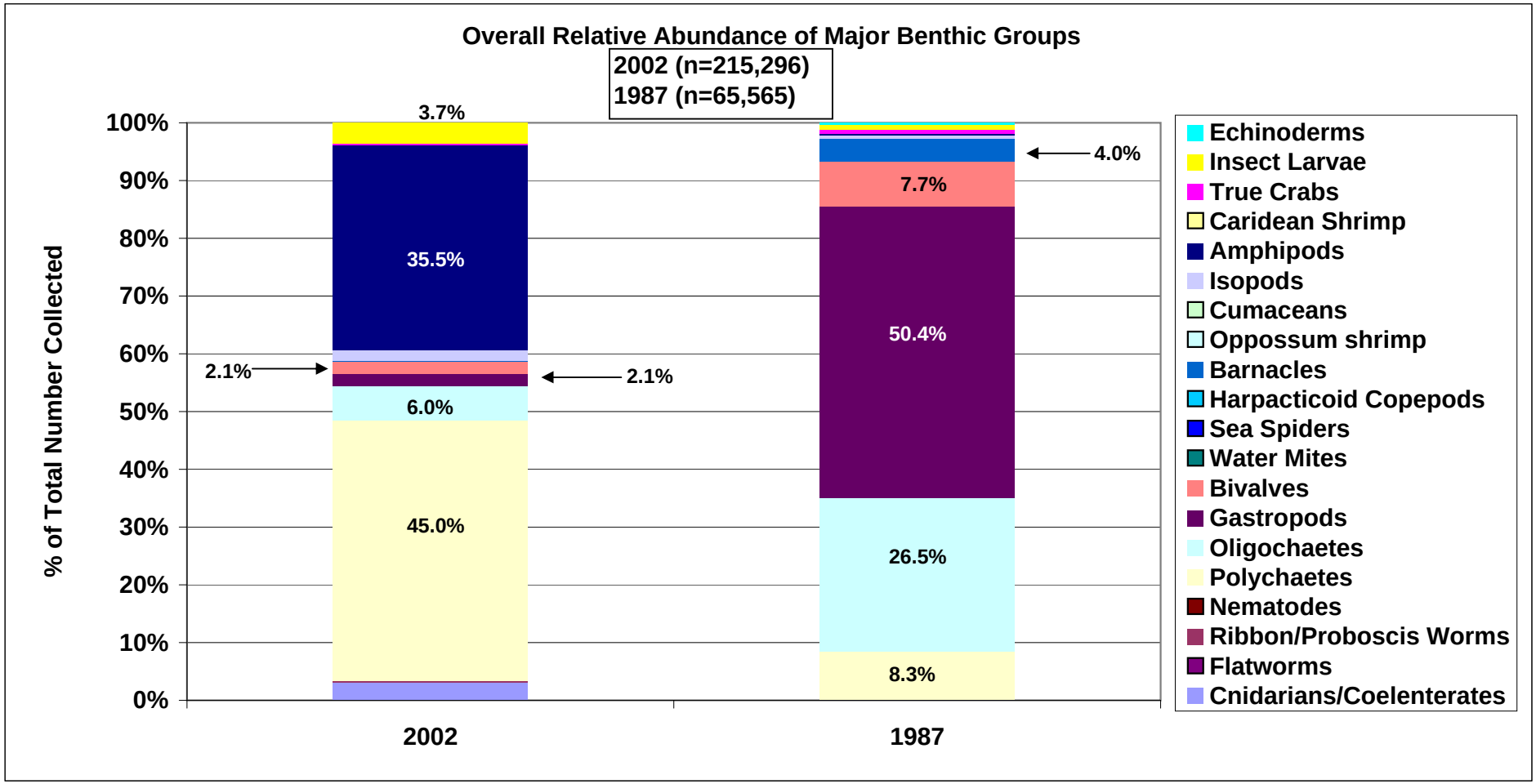


FIGURE 10A
Seasonal Relative Abundance of Major Benthic Groups - 1987 Collections
NJMC/MERI Hackensack River Benthic Inventory

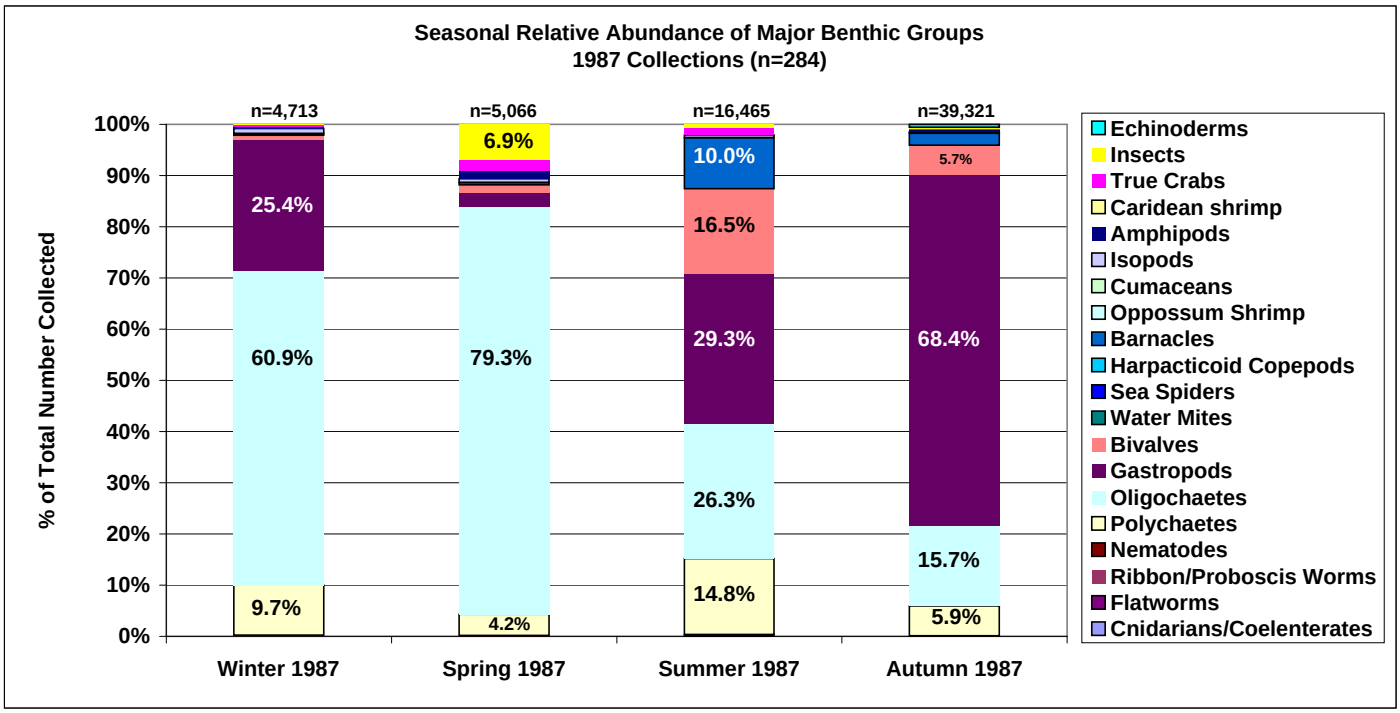


FIGURE 10B
Seasonal Relative Abundance of Major Benthic Groups - 2002 Collections
NJMC/MERI Hackensack River Benthic Inventory

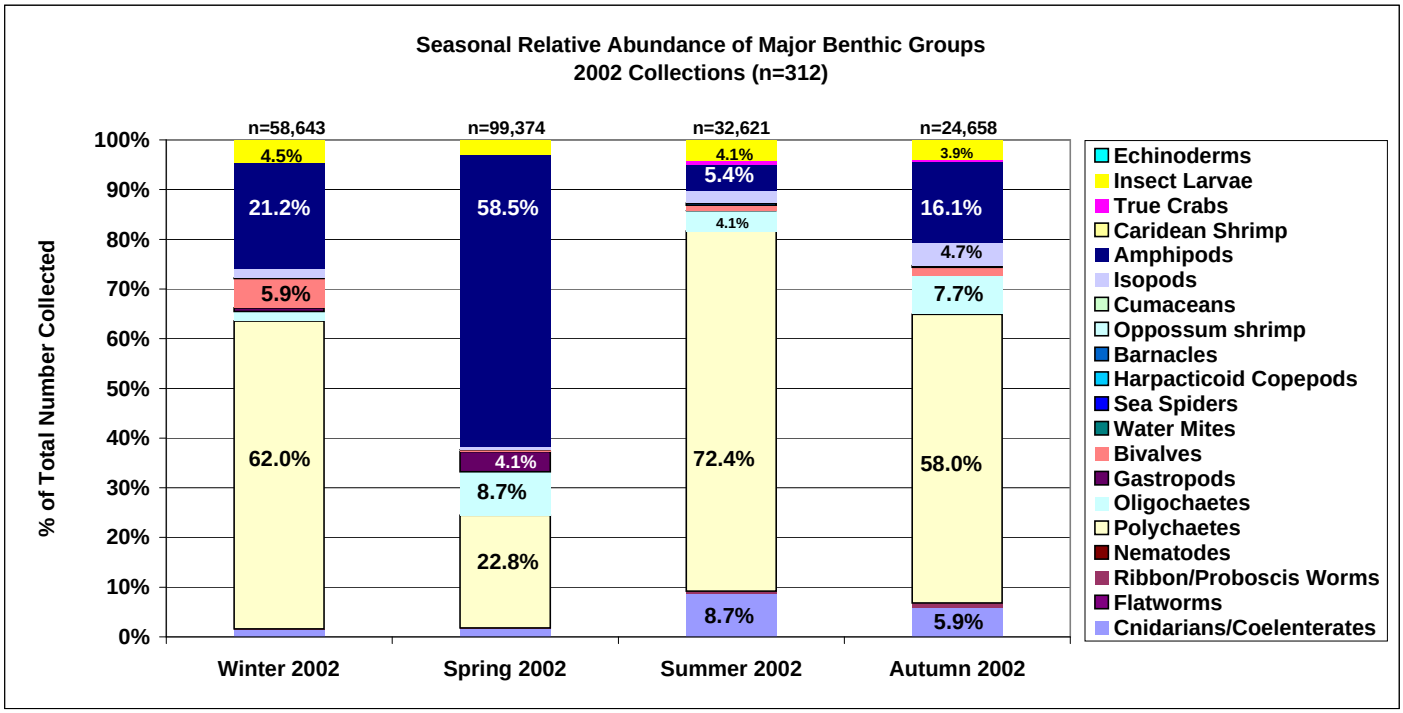


FIGURE 11
Seasonal Comparison of Total Number of Taxa Collected
NJMC/MERI Hackensack River Benthic Inventory

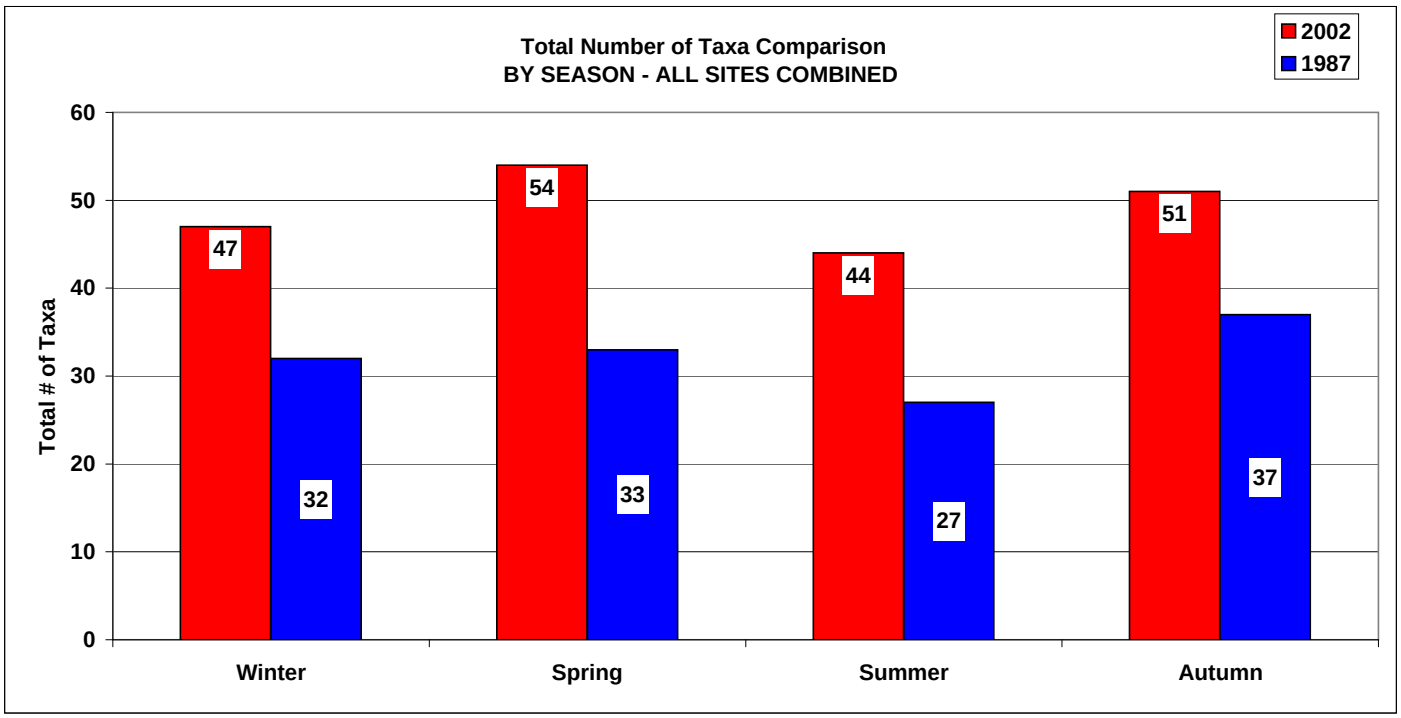


FIGURE 12
Comparison of Total Number of Taxa Collected at Each Site
NJMC/MERI Hackensack River Benthic Inventory

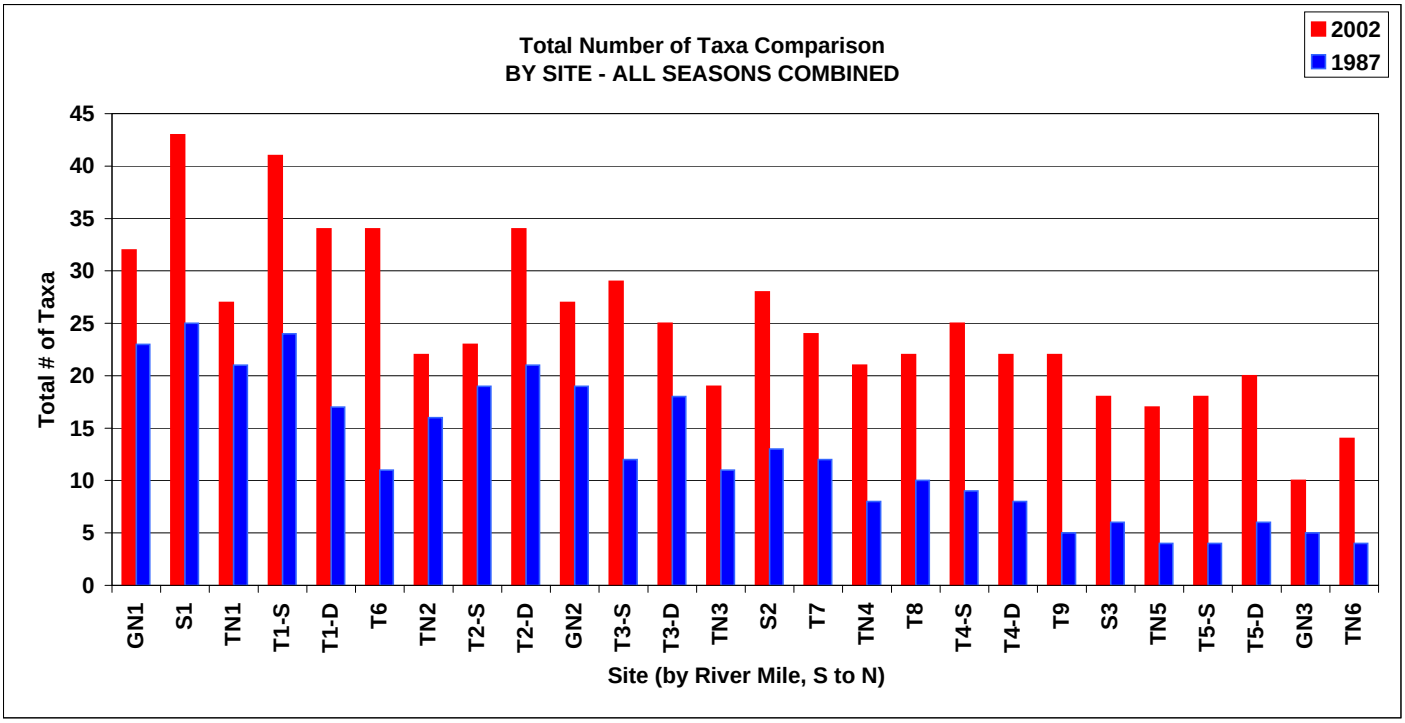


FIGURE 13
Seasonal Density of the Benthic Community
NJMC/MERI Hackensack River Benthic Inventory

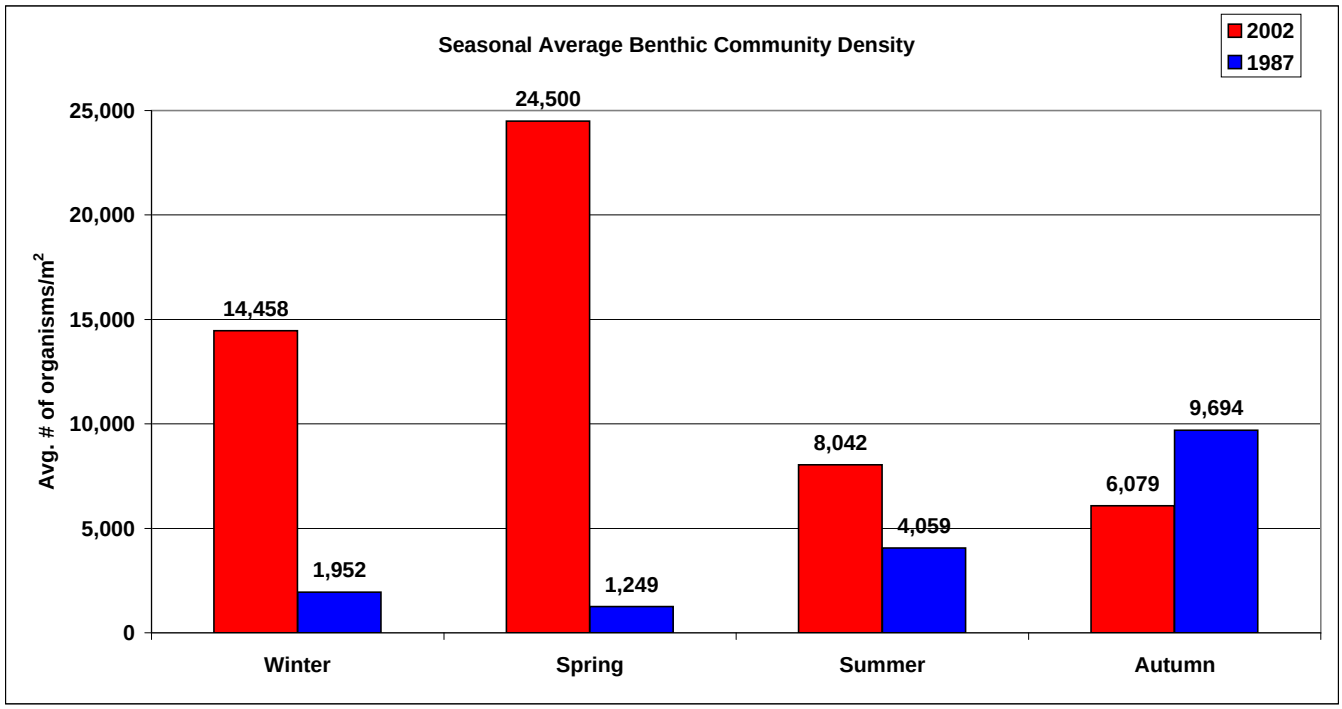


FIGURE 14
Spatial Density of the Benthic Community
NJMC/MERI Hackensack River Benthic Inventory

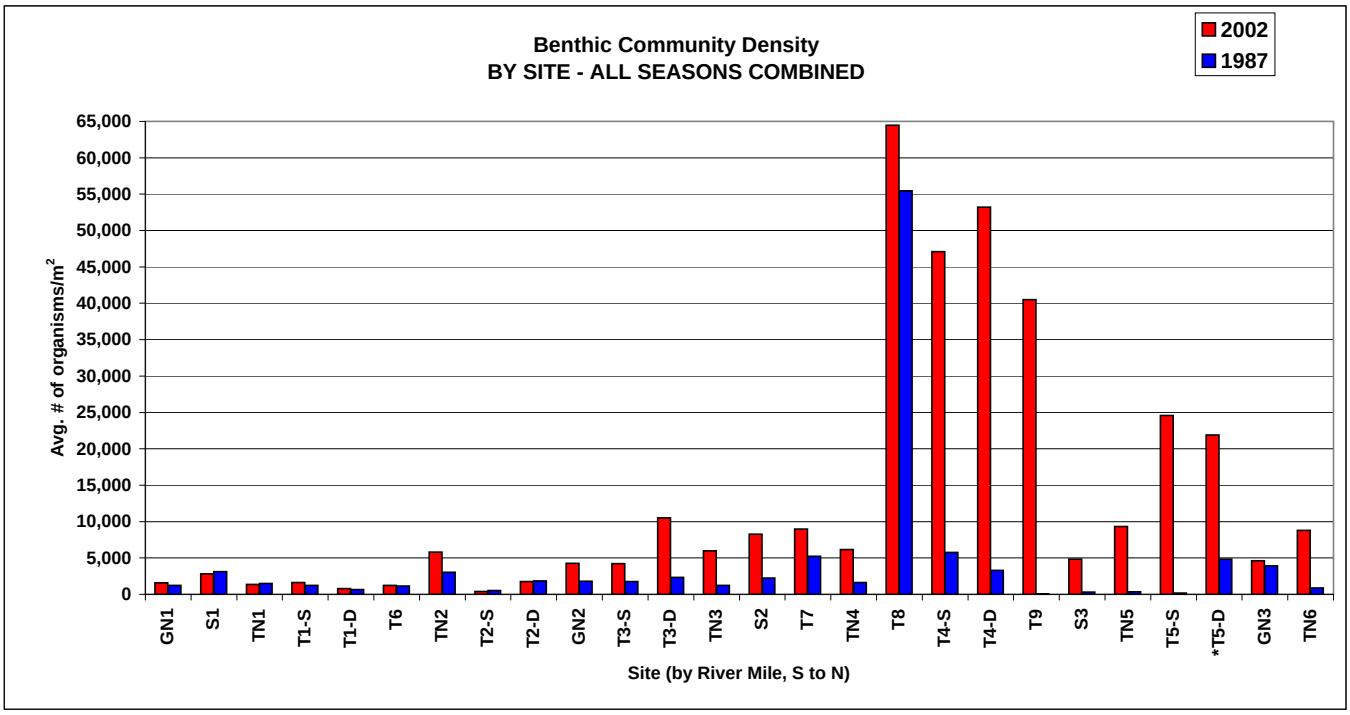


FIGURE 15
Comparison of the Relative Abundance for the Top Ten Species Collected in 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory

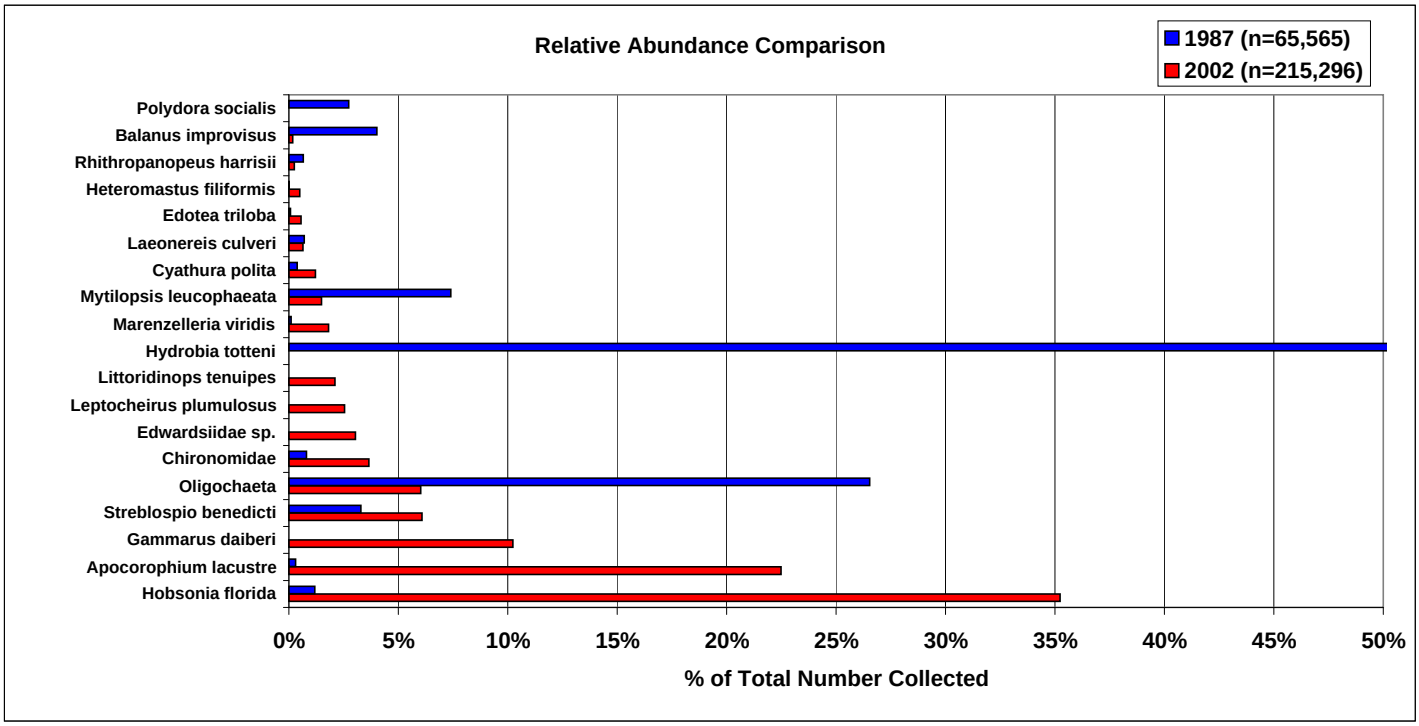


FIGURE 16
Comparison of the Percent Frequency of Occurrence for the Top Ten Species Collected in 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory

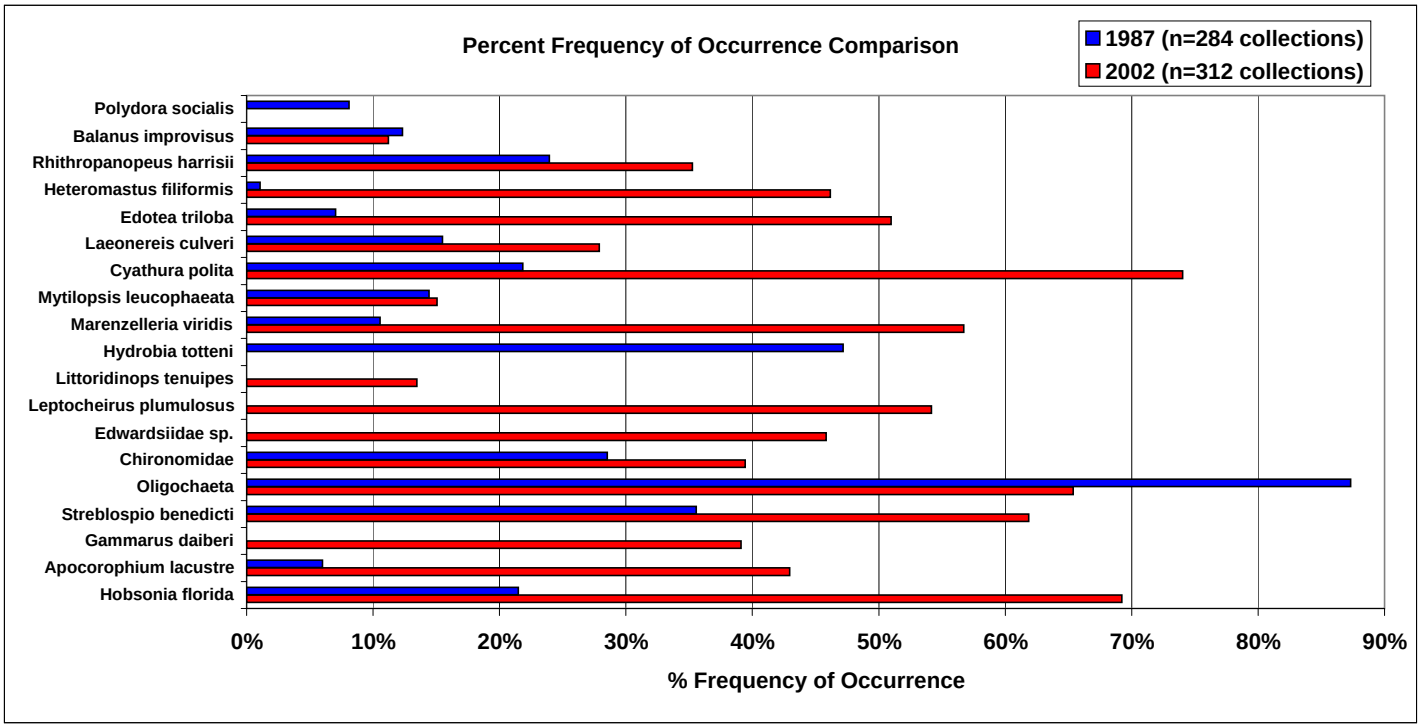
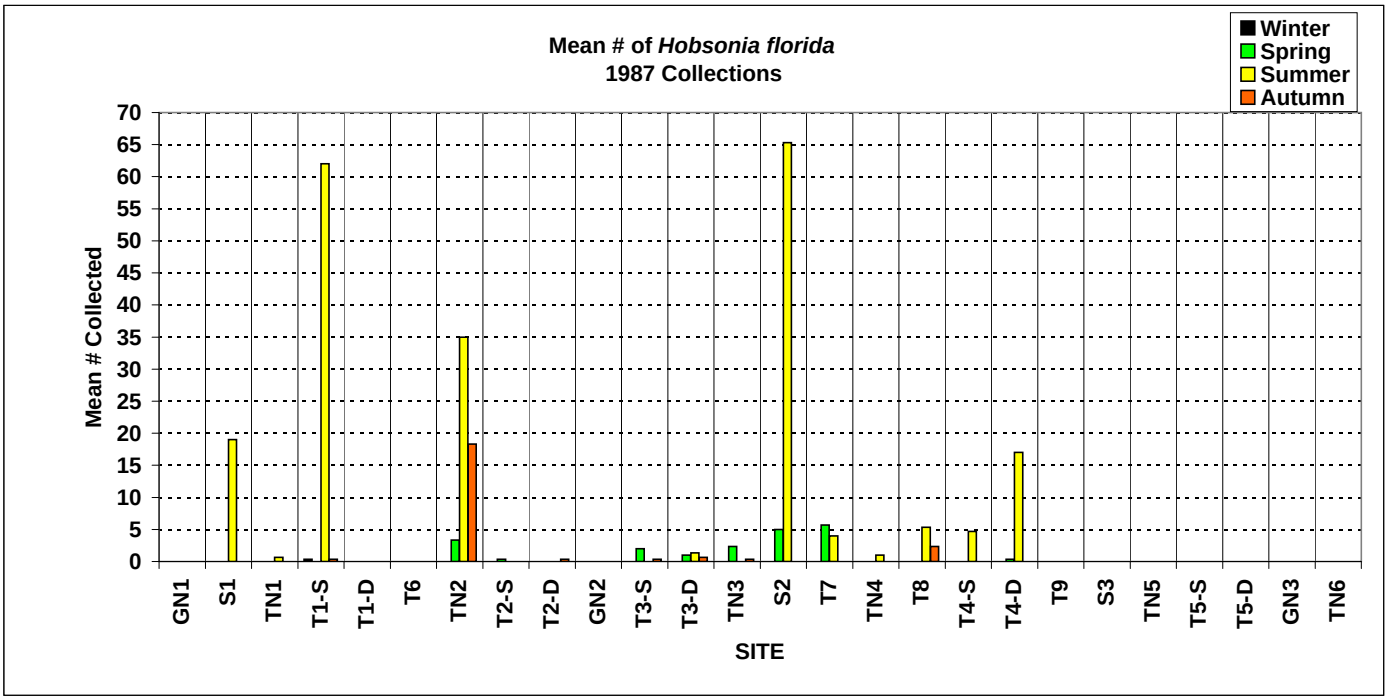


FIGURE 17
Comparison of the Spatial Distribution and Seasonal Abundance of the Polychaete Worm *Hobsonia florida* Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory



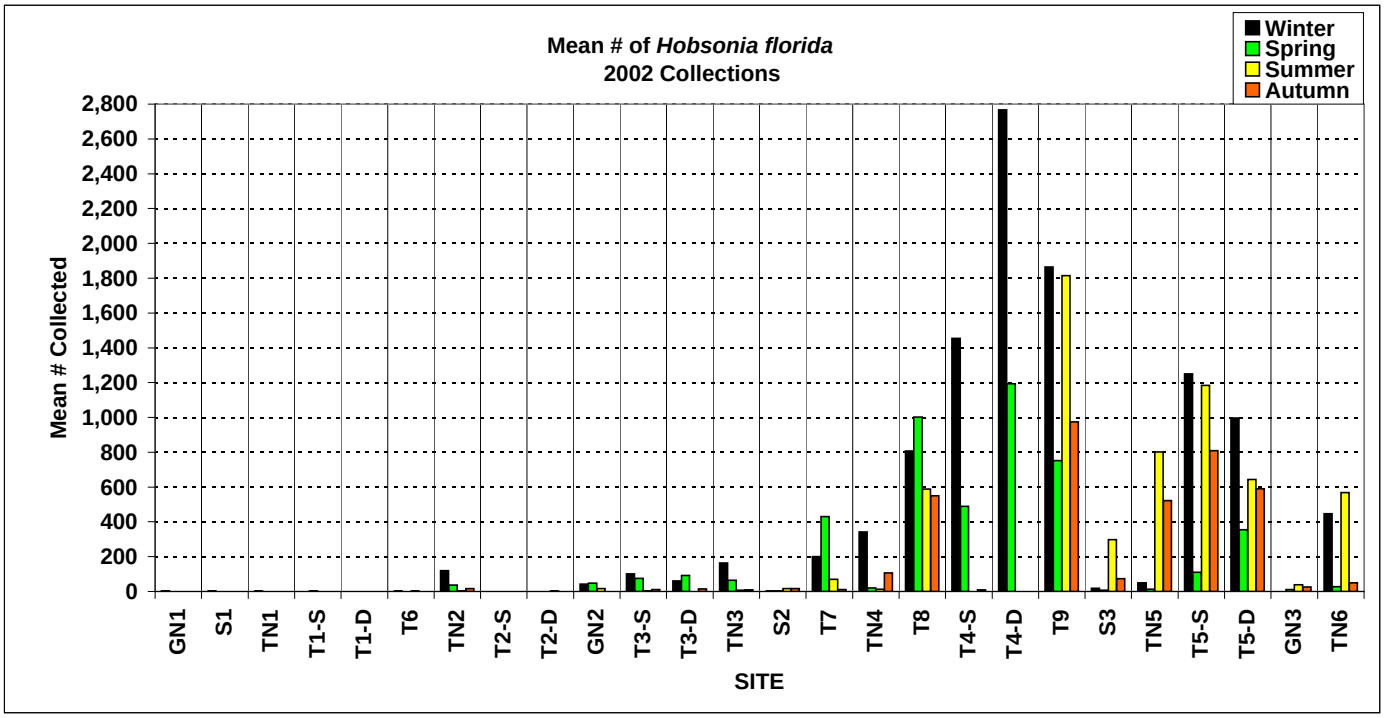
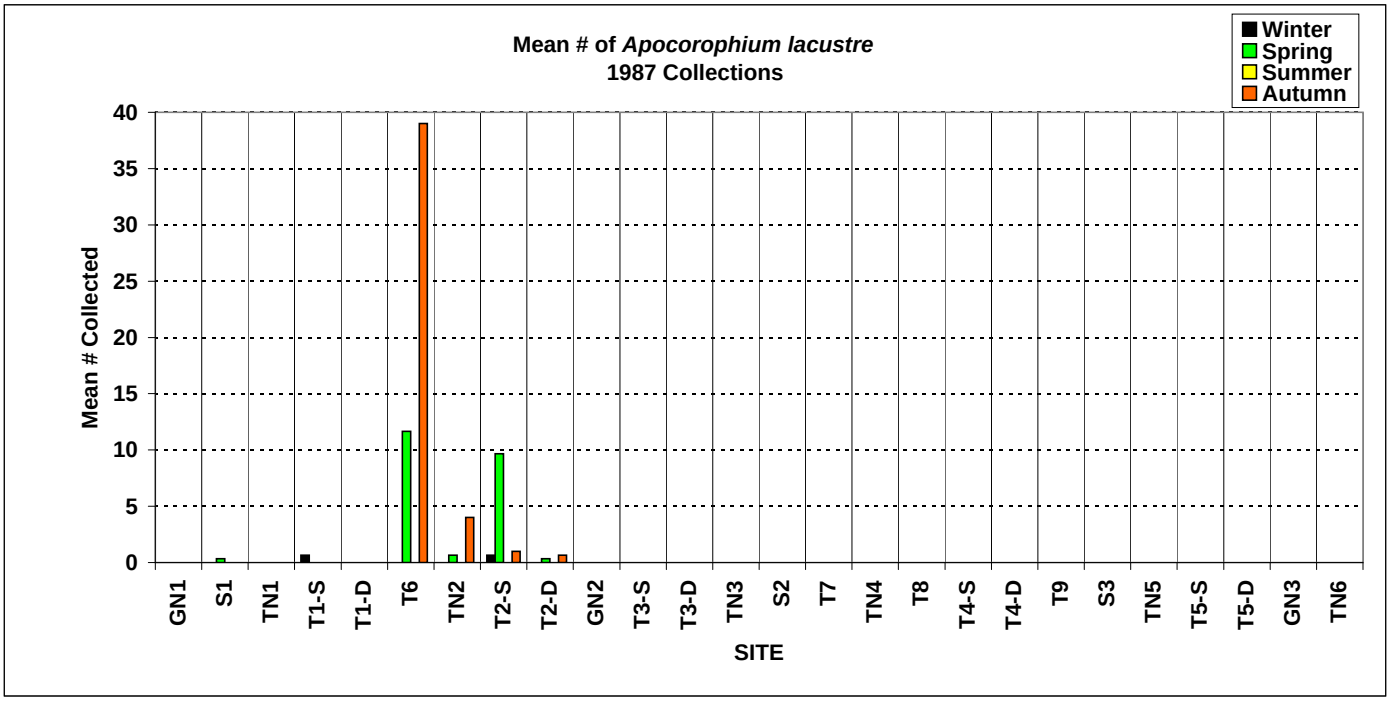


FIGURE 18
Comparison of the Spatial Distribution and Seasonal Abundance of the Amphipod *Apocorophium lacustre* Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory



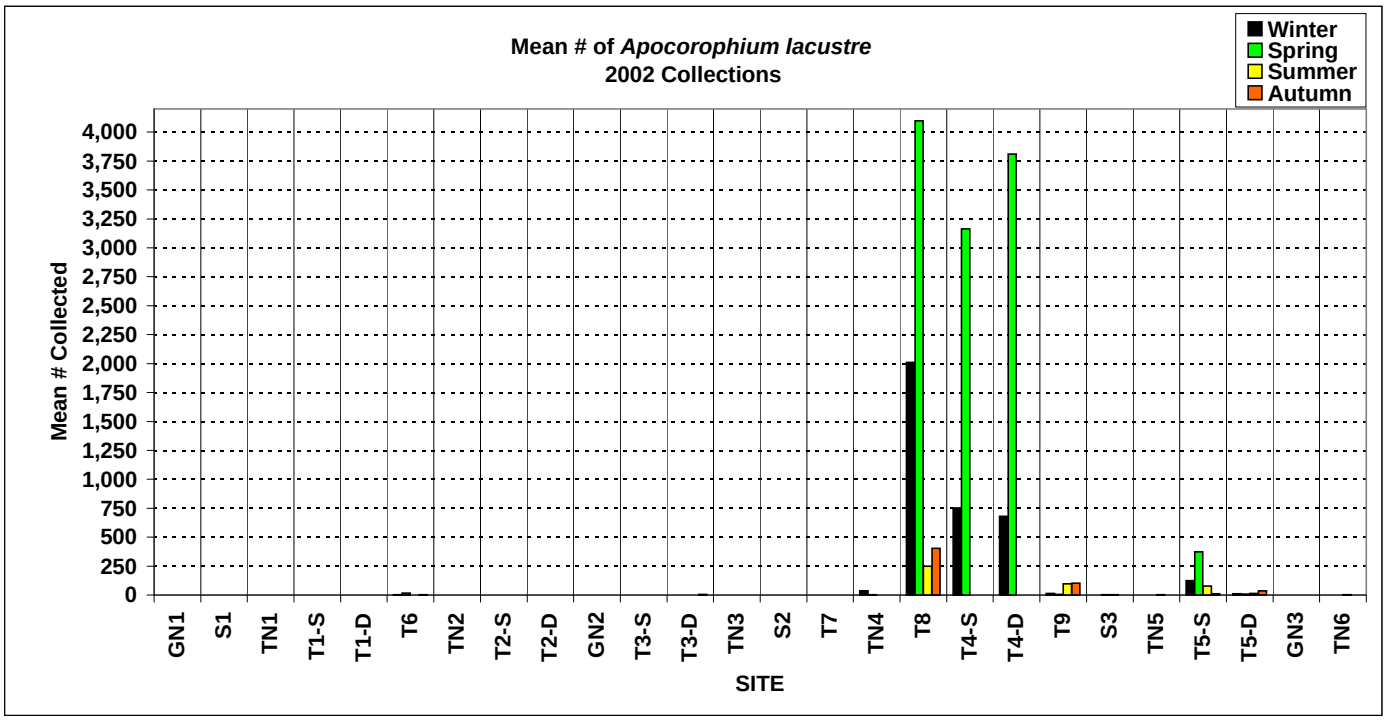
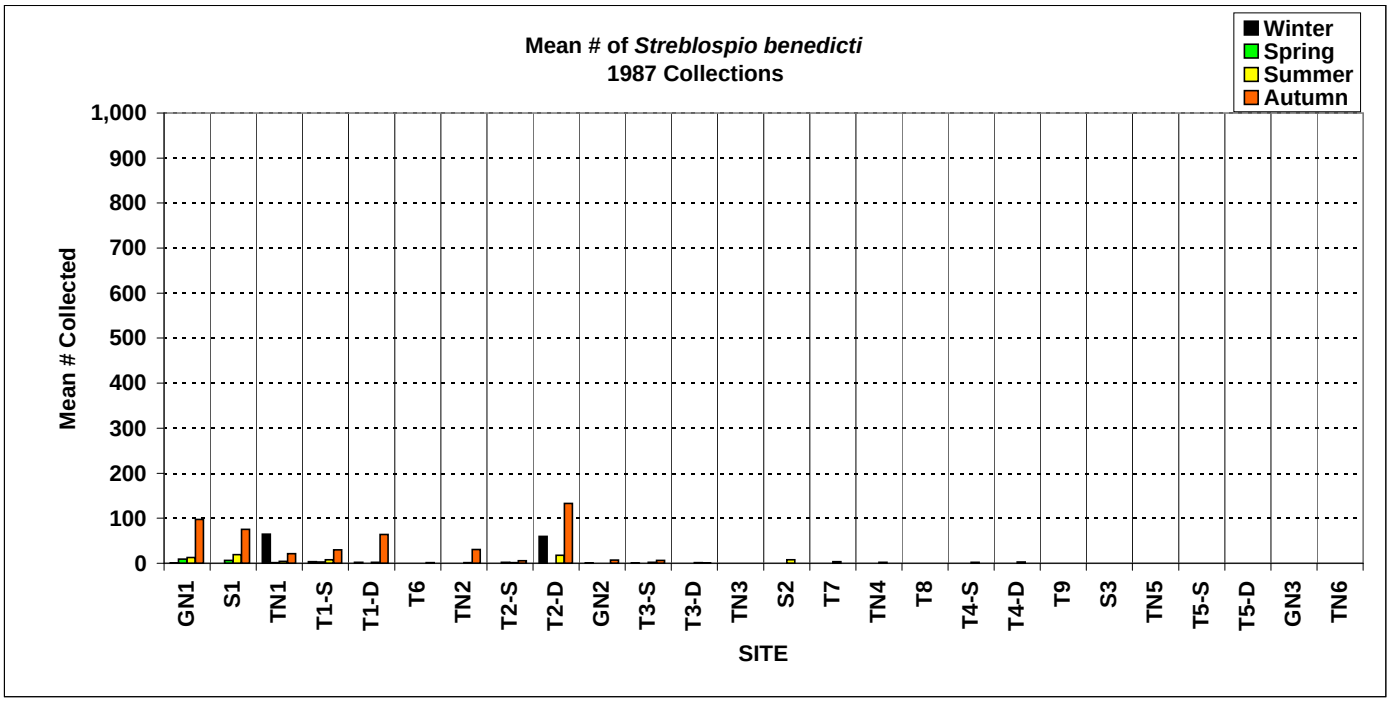


FIGURE 19
Comparison of the Spatial Distribution and Seasonal Abundance of the Polychaete Worm *Streblospio benedicti* Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory



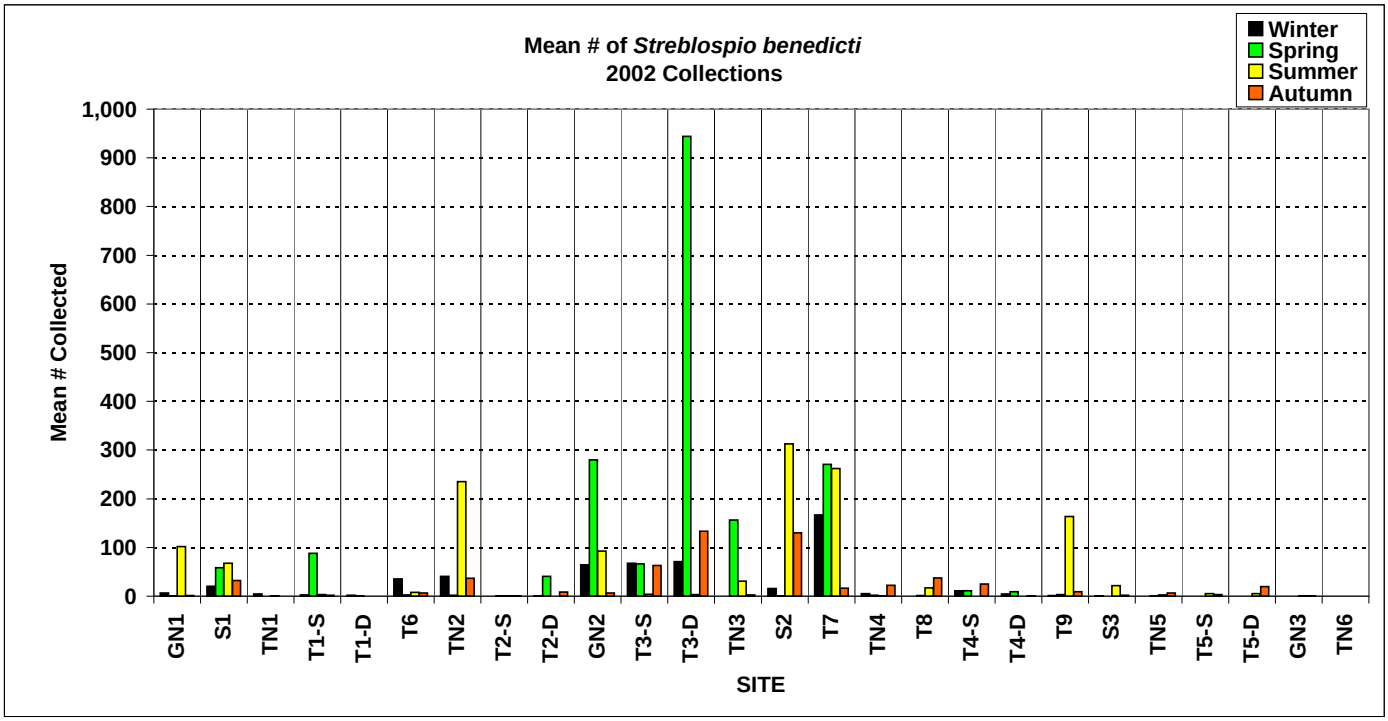
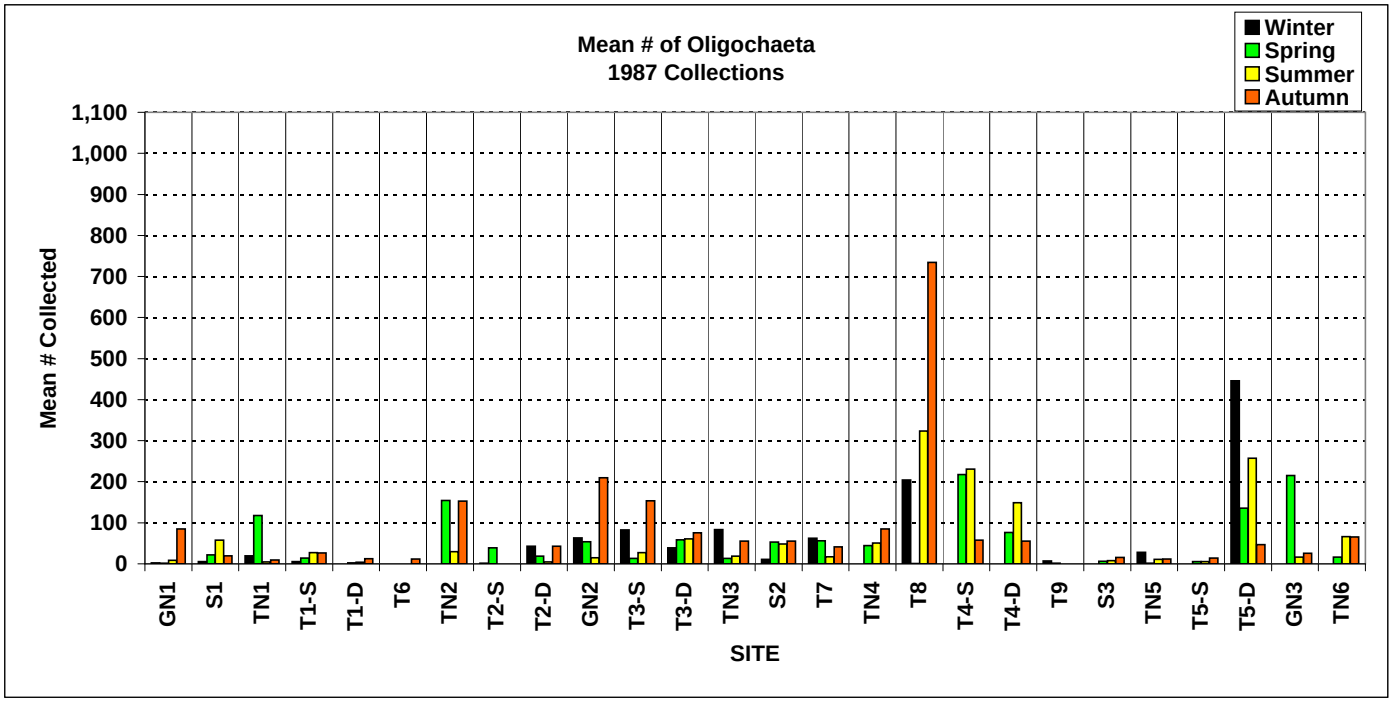


FIGURE 20
Comparison of the Spatial Distribution and Seasonal Abundance of the Oligochates Worms
Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory



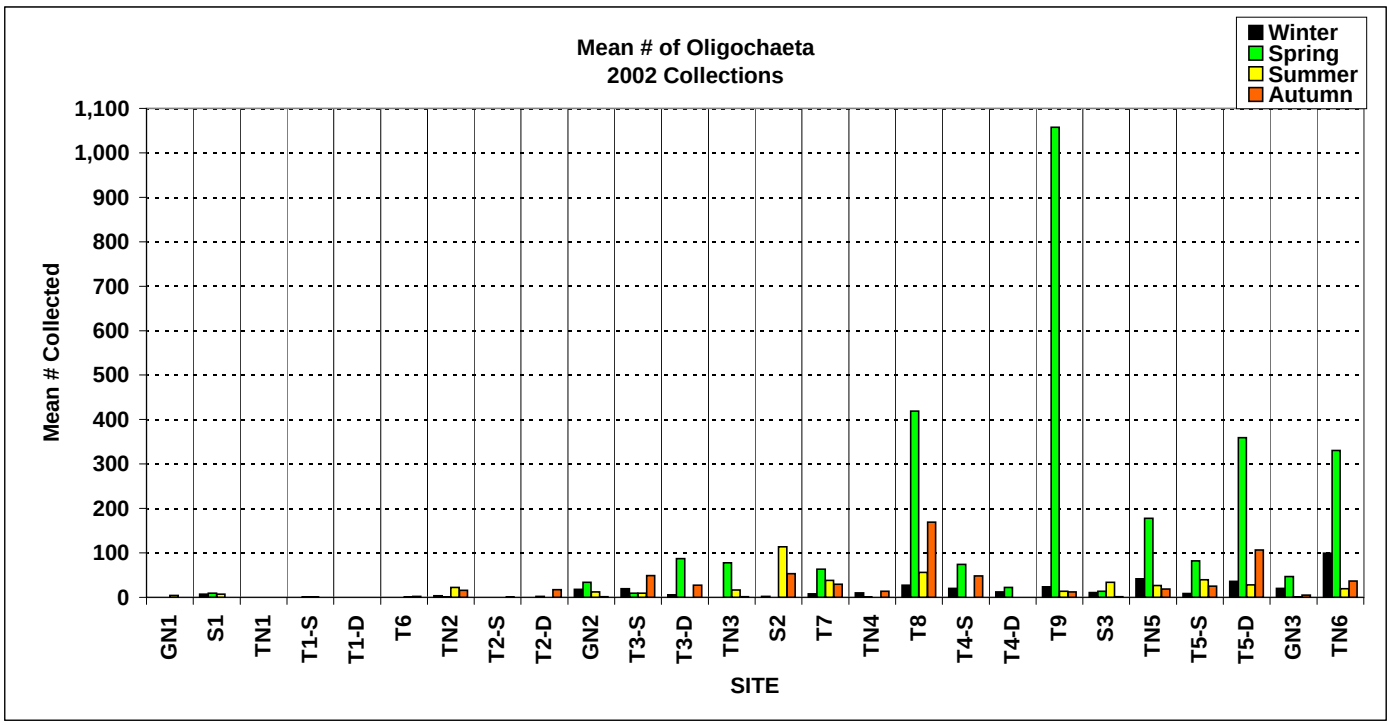
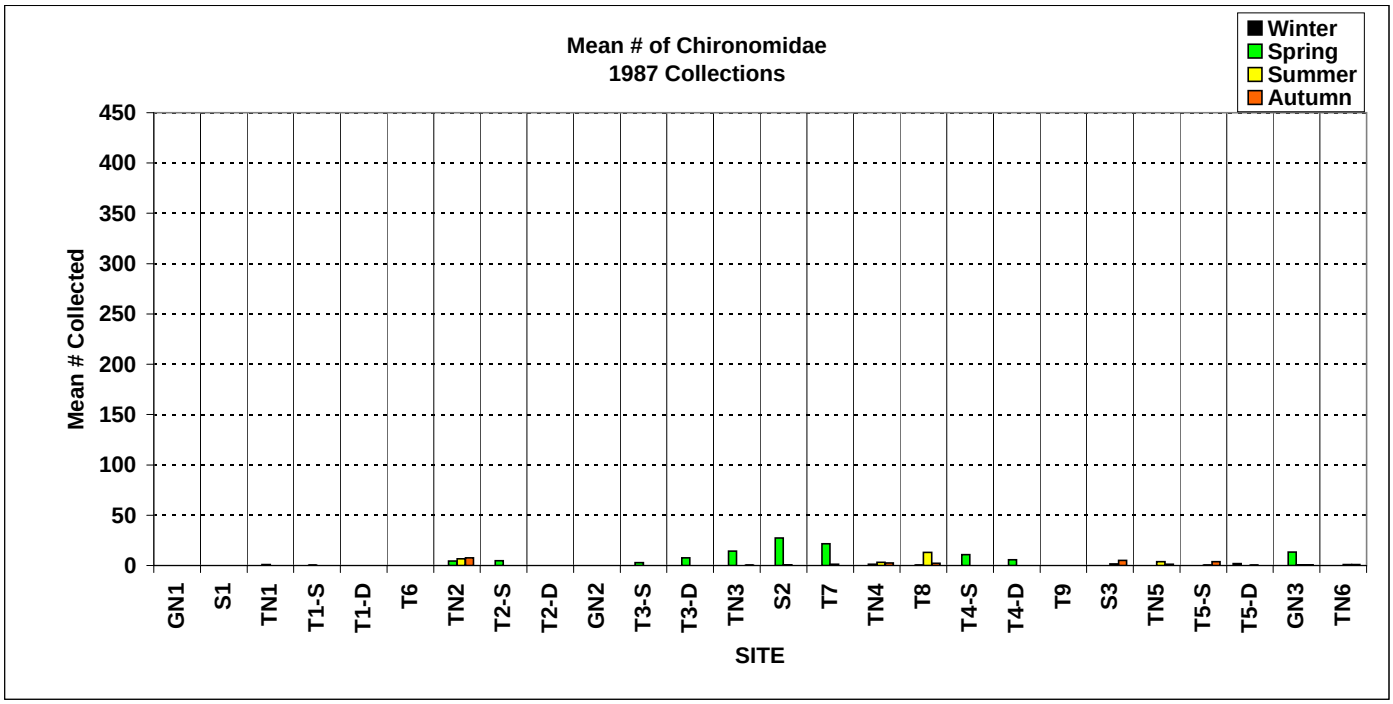


FIGURE 21
Comparison of the Spatial Distribution and Seasonal Abundance of the Chiromonidae
Collected During 1987 and 2002
NJMC/MERI Hackensack River Benthic Inventory



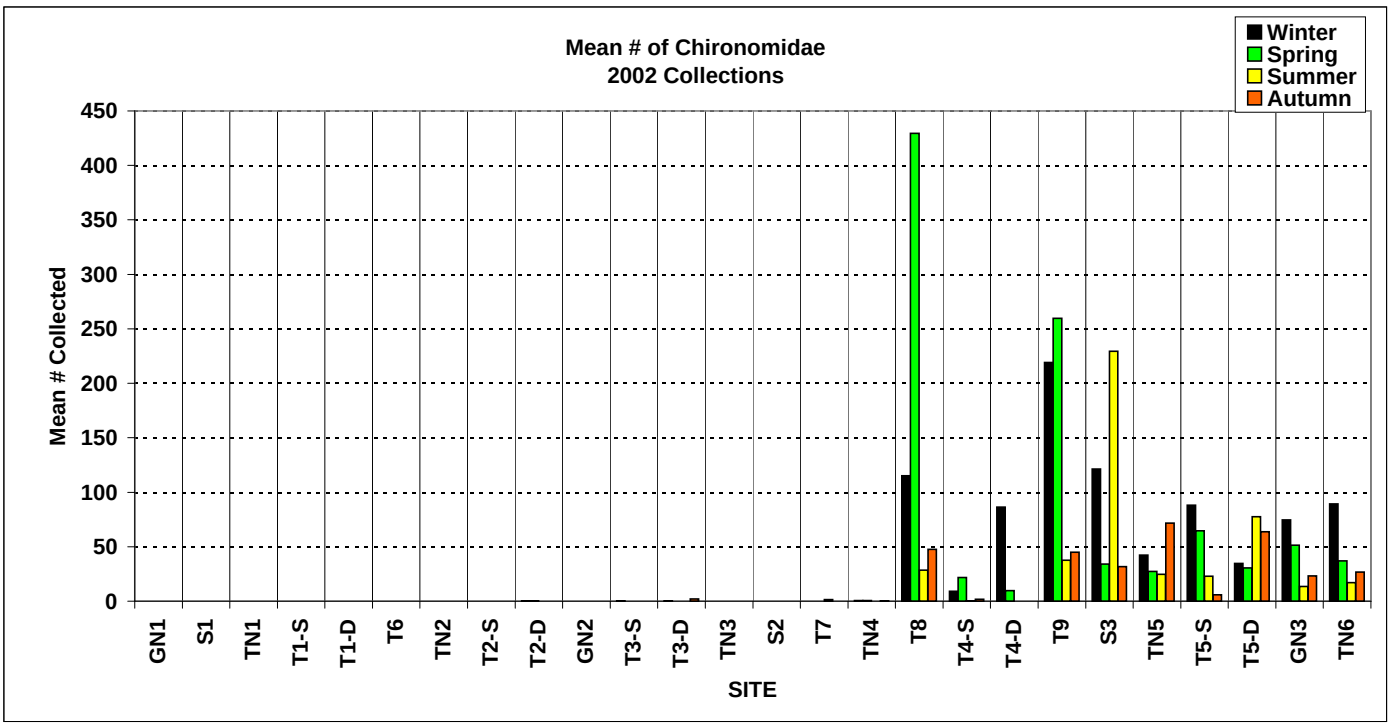
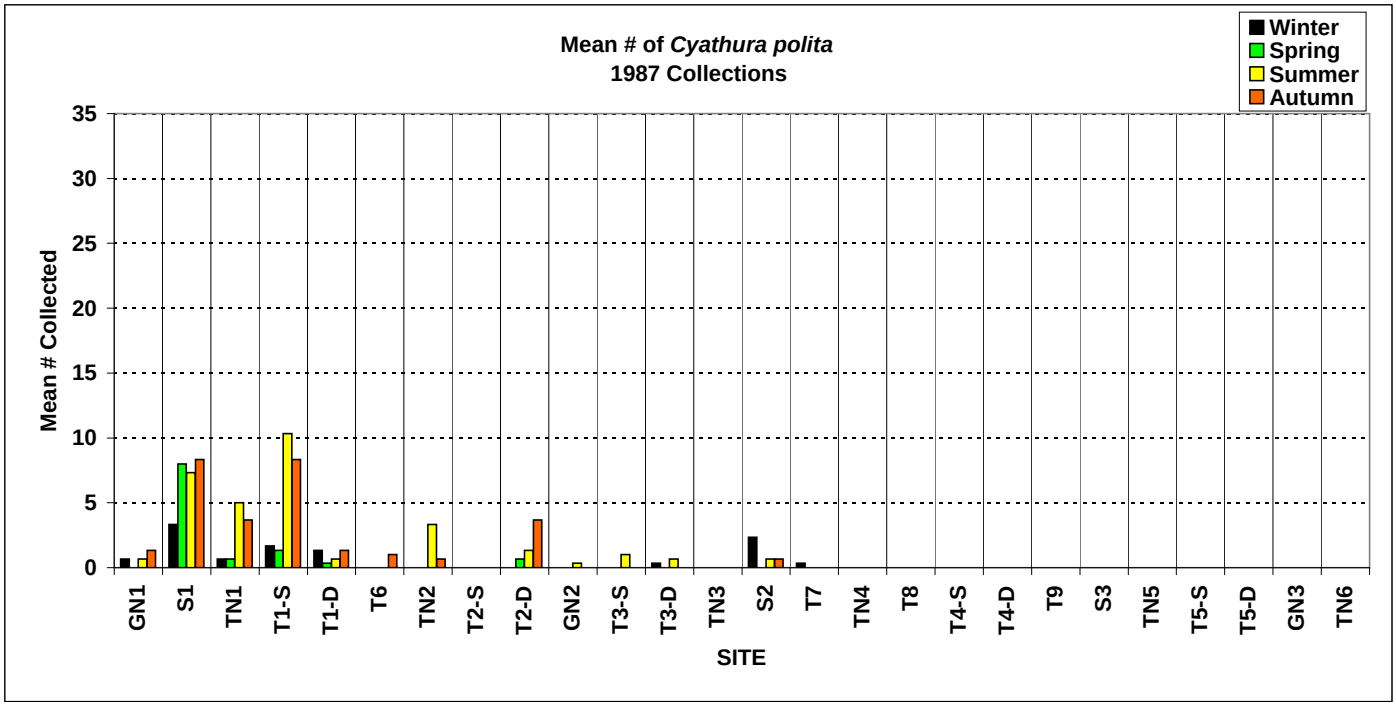


FIGURE 22
Comparison of the Spatial Distribution and Seasonal Abundance of the Slender Isopod
***Cyathura polita* Collected During 1987 and 2002**
NJMC/MERI Hackensack River Benthic Inventory



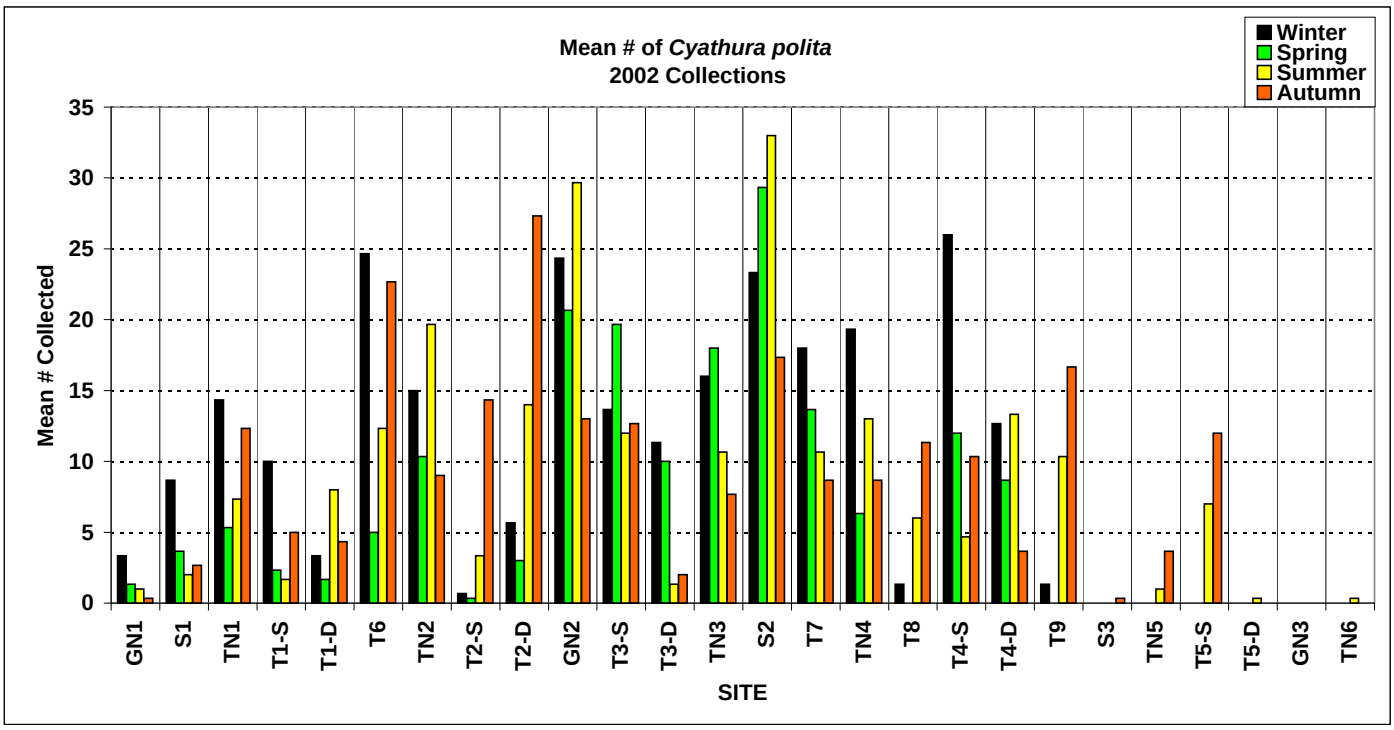
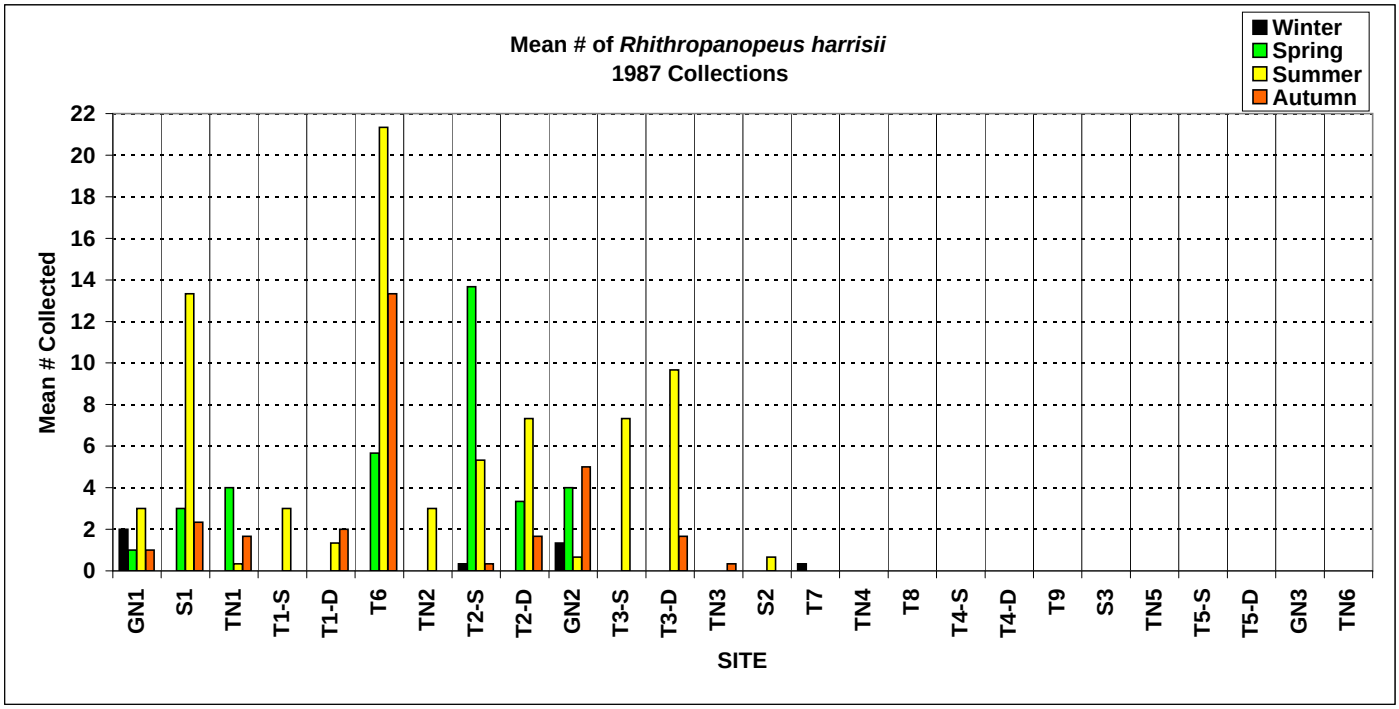


FIGURE 23
Comparison of the Spatial Distribution and Seasonal Abundance of the White-Fingered Mud Crab
***Rhithropanopeus harrisii* Collected During 1987 and 2002**
NJMC/MERI Hackensack River Benthic Inventory



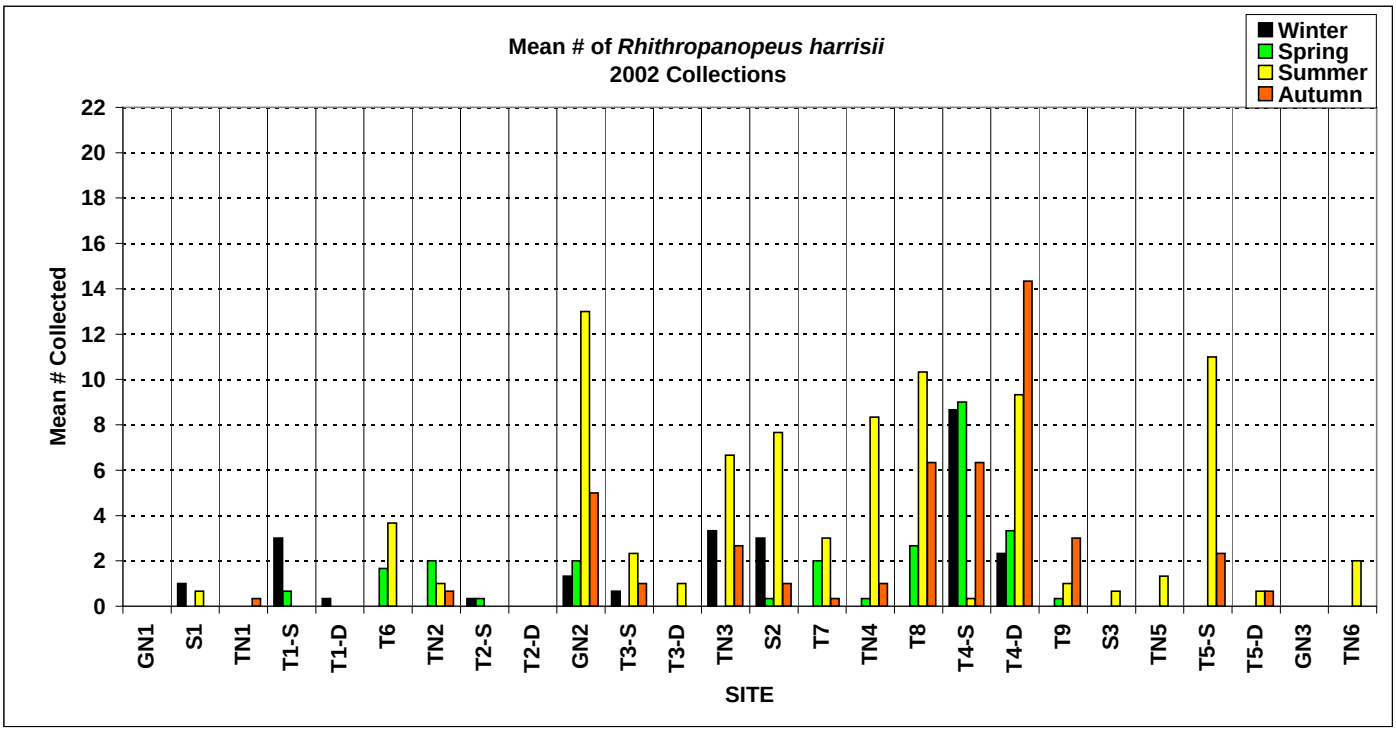
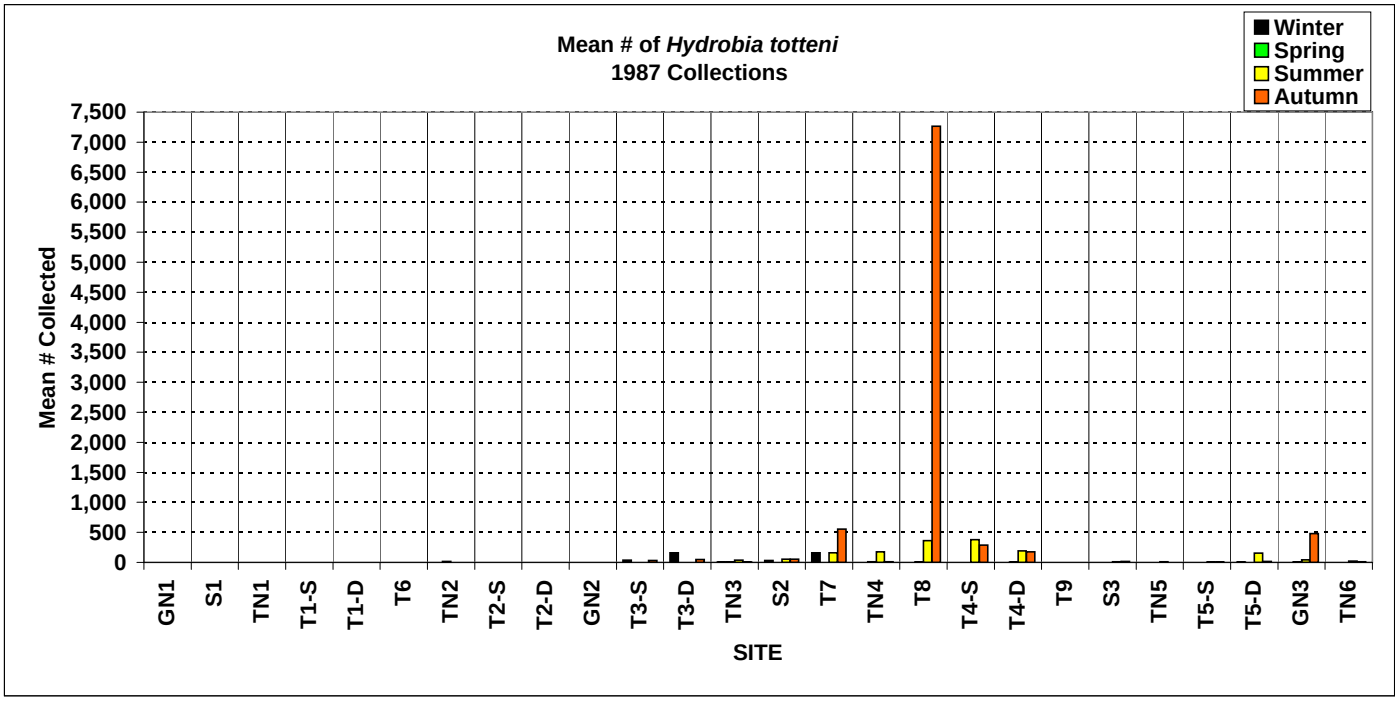


FIGURE 24
Comparison of the Spatial Distribution and Seasonal Abundance of the Hydrobid Snails
***Hydrobia totteni* and *Littoridinops tenuipes* Collected During 1987 and 2002**
NJMC/MERI Hackensack River Benthic Inventory



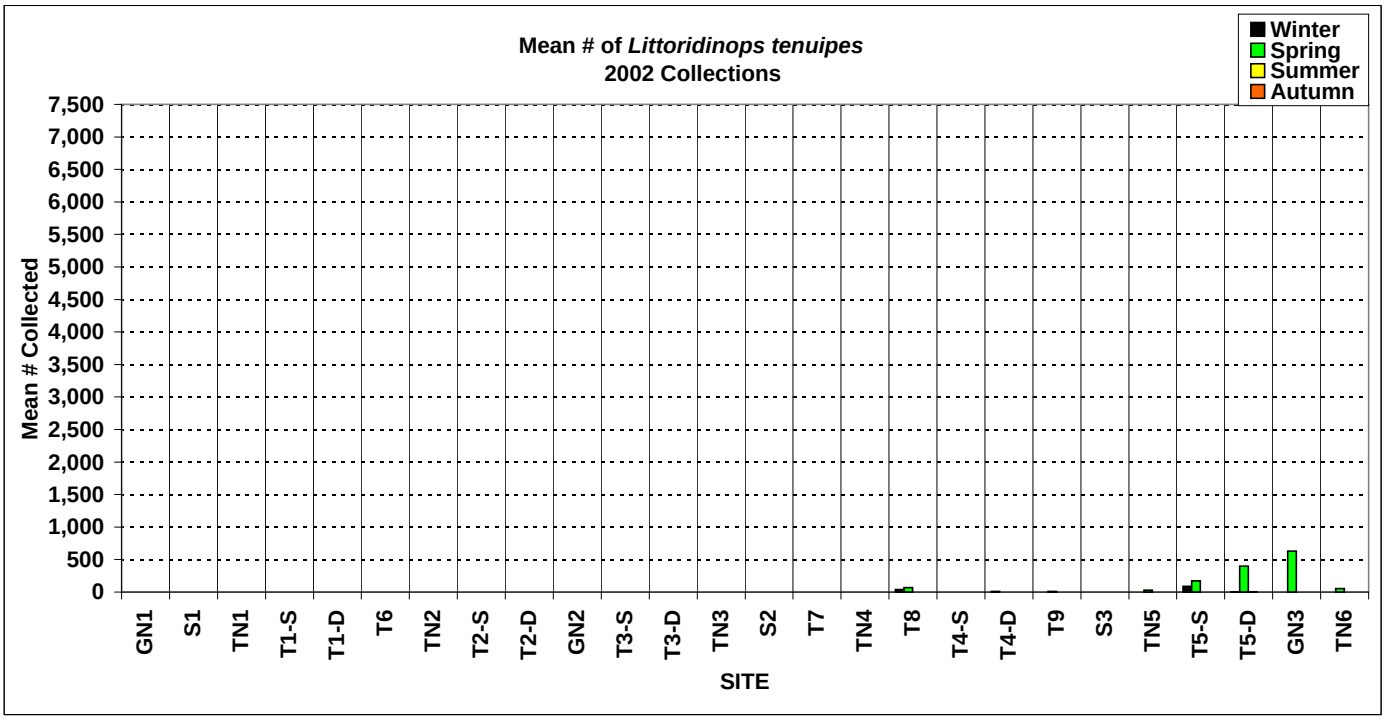


FIGURE 25
Comparison of Yearly Shannon Diversity Indexes
NJMC/MERI Hackensack River Benthic Inventory

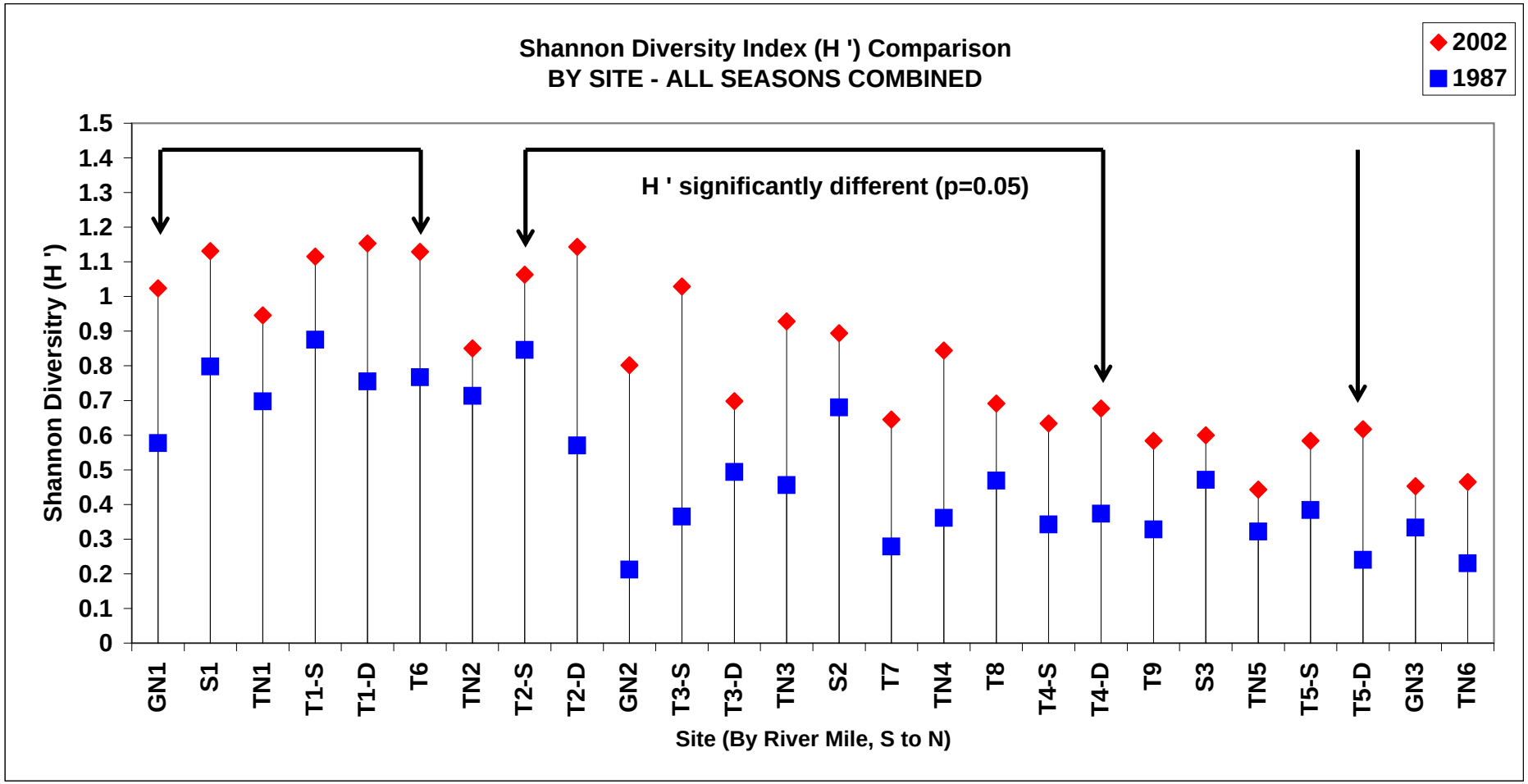
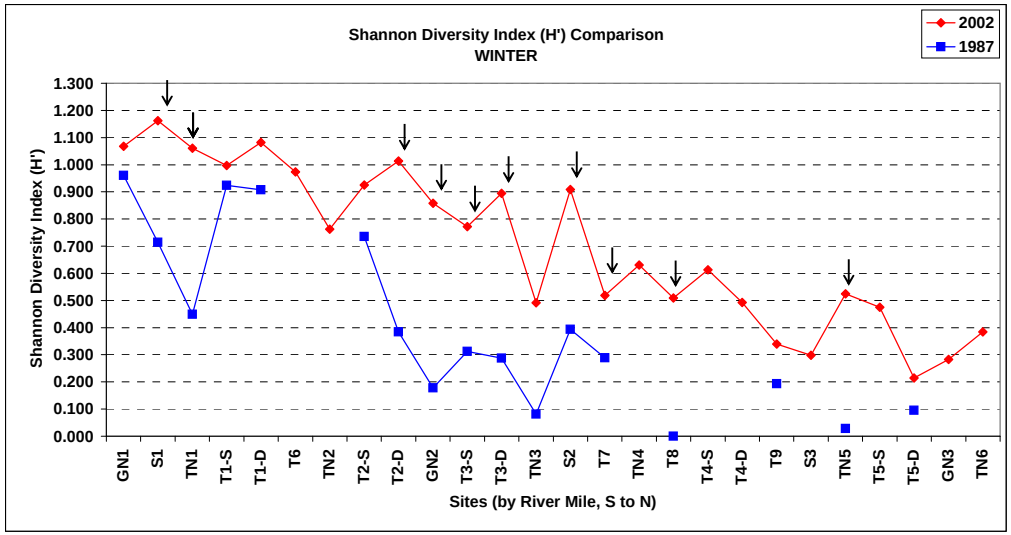
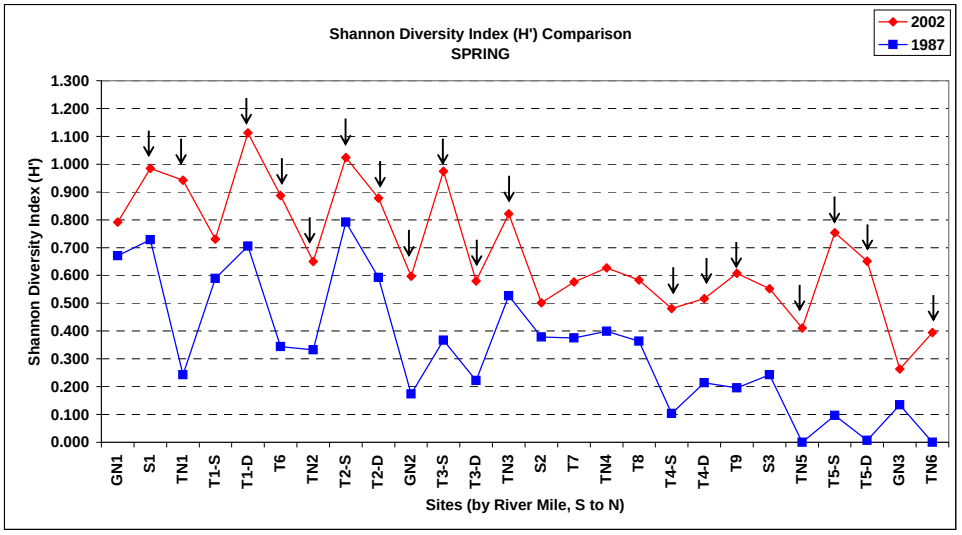
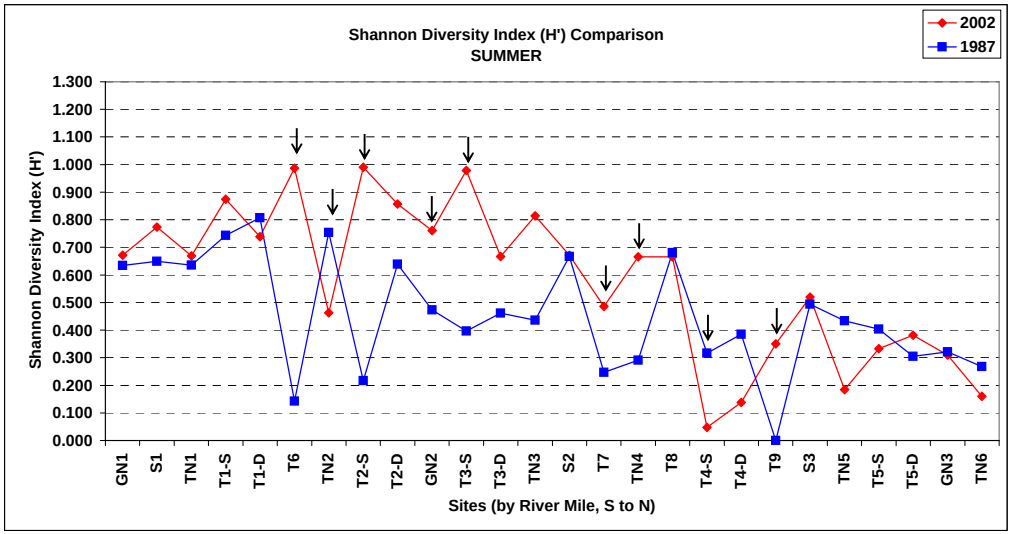
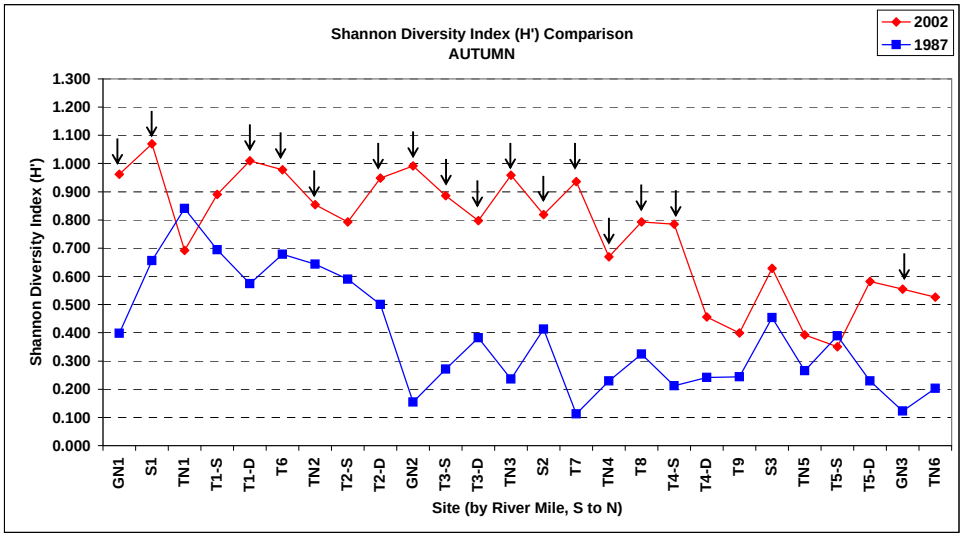


FIGURE 26
Seasonal Comparison of Shannon Diversity Indexes
NJMC/MERI Hackensack River Benthic Inventory









NOTE: Black arrows denote sites where the seasonal Shannon indexes were significantly different (p=0.05)

FIGURE 27
Comparison of Simpson Diversity Indexes
NJMC/MERI Hackensack River Benthic Inventory

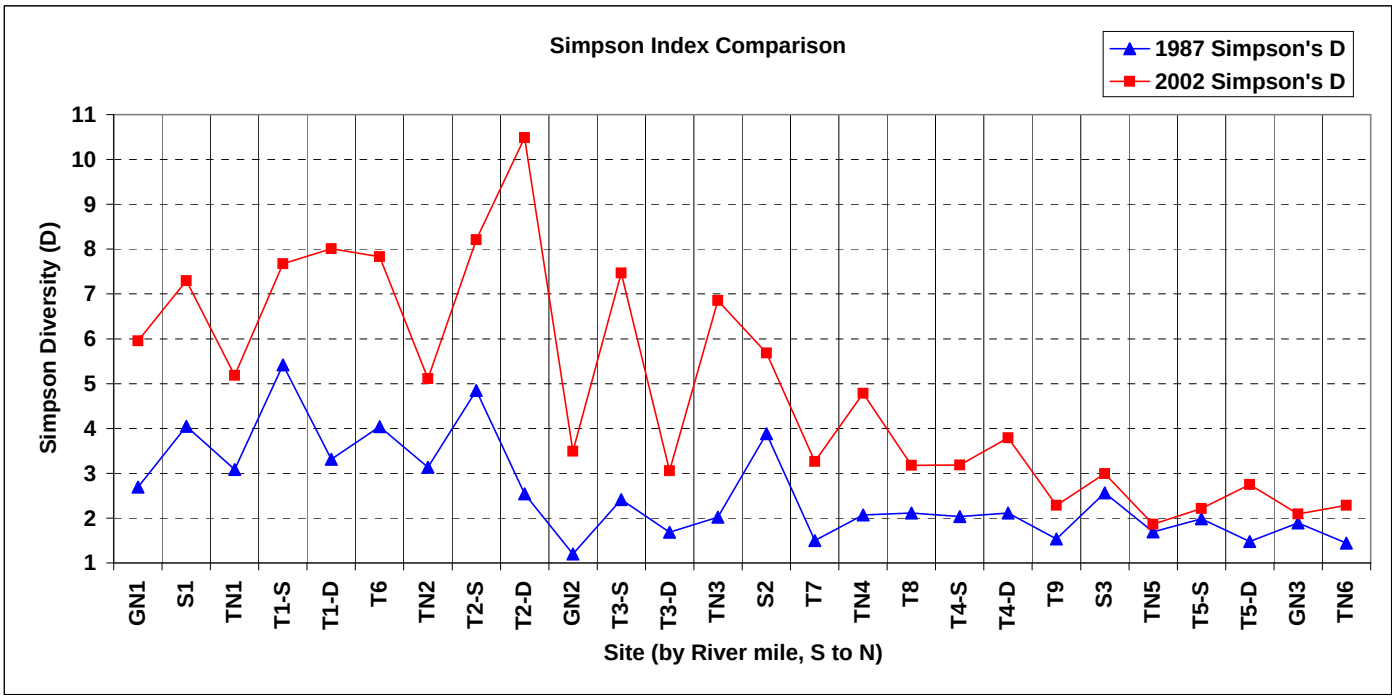


FIGURE 28
Comparison of Evenness Indexes
NJMC/MERI Hackensack River Benthic Inventory

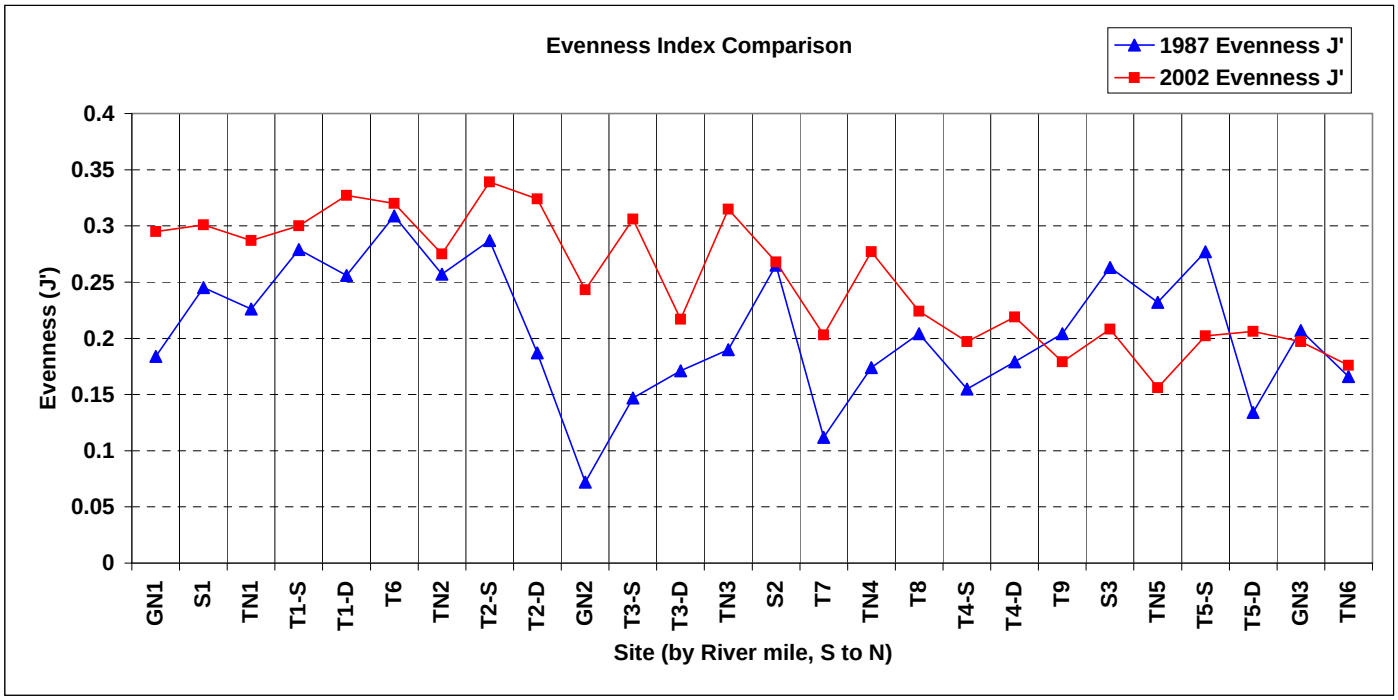
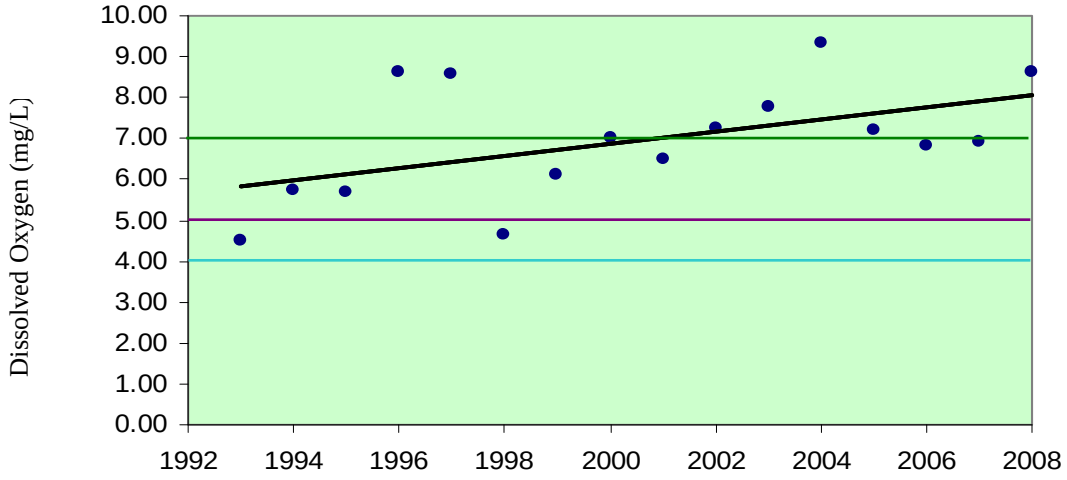


FIGURE 29
Dissolved Oxygen in the Hackensack River: 2008 Update



Criteria Level[1]
4.0

Aquatic Life
Stress Level[2]
5.0

Hackensack River
Running Average
7.0

Long Term Trend
Slope =15%

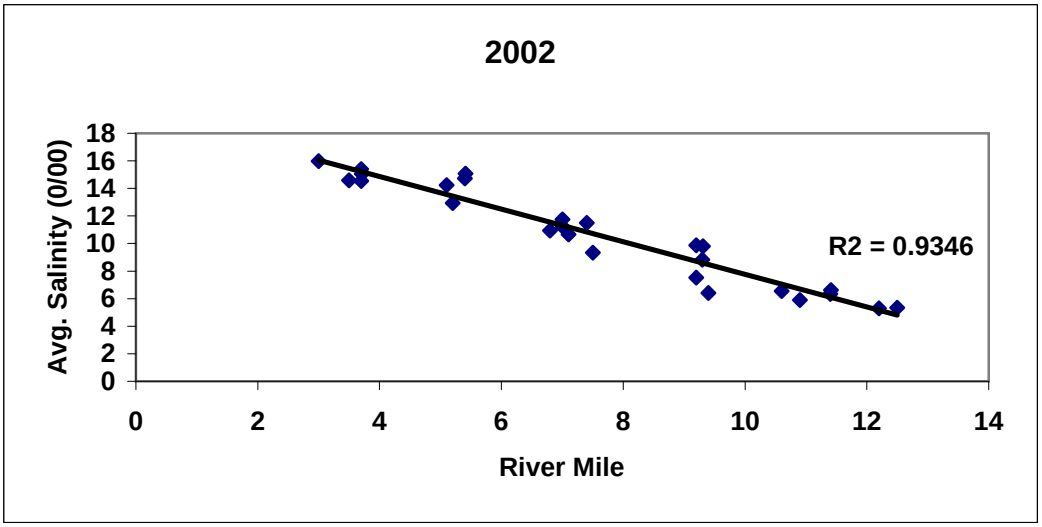
NOTES:

The Meadowlands Environmental Research Institute has completed its monitoring of the surface water of the Hackensack River for 2008.
All five sites were sampled once during each season.
An additional data point representing the 2008 average has been added to the chart above.
The running average and long term trend have changed in the positive direction as a result of this year's sampling.

[1] NJDEP criteria SE-2 (NJAC 7:9B) allows for secondary contact recreation and maintenance, migration and propagation of biota.

[2] Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen, USEPA, November 2000.

FIGURE 30
Relationship Between Salinity and River Mile
NJMC/MERI Hackensack River Benthic Inventory



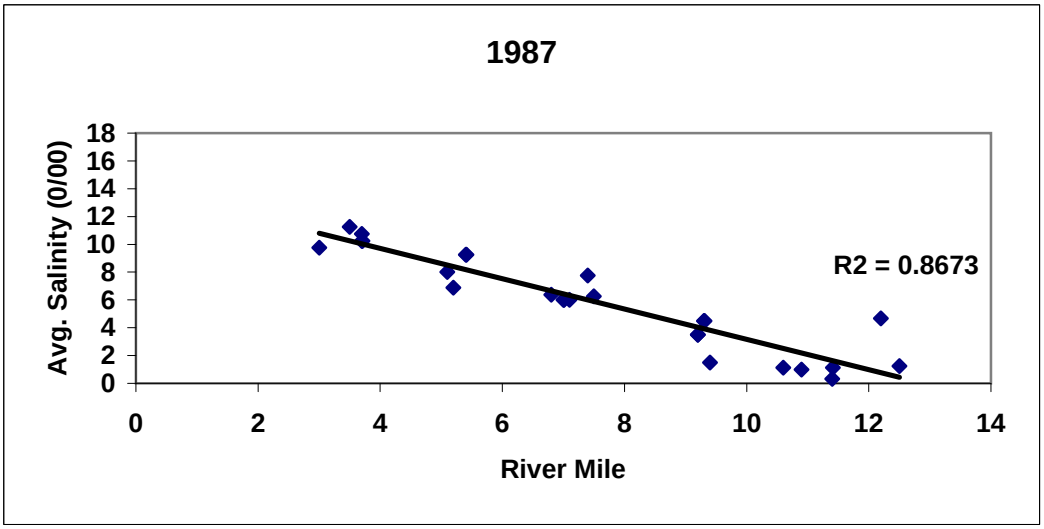
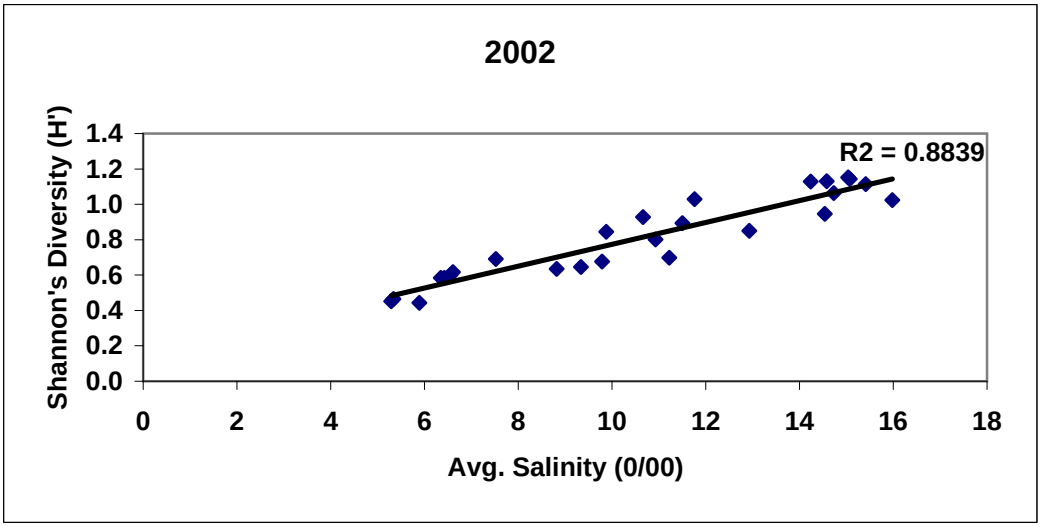


FIGURE 31
Relationship Between Shannon's Diversity and Average Salinity
NJMC/MERI Hackensack River Benthic Inventory



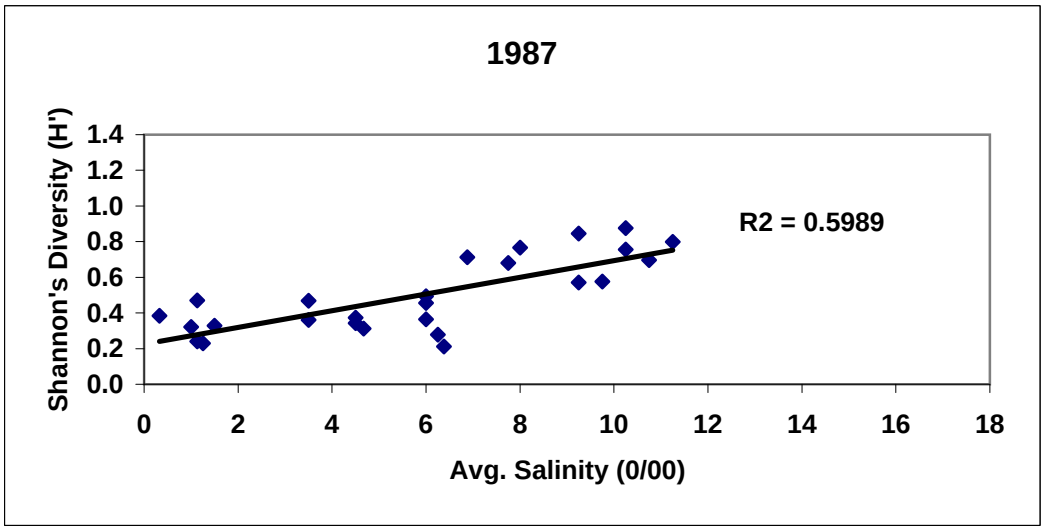
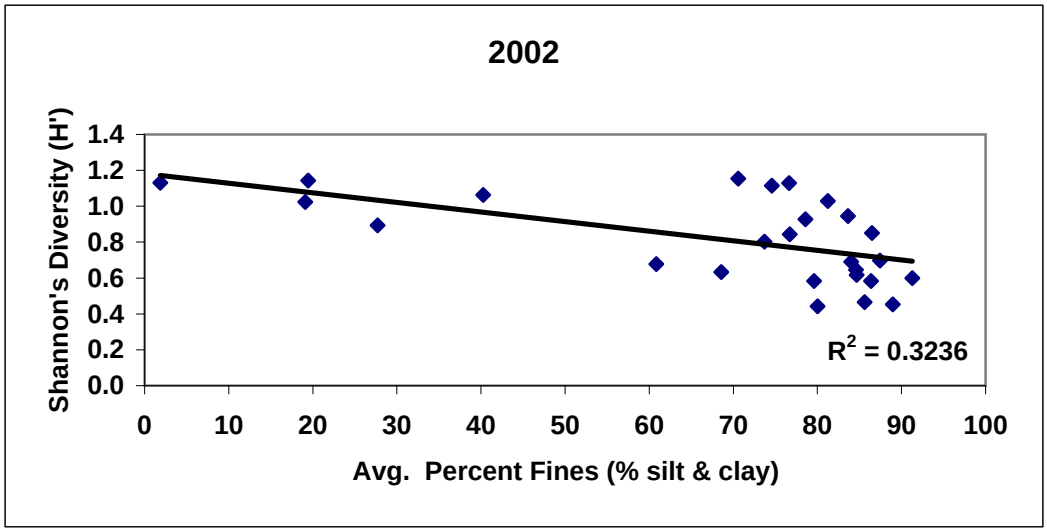
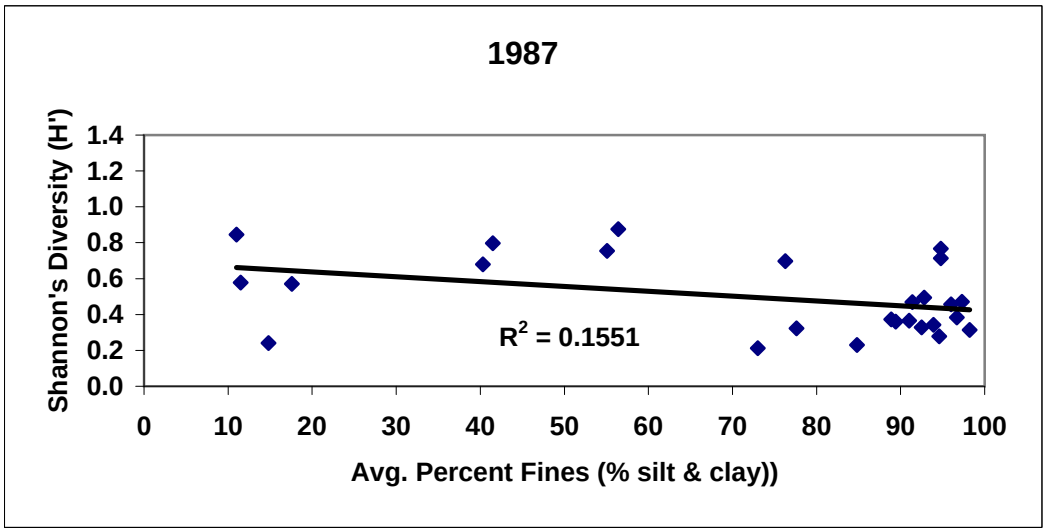


FIGURE 32
Relationship Between Shannon's Diversity and Sediment Texture
NJMC/MERI Hackensack River Benthic Inventory





APPENDIX A

TABLE A-1

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T1-Shallow (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T1 Shallow	Date	3/7/02			5/24/02			9/9/02			11/21/02		
	Time	13:54	14:04	14:18	11:10	11:29	11:34	12:54	12:56	13:02	12:39	12:42	12:49
	Collection Number	B076	B077	B078	B097	B098	B099	B217	B218	B219	B289	B290	B291
	Tidal Stage (+ hours)	Low + 3			High + 3.5			High + 1.5			High + 3.5		
	Depth (feet)	8 - 9			10.5 - 12			10.5 - 11			10 - 10.5		
Water Quality	Salinity (0/00) surface	16.06			9.16			22.88			11.51		
	bottom	16.33			10.32			23.27			11.70		
	Temp (^{o}C) surface	12.63			17.54			28.15			10.65		
	bottom	10.23			17.29			24.43			10.51		
	air	17			23			30			12		
	D.O. (mg/L) surface	7.55			5.95			3.60			6.10		
	bottom	7.58			5.46			3.38			5.90		
	pH surface	7.34			8.12			7.27			8.13		
	bottom	7.35			8.12			7.29			8.13		
	T.D.S. (g/l) surface	16.85			10.040			23.17			12.40		
	bottom	17.09			11.25			23.61			12.59		
	Redox (mV) surface	392			359			365			412		
	bottom	390			355			363			411		
	Secchi (cm)	95			70			80			70		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Coelenterates	Diadumene leucolena		8	131	1		15						
Ribbon Worms	Carinoma tremaphorus	1	3	6	3	6	5	1	3	2		1	1
Polychaete Worms	Eteone heteropoda	1		1	1		2	2	4	2			
	Neanthes succinea		1	8	1		6						
	Glycera americana			1				1		1		1	
	Leitoscoloplos robustus				9	7	26	1	2	3	1	1	3
	Polydora cornuta		2	3	1		1						
	Marenzelleria viridis			2		1	1						
	Spio setosa						2						
	Streblospio benedicti	2		5	43	25	196		8	2			6
	Tharyx sp. A					1	1						
	Heteromastus filiformis			38	4	1	24		3	1	5		4
	Mediomastus ambiseta				1		1						
	Sabellaria vulgaris			1									
	Pectinaria gouldii		1	7	1			1	4	1		1	2
	Hobsonia florida				2	1	2						
Oligochaete Worms	Oligochaeta				1		2	1	1				
Gastropods (snails)	Doridella obscura			1									
Bivalves (clams)	Mulinia lateralis	4	2	4			3	8	16	27	5	8	17
	Macoma balthica						1		1	1			1
	Macoma mitchelli										2		3
	Mya arenaria		2	1						1	2	3	1
Sea Spiders	Anoplodactylus petiolatus						1						
Barnacles	Balanus improvisus			34			3						
Oppossum Shrimp	Neomysis americana			1				1					
Cumaceans	Oxyurostylis smithi			1									
Isopods	Cyathura polita	11	16	3	2	3	2		2	3	5	4	6
	Synidotea laevidorsalis										1		
	Edotea triloba	2		6	1		1						
Amphipods	Ampelisca abdita	2	6	3	2		1	2	3	3	8	12	17
	Leptocheirus plumulosus	1	3	1								1	1
	Apocorophium lacustre			1			2		1				
	Monocorophium insidiosum			5									
	Gammarus daiberi			1									
	Mucrogammarus mucronatus						1						
	Melita nitida			4									
	Ameroculodes spp. complex				2		1						
	Crangon septemspinosa				3	4	4						
True Crabs	Callinectes sapidus	1											
	Rhithropanopeus harrisii			9		1	1						
Sea Squirts	Molgula manhattensis			2									
	total number of individuals	25	44	280	78	50	305	18	48	47	29	32	62
	total number of taxa	9	10	27	17	10	26	9	12	12	8	9	12
	mean number of individuals	116.3			144.3			37.7			41.0		
	mean number of taxa	15.3			17.7			11.0			9.7		
	TOTAL # OF TAXA	**28**			**27**			**15**			**14**		
	TOTAL # OF INDIVIDUALS	**349**			**433**			**113**			**123**		

TABLE A-2

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T1-Deep (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T1 Deep	Date	3/7/02			5/24/02			9/9/02			11/21/02		
	Time	13:04	13:18	13:30	11:57	12:01	12:15	12:22	12:26	12:32	11:33	11:36	11:41
	Collection Number	B073	B074	B075	B100	B101	B102	B214	B215	B216	B286	B287	B288
	Tidal Stage (+ hours)	Low + 3			High + 4.5			High + 1			High + 2.5		
	Depth (feet)	11 - 12			17			19 - 20.5			16.2		
Water Quality	Salinity (0/00) surface	15.13			8.90			22.32			12.26		
	bottom	15.29			8.93			23.52			12.40		
	Temp (^{o}C) surface	11.44			17.90			27.13			10.29		
	bottom	10.19			17.60			24.27			10.25		
	air	16			24			30			10		
	D.O. (mg/L) surface	7.17			6.44			3.52			6.05		
	bottom	7.22			5.94			3.68			6.36		
	pH surface	7.08			8.12			6.95			8.16		
	bottom	7.14			8.11			7.07			8.15		
	T.D.S. (g/l) surface	15.94			9.797			22.66			13.17		
	bottom	16.12			9.807			23.72			13.33		
	Redox (mV) surface	367			355			406			415		
	bottom	366			354			403			413		
	Secchi (cm)	130			65			90			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Coelenterates	Diadumene leucolena						1				1		
Ribbon Worms	Carinoma tremaphorus	1	4	2	1	1		4	3	4	1		3
	Amphiporus bioculatus								1				
Polychaete Worms	Eteone heteropoda		1	1				1					
	Neanthes succinea	1		2		1	2						
	Glycera americana	1		1	1	1	2						
	Leitoscoloplos robustus		3		9	8	15	6	2	4		1	1
	Polydora cornuta	2	7	4			2						1
	Marenzelleria viridis		2		1	1	7				1		
	Spio setosa				1		2						
	Streblospio benedicti	1		4			1						
	Heteromastus filiformis		3		6	8	7	6		2	2	2	3
	Pectinaria gouldii	2	1			2	1	6	3	7		1	
Gastropods (snails)	Doridella obscura											1	
Bivalves (clams)	Mulinia lateralis	19	2	6	3	2	4	38	27	32	1	3	10
	Macoma balthica		2	1	3				1		1		
	Macoma mitchelli							1			1		
	Mya arenaria	7	8	11									
Barnacles	Balanus improvisus					1					4		
Oppossum Shrimp	Neomysis americana			2									
Isopods	Cyathura polita	3	4	3	4		1	8	9	7	6	4	3
	Synidotea laevidorsalis				2		1						1
	Edotea triloba	1			1			2	2	4			
Amphipods	Ampelisca abdita						1	4		2			4
	Leptocheirus plumulosus	3	3	1							1		1
	Apocorophium lacustre		1								1		
	Monocorophium insidiosum				1								
	Gammarus daiberi				10	3	1						
	Mucrogammarus mucronatus				3	1							
	Ameroculodes spp. complex				1	1							
	Crangon septemspinosa		1			3	1			1			
True Crabs	Callinectes sapidus		1	1									
	Rhithropanopeus harrisii			1									
Sea Squirts	Molgula manhattensis									1			
total number of individuals		41	43	40	47	33	49	76	48	64	20	12	27
total number of taxa		11	15	14	15	13	16	10	8	10	11	6	9
mean number of individuals		41.3			43.0			62.7			19.7		
mean number of taxa		13.3			14.7			9.3			8.7		
	TOTAL # OF TAXA	**21**			**23**			**14**			**17**		
	TOTAL # OF INDIVIDUALS	**124**			**129**			**188**			**59**		

TABLE A-3

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T2-Shallow (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T2 Shallow	Date	2/26/02			6/3/02			9/10/02			11/26/02		
	Time	12:17	12:22	12:30	12:37	12:42	12:47	11:31	11:34	11:45	12:05	12:08	12:10
	Collection Number	B055	B056	B057	B121	B122	B123	B220	B221	B222	B298	B299	B300
	Tidal Stage (+ hours)	High + 4.5			Low + 2.25			Low + 5.5			Low + 5.25		
	Depth (feet)	10.6 - 11			12 - 13			14 - 14.5			11 - 13		
Water Quality	Salinity (0/00) surface	16.89			9.13			19.3			11.30		
	bottom	17.03			9.86			19.91			12.11		
	Temp (^{o}C) surface	9.24			23.09			26.02			10.30		
	bottom	9.15			22.81			25.4			10.28		
	air	15			20						9		
	D.O. (mg/L) surface	6.77			5.30			3.05			7.28		
	bottom	7.11			4.26			3.17			6.54		
	pH surface	7.23			7.85			7.51			7.81		
	bottom	7.36			7.87			7.42			7.84		
	T.D.S. (g/l) surface	17.72			10.030			19.87			12.20		
	bottom	17.76			10.77			20.47			13.02		
	Redox (mV) surface	449			363			369			422		
	bottom	444			362			366			415		
	Secchi (cm)	80			100			55			70		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Ribbon Worms	Carinoma tremaphorus	1						3	5	5	5	4	4
Polychaete Worms	Eteone heteropoda							1	2				
	Eteone foliosa				1								
	Laeonereis culveri							1					
	Leitoscoloplos robustus	1	1	1	2	1	1	2	2	1	6		1
	Marenzelleria viridis	4	2		3	4	1	2	2	6	4	2	5
	Streblospio benedicti					2			2		2		
	Heteromastus filiformis		2	1	1	4		4	5	3	15		1
	Pectinaria gouldii								1				
	Hobsonia florida								1				
Oligochaete Worms	Oligochaeta					1		1			1		1
Bivalves (clams)	Mulinia lateralis				1			1	1				
	Macoma balthica		2	3	1				1		1		
	Macoma mitchelli										4	4	3
	Mya arenaria	1		1		1							
Barnacles	Balanus improvisus					1							
Oppossum Shrimp	Neomysis americana							2					
Isopods	Cyathura polita		2				1	3	3	4	28	3	12
Amphipods	Leptocheirus plumulosus		2	1	1		2				1		
	Mucrogammarus mucronatus					1	8						
	Ameroculodes spp. complex			1									
Carridean Shrimp	Crangon septemspinosa						3	2				1	
True Crabs	Rhithropanopeus harrisii	1				1							
total number of individuals		8	11	8	10	16	16	22	25	19	67	14	27
total number of taxa		5	6	6	7	9	6	11	11	5	10	5	7
mean number of individuals		9.0			14.0			22.0			36.0		
mean number of taxa		5.7			7.3			9.0			7.3		
	TOTAL # OF TAXA	**10**			**15**			**15**			**11**		
	TOTAL # OF INDIVIDUALS	**27**			**42**			**66**			**108**		

TABLE A-4

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T2-Deep (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T2 Deep	Date	2/26/02			6/3/02			9/10/02			11/26/02		
	Time	11:43	11:46	11:52	12:09	12:13	12:20	12:11	12:17	12:25	11:20	11:24	11:29
	Collection Number	B052	B053	B054	B118	B119	B120	B223	B224	B225	B295	B296	B297
	Tidal Stage (+ hours)	High + 4			Low + 2			High			Low + 4.5		
	Depth (feet)	18 - 19			18 - 19			19			17		
Water Quality	Salinity (0/00) surface	17.08			7.14			20.61			10.25		
	bottom	17.67			10.76			21.1			10.76		
	Temp (^{o}C) surface	9.63			24.12			25.91			10.87		
	bottom	8.84			22.86			25.43			10.74		
	air	15			20			32			7		
	D.O. (mg/L) surface	6.59			6.25			3.23			6.73		
	bottom	6.96			4.31			3.13			6.72		
	pH surface	7.19			7.88			7.14			7.91		
	bottom	7.30			7.90			7.18			7.90		
	T.D.S. (g/l) surface	17.78			7.979			21.10			11.17		
	bottom	18.33			11.680			21.52			11.68		
	Redox (mV) surface	466			347			392			388		
	bottom	460			355			384			389		
	Secchi (cm)	80			65			70			85		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Ribbon Worms	Carinoma tremaphorus	1		2	1	2		8	11	5	19	11	11
Polychaete Worms	Eteone heteropoda	8	6	6	4	3	1	1	3				1
	Eteone foliosa											1	1
	Podarkeopsis levifuscina											2	
	Neanthes succinea	1	1				2						
	Laeonereis culveri									1			
	Leitoscoloplos robustus	10	9	3	3	1	1	1	2		11	4	13
	Polydora cornuta	1		1	2	2	2	1	1				
	Marenzelleria viridis		12	9	13	9	6	14	11	9	2	1	8
	Spio setosa						1						
	Streblospio benedicti	1			56	61	6				15	9	2
	Capitella capitata											1	
	Heteromastus filiformis	2	11	2	4	4	11	14	10	4	32	49	45
	Pectinaria gouldii		1				1				1	1	
	Hobsonia florida							1	1	1			
Oligochaete Worms	Oligochaeta				1	4	1				10	36	5
Gastropods (snails)	Epitonium rupicola								1				
	Mulinia lateralis	5	6	17		4	1		8	13	2	3	3
	Macoma balthica		2	1	7	12	15		1			1	
	Macoma mitchelli								2		9	6	6
	Mytilopsis leucophaeata						1						
	Mya arenaria	16	13	16							1	1	1
Barnacles	Balanus improvisus			3	3	2	11						
Oppossum Shrimp	Neomysis americana										1		
Isopods	Cyathura polita	3	5	9		3	6	14	15	13	25	26	31
	Synidotea laevidorsalis			2									
	Edotea triloba				1		1		1		2	1	1
Amphipods	Ampelisca abdita										4		
	Leptocheirus plumulosus	7	7	14							8	5	1
	Apocorophium lacustre						1						
	Gammarus daiberi						1						
Carridean Shrimp	Crangon septemspinosa						3						
Insect larvae	Chironomidae			1			1						
Sea Squirts	Molgula manhattensis			1									
total number of individuals		55	73	87	95	107	73	54	67	46	142	158	129
total number of taxa		11	11	15	11	12	20	8	13	7	15	17	14
mean number of individuals		71.7			91.7			55.7			143.0		
mean number of taxa		12.3			14.3			9.3			15.3		
	TOTAL # OF TAXA	**18**			**21**			**14**			**20**		
	TOTAL # OF INDIVIDUALS	**215**			**275**			**167**			**429**		

TABLE A-5

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T3-Shallow (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T3 Shallow	Date	2/25/02			6/13/02			9/13/02			11/19/02		
	Time	12:03	12:26	12:35	12:36	12:39	12:42	13:12	13:14	13:16	11:59	12:02	12:08
	Collection Number	B043	B044	B045	B148	B149	B150	B232	B233	B234	B265	B266	B267
	Tidal Stage (+ hours)	High + 5			High + 0.5			Low + 4.5			High + 4		
	Depth (feet)	9 - 10			9 - 13.7			4.5 - 5.0			7.5 - 8		
Water Quality	Salinity (0/00) surface	13.24			9.01			14.5			7.10		
	bottom	13.73			10.11			15.34			7.85		
	Temp (^{o}C) surface	7.84			24.00			24.07			8.79		
	bottom	7.77			24.05			23.6			9.11		
	air	10			19			25			9		
	D.O. (mg/L) surface	7.15			3.21			3.66			5.77		
	bottom	7.09			3.24			3.09			6.36		
	pH surface	7.25			7.76			7.42			7.56		
	bottom	7.41			7.73			7.38			7.56		
	T.D.S. (g/l) surface	14.15			9.921			15.37			7.926		
	bottom	14.60			11.03			16.20			8.71		
	Redox (mV) surface	477			336			327			423		
	bottom	467			340			325			422		
	Secchi (cm)	65			70			50			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.		1		38	52	48	3	8	1	1		1
Ribbon Worms	Carinoma tremaphorus	2	5	3	1	2	4			2	12	4	7
Polychaete Worms	Eteone heteropoda	1		3	1		4				3	2	
	Neanthes succinea						1						
	Laeonereis culveri							2	13	4			
	Leitoscoloplos robustus	1											
	Marenzelleria viridis	13	16	9	14	22	16	5	8	5	1	3	5
	Streblospio benedicti	98	49	56	30	19	150	1	4	7	93	63	34
	Heteromastus filiformis	4	4	6	2		4		3		11	25	8
	Hobsonia florida	82	123	101	98	48	79	2	4	2	7	14	13
Oligochaete Worms	Oligochaeta	17	15	27	7	1	21	6	15	7	50	61	35
Gastropods (snails)	Littoridinops tenuipes						1						
	Mulinia lateralis									4			1
	Macoma balthica			2	10	7	21		2	1	1	6	2
	Macoma mitchelli							10	11	11	8	8	10
Oppossum Shrimp	Neomysis americana	1			2	1	2				5	3	
Cumaceans	Leucon americanus	4	1				1					1	
Isopods	Cyathura polita	18	11	12	20	14	25	7	18	11	12	10	16
	Synidotea laevidorsalis				2								
	Edotea triloba	6	5	18	25	6	17				8	2	6
Amphipods	Leptocheirus plumulosus	11	8	7	115	32	81				4	4	7
	Apocorophium lacustre				1		1				1		
	Gammarus daiberi				36	10	17						
	Mucrogammarus mucronatus				6		2						
	Ameroculodes spp. complex	3		1	1	2							
Carridean Shrimp	Crangon septemspinosa				4	3	1						
True Crabs	Callinectes sapidus	1	1										
	Rhithropanopeus harrisii	2								7		3	
Insect larvae	Chironomidae	1											
total number of individuals		265	239	245	413	219	496	36	86	62	217	209	145
total number of taxa		17	12	12	19	14	20	8	10	12	15	15	13
mean number of individuals		249.7			376.0			61.3			190.3		
mean number of taxa		13.7			17.7			10.0			14.3		
	TOTAL # OF TAXA	**19**			**22**			**13**			**18**		
	TOTAL # OF INDIVIDUALS	**749**			**1,128**			**184**			**571**		

TABLE A-6

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T3-Deep (Hackensack River

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T3 Deep	Date	2/25/02			6/13/02			9/13/02			11/19/02		
	Time	13:19	13:42	13:50	12:04	12:08	12:11	12:11	12:14	12:17	11:18	11:22	11:27
	Collection Number	B046	B047	B048	B145	B146	B147	B229	B230	B231	B262	B263	B264
	Tidal Stage (+ hours)	Low			High			Low + 3.5			High + 3		
	Depth (feet)	10 - 11			16 - 17			13.6			13		
Water Quality	Salinity (0/00) surface	12.06			7.34			13.81			6.85		
	bottom	12.86			10.00			14.32			7.71		
	Temp (^{o}C) surface	7.82			23.25			23.21			9.45		
	bottom	8.05			23.95			23.05			9.19		
	air	11			19			25			10		
	D.O. (mg/L) surface	7.35			4.70			4.37			6.02		
	bottom	7.11			3.53			3.55			5.67		
	pH surface	7.34			7.70			7.12			7.57		
	bottom	7.40			7.63			7.16			7.56		
	T.D.S. (g/l) surface	13.00			8.17			14.72			7.664		
	bottom	13.76			10.93			16.50			8.568		
	Redox (mV) surface	446			335			404			443		
	bottom	444			341			402			440		
	Secchi (cm)	60			55			55			55		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	20	82	19	396	267	331	9	8	12	65	55	3
Ribbon Worms	Carinoma tremaphorus	5	3	5	1	2	1	1				2	
Polychaete Worms	Eteone heteropoda	1	3	1		2					11	4	8
	Marenzelleria viridis	17	37	13	32	30	24						
	Streblospio benedicti	97	111	4	235	919	1679	2	5	2	96	177	127
	Heteromastus filiformis	2		2	5	4	6					1	
	Hobsonia florida	45	122	17	12	106	157	2			15	8	23
Oligochaete Worms	Oligochaeta	5	12	1	4	129	129				29	44	10
Bivalves (clams)	Mulinia lateralis	1	2							1			
	Macoma balthica	4	2	1	5	6	9			1			
	Macoma mitchelli								2		7	11	6
	Mya arenaria			1							1		
Barnacles	Balanus improvisus				1								
Oppossum Shrimp	Neomysis americana										9	2	7
Isopods	Cyathura polita	14	15	5	4	10	16		1	3	3	2	1
	Synidotea laevidorsalis				1								
	Edotea triloba	28	47	34	36	16	14				12	10	17
Amphipods	Ampelisca abdita										1		
	Leptocheirus plumulosus	14	16	6	38	71	53				34	37	33
	Apocorophium lacustre					2		1			3	2	9
	Gammarus daiberi	1			4	3	6						
	Ameroculodes spp. complex	3	10	2	1	3	3						
	Crangon septemspinosa				9	1	3						
True Crabs	Rhithropanopeus harrisii									3			
Insect larvae	Chironomidae		1								2	3	1
total number of individuals		257	463	111	784	1571	2431	15	16	22	288	358	245
total number of taxa		15	14	14	16	16	14	5	4	6	14	14	12
mean number of individuals		277.0			1595.3			17.7			297.0		
mean number of taxa		14.3			15.3			5.0			13.3		
	TOTAL # OF TAXA	**17**			**18**			**10**			**16**		
	TOTAL # OF INDIVIDUALS	**831**			**4,786**			**53**			**891**		

TABLE A-7

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T4-Shallow (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T4 Shallow	Date	1/30/02			6/5/02			9/6/02			10/23/02		
	Time	13:00	13:26	13:37	12:03	12:09	12:24	11:53	11:56	12:02	11:44	11:47	11:52
	Collection Number	B019	B020	B021	B133	B134	B135	B205	B206	B207	B250	B251	B252
	Tidal Stage (+ hours)	High + 2			High + 5			High + 3			High + 1		
	Depth (feet)	11.5 - 12.5			8 - 9.5			10 - 11			11.5 - 12		
Water Quality	Salinity (0/00) surface	11.77			4.04			9.97			6.58		
	bottom	12.83			4.27			10.47			7.70		
	Temp (^{o}C) surface	7.59			23.46			23.3			13.37		
	bottom	7.64			22.30			23.29			13.52		
	air	14			26			22			9		
	D.O. (mg/L) surface	5.84			7.19			4.81			5.51		
	bottom	6.11			4.92			3.86			5.05		
	pH surface	7.20			8.08			7.08			7.33		
	bottom	7.21			8.06			7.2			7.33		
	T.D.S. (g/l) surface	12.70			4.626			10.85			7.391		
	bottom	13.71			4.885			11.39			8.544		
	Redox (mV) surface	406			350			422			375		
	bottom	403			352			401			377		
	Secchi (cm)	60			50			50			85		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	112	95	40	66	31	37	252	308	220	92	137	14
Flatworms	Stylochus ellipticus					2							
Ribbon Worms	Carinoma tremaphorus	1	6	2	1	3	4						
Polychaete Worms	Laeonereis culveri		2			1							
	Marenzelleria viridis	267	247	223	86	60	69				9	2	9
	Streblospio benedicti	29	4	1	27						46	24	4
	Boccardiella ligerica	2			24		2						
	Heteromastus filiformis			1	1	1							
	Hobsonia florida	1,762	1,166	1,433	1370	723	1489				13	13	2
	Manayunkia aestuarina				2								
Oligochaete Worms	Oligochaeta	39	9	13	66						56	69	19
Bivalves (clams)	Rangia cuneata						1						
	Macoma balthica						1						
	Macoma mitchelli											1	
	Mytilopsis leucophaeata	75	47	133	7		4						
Barnacles	Balanus improvisus												36
Oppossum Shrimp	Neomysis americana			1									
Isopods	Cyathura polita	33	22	23	7	6	13	4	6	4	8	8	15
	Edotea triloba	50	62	26	3	1	2				4	2	2
Amphipods	Leptocheirus plumulosus		2	2	1	1	1				1		
	Apocorophium lacustre	528	416	1,316	3616	2972	4843						
	Gammarus daiberi	55	49	43	1472	881	1656				1		7
True Crabs	Callinectes sapidus	1											
	Rhithropanopeus harrisii	15	10	1	5	2	3		1			1	18
Insect larvae	Chironomidae	9	3	15	12	12	5	1			5		
total number of individuals		2978	2140	3273	6766	4696	8130	257	315	224	235	257	126
total number of taxa		15	15	16	17	14	15	3	3	2	10	9	10
mean number of individuals		2797.0			6530.7			265.3			206.0		
mean number of taxa		15.3			15.3			2.7			9.7		
	TOTAL # OF TAXA	**19**			**21**			**4**			**13**		
	TOTAL # OF INDIVIDUALS	**8,391**			**19,592**			**796**			**618**		

TABLE A-8

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T4-Deep (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T4 Deep	Date	1/30/02			6/5/02			9/6/02			10/23/02		
	Time	11:38	12:08	12:29	11:27	11:38	11:47	11:06	11:08	11:11	11:07	11:13	11:18
	Collection Number	B016	B017	B018	B130	B131	B132	B202	B203	B204	B247	B248	B249
	Tidal Stage (+ hours)	High + 1			High + 5.5			High + 2			High		
	Depth (feet)	19			12.5 - 13			16.2			16 - 17		
Water Quality	Salinity (0/00) surface	13.70			3.85			10.58			6.29		
	bottom	15.35			4.48			11.65			7.67		
	Temp (^{o}C) surface	7.96			22.50			23.07			13.50		
	bottom	7.12			22.60			23.12			13.67		
	air	15			25			22			9		
	D.O. (mg/L) surface	5.84			4.23			4.01			4.62		
	bottom	6.82			2.62			2.08			5.49		
	pH surface	7.09			7.87			7.11			7.34		
	bottom	7.19			7.83			7.11			7.34		
	T.D.S. (g/l) surface	14.39			4.244			11.50			7.072		
	bottom	16.14			5.122			13.60			8.528		
	Redox (mV) surface	407			340			420			382		
	bottom	402			341			420			384		
	Secchi (cm)	85			45			60			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	38	31	10	21	118	56	576	159	193	15	1	4
Flatworms	Stylochus ellipticus					2							
	Euplana gracilis	1	2										
Ribbon Worms	Carinoma tremaphorus	3	1			4	2						
	Marenzelleria viridis	206	153	93	148	231	160						
	Streblospio benedicti	3	11			21	12				2		
	Boccardiella ligerica		9		1	17	2						
	Heteromastus filiformis			2									
	Hobsonia florida	3,060	3,829	1,414	318	609	540			1			
	Manayunkia aestuarina					7	3						
Oligochaete Worms	Oligochaeta		25	11	6	150	66	1					
Gastropods (snails)	Littoridinops tenuipes	7	19	3	6		1						
	Rangia cuneata						1						
	Macoma balthica					2							
	Mytilopsis leucophaeata	263	342	411	12	13	4						
Isopods	Cyathura polita	10	13	15	10	14	12	8	16	16	4	3	4
	Edotea triloba	4		3	9	1							
Amphipods	Leptocheirus plumulosus	3	1										
	Apocorophium lacustre	770	868	405	77	4828	4585		1				
	Gammarus daiberi	63	45	41	2826	3332	1355						
True Crabs	Rhithropanopeus harrisii	2	3	2	1	20	6	3	25		17	26	
Insect larvae	Chironomidae	97	110	52	9	47	9						
total number of individuals		4530	5462	2462	3444	9416	6814	588	201	210	38	30	8
total number of taxa		15	16	13	13	17	16	4	4	3	4	3	2
mean number of individuals		4151.3			6558.0			333.0			25.3		
mean number of taxa		14.7			15.3			3.7			3.0		
	TOTAL # OF TAXA	**18**			**19**			**6**			**4**		
	TOTAL # OF INDIVIDUALS	**12,454**			**19,674**			**999**			**76**		

TABLE A-9

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T5-Shallow (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T5 Shallow	Date	1/29/02			5/28/02			9/5/02			10/22/02		
	Time	12:40	13:00	13:23	13:14	13:20	13:30	11:19	11:25	11:33	12:42	12:45	12:48
	Collection Number	B007	B008	B009	B115	B116	B117	B193	B194	B195	B241	B242	B243
	Tidal Stage (+ hours)	High + 2			High + 2			High + 3			High + 3		
	Depth (feet)	7 - 8			7			5.5 - 6.0			7.5		
Water Quality	Salinity (0/00) surface	8.25			3.25			7.47			3.89		
	bottom	9.33			3.73			7.83			4.52		
	Temp (^{o}C) surface	9.17			21.44			23.93			14.27		
	bottom	7.59			20.43			23.4			14.03		
	air	21			25			28			15		
	D.O. (mg/L) surface	5.55			5.60			2.91			5.28		
	bottom	5.37			3.32			2.2			4.36		
	pH surface	7.15			7.88			7.18			7.29		
	bottom	7.16			7.82			7.21			7.24		
	T.D.S. (g/l) surface	9.136			3.766			8.317			4.476		
	bottom	10.230			4.30			8.690			5.167		
	Redox (mV) surface	378			367			370			338		
	bottom	370			367			317			342		
	Secchi (cm)	80			50			35			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.							22	7	5	17	23	7
Ribbon Worms	Carinoma tremaphorus							2		3	2	1	2
	Neanthes succinea							1		1		1	1
	Marenzelleria viridis	2	1	3	5	2	4			8			
	Streblospio benedicti							10	4	1	4	5	1
	Boccardiella ligerica	8	21	4	38	18	3	3			1	1	
	Hobsonia florida	1,012	1,734	1,006	157	62	111	1762	1053	738	870	804	755
Oligochaete Worms	Oligochaeta	8	7	11	150	91	6	45	42	32	28	33	14
Gastropods (snails)	Littoridinops tenuipes	100	86	78		4	508			5			
	Mytilopsis leucophaeata	135	155	150	5	4	8		4	5			
Isopods	Cyathura polita							7	5	9	13	11	12
	Edotea triloba						1	3	1	5	19	22	17
Amphipods	Leptocheirus plumulosus				3	2	4	9	16	4	42	90	24
	Apocorophium lacustre	57	168	151	565	282	274	68	21	145	10	17	3
	Gammarus daiberi	55	51	21	247	45	105	43	23	12	22	19	10
	Crangon septemspinosa										1		
True Crabs	Rhithropanopeus harrisii							18	10	5	4	2	1
Insect larvae	Chironomidae	78	106	80	100	41	53	19	37	13	7	11	
total number of individuals		1455	2329	1504	1270	551	1077	2012	1223	991	1040	1040	847
total number of taxa		9	9	9	9	10	11	14	12	16	14	14	12
mean number of individuals		1762.7			966.0			1408.7			975.7		
mean number of taxa		9.0			10.0			14.0			13.3		
	TOTAL # OF TAXA	**9**			**11**			**17**			**15**		
	TOTAL # OF INDIVIDUALS	**5,288**			**2,898**			**4,226**			**2,927**		

TABLE A-10

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T5-Deep (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T5 Deep	Date	1/29/02			5/28/02			9/5/02			10/22/02		
	Time	11:50	12:06	12:14	12:36	12:43	12:50	12:03	12:07	12:13	11:53	11:58	12:03
	Collection Number	B004	B005	B006	B112	B113	B114	B196	B197	B198	B238	B239	B240
	Tidal Stage (+ hours)	High + 1			High + 1			High + 4			High + 2		
	Depth (feet)	15			18.5 - 19.5			15.5			18 - 18.5		
Water Quality	Salinity (0/00) surface	8.05			3.06			6.39			3.23		
	bottom	10.69			4.14			6.72			4.87		
	Temp (^{o}C) surface	8.33			21.28			23.54			14.44		
	bottom	6.54			20.35			23.25			13.83		
	air	21			25			28			12		
	D.O. (mg/L) surface	5.69			5.57			4.10			4.74		
	bottom	6.54			2.72			2.01			4.05		
	pH surface	7.09			7.85			7.41			7.27		
	bottom	7.16			7.85			7.31			7.22		
	T.D.S. (g/l) surface	8.88			3.553			7.178			3.781		
	bottom	11.61			4.757			7.526			5.551		
	Redox (mV) surface	385			367			319			389		
	bottom	380			370			319			370		
	Secchi (cm)	80			50			70			65		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.							7	8	18	115	89	52
Ribbon Worms	Carinoma tremaphorus										1	2	
Polychaete Worms	Neanthes succinea				1			1			1	1	1
	Marenzelleria viridis	2	4	2		1							
	Streblospio benedicti							3		13	21	15	24
	Boccardiella ligerica		2	1	3		5						
	Heteromastus filiformis				1								
	Hobsonia florida	716	992	1,282	243	202	619	662	551	716	592	730	448
Oligochaete Worms	Oligochaeta	44	4	60	384	284	410	19	6	60	81	125	113
Gastropods (snails)	Littoridinops tenuipes	3	5	4	523	519	152		16				
	Mytilopsis leucophaeata	6	15	4	4		4	1	1	2			
Oppossum Shrimp	Neomysis americana											2	
Isopods	Cyathura polita							1					
	Edotea triloba						2		1		5	5	2
Amphipods	Leptocheirus plumulosus				1	2	3	2		2		1	1
	Apocorophium lacustre	6	19	6	5		20	10	6	25	40	40	30
	Gammarus daiberi	19	15	9	481	214	857	43	16	30	48	56	24
True Crabs	Rhithropanopeus harrisii									2	1		1
Insect larvae	Chaoborus sp.										1		
	Chironomidae	21	45	38	42	17	33	71	89	72	57	78	56
total number of individuals		817	1101	1406	1688	1239	2105	820	694	940	963	1144	752
total number of taxa		8	9	9	11	7	10	11	9	10	12	12	11
mean number of individuals		1108.0			1677.3			818.0			953.0		
mean number of taxa		8.7			9.3			10.0			11.7		
	TOTAL # OF TAXA	**9**			**13**			**14**			**14**		
	TOTAL # OF INDIVIDUALS	**3,324**			**5,032**			**2,454**			**2,859**		

TABLE A-11
Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T6 (Sawmill Creek)
NJMC/MERI Hackensack River Benthic Inventory
Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T6	Date	2/26/02			5/24/02			9/9/02			11/26/02		
	Time	13:45	13:57	14:01	13:37	13:48	13:54	11:29	11:30	11:33	12:38	12:50	12:58
	Collection Number	B061	B062	B063	B106	B107	B108	B211	B212	B213	B301	B302	B303
	Tidal Stage (+ hours)	High + 5.5			High + 5.75			High			High		
	Depth (feet)	15 - 16			10 - 12			21 - 21.5			19 - 21		
Water Quality	Salinity (0/00) surface	16.71			8.10			19.22			11.67		
	bottom	16.68			8.13			20.13			12.03		
	Temp (^{o}C) surface	10.30			20.46			25.55			10.30		
	bottom	9.78			20.44			25.21			10.24		
	air	16			28			29			9		
	D.O. (mg/L) surface	7.60			9.70			2.85			6.63		
	bottom	7.96			9.07			2.8			6.54		
	pH surface	7.52			8.21			7.09			7.81		
	bottom	7.65			8.23			7.01			7.82		
	T.D.S. (g/l) surface	17.45			8.991			19.76			12.57		
	bottom	17.41			8.998			20.68			12.93		
	Redox (mV) surface	426			328			435			407		
	bottom	421			324			428			403		
	Secchi (cm)	60			70			65			85		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Ribbon Worms	Carinoma tremaphorus	4		5					12	4	3	10	
Polychaete Worms	Eteone heteropoda	1		5						1			
	Neanthes succinea					1					1		
	Laeonereis culveri	4								1			
	Leitoscoloplos robustus	1		6		1				1	6	3	
	Polydora cornuta	6	1	7		4			2	1	3		
	Marenzelleria viridis	11		2						1	3		
	Streblospio benedicti			107		8			2	21	5	9	6
	Boccardiella ligerica					10							
	Heteromastus filiformis			6					4	4	9	3	
	Pectinaria gouldii	1								2	2	1	
	Hobsonia florida	1		5						3			1
Oligochaete Worms	Oligochaeta								1	1	5	2	
Gastropods (snails)	Doridella obscura										3		
Bivalves (clams)	Crassostrea virginica		1										
	Mulinia lateralis			1					1		1		
	Macoma balthica									1			
	Macoma mitchelli												1
	Mytilopsis leucophaeata	1		1									
	Mya arenaria	10		6									
Barnacles	Balanus improvisus	1	7							4	4	2	
Oppossum Shrimp	Neomysis americana								1				
Isopods	Cyathura polita	42	1	31	5	2	8		8	29	21	38	9
	Edotea triloba	1	2	1	3	1	5		1	2	1	3	4
Amphipods	Ampelisca abdita								1	1			1
	Leptocheirus plumulosus	12	1	22	1								1
	Apocorophium lacustre	1	8		24	18	7			3	7	1	
	Mucrogammarus mucronatus				2	2	15						
	Melita nitida		1				1				1		
	Incisocalliope aestuarius										2		
Carridean Shrimp	Crangon septemspinosa	3			5	8							
True Crabs	Callinectes sapidus		1										
	Rhithropanopeus harrisii				4		1	11					
Sea Squirts	Molgula manhattensis		3									1	
total number of individuals		100	26	205	44	55	37	11	33	80	77	73	23
total number of taxa		16	10	14	7	10	6	1	10	17	17	11	7
mean number of individuals		110.3			45.3			41.3			57.7		
mean number of taxa		13.3			7.7			9.3			11.7		
	TOTAL # OF TAXA	**23**			**13**			**20**			**22**		
	TOTAL # OF INDIVIDUALS	**331**			**136**			**124**			**173**		

TABLE A-12

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T7 (Berry's Creek Canal)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T7	Date	2/25/02			6/17/02			8/22/02			12/3/02		
	Time	14:23	14:31	15:01	12:10	12:13	12:15	11:35	11:48	11:50	13:35	13:38	13:43
	Collection Number	B049	B050	B051	B151	B152	B153	B178	B179	B180	B310	B311	B312
	Tidal Stage (+ hours)	Low			Low + 3			High + 2			High + 5.5		
	Depth (feet)	10 - 11			15			15.5			9.5 - 10		
Water Quality	Salinity (0/00) surface	11.34			6.43			13.81			4.00		
	bottom	11.46			6.73			15.18			3.98		
	Temp (^{o}C) surface	7.59			22.43			27.74			1.60		
	bottom	7.56			21.85			28.22					
	air	10			23			27			7		
	D.O. (mg/L) surface	11.75			3.98			3.72			10.07		
	bottom	11.62			2.93			2.13			8.84		
	pH surface	8.20			7.08			7.35			7.21		
	bottom	8.23			7.02			7.31			7.22		
	T.D.S. (g/l) surface	12.26			7.224			14.68			4.583		
	bottom	12.36			7.538			16.02			4.577		
	Redox (mV) surface	421			346			365			447		
	bottom	418			344			364			446		
	Secchi (cm)	50			45			70			40		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.				2	2	2	1	2	5			
Ribbon Worms	Carinoma tremaphorus					1		2	9	10	5	5	1
Polychaete Worms	Marenzelleria viridis	13	9	2			2				2	3	2
	Streblospio benedicti	335	8	158	17	326	469	258	256	272	12	4	33
	Heteromastus filiformis	1	1	3		1			1		3	3	4
	Hobsonia florida	507	16	80	56	661	571	31	101	75	10	6	16
Oligochaete Worms	Oligochaeta	16	2	5	14	79	96	37	32	45	28	21	40
Bivalves (clams)	Mulinia lateralis								1	1			
	Rangia cuneata											1	
	Macoma balthica		4										1
	Macoma mitchelli									1	6	4	1
	Mytilopsis leucophaeata								1	1			
	Mya arenaria										1	1	1
Barnacles	Balanus improvisus				1								
Isopods	Cyathura polita	18	17	19	5	18	18	9	13	10	8	9	9
	Edotea triloba	13	1	6	2	1	1	1		2	6	9	17
Amphipods	Leptocheirus plumulosus	8	1	5							5	6	3
	Apocorophium lacustre	1		1	1	1					1		2
	Gammarus daiberi			4	77	264	168				1		2
	Ameroculodes spp. complex			1									
Carridean Shrimp	Palaemonetes pugio						1		2				
	Crangon septemspinosa				2								
True Crabs	Rhithropanopeus harrisii				4	1	1	6	3		1		
Insect larvae	Chironomidae							1		3			
total number of individuals		912	59	284	181	1355	1329	346	421	425	89	72	132
total number of taxa		9	9	11	11	11	10	9	11	11	14	12	14
mean number of individuals		418.3			955.0			397.3			97.7		
mean number of taxa		9.7			10.7			10.3			13.3		
	TOTAL # OF TAXA	**12**			**15**			**14**			**16**		
	TOTAL # OF INDIVIDUALS	**1,255**			**2,865**			**1,192**			**293**		

TABLE A-13
Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T8 (Mill Creek)
NJMC/MERI Hackensack River Benthic Inventory
Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T8	Date	2/8/02			6/13/02			9/6/02			10/23/02		
	Time	10:56	10:59	11:22	11:15	11:17	11:19	12:53	12:55	12:57	12:28	12:35	12:41
	Collection Number	B034	B035	B036	B142	B143	B144	B208	B209	B210	B253	B254	B255
	Tidal Stage (+ hours)	High + 4			Low + 5.25			High + 4			High + 2		
	Depth (feet)	5.5 - 6			9			6 - 6.5			7.8 - 8		
Water Quality	Salinity (0/00) surface	9.94			5.66			8.46			5.79		
	bottom	10.02			5.80			8.42			5.82		
	Temp (^{o}C) surface	6.34			22.44			23.19			13.35		
	bottom	5.08			23.15			23.18			13.49		
	air												
	D.O. (mg/L) surface	6.15			3.42			4.58			5.05		
	bottom	6.52			2.51			4.09			4.90		
	pH surface	7.03			7.67			7.4			7.35		
	bottom	7.11			7.65			7.35			7.35		
	T.D.S. (g/l) surface	10.86			6.404			9.341			6.547		
	bottom	10.95			6.559			9.303			6.572		
	Redox (mV) surface	454			344			372			367		
	bottom	447			340			371			368		
	Secchi (cm)	65			55			35			65		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.		1	2	4		14	136	77	117	218	141	118
	Euplana gracilis							1					
Ribbon Worms	Carinoma tremaphorus								2			2	2
Polychaete Worms	Neanthes succinea												1
	Laeonereis culveri	31	13	13	15	16	10	9	7	7	6	12	19
	Marenzelleria viridis	6	5	5	7	2	3	3	2	1	3	2	14
	Streblospio benedicti				1	1	1	23	8	20	43	44	26
	Boccardiella ligerica	1	6	11	3		11	4	3	7			
	Heteromastus filiformis							1					
	Hobsonia florida	1,181	569	671	1034	500	1471	709	502	556	200	483	968
	Manayunkia aestuarina				3		4						
Oligochaete Worms	Oligochaeta		30	52	489	155	612	75	21	72	371	105	32
Gastropods (snails)	Littoridinops tenuipes	31	34	47	3	23	175						
	Mytilopsis leucophaeata	309	190	233									
Barnacles	Balanus improvisus					1							
Isopods	Cyathura polita		2	2				9	5	4	11	15	8
	Edotea triloba	2	1	3				16	4	1	63	28	45
Amphipods	Leptocheirus plumulosus	3	4	5	51	186	100	68	28	19	434	341	443
	Apocorophium lacustre	2,222	1,872	1,938	3183	4310	4798	414	171	160	882	232	96
	Gammarus daiberi	60	61	13	1421	663	728	21	2	3			
True Crabs	Rhithropanopeus harrisii				2	3	3	9	9	13	8	7	4
Insect larvae	Chironomidae	169	50	126	329	399	560	35	29	22	39	50	54
total number of individuals		4015	2838	3121	6545	6259	8490	1533	870	1002	2278	1462	1830
total number of taxa		11	14	14	14	12	14	16	15	14	12	13	14
mean number of individuals		3324.7			7098.0			1135.0			1856.7		
mean number of taxa		13.0			13.3			15.0			13.0		
	TOTAL # OF TAXA	**14**			**15**			**17**			**14**		
	TOTAL # OF INDIVIDUALS	**9,974**			**21,294**			**3,405**			**5,570**		

TABLE A-14

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T9 (Cromakill Creek)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
T9	Date	1/30/02			6/5/02			9/13/02			12/3/02		
	Time	14:20	14:39	14:43	12:50	13:06	13:19	10:48	10:50	10:53	12:13	12:16	12:19
	Collection Number	B022	B023	B024	B136	B137	B138	B226	B227	B228	B307	B308	B309
	Tidal Stage (+ hours)	High + 2.5			Low + 0.5			Low + 2			High + 4		
	Depth (feet)	11 - 12			7 - 10			6 - 8			5 - 7		
Water Quality	Salinity (0/00) surface	10.27			3.07			5.97			2.33		
	bottom	10.73			3.94			8.6			2.40		
	Temp (^{o}C) surface	8.70			23.38			21.59			2.72		
	bottom	8.40			22.18			20.88			2.68		
	air	14.5			28			26			6		
	D.O. (mg/L) surface	5.79			3.55			2.62			6.22		
	bottom	5.20			2.47			2.13			6.55		
	pH surface	7.12			8.24			7.13			7.14		
	bottom	7.16			8.23			7.14			7.18		
	T.D.S. (g/l) surface	11.18			3.562			6.725			2.735		
	bottom	11.66			4.526			9.497			2.816		
	Redox (mV) surface	400			344			397			457		
	bottom	389			339			396			456		
	Secchi (cm)	40			37			50			45		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	3		4		3	2	46	20	30	5	30	6
Ribbon Worms	Carinoma tremaphorus								1				
Polychaete Worms	Neanthes succinea							4	5	2	3	7	1
	Laeonereis culveri	3	1		2		3	1	15	3		4	4
	Marenzelleria viridis					1							
	Streblospio benedicti		2	1	2	7		113	89	289	12	13	2
	Boccardiella ligerica	13	11	3	30	131	6	6	19	46	29	21	4
	Hobsonia florida	1,988	1,642	1,964	907	864	487	1785	2048	1608	1167	1092	664
	Manayunkia aestuarina			1								1	
Oligochaete Worms	Oligochaeta	7	46	18	1805	932	436	14	12	15	17	19	
Gastropods (snails)	Littoridinops tenuipes		1	2			24						
	Elysia chlorotica	1											
Bivalves (clams)	Mytilopsis leucophaeata	473	86	84					1				1
Isopods	Cyathura polita	4						9	8	14	19	18	13
	Edotea triloba					1		10	10	6	31	19	30
Amphipods	Leptocheirus plumulosus				2	2		1	4	2	1	4	
	Apocorophium lacustre	32	9	4	3	7	7	62	37	193	100	133	70
	Gammarus daiberi	18	19	12	108	55	1218	1	2	1	1		
	Gammarus palustris											2	
	Mucrogammarus mucronatus											2	
True Crabs	Rhithropanopeus harrisii						1		3		1	1	7
Insect larvae	Chironomidae	265	262	130	312	326	141	46	24	43	48	71	16
total number of individuals		2807	2079	2223	3171	2329	2325	2098	2298	2252	1434	1437	818
total number of taxa		11	10	11	9	11	10	13	16	13	13	16	12
mean number of individuals		2369.7			2608.3			2216.0			1229.7		
mean number of taxa		10.7			10.0			14.0			13.7		
	TOTAL # OF TAXA	**14**			**14**			**16**			**18**		
	TOTAL # OF INDIVIDUALS	**7,109**			**7,825**			**6,648**			**3,689**		

TABLE A-15

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S1 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
S1	Date	3/1/02			5/23/02			8/19/02			11/20/02		
	Time	11:54	12:11	12:30	13:34	13:44	13:48	12:24	12:26	12:30	12:36	12:38	12:40
	Collection Number	B067	B068	B069	B091	B092	B093	B160	B161	B162	B277	B278	B279
	Tidal Stage (+ hours)	High + 2			Low + 0.5			High + 5.5			High + 4		
	Depth (feet)	6 -7			2			2 - 3			3.5		
Water Quality	Salinity (0/00) surface	20.11			8.52			18.16			11.53		
	bottom	21.17											
	Temp (^{o}C) surface	7.40			21.94			32.24			13.58		
	bottom	7.66											
	air	5			22			33			13		
	D.O. (mg/L) surface	9.33			6.48			4.06			6.28		
	bottom	8.76											
	pH surface	7.67			8.26			7.56			7.85		
	bottom	7.75											
	T.D.S. (g/l) surface	20.60			9.402			18.82			12.44		
	bottom	21.63											
	Redox (mV) surface	363			368			323			363		
	bottom	362											
	Secchi (cm)	125			90			75			65		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Ribbon Worms	Carinoma tremaphorus	2	5	1			1	1	5	5			1
	Amphiporus bioculatus								1				
Polychaete Worms	Eteone heteropoda	1	2	7	1	2	3	3	6	9	7	4	1
	Eteone foliosa									1			1
	Microphthalmus sczelkowii				1								
	Neanthes succinea		3	8	1	2	3					1	
	Laeonereis culveri	1	5			3		45	86	76	1	1	6
	Nephtys picta				1		1						
	Glycera americana			2									
	Leitoscoloplos robustus	8	9	1	23	16	10	5	9	12	12	9	4
	Polydora cornuta			11			12	1			2	2	1
	Marenzelleria viridis	1	1	1		4	2						
	Streblospio benedicti	6	24	32	33	2	141	31	50	122	47	43	6
	Tharyx sp. A					1							
	Capitella capitata							3	10	3			
	Heteromastus filiformis	23	25	18	24	19	8	10	23	15	4	13	9
	Mediomastus ambiseta										1		
	Pectinaria gouldii	4	4						2	1	4	2	
	Hobsonia florida	4	2	2			2						
Oligochaete Worms	Oligochaeta	2	12	7	17		10		4	18		1	
Gastropods (snails)	Haminoea solitaria							3					
Bivalves (clams)	Crassostrea virginica				1								
	Mulinia lateralis			2				5	7	4	15	29	18
	Macoma balthica	1			3	5	2			1			
	Macoma mitchelli										2	12	7
	Mya arenaria	3	2	8							11	7	1
Barnacles	Balanus improvisus			23	7		29			2	5	1	
Oppossum Shrimp	Neomysis americana			1		2							
Cumaceans	Leucon americanus				3						3	11	5
Isopods	Cyathura polita	8	8	10	5	4	2		3	3	3	5	
	Edotea triloba	1	1	6	1	1			1				
Amphipods	Ampelisca abdita		1	3				1			8	7	5
	Leptocheirus plumulosus	3	2	9							7	12	8
	Monocorophium insidiosum			1	1		7						
	Gammarus daiberi			1	1								1
	Mucrogammarus mucronatus				4		2						
	Melita nitida			1			4						
	Ameroculodes spp. complex					1							
	Incisocalliope aestuarius						1						1
Carridean Shrimp	Crangon septemspinosa				12	8	1				1		
True Crabs	Callinectes sapidus				3							1	
	Rhithropanopeus harrisii		1	2						2			
Sea Squirts	Molgula manhattensis			1							1		
total number of individuals		68	107	158	142	70	241	108	207	274	134	161	75
total number of taxa		15	17	24	19	14	19	11	13	15	18	18	16
mean number of individuals		111.0			151.0			196.3			123.3		
mean number of taxa		18.7			17.3			13.0			17.3		
	TOTAL # OF TAXA	**27**			**29**			**20**			**25**		
	TOTAL # OF INDIVIDUALS	**333**			**453**			**589**			**370**		

TABLE A-16

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S2 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
S2	Date	1/31/02			6/17/02			8/22/02			11/19/02		
	Time	14:35	14:56	15:18	13:24	13:26	13:30	10:58	11:01	11:04	12:31	12:33	12:42
	Collection Number	B031	B032	B033	B154	B155	B156	B175	B176	B177	B268	B269	B270
	Tidal Stage (+ hours)	High + 4			Low + 4.5			High + 1.5			High + 4.5		
	Depth (feet)	11 - 12			6.5 - 7			6 - 7			3 - 4		
Water Quality	Salinity (0/00) surface	15.51			8.22			15.62			6.00		
	bottom	15.71			8.58			15.71					
	Temp (^{o}C) surface	6.34			22.16			27.98			8.55		
	bottom	6.69			22.09			28.44					
	air	3			24			27			9		
	D.O. (mg/L) surface	6.63			2.87			3.91			6.73		
	bottom	6.09			3.14			2.88					
	pH surface	7.05			6.90			7.14			7.57		
	bottom	7.17			6.90			7.21					
	T.D.S. (g/l) surface	16.37			9.088			16.06			6.773		
	bottom	16.52			9.464			17.00					
	Redox (mV) surface	412			364			392			411		
	bottom	402			362			382					
	Secchi (cm)	60			55			60					
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.				2	4	1	1	117	44	2	1	4
	Diadumene leucolena		1										
Ribbon Worms	Carinoma tremaphorus				1	5	2	7	3	3	7	4	4
Polychaete Worms	Eteone heteropoda												1
	Neanthes succinea											2	
	Laeonereis culveri										10	6	4
	Marenzelleria viridis	23	14	8	87	119	56	34	62	51	29	20	22
	Streblospio benedicti	27	20		1	1		372	487	80	124	123	144
	Capitella capitata											1	
	Heteromastus filiformis	3	3	2	5	4	6	2	13	5	34	46	29
	Hobsonia florida	3			2	4		28	15	6	26	14	7
Oligochaete Worms	Oligochaeta	3	3			1		69	183	89	63	23	74
Bivalves (clams)	Mulinia lateralis							2	1				
	Rangia cuneata												1
	Macoma balthica	1			6	3	3	1	1	1		1	1
	Macoma mitchelli							1			9	4	6
	Mytilopsis leucophaeata							1					
Barnacles	Balanus improvisus							13				6	
Oppossum Shrimp	Neomysis americana			1									
Isopods	Cyathura polita	24	26	20	36	37	15	33	36	30	22	16	14
	Edotea triloba	3	2	6	4	5	5	1	1	2	2	2	3
Amphipods	Leptocheirus plumulosus	17	12	7	142	99	130					2	3
	Apocorophium lacustre										1		
	Gammarus daiberi	31	9	17	530	253	544						
	Ameroculodes spp. complex	4	7	1									
Carridean Shrimp	Palaemonetes pugio											1	
	Crangon septemspinosa										1		
True Crabs	Rhithropanopeus harrisii	2	1	6			1	12	8	3	1	2	
total number of individuals		141	98	68	816	535	763	577	927	314	331	274	317
total number of taxa		12	11	9	11	12	10	15	12	11	14	18	15
mean number of individuals		102.3			704.7			606.0			307.3		
mean number of taxa		10.7			11.0			12.7			15.7		
	TOTAL # OF TAXA	**14**			**13**			**15**			**22**		
	TOTAL # OF INDIVIDUALS	**307**			**2,114**			**1,818**			**922**		

TABLE A-17
Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S3 (Hackensack River)
NJMC/MERI Hackensack River Benthic Inventory
Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
S3	Date	1/31/02			5/28/02			8/23/02			12/3/02		
	Time	11:33	11:38	12:06	11:52	12:03	12:09	10:57	11:00	11:06	11:20	11:23	11:24
	Collection Number	B025	B026	B027	B109	B110	B111	B184	B185	B186	B304	B305	B306
	Tidal Stage (+ hours)	High			High			High + 1			High + 3.5		
	Depth (feet)	5.0 - 5.5			3.5 - 4.0			3.5			1.5		
Water Quality	Salinity (0/00) surface	9.02			4.26			9.79			3.12		
	bottom	11.90			4.97								
	Temp (^{o}C) surface	6.56			21.45			26.24			3.26		
	bottom	6.80			20.53								
	air	3			25			25			6		
	D.O. (mg/L) surface	5.72			4.67			2.96			7.11		
	bottom	5.14			3.33								
	pH surface	7.31			7.87			7.19			7.07		
	bottom	7.21			7.88								
	T.D.S. (g/l) surface	9.927			4.884			10.70			3.622		
	bottom	12.81			5.659								
	Redox (mV) surface	401			370			370			465		
	bottom	379			368								
	Secchi (cm)	85			60			60			45		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	1						9	14	7	1	1	1
Ribbon Worms	Carinoma tremaphorus										1	1	1
Polychaete Worms	Laeonereis culveri					1	1	6	23	16	26	19	17
	Marenzelleria viridis				1	2							
	Streblospio benedicti			1				27	15	24	5		
	Hobsonia florida	12	26	16	14	6		235	301	355	71	93	54
Oligochaete Worms	Oligochaeta	8	10	14	4	19	19	41	28	32	2	2	
Gastropods (snails)	Littoridinops tenuipes		1										
Bivalves (clams)	Macoma mitchelli												1
	Mytilopsis leucophaeata	1											
Isopods	Cyathura polita												1
Amphipods	Leptocheirus plumulosus				2						39	51	60
	Apocorophium lacustre		1		1		4	2	2	1		1	
	Gammarus daiberi				2	1	2	1					
	Mucrogammarus mucronatus								1				
Carridean Shrimp	Palaemonetes pugio								2				
True Crabs	Rhithropanopeus harrisii								2				
Insect larvae	Chironomidae	88	148	128	35	43	24	194	245	249	28	34	33
total number of individuals		110	186	159	59	72	50	515	633	684	173	202	168
total number of taxa		5	5	4	7	6	5	8	10	7	8	8	8
mean number of individuals		151.7			60.3			610.7			181.0		
mean number of taxa		4.7			6.0			8.3			8.0		
	TOTAL # OF TAXA	**8**			**8**			**11**			**11**		
	TOTAL # OF INDIVIDUALS	**455**			**181**			**1,832**			**543**		

TABLE A-18

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN1 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
GN1	Date	3/1/02			5/23/02			8/19/02			11/20/02		
	Time	11:05	11:14	11:25	12:56	13:02	13:07	11:46	11:50	11:56	11:45	11:50	12:07
	Collection Number	B064	B065	B066	B088	B089	B090	B157	B158	B159	B274	B275	B276
	Tidal Stage (+ hours)	High + 1			Low			High + 5			High + 3.25		
	Depth (feet)	16 - 18.5			11 - 13			17 - 20			11.5 - 13		
Water Quality	Salinity (0/00) surface	22.55			8.96			19.16			12.87		
	bottom	22.98			8.97			19.15			12.81		
	Temp (^{o}C) surface	6.84			17.57			31.23			10.25		
	bottom	6.08			17.09			31.14			10.39		
	air	4			21			31			10		
	D.O. (mg/L) surface	9.83			6.35			2.78			8.12		
	bottom	8.78			6.31			3.01			7.53		
	pH surface	7.47			8.22			7.53			8.04		
	bottom	7.86			8.15			7.53			8.03		
	T.D.S. (g/l) surface	22.84			9.842			19.76			13.76		
	bottom	23.28			9.872			19.73			13.71		
	Redox (mV) surface	398			352			343			349		
	bottom	391			350			341			349		
	Secchi (cm)	115			80			70			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Flatworms	Stylochus ellipticus					1							
Ribbon Worms	Carinoma tremaphorus		2	4					1		1		1
Polychaete Worms	Eteone heteropoda		3					2	11	2			
	Neanthes succinea	5	1		1	1	1				2	2	5
	Laeonereis culveri								2				
	Glycera americana		2					2					
	Leitoscoloplos robustus		3	1				2	20	7			
	Polydora cornuta	36	2		8	8	7	2	5	1	13	5	1
	Streblospio benedicti	3	7	9		1		25	271	9		3	
	Heteromastus filiformis		1	4				1	7	2			
	Pectinaria gouldii		1						8	1			
	Hobsonia florida		3	7									
Oligochaete Worms	Oligochaeta								12				
Gastropods (snails)	Doridella obscura					1						1	
Bivalves (clams)	Mulinia lateralis	3	7	23				1	15	4	4	5	
	Macoma balthica							1	6	3			
	Mya arenaria	15	17	15						1	6	6	1
Barnacles	Balanus improvisus				1	19	2	4	120	12	7	15	7
Cumaceans	Leucon americanus			2									
Isopods	Cyathura polita	1	2	7		1	3	1	1	1		1	
	Synidotea laevidorsalis										1		
	Edotea triloba		2	2			2		1		1		2
Amphipods	Ampelisca abdita			1					2				
	Leptocheirus plumulosus		6	12									
	Apocorophium lacustre	2									2	1	1
	Monocorophium insidiosum	24	1		3	1	1		1				
	Melita nitida					1			1				
	Incisocalliope aestuarius						2						1
Carridean Shrimp	Palaemonetes pugio										1		
	Crangon septemspinosa						3	1					
True Crabs	Callinectes sapidus			1									1
Sea Squirts	Molgula manhattensis	1									5	3	3
total number of individuals		90	60	88	13	34	21	42	484	43	43	42	23
total number of taxa		9	16	13	4	9	8	11	17	11	11	10	10
mean number of individuals		79.3			22.7			189.7			36.0		
mean number of taxa		12.7			7.0			13.0			10.3		
TOTAL # OF TAXA		**21**			**12**			**20**			**16**		
TOTAL # OF INDIVIDUALS		**238**			**68**			**569**			**108**		

TABLE A-19

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN2 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
GN2	Date	2/25/02			6/3/02			8/21/02			11/21/02		
	Time	10:56	11:05	11:41	13:08	13:22	13:40	12:36	12:41	12:58	13:56	13:59	14:02
	Collection Number	B040	B041	B042	B124	B125	B126	B169	B170	B171	B292	B293	B294
	Tidal Stage (+ hours)	High + 4			Low + 2.5			High + 4			High + 5		
	Depth (feet)	10 - 11			12.5 - 13.5			12.5 - 13			10. 5 - 11		
Water Quality	Salinity (0/00) surface	14.46			7.27			13.75			6.99		
	bottom	14.44			7.88			14.12			7.27		
	Temp (^{o}C) surface	9.25			23.35			28.19			9.90		
	bottom	7.78			23.02			28.66			9.53		
	air				21			28			12		
	D.O. (mg/L) surface	6.65			5.87			3.29			5.64		
	bottom	6.82			4.52			3.15			5.71		
	pH surface	7.13			7.86			7.57			8.15		
	bottom	7.23			7.88			7.50			8.14		
	T.D.S. (g/l) surface	15.35			8.096			14.62			7.815		
	bottom	15.29			8.748			14.95			8.087		
	Redox (mV) surface	484			363			320			406		
	bottom	481			362			321			407		
	Secchi (cm)	65			80			50			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.						10			4			
Ribbon Worms	Carinoma tremaphorus	1	5	1		1	2	5	9	7	1	14	5
Polychaete Worms	Eteone heteropoda		1	1		1	2		1				
	Marenzelleria viridis	4	2	9	3	12	35	4	5	18	1	5	1
	Streblospio benedicti	119	20	55	169	31	640	1	78	198	3	13	4
	Heteromastus filiformis	4	3	1	2	1	4	2	4	2		38	8
	Pectinaria gouldii											1	
	Hobsonia florida	44	39	42	4	9	129	8	11	33			
Oligochaete Worms	Oligochaeta	47	3	4	17	6	79		26	10		4	
Bivalves (clams)	Mulinia lateralis								2	1			
	Rangia cuneata												1
	Macoma balthica	1	2	5		11	20	3	4	4			
	Macoma mitchelli											8	4
	Mya arenaria	1	1										
Oppossum Shrimp	Neomysis americana			1									
Cumaceans	Leucon americanus	2	2				1						
Isopods	Cyathura polita	21	21	31	12	15	35	30	27	32	14	20	5
	Edotea triloba	13	5	24			2		1	9	3	8	3
Amphipods	Ampelisca abdita		1	1							1		2
	Leptocheirus plumulosus	4	4	4	1	1	16				2	11	2
	Apocorophium lacustre					2	1				1	1	
	Gammarus daiberi						4					1	
	Melita nitida				1								
	Ameroculodes spp. complex	5		13		1	10				1		
Carridean Shrimp	Crangon septemspinosa				2		1					1	
True Crabs	Callinectes sapidus						1						
	Rhithropanopeus harrisii	1		3	3	3		20	5	14	11	2	2
total number of individuals		267	109	195	214	94	992	73	173	332	38	127	37
total number of taxa		14	14	15	10	13	18	8	12	12	10	14	11
mean number of individuals		190.3			433.3			192.7			67.3		
mean number of taxa		14.3			13.7			10.7			11.7		
	TOTAL # OF TAXA	**17**			**20**			**13**			**17**		
	TOTAL # OF INDIVIDUALS	**571**			**1,300**			**578**			**202**		

TABLE A-20

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN3 (Overpeck Creek)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
GN3	Date	2/8/02			5/21/02			9/5/02			11/14/02		
	Time	12:42	12:58	13:18	11:43	11:58	12:05	12:55	12:58	13:08	11:55	11:58	12:04
	Collection Number	B037	B038	B039	B079	B080	B081	B199	B200	B201	B259	B260	B261
	Tidal Stage (+ hours)	Low + 0.5			Low			High + 5			Low		
	Depth (feet)	6.5 - 8			6 - 8			5.6 - 6.5			5.7 - 6		
Water Quality	Salinity (0/00) surface	7.70			1.24			5.44			3.34		
	bottom	7.76			1.26			6.75			5.38		
	Temp (^{o}C) surface	5.98			16.44			24.08			11.30		
	bottom	5.66			16.25			23.38			11.56		
	air	11			16			26			17		
	D.O. (mg/L) surface	8.64			7.98			4.83			6.54		
	bottom	8.42			8.31			1.52			5.08		
	pH surface	7.22			7.83			7.13			7.78		
	bottom	7.46			7.85			7.11			7.70		
	T.D.S. (g/l) surface	8.536			1.48			6.174			3.869		
	bottom	8.621			1.506			7.565			6.110		
	Redox (mV) surface	438			346			371			409		
	bottom	406			346			339			415		
	Secchi (cm)	65			40			50			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Ribbon Worms	Carinoma tremaphorus											2	
Polychaete Worms	Marenzelleria viridis	2		3									
	Streblospio benedicti							1	1			1	
	Hobsonia florida			2	13	8	14	94	11	10	22	37	17
Oligochaete Worms	Oligochaeta		48	12	96	36	9	1	2			13	3
Gastropods (snails)	Littoridinops tenuipes				1264	625	6				1		4
Oppossum Shrimp	Neomysis americana											1	
Amphipods	Apocorophium lacustre				1						1	1	
	Gammarus daiberi	1			15	3						1	2
Insect larvae	Chironomidae	65	85	74	58	41	55	27	8	5	13	37	20
total number of individuals		68	133	91	1447	713	84	123	22	15	37	93	46
total number of taxa		3	2	4	6	5	4	4	4	2	4	8	5
mean number of individuals		97.3			748.0			53.3			58.7		
mean number of taxa		3.0			5.0			3.3			5.7		
	TOTAL # OF TAXA	**5**			**6**			**4**			**9**		
	TOTAL # OF INDIVIDUALS	**292**			**2,244**			**160**			**176**		

TABLE A-21
Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN1 (Hackensack River)
NJMC/MERI Hackensack River Benthic Inventory
Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN1	Date	3/1/02			5/23/02		5/24/02 *	8/19/02			11/20/02		
	Time	12:45	13:01	13:15	14:08	14:15	10:52	12:51	12:54	12:58	13:32	13:35	13:37
	Collection Number	B070	B071	B072	B094	B095	B096	B163	B164	B165	B280	B281	B282
	Tidal Stage (+ hours)	High + 3			Low + 1			Low			High + 5		
	Depth (feet)	5 - 6			1 - 2.5			2			2 - 3		
Water Quality	Salinity (0/00) surface	21.26			7.72			18.22			10.96		
	bottom	21.45											
	Temp (^{o}C) surface	7.05			25.20			39.08			13.99		
	bottom	7.02											
	air	6			22			33			15		
	D.O. (mg/L) surface	9.78			6.04			2.99			6.54		
	bottom	9.21											
	pH surface	7.66			7.86			7.37			7.92		
	bottom	7.74											
	T.D.S. (g/l) surface	21.68			8.579			18.88			11.87		
	bottom	21.87											
	Redox (mV) surface	386			376			307			370		
	bottom	385											
	Secchi (cm)	100			75			65			75		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.							6	4	5	4		1
Ribbon Worms	Carinoma tremaphorus	5	6	2	5	2		5		4	4	4	4
	Amphiporus bioculatus				1								
Polychaete Worms	Eteone heteropoda	1	3	2		1		2	1				
	Neanthes succinea		1		1							2	
	Laeonereis culveri	1	1		3	9	1	49	50	44	73	33	51
	Glycera americana		2	1									
	Leitoscoloplos robustus	1	3	5	15	7		10	5	1		1	1
	Marenzelleria viridis	2	1	3	6	1		4	2	1	1		
	Streblospio benedicti	5	4	4				1					
	Heteromastus filiformis	9	7	5	15	5		5	5	11	22	12	29
	Hobsonia florida		3						1	1			
Bivalves (clams)	Mulinia lateralis	3	4	3					1		2		2
	Macoma balthica	1			8	12	2		4	2	1		1
	Macoma mitchelli										1	4	8
	Mya arenaria	3	2								1	1	
Cumaceans	Oxyurostylis smithi	1											
	Leucon americanus		1			1							
Isopods	Cyathura polita	15	16	12	8	7	1	8	7	7	18	10	9
	Edotea triloba	1									1		
Amphipods	Ampelisca abdita	10	1	3	1	2					2	1	
	Leptocheirus plumulosus	7	6	2									1
	Mucrogammarus mucronatus						2						
	Melita nitida												1
Carridean Shrimp	Crangon septemspinosa				1		1						
True Crabs	Callinectes sapidus										1		
	Rhithropanopeus harrisii												1
total number of individuals		65	61	42	64	47	7	90	80	76	131	68	109
total number of taxa		15	16	11	11	10	5	9	10	9	13	9	12
mean number of individuals		56.0			39.3			82.0			102.7		
mean number of taxa		14.0			8.7			9.3			11.3		
	TOTAL # OF TAXA	**19**			**14**			**12**			**18**		
	TOTAL # OF INDIVIDUALS	**168**			**118**			**246**			**308**		

TABLE A-22

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN2 (Sawmill Creek)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN2	Date	2/26/02			5/24/02			8/21/02			11/20/02		
	Time	12:53	12:57	13:01	12:50	12:54	13:02	11:31	11:33	11:35	14:33	14:35	14:38
	Collection Number	B058	B059	B060	B103	B104	B105	B166	B167	B168	B283	B284	B285
	Tidal Stage (+ hours)	High + 5			High + 5			High + 3			High + 6		
	Depth (feet)	2 - 3			1 - 2			4.5 - 5.0			3		
Water Quality	Salinity (0/00) surface	16.69			8.16			17.44			9.44		
	bottom							17.55					
	Temp (^{o}C) surface	9.96			20.12			29.06			10.68		
	bottom							29.15					
	air				2.6			28			15		
	D.O. (mg/L) surface	7.49			10.30			4.45			7.72		
	bottom							3.57					
	pH surface	7.55			8.18			7.36			7.93		
	bottom							7.43					
	T.D.S. (g/l) surface	17.38			9.031			18.13			10.34		
	bottom							18.27					
	Redox (mV) surface	430			328			326			361		
	bottom							322					
	Secchi (cm)	60			60			60			60		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.		1	2	8	15	29	18	3	13	12	2	16
Ribbon Worms	Carinoma tremaphorus			2		1			1		2		
Polychaete Worms	Eteone heteropoda									1			1
	Laeonereis culveri	34	111	87	31	21	38	7	7	7	2	1	2
	Marenzelleria viridis	1	8	13	8	4	7	2	2			1	1
	Streblospio benedicti	39	58	25		2	3	32	357	316	5		106
	Heteromastus filiformis		4	9	2		2	2	1	3		2	2
	Hobsonia florida	52	167	137	27	29	53		7	2	19	8	20
Oligochaete Worms	Oligochaeta		5	6		2		2	31	35		1	46
Gastropods (snails)	Elysia chlorotica		1	2									
	Alderia modesta		1	2									
Bivalves (clams)	Macoma balthica				1								
	Macoma mitchelli										3		2
Isopods	Cyathura polita	14	16	15	10	11	10	19	18	22	12	8	7
	Edotea triloba		4	3	3	3	6			2	1		4
Amphipods	Leptocheirus plumulosus	17	108	109	223	232	284	15	9	14	33	18	43
	Apocorophium lacustre		2	2				1			1		2
	Gammarus daiberi		8	3	32	43	14						
	Mucrogammarus mucronatus				20	17	21						
	Melita nitida											1	
Carridean Shrimp	Crangon septemspinosa				2	3							
True Crabs	Rhithropanopeus harrisii				1	1	4		2	1	1	1	
total number of individuals		157	494	417	368	384	471	98	438	416	91	43	252
total number of taxa		6	14	15	13	14	12	9	11	11	11	10	13
mean number of individuals		356.0			407.7			317.3			128.7		
mean number of taxa		11.7			13.0			10.3			11.3		
	TOTAL # OF TAXA	**15**			**16**			**14**			**16**		
	TOTAL # OF INDIVIDUALS	**1,068**			**1,223**			**952**			**386**		

TABLE A-23

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN3 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN3	Date	1/31/02			6/3/02			8/21/02			11/19/02		
	Time	13:11	13:39	13:48	14:03	14:15	14:19	13:24	13:26	13:27	13:16	13:33	13:38
	Collection Number	B028	B029	B030	B127	B128	B129	B172	B173	B174	B271	B272	B273
	Tidal Stage (+ hours)	High + 2			Low + 3.5			High + 4			High + 5.5		
	Depth (feet)	13.5 - 14			8 - 9			5 - 6			3		
Water Quality	Salinity (0/00) surface	16.84			7.1			11.64			5.25		
	bottom	17.37			8.20			11.83					
	Temp (^{o}C) surface	6.46			23.30			28.58			8.60		
	bottom	6.54			22.76			28.59					
	air	3			22			28			8		
	D.O. (mg/L) surface	6.28			5.26			4.82			6.25		
	bottom	6.31			4.71			4.27					
	pH surface	6.99			8.08			7.75			7.62		
	bottom	7.14			8.10			7.73					
	T.D.S. (g/l) surface	17.57			7.913			12.57			5.961		
	bottom	18.09			9.055			12.73					
	Redox (mV) surface	413			343			315			408		
	bottom	409			342			315					
	Secchi (cm)	120			65			70			40		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.				12	23	6	43	39	52			
Ribbon Worms	Carinoma tremaphorus	3	4		1	2	1			2	3	5	2
Polychaete Worms	Eteone heteropoda					1							
	Marenzelleria viridis	14	7	5	51	43	47	22	12	29	5	4	
	Streblospio benedicti				164	306		10	22	61	5	1	1
	Heteromastus filiformis		2		2	5	1	2		4	2	4	
	Hobsonia florida	176	149	165	47	108	39	5	1	17	2	17	11
Oligochaete Worms	Oligochaeta				53	181		7	31	12	2		3
Bivalves (clams)	Mulinia lateralis											1	
	Macoma balthica	3	2	3	7	9	15			1		1	
	Macoma mitchelli										2	11	8
Isopods	Cyathura polita	22	19	7	17	25	12	9	9	14	6	11	6
	Edotea triloba	6	2	4	3	8	7		2			1	2
Amphipods	Leptocheirus plumulosus	3	5	4	276	295	179	1			8	21	14
	Apocorophium lacustre	1	1	2			1				2	1	
	Gammarus daiberi	13	52	4	155	148	185						
	Ameroculodes spp. complex				4	4							
Carridean Shrimp	Palaemonetes pugio								1				
True Crabs	Rhithropanopeus harrisii	6	2	2				6	5	9	8		
total number of individuals		247	245	196	792	1158	493	105	122	201	45	78	47
total number of taxa		10	11	9	13	14	11	9	9	10	11	12	8
mean number of individuals		229.3			814.3			142.7			56.7		
mean number of taxa		10.0			12.7			9.3			10.3		
	TOTAL # OF TAXA	**11**			**15**			**13**			**14**		
	TOTAL # OF INDIVIDUALS	**688**			**2,443**			**428**			**170**		

TABLE A-24

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN4 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN4	Date	1/30/02			6/13/02			8/22/02			10/23/02		
	Time	10:27	10:36	10:52	10:40	10:43	10:45	12:52	13:00	13:05	13:47	13:49	13:52
	Collection Number	B013	B014	B015	B139	B140	B141	B181	B182	B183	B256	B257	B258
	Tidal Stage (+ hours)	High			Low + 4.5			High + 3.5			High + 3.5		
	Depth (feet)	7			3 - 4			3 - 3.5			3.5		
Water Quality	Salinity (0/00) surface	14.02			6.57			11.23			5.28		
	bottom	15.27			7.04						5.96		
	Temp (^{o}C) surface	8.13			22.92			27.51			13.21		
	bottom	7.34			23.01						13.63		
	air	15			18.5			28			14		
	D.O. (mg/L) surface	5.60			2.20			5.25			5.16		
	bottom	6.45			2.15						5.17		
	pH surface	7.06			7.60			7.72			7.37		
	bottom	7.08			7.62						7.37		
	T.D.S. (g/l) surface	14.90			7.358			12.15			5.598		
	bottom	16.09			7.863						6.716		
	Redox (mV) surface	411			364			366			360		
	bottom	410			361						363		
	Secchi (cm)	85			35			30			80		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.	66	58	52	3	5	4	82	78	25	25	105	60
Ribbon Worms	Carinoma tremaphorus	3	1	1		1				2	2		
Polychaete Worms	Laeonereis culveri	7	5	4	38	16	19					1	
	Marenzelleria viridis	137	53	70	28	29	53	13	19	30	2	1	3
	Streblospio benedicti		1	15	1	4			1	1	1	36	31
	Boccardiella ligerica	1											
	Heteromastus filiformis		1	1					1				1
	Hobsonia florida	527	149	350	10	36	17	10	17	14	67	138	115
Oligochaete Worms	Oligochaeta	1	1	28		3		1			6	16	19
Gastropods (snails)	Littoridinops tenuipes						1						
Bivalves (clams)	Rangia cuneata								1				
	Macoma mitchelli										2		2
	Mytilopsis leucophaeata	5											
Oppossum Shrimp	Neomysis americana		1										
Isopods	Cyathura polita	35	11	12	4	9	6	15	11	13	7	11	8
	Edotea triloba					3	3	10	4		8	13	8
Amphipods	Leptocheirus plumulosus	10	7	4	14	49	43				1	2	
	Apocorophium lacustre	100	5	6	3	7	2					2	
	Gammarus daiberi	22	6	4	175	293	124						
True Crabs	Rhithropanopeus harrisii						1	5	10	10		2	1
Insect larvae	Chironomidae		1	1	1	1						1	
total number of individuals		914	300	548	277	456	273	136	142	95	121	328	248
total number of taxa		12	14	13	10	13	11	7	9	7	10	12	10
mean number of individuals		587.3			335.3			124.3			232.3		
mean number of taxa		13.0			11.3			7.7			10.7		
	TOTAL # OF TAXA	**16**			**15**			**11**			**15**		
	TOTAL # OF INDIVIDUALS	**1,762**			**1,006**			**373**			**697**		

TABLE A-25

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN5 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN5	Date	1/29/02			5/21/02			8/23/02			10/22/02		
	Time	13:43	14:01	14:22	13:44	13:55	14:03	11:33	11:35	11:39	13:24	13:27	13:31
	Collection Number	B010	B011	B012	B085	B086	B087	B187	B188	B189	B244	B245	B246
	Tidal Stage (+ hours)	High + 3			Low + 2			High + 1.5			High + 3.5		
	Depth (feet)	7 - 8			1 - 2			3.6 - 4.2			3		
Water Quality	Salinity (0/00) surface	8.69			1.95			8.91			4.00		
	bottom	8.83						9.08					
	Temp (^{o}C) surface	8.48			15.78			26.4			15.33		
	bottom	7.87						26.57					
	air	20			15						19		
	D.O. (mg/L) surface	5.16			5.28			4.33			5.06		
	bottom	5.64						3.24					
	pH surface	7.17			7.69			7.32			7.28		
	bottom	7.19						7.30					
	T.D.S. (g/l) surface	9.601			2.29			9.808			4.602		
	bottom	9.72						9.972					
	Redox (mV) surface	374			353			333			341		
	bottom	371						320					
	Secchi (cm)	60			50			60			75		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.							1	5	3	8	1	5
Ribbon Worms	Carinoma tremaphorus							1	1		3		
Polychaete Worms	Laeonereis culveri							3	18	2	5	7	7
	Marenzelleria viridis				1								
	Streblospio benedicti					1			5	2	12	1	6
	Boccardiella ligerica		2										
	Hobsonia florida	70	53	28	4	28	9	898	872	632	640	346	583
Oligochaete Worms	Oligochaeta	21	78	26	153	271	109	4	65	10	28	2	26
Gastropods (snails)	Littoridinops tenuipes				24	69	2						
	Mytilopsis leucophaeata	1											
Isopods	Cyathura polita							2		1	2	5	4
	Edotea triloba							1			7	9	5
Amphipods	Leptocheirus plumulosus	1			2		1	3	2	4	22	47	43
	Apocorophium lacustre	1						4		1			
	Gammarus daiberi	3	1						1				
True Crabs	Rhithropanopeus harrisii							1	3				
Insect larvae	Chironomidae	23	58	46	35	28	19	16	40	18	112	36	67
total number of individuals		120	192	100	219	397	140	934	1012	673	839	454	746
total number of taxa		7	5	3	6	5	5	11	10	9	10	9	9
mean number of individuals		137.3			252.0			873.0			679.7		
mean number of taxa		5.0			5.3			10.0			9.3		
	TOTAL # OF TAXA	**8**			**7**			**13**			**10**		
	TOTAL # OF INDIVIDUALS	**412**			**756**			**2,619**			**2,039**		

TABLE A-26

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN6 (Hackensack River)

NJMC/MERI Hackensack River Benthic Inventory

Winter 2001-02 to Autumn 2002

		WINTER 2001/02			SPRING 2002			SUMMER 2002			AUTUMN 2002		
TN6	Date	1/29/02			5/21/02			8/23/02			10/22/02		
	Time	10:31	10:57	11:16	12:46	12:58	13:06	12:26	12:29	12:33	11:11	11:13	11:20
	Collection Number	B001	B002	B003	B082	B083	B084	B190	B191	B192	B235	B236	B237
	Tidal Stage (+ hours)	High			Low + 1			High + 2.5			High + 1		
	Depth (feet)	6 - 8			1			5.5			5.5		
Water Quality	Salinity (0/00) surface	8.40			0.74			7.57			3.48		
	bottom	9.04						7.83			3.73		
	Temp (^{o}C) surface	7.79			16.61			26.73			14.06		
	bottom	7.32						26.62			14.08		
	air	16			18			25			12		
	D.O. (mg/L) surface	5.22			5.69			3.28			3.93		
	bottom	4.88						2.01			3.79		
	pH surface	7.04			7.74			7.33			7.25		
	bottom	7.06						7.28			7.25		
	T.D.S. (g/l) surface	9.282			0.893			8.439			4.029		
	bottom	9.947						8.686			4.301		
	Redox (mV) surface	371			344			339			395		
	bottom	368						322			394		
	Secchi (cm)	60			30			45			45		
Taxonomic Group	**SPECIES**	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3
Cnidaria	Edwardsiidae sp.											3	2
Ribbon Worms	Carinoma tremaphorus									1			
Polychaete Worms	Marenzelleria viridis	6			1						1		
	Hobsonia florida	1,039	17	283	34	17	30	605	681	418	25	47	78
Oligochaete Worms	Oligochaeta	184	78	36	405	411	175	17	19	23	14	26	70
Gastropods (snails)	Littoridinops tenuipes			1	97	27	39						
Bivalves (clams)	Mytilopsis leucophaeata	5							1	1			
Isopods	Cyathura polita								1				
Amphipods	Leptocheirus plumulosus				2		1					2	1
	Apocorophium lacustre	1						6	3	3	1		1
	Gammarus daiberi	9	1		5	4		3	1	1			
Carridean Shrimp	Palaemonetes pugio							1					
True Crabs	Rhithropanopeus harrisii							1	4	1			
Insect larvae	Chironomidae	143	67	58	33	42	36	23	13	15	23	29	28
total number of individuals		1387	163	378	577	501	281	656	723	463	64	107	180
total number of taxa		7	4	4	7	5	5	7	8	8	5	5	6
mean number of individuals		642.7			453.0			614.0			117.0		
mean number of taxa		5.0			5.7			7.7			5.3		
	TOTAL # OF TAXA	**8**			**7**			**10**			**7**		
	TOTAL # OF INDIVIDUALS	**1,928**			**1,359**			**1,842**			**351**		

APPENDIX B

TABLE B-1

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T1-Shallow (Hackensack River)
HMDC Hackensack River Benthic Inventory
Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T1-S			T1-S			T1-S			T1-S	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	103	104	105	301	302	303	571	572	573	707	708	709
	Date	4/22/1987			8/13/1987			12/8/1987			3/24/1988		
	Time	11:55	12:00	12:05	12:20	12:25	12:30	11:43	11:45	11:49	11:58	12:00	12:03
	Tidal Stage	Low + 1			Low + 5			High + 2			Low + 3.5		
	Depth				15 ft			15 ft			15 ft		
	Salinity (0/00) surface	4			17			8			10		
	bottom	5			17			8			11		
	Temp (oC) surface	19.5			27			9.9			7.6		
	bottom	17			25.5			7.1			6.8		
	air	18.5			24			7			20		
	D.O. (mg/L) surface	7.9			3.1			9			12		
	bottom	8.1			3.7			9.6			11.6		
	pH surface	7.7			7.3			7.5			8.08		
	bottom	7.7			7.3			7.5			8.11		
	Secchi (cm)	70			70			70			70		
Anthozoa	Actinaria sp.				1								
Nemertea	Nemertea		3	1		3	1	5	3	2		2	
Polychaeta	Eteone sp.				1		1						
	Laeoneries culveri				7	9	6	11		1			
	Glycera dibranchiata						1						
	Leitoscoloplos fragilis									1			
	Polydora ligni									1			
	Streblospio benedicti		7	1	3	11	10	15	11	63		10	
	Marenzellaria viridis				3	1	1	1		2	1		2
	Heteromastus filliformis							3	4	2			
	Pectinaria gouldii				1	1			1				
	Hypaniola florida				51	49	86			1		1	
Oligochaeta	Oligochaeta	4	37		8	30	45	29	40	10		14	3
Bivalvia	Geukensia demissus											7	
	Macoma balthica	1	1	9	12	13	13	1				4	
	Mya arenaria			1						2	2	1	
Isopoda	Cyathura polita	1	2	1	10	12	9	3	10	12	3	2	
	Edotea triloloba						2					1	
Amphipoda	Corophium lacustre										2		
Caridean Shrimp	Palaemonetes pugio					1							
	Crangon septemspinosa		1										
True Crabs	Rithropanopeus harrisii				4	1	4						
Insecta	Coleoptera										2		
	Chironomidae	1											
	total number of individuals	7	51	13	101	131	179	68	69	97	10	42	5
	total number of taxa	4	6	5	11	11	12	8	6	11	5	9	2
	mean number of individuals	23.7			137.0			78.0			19.0		
	mean number of taxa	5.0			11.3			8.3			5.3		
	TOTAL # OF TAXA	**8**			**15**			**13**			**12**		
	TOTAL # OF INDIVIDUALS	**71**			**411**			**234**			**57**		

TABLE B-2

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T1-Deep (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T1-D			T1-D			T1-D			T1-D	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	106	107	108	304	305	306	574	575	576	710	711	712
	Date	4/22/1987			8/13/1987			12/8/1987			3/24/1988		
	Time	12:15	12:25	12:35	12:34	12:37	12:45	11:53	11:57	12:02	12:09	12:12	12:17
	Tidal Stage	Low + 1			Low + 5			High + 2.5			Low + 3.5		
	Depth				25 ft			25 ft			20 ft		
	Salinity (0/00) surface	4			17.0			8			10		
	bottom	5			17.0			8			11		
	Temp (oC) surface	19.5			27.0			9.9			7.6		
	bottom	17			25.5			7.1			6.8		
	air	18.5			24.0			7			20		
	D.O. (mg/L) surface	7.9			3.1			9			12		
	bottom	8.1			3.7			9.6			11.6		
	pH surface	7.7			7.3			7.5			8.08		
	bottom	7.7			7.3			7.5			8.11		
	Secchi (cm)	70			70			70			70		
Nemertea	Nemertea		1		1					1		1	4
Polychaeta	Eteone sp.				1								
	Eteone heteropoda							1	1	1			
	Laeoneries culveri				1			1					
	Haploscoloplos sp.												2
	Leitoscoloplos fragilis								1				
	Streblospio benedicti				2	3	1	88	57	47			7
	Marenzellaria viridis		1	1	7		1	3	2	1	7		1
Oligochaeta	Oligochaeta	3	4		6	5		25	6	6		1	
Bivalvia	Macoma balthica	1		3		2							2
	Congeria leucophaeta				1			8					
	Mya arenaria									1			1
Cirripedia	Balanus improvisus		1					50	1		2		
Isopoda	Cyathura polita		1		2			3	1				4
Amphipoda	Melita nitida							4					
	Monoculodes edwardsi										2	1	
Caridean Shrimp	Crangon septemspinosa	1											
True Crabs	Rithropanopeus harrisii				1	3		3	3				
	total number of individuals	5	8	4	22	13	2	186	72	57	11	3	21
	total number of taxa	3	5	2	9	4	2	10	8	6	3	3	7
	mean number of individuals	5.7			12.3			105.0			11.7		
	mean number of taxa	3.3			5.0			8.0			4.3		
	TOTAL # OF TAXA	**7**			**10**			**13**			**10**		
	TOTAL # OF INDIVIDUALS	**17**			**37**			**315**			**35**		

TABLE B-3

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T2-Shallow (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T2-S			T2-S			T2-S			T2-S	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	137	138	139	319	320	321	601	602	603	683	684	685
	Date	5/11/1987			8/26/1987			12/10/1987			3/8/1988		
	Time	13:11	13:15	13:17	10:59	11:05	11:10	12:50	12:53	12:55	10:45	10:47	10:49
	Tidal Stage	High + 4			High + 0			High + 0			Low + 5		
	Depth	10 ft			10-20 ft			10 ft			10 ft		
	Salinity (0/00) surface	6			15.5			8			6		
	bottom	7			16.0			8			6		
	Temp (oC) surface	18			26.0			9.6			7		
	bottom	18.5			25.5			8.9			7.1		
	air	19			21.0			12			8		
	D.O. (mg/L) surface	5.4			3.8			7.2			10.2		
	bottom	5.1			4.5			7.6			10.1		
	pH surface	7.7			7.6			7.5			7.8		
	bottom	7.7			7.6			7.4			7.8		
	Secchi (cm)	60			70			90			60		
Polychaeta	Nereis succinea	1	2										
	Polydora socialis	6	16	10				3	2	4			6
	Streblospio benedicti		4	2	1	3		1		15		1	
	Marenzellaria viridis			1									
	Hypaniola florida		1										
	Manayunkia aesturina		3										
Oligochaeta	Oligochaeta		91	26						1	1	4	
Bivalvia	Geukensia demissus		1										
	Macoma balthica		5	1									
Copepoda	Harpacticoida			2									
Cirripedia	Balanus improvisus	1											
Cumacea	Leucon americanus												2
Isopoda	Edotea triloloba	2						1				1	
Amphipoda	Corophium lacustre	3	17	9					3			2	
	Melita nitida	1	3										
Caridean Shrimp	Palaemonetes pugio	1											
	Crangon septemspinosa									1			
True Crabs	Rithropanopeus harrisii	8	26	7	5	5	6	1					1
Insecta	Chironomidae	1	11	2									
	total number of individuals	24	180	60	6	8	6	6	5	21	1	8	9
	total number of taxa	9	12	9	2	2	1	4	2	4	1	4	3
	mean number of individuals	88.0			6.7			10.7			6.0		
	mean number of taxa	10.0			1.7			3.3			2.7		
	TOTAL # OF TAXA	**17**			**2**			**7**			**7**		
	TOTAL # OF INDIVIDUALS	**264**			**20**			**32**			**18**		

TABLE B-4

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T2-Deep (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T2-D			T2-D			T2-D			T2-D	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	140	141	142	322	323	324	598	599	600	680	681	682
	Date	5/11/1987			8/26/1987			12/10/1987			3/8/1988		
	Time	13:19	13:24	13:30	11:13	11:17	11:20	12:30	12:37	12:45	10:55	10:58	11:00
	Tidal Stage	High + 5			High + 0			High + 0			Low + 5		
	Depth	20 ft			30 ft			25 ft			20 ft		
	Salinity (0/00) surface	6			15.5			8			6		
	bottom	7			16.0			8			6		
	Temp (oC) surface	18			25.5			9.6			7		
	bottom	18.5			25.5			8.9			7.1		
	air	19			21.0			12			8		
	D.O. (mg/L) surface	5.4			3.8			7.2			10.2		
	bottom	5.1			4.5			7.6			10.1		
	pH surface	7.7			7.6			7.5			7.83		
	bottom	7.7			7.6			7.4			7.81		
	Secchi (cm)	60			70			90			60		
Nemertea	Nemertea								1		1		
Nematoda	Nematoda		1						1				
Polychaeta	Eteone sp.				1								
	Eteone heteropoda							1		1			
	Nereis succinea	1						2					
	Spionidae sp.		1										
	Polydora sp.					1							
	Polydora socialis	2											
	Streblospio benedicti				35	4	15	195	157	47	27	108	45
	Marenzellaria viridis				3		1	7	3	2	4		
	Hypaniola florida								1				
Oligochaeta	Oligochaeta		32	24	8	1	6	77	44	7	59	27	42
Gastropoda	Hydrobia totteni			1				4	2				1
Bivalvia	Macoma balthica	1	3	15			2		1	1		1	
	Congeria leucophaeta												1
Cirripedia	Balanus improvisus				9	1		11	17	9			7
Mysidacea	Neomysis americana			1									
Isopoda	Cyathura polita		1	1	4			5	4	2			
	Edotea triloloba								1	2			
Amphipoda	Corophium lacustre	1						1	1				
	Melita nitida							1					
Caridean Shrimp	Crangon septemspinosa		1										
True Crabs	Rithropanopeus harrisii	10				16	6		4	1			
	total number of individuals	15	39	42	60	23	30	304	237	72	91	136	96
	total number of taxa	5	6	5	6	5	5	10	13	9	4	3	5
	mean number of individuals	32.0			37.7			204.3			107.7		
	mean number of taxa	5.3			5.3			10.7			4.0		
	TOTAL # OF TAXA	**11***			**9**			**16**			**8**		
	TOTAL # OF INDIVIDUALS	**96**			**113**			**613**			**323**		

*** Eteone sp. & Spionidae sp. not counted as a separate taxa**

TABLE B-5

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T3-Shallow (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T3-S			T3-S			T3-S			T3-S	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	197	198	199	366	367	368	487	488	489	671	672	673
	Date	6/9/1987			9/15/1987			11/16/1987			2/29/1988		
	Time	11:14	11:16	11:18	11:08	11:11	11:13	12:20	12:28	12:30	12:35	12:38	12:41
	Tidal Stage	High + 4			Low + 1			Low + 0			High + 5		
	Depth	10 ft			10 ft			10 ft			12 ft		
	Salinity (0/00) surface	8			6.0			5			2		
	bottom	9			8.0			5			2		
	Temp (oC) surface	24			25.0			10			6.7		
	bottom	24			25.0			10			6.1		
	air	21			21.0						5		
	D.O. (mg/L) surface	3.2			2.5			4.2			8.2		
	bottom	3.5			2.5			5.2			9.6		
	pH surface	7.6			7.5			8.8			7.7		
	bottom	7.6			7.4			9			7.6		
	Secchi (cm)	70			100			70			70		
Polychaeta	Streblospio benedicti					4	2	10	3	6	1	1	
	Hypaniola florida	2	1	3					1				
Oligochaeta	Oligochaeta	19	16	5	33	29	21	189	184	87	86	125	37
Gastropoda	Hydrobia totteni							40	17	38	25	52	28
Bivalvia	Macoma balthica	1				1	1					1	
Cumacea	Leucon americanus							1				3	
Isopoda	Cyathura polita					2	1						
Amphipoda	Melita nitida							1					
	Monoculodes edwardsi										1		
Caridean Shrimp	Palaemonetes pugio					1							
True Crabs	Rithropanopeus harrisii				20	1	1						
Insecta	Chironomidae	5	2	2									
	total number of individuals	27	19	10	53	38	26	241	205	131	113	182	65
	total number of taxa	4	3	3	2	6	5	5	4	3	4	5	2
	mean number of individuals	18.7			39.0			192.3			120.0		
	mean number of taxa	3.3			4.3			4.0			3.7		
	TOTAL # OF TAXA	**4**			**6**			**6**			**6**		
	TOTAL # OF INDIVIDUALS	**56**			**117**			**577**			**360**		

TABLE B-6

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T3-Deep (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T3-D			T3-D			T3-D			T3-D	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	194	195	196	369	370	371	490	491	492	668	669	670
	Date	6/9/1987			9/15/1987			11/16/1987			2/29/1988		
	Time	11:05	11:07	11:09	11:16	11:22	11:24	12:39	12:43	12:47	12:!5	12:17	12:20
	Tidal Stage	High + 4			Low + 1			Low + 0.5			High + 4.5		
	Depth	25 ft			20 ft			25 ft			20 ft		
	Salinity (0/00) surface	8			6.0			5			2		
	bottom	9			8.0			5			2		
	Temp (oC) surface	24			25.0			10			6.7		
	bottom	24			25.0			10			6.1		
	air	21			21.0						5		
	D.O. (mg/L) surface	3.2			2.5			4.2			8.2		
	bottom	3.5			2.5			5.2			9.6		
	pH surface	7.6			7.5			8.8			7.7		
	bottom	7.6			7.4			9			7.6		
	Secchi (cm)	70			100			70			70		
Polychaeta	Laeoneries culveri				2								
	Streblospio benedicti					2	3	1		2		1	
	Marenzellaria viridis				1								
	Hypaniola florida	1	1	1	2	2		1		1			
Oligochaeta	Oligochaeta	100	66	9	69	43	70	168	11	47	46	41	31
Gastropoda	Hydrobia totteni	1	1					127	3	6	217	187	82
Bivalvia	Macoma balthica				4		3	1			1	3	
	Congeria leucophaeta				8	6	6			3			
Copepoda	Harpacticoida		1										
Mysidacea	Neomysis americana							1	1				
Cumacea	Leucon americanus											2	
Isopoda	Cyathura polita					1	1					1	
	Edotea triloloba										2	6	1
Amphipoda	Melita nitida										1		
	Monoculodes edwardsi											1	
Caridean Shrimp	Palaemonetes pugio				1	1							
True Crabs	Rithropanopeus harrisii				4	14	11	1		4			
Insecta	Chironomidae	5	6	12									
	total number of individuals	107	75	22	91	69	94	300	15	63	267	242	114
	total number of taxa	4	5	3	8	7	6	7	3	6	5	8	3
	mean number of individuals	68.0			84.7			126.0			207.7		
	mean number of taxa	4.0			7.0			5.3			5.3		
	TOTAL # OF TAXA	**5**			**10**			**8**			**9**		
	TOTAL # OF INDIVIDUALS	**204**			**254**			**378**			**623**		

TABLE B-7

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T4-Shallow (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T4-S			T4-S			T4-S			T4-S	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	165	166	167	378	379	380	589	590	591	653	654	655
	Date	5/28/1987			9/15/1987			12/10/1987			2/25/1988		
	Time	13:55	14:00	14:03	11:57	12:01	12:05	10:59	11:10	11:15	12:07	12:10	12:12
	Tidal Stage	High + 3			Low + 2			Low + 5			Low + 1.5		
	Depth	7 ft			12 - 15 ft			15 ft			15 ft		
	Salinity (0/00) surface	6			5			5			0		
	bottom	6			7.0			5			0		
	Temp (oC) surface	21.5			26.0			9			10.3		
	bottom	19.5			25.0			8.7			8.8		
	air	29			21.0			12			-1		
	D.O. (mg/L) surface	4.2			2.9			5.1			6.2		
	bottom	4.2			2.4			5.4			5.8		
	pH surface	7.5			7.4			7.4			7.6		
	bottom	7.5			7.4			7.4			7.5		
	Secchi (cm)	80			80			70			70		
Polychaeta	Laeoneries culveri			1									
	Streblospio benedicti				1		5			1			
	Hypaniola florida		3		11	1	2						
Oligochaeta	Oligochaeta	49	509	95	42	131	520	70	35	67			
Gastropoda	Hydrobia totteni				174	356	612	26	314	528	**SORTED**		
Bivalvia	Congeria leucophaeta				1		1		2			**BUT**	
Copepoda	Harpacticoida		1								**NEVER**		
Mysidacea	Neomysis americana								3		**IDENTIFIED**		
Insecta	Chironomidae	13	16	3									
	total number of individuals	62	529	99	229	488	1140	96	354	596			
	total number of taxa	2	4	3	5	3	5	2	4	3			
	mean number of individuals	230.0			619.0			348.7					
	mean number of taxa	3.0			4.3			3.0					
	TOTAL # OF TAXA	**5**			**5**			**5**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**690**			**1,857**			**1,046**			**N.D.**		

TABLE B-8

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T4-Deep (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T4-D			T4-D			T4-D			T4-D	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	168	169	170	381	382	383	586	587	588	650	651	652
	Date	5/28/1987			9/15/1987			12/10/1987			2/25/1988		
	Time	14:07	14:11	14:15	12:12	12:13	12:16	10:42	10:45	10:45	11:50	11:52	11:58
	Tidal Stage	High + 3			Low + 2			Low + 4.5			Low + 1.5		
	Depth	30 ft			20 ft			23 ft			25-30 ft		
	Salinity (0/00) surface	6			5			5			0		
	bottom	6			7			5			0		
	Temp (oC) surface	21.5			26			9			10.3		
	bottom	19.5			25			8.7			8.8		
	air	29			21			12			-1		
	D.O. (mg/L) surface	4.2			2.9			5.1			6.2		
	bottom	4.2			2.4			5.4			5.8		
	pH surface	7.5			7.4			7.4			7.6		
	bottom	7.5			7.4			7.4			7.5		
	Secchi (cm)	80			80			70			70		
Polychaeta	Streblospio benedicti				3	1	4				**SORTED**		
	Hypaniola florida	1			11	23	17					**BUT**	
Oligochaeta	Oligochaeta	52	1	177	124	253	69	74	27	64	**NEVER**		
Gastropoda	Hydrobia totteni	6	1	7	123	212	248	81	107	347	**IDENTIFIED**		
Bivalvia	Congeria leucophaeta					1							
Copepoda	Harpacticoida	1											
Cumacea	Leucon americanus									1			
Insecta	Chironomidae	11		6									
	total number of individuals	71	2	190	261	490	338	155	134	412			
	total number of taxa	5	2	3	4	5	4	2	2	3			
	mean number of individuals	87.7			363.0			233.7					
	mean number of taxa	3.3			4.3			2.3					
	TOTAL # OF TAXA	**5**			**5**			**3**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**263**			**1,089**			**701**			**N.D.**		

TABLE B-9

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T5-Shallow (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T5-S			T5-S			T5-S			T5-S	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	57	58	59	407	408	409	511	512	513	636	637	638
	Date	4/1/1987			9/21/1987			11/23/1987			2/23/1988		
	Time	11:00	11:10	11:15	14:52	14:57	15:00	11:31	11:35	11:37	11:50	11:55	11:59
	Tidal Stage	High			Low + 0			High + 1			Low + 4		
	Depth	5 ft			4 ft			8 ft			7 ft		
	Salinity (0/00) surface	0			4			0			0		
	bottom	0						1			0		
	Temp (oC) surface	15			27			6			12.7		
	bottom	13						6			13.1		
	air	8.5			20			10			11		
	D.O. (mg/L) surface	8.2			2.5			5.8			7		
	bottom	7.3						6.1			7		
	pH surface	7.6			7.4			7.5			7.6		
	bottom	7.6						7.5			7.5		
	Secchi (cm)	50			80			50			40		
Oligochaeta	Oligochaeta	6	3	7	4	2	10	17	10	15	**SORTED**		
Gastropoda	Hydrobia totteni	1			1	6	4	4	4	4		**BUT**	
Bivalvia	Congeria leucophaeta				1						**NEVER**		
Insecta	Chironomidae						1	3	3	5	**IDENTIFIED**		
	total number of individuals	7	3	7	6	8	15	24	17	24			
	total number of taxa	2	1	1	3	2	3	3	3	3			
	mean number of individuals	5.7			9.7			21.7					
	mean number of taxa	1.3			2.7			3.0					
	TOTAL # OF TAXA	**2**			**4**			**3**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**17**			**29**			**65**			**N.D.**		

TABLE B-10

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T5-Deep (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T5-D			T5-D			T5-D			T5-D	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	60	61	62	404	405	406	508	509	510	633	634	635
	Date	4/1/1987			9/21/1987			11/23/1987			2/23/1988		
	Time	11:20	11:25	11:35	14:45	14:47	14:49	11:13	11:15	11:18	11:35	11:40	11:45
	Tidal Stage	High			Low + 0			High + 0.5			Low + 3.5		
	Depth	15 ft			15 ft			20 ft			15-20 ft		
	Salinity (0/00) surface	0			3.5			0			0		
	bottom	0			3.5			1			0		
	Temp (oC) surface	15			22			6			12.7		
	bottom	13			22			6			13.1		
	air	8.5			20			10			11		
	D.O. (mg/L) surface	8.2			2.7			5.8			7		
	bottom	7.3			3.8			6.1			7		
	pH surface	7.6			7.4			7.5			7.6		
	bottom	7.6			7.5			7.5			7.5		
	Secchi (cm)	50			80			50			40		
Oligochaeta	Oligochaeta	230	165	12	274	120	378	29	85	27	339	553	**SORTED**
Gastropoda	Hydrobia totteni			1	113	115	233	13	17	10	2	13	**BUT**
Bivalvia	Congeria leucophaeta				2		6				13		**NEVER**
Cirripedia	Balanus improvisus										3		**IDENTIFIED**
Amphipoda	Monoculodes edwardsi											2	
Insecta	Chironomidae						1					4	
	total number of individuals	230	165	13	389	235	618	42	102	37	357	572	N.D.
	total number of taxa	1	1	2	3	2	4	2	2	2	4	4	N.D.
	mean number of individuals	136.0			414.0			60.3			464.5		
	mean number of taxa	1.3			3.0			2.0			4.0		
	TOTAL # OF TAXA	**2**			**4**			**2**			**6**		
	TOTAL # OF INDIVIDUALS	**408**			**1,242**			**181**			**929**		

TABLE B-11

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T6 (Sawmill Creek)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T6			T6			T6			T6	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	109	110	111	325	326	327	577	578	579	686	687	688
	Date	4/22/1987			8/26/1987			12/8/1987			3/8/1988		
	Time	12:50	12:55	13:02	11:32	11:36	11:40	12:15	12:18	12:25	11:17	11:18	11:20
	Tidal Stage	Low + 2			High + 0			High + 3			Low + 5.5		
	Depth	10 ft			10-15 ft			12 ft			15 ft		
	Salinity (0/00) surface	3			15			5			6		
	bottom	3			16			7			6		
	Temp (oC) surface	19.5			25.5			8			6.6		
	bottom	19.5			25			7.8			6.6		
	air	21			21			6			8		
	D.O. (mg/L) surface	13			4			8			10.6		
	bottom	13			4.1			8.6			10.8		
	pH surface	8.5			7.5			7.3			7.8		
	bottom	8.5			7.5			7.3			7.7		
	Secchi (cm)	40			75			90			60		
Polychaeta	Polydora socialis			1			3	8					
	Boccardia ligerica								12	15	**SORTED**		
	Streblospio benedicti						1	1	1	3		**BUT**	
Oligochaeta	Oligochaeta			1						34	**NEVER**		
Bivalvia	Congeria leucophaeta							6	10	9	**IDENTIFIED**		
Cirripedia	Balanus improvisus							29	55	217			
Isopoda	Cyathura polita									3			
	Edotea triloloba									3			
Amphipoda	Corophium sp.							26	40	51			
	Corophium lacustre	14		21									
	Melita nitida				1			1	5	14			
True Crabs	Rithropanopeus harrisii	8	1	8	33	14	17	4	25	11			
	total number of individuals	22	1	31	34	14	21	75	148	360			
	total number of taxa	2	1	4	2	1	3	7	7	10			
	mean number of individuals	18.0			23.0			194.3					
	mean number of taxa	2.3			2.0			8.0					
	TOTAL # OF TAXA	**4**			**4**			**11**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**54**			**69**			**583**			**N.D.**		

TABLE B-12

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T7 (Berry's Creek Canal)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T7			T7			T7			T7	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	191	192	193	375	376	377	595	596	597	662	663	664
	Date	6/9/1987			9/15/1987			12/10/1987			2/29/1988		
	Time	10:43	10:46	10:49	11:43	11:46	11:48	12:03	12:07	12:11	11:35	11:38	11:40
	Tidal Stage	High + 2			Low + 2			Low + 5			High + 4		
	Depth	10 ft			10 ft			15 ft			15 ft		
	Salinity (0/00) surface	8			4			5			2		
	bottom	9			8			6			2		
	Temp (oC) surface	24			24			8.5			5.6		
	bottom	24			24			8.1			5.4		
	air	21			21			11			5		
	D.O. (mg/L) surface	2.8			2.2			6.4			9.2		
	bottom	3.8			2.4			6.8			9		
	pH surface	7.5			7.4			7.4			7.9		
	bottom	7.5			7.4			7.4			7.8		
	Secchi (cm)	80			70			70			60		
Polychaeta	Streblospio benedicti				1	4	6						
	Hypaniola florida	2	11	4	5	3	4						
Oligochaeta	Oligochaeta	52	110	6	9	11	32	36	64	25	67	56	64
Gastropoda	Hydrobia totteni	1	1		167	155	157	842	554	267	42	383	48
Bivalvia	Macoma balthica	1											
	Congeria leucophaeta				1		1	1					
Isopoda	Cyathura polita											1	
Amphipoda	Melita dentata											1	
	Monoculodes edwardsi												2
Caridean Shrimp	Palaemonetes pugio										2		
True Crabs	Rithropanopeus harrisii											1	
Insecta	Chironomidae	18	41	6	1	2	1						
	total number of individuals	74	163	16	184	175	201	879	618	292	111	442	114
	total number of taxa	5	4	3	6	5	6	3	2	2	3	5	3
	mean number of individuals	84.3			186.7			596.3			222.3		
	mean number of taxa	4.0			5.7			2.3			3.7		
	TOTAL # OF TAXA	**5**			**6**			**3**			**7**		
	TOTAL # OF INDIVIDUALS	**253**			**560**			**1,789**			**667**		

TABLE B-13

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T8 (Mill Creek)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T8			T8			T8			T8	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	162	163	164	392	393	394	592	593	594	656	657	658
	Date	5/28/1987			9/21/1987			12/10/1987			2/25/1988		
	Time	13:17	13:20	13:26	13:35	13:37	13:41	11:25	11:28	11:32	12:28	12:30	12:33
	Tidal Stage	High + 2			High + 4			Low + 5			Low + 2		
	Depth	8 ft			5 ft			10 ft			6 ft		
	Salinity (0/00) surface	5			4			4			0		
	bottom	6			4			4			0		
	Temp (oC) surface	21			20			10.4			8.8		
	bottom	20.5			20			10.2			8.7		
	air	27			22			12			-1		
	D.O. (mg/L) surface	2.5			2.2			4.2			4.2		
	bottom	4.8			2.2			4.2			3.8		
	pH surface	7.6			7.4			7.3			7.6		
	bottom	7.5			7.4			7.3			7.5		
	Secchi (cm)	90			90			60			50		
Polychaeta	Laeoneries culveri						3	1					
	Polydora socialis				446	511	157	225	339	39			
	Hypaniola florida				1	2	13	3	3	1			
	Manayunkia aesturina			1									
Oligochaeta	Oligochaeta	53	48	32	236	453	282	1309	546	349	588	25	
Gastropoda	Hydrobia totteni	30	5		250	175	665	9358	8824	3621			
Bivalvia	Congeria leucophaeta	1			732	697	1003	547	827	777			
Cirripedia	Balanus improvisus	3	6		246	274	312	125	280	121			
Caridean Shrimp	Palaemonetes pugio					1							
Insecta	Chironomidae	2		2	2	5	32	1	2	4			
	total number of individuals	89	59	35	1913	2118	2467	11569	10821	4912	588	25	0
	total number of taxa	5	3	3	7	8	8	8	7	7	1	1	0
	mean number of individuals	61.0			2166.0			9100.7			204.3		
	mean number of taxa	3.7			7.7			7.3			0.7		
	TOTAL # OF TAXA	**6**			**9**			**8**			**1**		
	TOTAL # OF INDIVIDUALS	**183**			**6,498**			**27,302**			**613**		

TABLE B-14

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location T9 (Cromakill Creek)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		T9			T9			T9			T9	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	69	70	71	389	390	391	583	584	585	659	660	661
	Date	4/1/1987			9/21/1987			12/10/1987			2/25/1988		
	Time	13:10	13:15	13:20	13:07	13:09	13:17	10:17	10:21		12:57	12:59	13:04
	Tidal Stage	High			High + 3.5			Low + 4			Low + 2.5		
	Depth	8 ft			5 ft			10 ft			7 ft		
	Salinity (0/00) surface	0			2.5			4			0		
	bottom	0			3			3			0		
	Temp (oC) surface	12			20			12.1			6.4		
	bottom	12			20			12.1			6.5		
	air	5.5			20			12			-1		
	D.O. (mg/L) surface	6.4			1			2.2			2.4		
	bottom	6.4			2.2			2.8			1.7		
	pH surface	7.7			7.4			6.8			7.6		
	bottom	7.7			7.4			7.1			7.5		
	Secchi (cm)	60			70			60			50		
Oligochaeta	Oligochaeta		4	1					1		20	2	
Gastropoda	Hydrobia totteni									3			
	Melampus bidentatus	1											
Insecta	Coleoptera											2	
	Tabanidae											1	
	total number of individuals	1	4	1	0	0	0	0	1	3	20	5	0
	total number of taxa	1	1	1	0	0	0	0	1	1	1	3	0
	mean number of individuals	2.0			0.0			1.3			8.3		
	mean number of taxa	1.0			0.0			0.7			1.3		
	TOTAL # OF TAXA	**2**			**0**			**2**			**3**		
	TOTAL # OF INDIVIDUALS	**6**			**0**			**4**			**25**		

TABLE B-15

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S1 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		S1			S1			S1			S1	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	131	132	133	295	296	297	565	566	567	704	705	706
	Date	5/11/1987			8/13/1987			12/8/1987			3/24/1988		
	Time	12:09	12:18	12:22	11:40	11:45	11:46	11:15	11:19	11:22	11:40	11:45	11:48
	Tidal Stage	High + 3			Low + 4			High + 1			Low + 3		
	Depth	5 ft			5 ft			10 - 15 ft			5 ft		
	Salinity (0/00)surface	8			17			8			12		
	bottom							8					
	Temp (oC) surface	17			25			7.3			6.7		
	bottom							6.6					
	air	22			23			6			16		
	D.O. (mg/L) surface	5.6			2.8			9			11.1		
	bottom							9.5					
	pH surface	7.6			7.3			7.4			8		
	bottom							7.5					
	Secchi (cm)	70			70			80			70		
Nemertea	Nemertea	1											1
Nematoda	Nematoda		1										
Polychaeta	Eteone heteropoda						1	2	1	3			
	Nereis succinea						13	9		9			
	Nereis diversicolor									1			
	Laeoneries culveri	1		1	23	3	3				2		5
	Leitoscoloplos robustus								1				
	Spionidae sp.	3											
	Polydora socialis				1								
	Polydora ligni						15			1			
	Streblospio benedicti		7	12	15	19	24	58	27	142			
	Marenzellaria viridis							1	1				
	Hypaniola florida				39	5	13						
Oligochaeta	Oligochaeta	7	41	18	48	63	62	35	4	19	1	10	5
Bivalvia	Macoma balthica			3	4	2	4		1		1		
	Congeria leucophaeta					9	135	4		4			
	Mya arenaria		1					2	1	2			
Cirripedia	Balanus improvisus		1	5		52	753	19	3	6			2
Mysidacea	Neomysis americana										1		
Cumacea	Leucon americanus											2	2
Isopoda	Cyathura polita	9	7	8	9	8	5	6	6	13	3	4	3
	Edotea triloloba				1								
Amphipoda	Corophium lacustre		1										
	Melita nitida	2	1	1			4		2	2			
True Crabs	Rithropanopeus harrisii	2	6	1	2	9	29	4		3			
Echinodermata	Holothuroidea				1								
	total number of individuals	25	66	49	143	170	1061	140	47	205	8	16	18
	total number of taxa	7	9	8	10	9	13	10	10	12	5	3	6
	mean number of individuals	46.7			458.0			130.7			14.0		
	mean number of taxa	8.0			10.7			10.7			4.7		
	TOTAL # OF TAXA	**12***			**16**			**15**			**8**		
	TOTAL # OF INDIVIDUALS	**140**			**1,374**			**392**			**42**		

*** Spionidae sp. not counted as a separate taxa**

TABLE B-16

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S2 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		S2			S2			S2			S2	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	210	211	212	334	335	336	496	497	498	665	666	667
	Date	6/15/1987			8/26/1987			11/16/1987			2/29/1988		
	Time	12:01	12:04	12:06	12:40	12:45	12:50	13:03	13:04	13:06	11:55	11:58	12:00
	Tidal Stage	Low + 5			High + 1			Low + 1			High + 4.5		
	Depth	3 ft			8 ft			3 ft			4 ft		
	Salinity (0/00) surface	12			11			5			3		
	bottom				11			5					
	Temp (oC) surface	25.5			25			10			6.7		
	bottom				25			10					
	air	33			23						5		
	D.O. (mg/L) surface	3.7			3.2			4.2			8		
	bottom				3.9			5.2					
	pH surface	7.6			7.5			8.8			7.6		
	bottom				7.5			9					
	Secchi (cm)	60			70			70			70		
Polychaeta	Laeoneries culveri				19	42	44	9	1	4	2	3	
	Polydora socialis				1		1						
	Streblospio benedicti				4	3	16			1			
	Hypaniola florida	2	9	4	42	54	100						
Oligochaeta	Oligochaeta	62	66	31	45	46	55	57	10	98	11	12	9
Gastropoda	Hydrobia totteni				47	95	20	54	62	41	29	41	31
Bivalvia	Macoma balthica	1						2			2		
Copepoda	Harpacticoida							1					
Isopoda	Cyathura polita					1	1		2		4		3
	Edotea triloloba									1			
True Crabs	Rithropanopeus harrisii						2						
Insecta	Coleoptera	1											
	Chironomidae	13	22	47		1	1						
	total number of individuals	79	97	82	158	242	240	123	75	145	48	56	43
	total number of taxa	5	3	3	6	7	9	5	4	5	5	3	3
	mean number of individuals	86.0			213.3			114.3			49.0		
	mean number of taxa	3.7			7.3			4.7			3.7		
	TOTAL # OF TAXA	**5**			**9**			**8**			**5**		
	TOTAL # OF INDIVIDUALS	**258**			**640**			**343**			**147**		

TABLE B-17

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location S3 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		S3			S3			S3			S3	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	63	64	65	395	396	397	517	518	519	642	643	644
	Date	4/1/1987			9/21/1987			11/23/1987			2/23/1988		
	Time	11:50	11:55	12:07	14:03	14:05	14:06	12:05	12:08	12:19	12:20	12:22	12:25
	Tidal Stage	High			High + 4.5			High + 1.5			Low + 4.5		
	Depth	5 ft			2-3 ft			5 ft			4 ft		
	Salinity (0/00) surface	0			4.5			0			0		
	bottom	0						1			0		
	Temp (oC) surface	13			24			6			9.2		
	bottom	13						6			8.9		
	air	8.5			22			10			11		
	D.O. (mg/L) surface	7.3			3.2			5.8			7.2		
	bottom	7.3						6.1			6.9		
	pH surface	7.7			7.5			7.5			7.5		
	bottom	7.7						7.5			7.5		
	Secchi (cm)	50			90			50			50		
Oligochaeta	Oligochaeta	8	4	7	7	15	1	12	17	17			
Gastropoda	Hydrobia totteni	1	1	1	9	6	9	12	24	10	**SORTED**		
Bivalvia	Congeria leucophaeta					1	1			1		**BUT**	
Hydracarina	Hydracarina	1									**NEVER**		
Insecta	Chaoborus sp.				1						**IDENTIFIED**		
	Chironomidae				4		1	2	8	5			
	total number of individuals	10	5	8	21	22	12	26	49	33			
	total number of taxa	3	2	2	4	3	4	3	3	4			
	mean number of individuals	7.7			18.3			36.0					
	mean number of taxa	2.3			3.7			3.3					
	TOTAL # OF TAXA	**3**			**5**			**4**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**23**			**55**			**108**			**N.D.**		

TABLE B-18

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN1 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		GN1			GN1			GN1			GN1	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	100	101	102	292	293	294	562	563	564	701	702	703
	Date	4/22/1987			8/13/1987			12/8/1987			3/24/1988		
	Time	11:30	11:35	11:40	11:10	11:18	11:25	10:51	10:55	10:57	11:21	11:25	11:34
	Tidal Stage	Low + 0			Low + 4			High + 0			Low + 3		
	Depth				20 ft			20 ft			20 - 25 ft		
	Salinity (0/00) surface	4			15			7			10		
	bottom	4			16			9			12		
	Temp (oC) surface	17			25.5			6.5			7.1		
	bottom	16.5			25.5			6.7			6.9		
	air	21			28			5					
	D.O. (mg/L) surface	7.3			3.1			9.8			11.4		
	bottom	7.7			3.5			9.8			11.2		
	pH surface	7.7			7.4			7.7			8.3		
	bottom	7.7			7.4			7.7			8.2		
	Secchi (cm)	80			60			80			70		
Nemertea	Nemertea									1			
Polychaeta	Eteone longa						1						
	Eteone heteropoda								1	1			
	Nereis succinea	1										1	2
	Glycera dibranchiata								1				
	Polydora sp.								1				
	Streblospio benedicti	5	13	10		8	31	56	148	88			2
	Marenzellaria viridis	3	1										
Oligochaeta	Oligochaeta	2	2			4	21	71	52	132			7
Gastropoda	Eupleura caudata												1
Bivalvia	Mulinia lateralis								1				
	Macoma balthica		2	1		6	30		2	1			
	Mya arenaria	1							3				
Cirripedia	Balanus improvisus	6											3
Cumacea	Leucon americanus							1		1		2	
Isopoda	Cyathura polita						2		4				2
	Edotea triloloba												2
Amphipoda	Melita dentata					1							
	Monoculodes edwardsi	1											
Caridean Shrimp	Palaemonetes pugio				1						2		
	Crangon septemspinosa							1					
True Crabs	Callinectus sapidus												1
	Rithropanopeus harrisii			3	2	6	1	3			1	4	1
	total number of individuals	19	18	14	3	25	86	132	213	224	3	7	21
	total number of taxa	7	4	3	2	5	6	5	9	6	2	3	9
	mean number of individuals	17.0			38.0			189.7			10.3		
	mean number of taxa	4.7			4.3			6.7			4.7		
	TOTAL # OF TAXA	**9**			**8**			**13**			**11**		
	TOTAL # OF INDIVIDUALS	**51**			**114**			**569**			**31**		

TABLE B-19

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN2 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		GN2			GN2			GN2			GN2	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	126	127	128	331	332	333	484	485	486	677	678	679
	Date	5/11/1987			8/26/1987			11/16/1987			2/29/1988		
	Time	11:27	11:29		12:15	12:25	12:30	12:06	12:13	12:15	13:17	13:20	13:23
	Tidal Stage	High + 3			High + 1			Low + 0			Low + 0		
	Depth	15 ft			18 ft			20 ft			20 ft		
	Salinity (0/00) surface	5			11			5			2		
	bottom	6			12.5			5			2		
	Temp (oC) surface	18			25			10			6.6		
	bottom	17.5			25			10			6		
	air	22			22						5		
	D.O. (mg/L) surface	4.8			4.5			4.2			8.6		
	bottom	5			3.6			5.2			9.2		
	pH surface	7.8			7.5			8.8			7.8		
	bottom	7.7			7.5			9			7.4		
	Secchi (cm)	70			70			70			70		
Polychaeta	Nereis succinea									1			
	Laeoneries culveri								1				
	Polydora sp.				2								
	Streblospio benedicti							3	7	11			2
	Marenzellaria viridis				3					1			
Oligochaeta	Oligochaeta	48	104	9	38	7		175	252	201	31	92	66
Gastropoda	Hydrobia totteni							2	1	1	1		
Bivalvia	Macoma balthica				1	3					2		
Copepoda	Harpacticoida									1			
Cirripedia	Balanus improvisus		1										
Mysidacea	Neomysis americana							2					
Cumacea	Leucon americanus										2	2	1
Isopoda	Cyathura polita					1							
Amphipoda	Gammarus tigrinus		1										
	Melita nitida		3						1				
	Monoculodes edwardsi										1		
Caridean Shrimp	Palaemonetes pugio				3	1	3						
True Crabs	Rithropanopeus harrisii		12		2				15				4
Echinodermata	Holothuroidea												1
	total number of individuals	48	121	9	49	12	3	182	277	216	37	94	74
	total number of taxa	1	5	1	6	4	1	4	6	6	5	2	5
	mean number of individuals	59.3			21.3			225.0			68.3		
	mean number of taxa	2.3			3.7			5.3			4.0		
	TOTAL # OF TAXA	**5**			**7**			**10**			**8**		
	TOTAL # OF INDIVIDUALS	**178**			**64**			**675**			**205**		

TABLE B-20

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location GN3 (Overpeck Creek)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		GN3			GN3			GN3			GN3	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	229	230	231	411	412	413	523	524	525		**NOT**	
	Date	6/23/1987			9/28/1987			11/24/1987				**SAMPLED**	
	Time	14:00	14:05	14:10	11:15	11:20	11:25	10:46	10:56	11:03			
	Tidal Stage	Low + 0			Low + 4			High + 0					
	Depth	10 ft			10 ft			10-15 ft					
	Salinity (0/00) surface	7			4			2					
	bottom	8			4			2					
	Temp (oC) surface	28.5			27			7.5					
	bottom	28			27			7.3					
	air	28			22			8.5					
	D.O. (mg/L) surface	1.9			1.8			6.8					
	bottom	2.9			1.9			7.3					
	pH surface	7.6			7.4			7.62					
	bottom	7.5			7.5			7.61					
	Secchi (cm)	60			65			50					
Oligochaeta	Oligochaeta	377	67	202	41	1	6	31	41	5			
Gastropoda	Hydrobia totteni	4	7	2	124	7		289	1031	124		**NOT**	
Bivalvia	Congeria leucophaeta					1			22			**SAMPLED**	
Cirripedia	Balanus improvisus					3							
Insecta	Chironomidae	16	13	11		2		2					
	total number of individuals	397	87	215	165	14	6	322	1094	129			
	total number of taxa	3	3	3	2	5	1	3	3	2			
	mean number of individuals	233.0			61.7			515.0					
	mean number of taxa	3.0			2.7			2.7					
	TOTAL # OF TAXA	**3**			**5**			**4**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**699**			**185**			**1,545**			**N.D.**		

TABLE B-21

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN1 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN1			TN1			TN1			TN1	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	134	135	136	298	299	300	568	569	570	692	693	694
	Date	5/11/1987			8/13/1987			12/8/1987			3/8/1988		
	Time	12:31	12:37	12:40	11:55	11:57	12:00	11:29	11:32	11:34	12:03	12:04	12:08
	Tidal Stage	High + 4			Low + 5			High + 1			High + 0		
	Depth	5 ft			10 ft			10 ft			7 ft		
	Salinity (0/00) surface	8			17			8			10		
	bottom							8			10		
	Temp (oC) surface	23			25			7.3			6.1		
	bottom							6.6			5.8		
	air	22			23			6			6		
	D.O. (mg/L) surface	4.8			2.8			9			10.6		
	bottom							9.5			10.4		
	pH surface	7.6			7.3			7.4			7.74		
	bottom							7.5			7.72		
	Secchi (cm)	70			70			80			90		
Nemertea	Nemertea					1	1	3					
Nematoda	Nematoda	4											
Polychaeta	Eteone heteropoda											1	
	Nereis succinea	4		3				2		3	2	1	3
	Laeoneries culveri				6	7	36		1			1	
	Polydora sp.									8			
	Polydora socialis										1	5	8
	Boccardia ligerica							19					
	Streblospio benedicti	2		2	1	3	9	21	4	38	56	93	44
	Hypaniola florida						2						
Oligochaeta	Oligochaeta	232	31	90	4	4	6	9	1	18	30	13	16
Bivalvia	Mulinia lateralis								1				
	Macoma balthica	2	3	2									
	Congeria leucophaeta				1	1							
	Mya arenaria								2	1			
Copepoda	Harpacticoida	1											
Mysidacea	Neomysis americana									3			
Cumacea	Leucon americanus							1		2	7	5	1
Isopoda	Cyathura polita	1		1	4	4	7	4		7	2		
	Edotea triloloba			3					1	2			
True Crabs	Rithropanopeus harrisii	7		5		1		2		3			
Insecta	Chironomidae		3										
	total number of individuals	253	37	106	16	21	61	61	10	85	98	119	72
	total number of taxa	8	3	7	5	7	6	8	6	10	6	7	5
	mean number of individuals	132.0			32.7			52.0			96.3		
	mean number of taxa	6.0			6.0			8.0			6.0		
	TOTAL # OF TAXA	**10**			**8**			**14**			**8**		
	TOTAL # OF INDIVIDUALS	**396**			**98**			**156**			**289**		

TABLE B-22

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN2 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN2			TN2			TN2			TN2	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	112	113	114	328	329	330	580	581	582	689	690	691
	Date	4/22/1987			8/26/1987			12/8/1987			3/8/1988		
	Time	13:05	13:10	13:15	11:50	11:55	12:00	12:40	12:42	12:45	11:33	11:36	11:39
	Tidal Stage	Low + 2			High + 1			High + 3			Low + 5.5		
	Depth	3 ft			10 ft			8 ft			5 ft		
	Salinity (0/00) surface	3			13			5			6		
	bottom	3			13.5			5			6		
	Temp (oC) surface	19.5			25.5			7.9			9.2		
	bottom	19.5			25.5			7.9			7.6		
	air	21			21			7			7.5		
	D.O. (mg/L) surface	13			3.6			8.2			11.6		
	bottom	13			4.3			8.4			10.8		
	pH surface	8.5			7.5			7.5			7.78		
	bottom	8.5			7.5			7.5			7.83		
	Secchi (cm)	40			60			80			60		
Anthozoa	Actinaria sp.				21	20	7						
Polychaeta	Laeoneries culveri	11	5	3	22	36	34	23	21	11	**SORTED**		
	Streblospio benedicti						5	18	46	27		**BUT**	
	Hypaniola florida		6	4	37		68	19	22	14	**NEVER**		
Oligochaeta	Oligochaeta	162	170	131	9	30	51	173	209	77	**IDENTIFIED**		
Gastropoda	Hydrobia totteni	20	28	7				1					
	Macoma balthica	2	3	1	1	1							
Isopoda	Cyathura polita				1	5	4	2					
	Edotea triloloba			2				4		8			
Amphipoda	Corophium lacustre	2								12			
	Melita nitida									1			
Caridean Shrimp	Palaemonetes pugio				1								
True Crabs	Rithropanopeus harrisii				2	1	6						
Insecta	Chironomidae	5	5	3	11	4	5	11	8	4			
	Tabanidae		1										
Echinodermata	Holothuroidea							68	89	84			
	total number of individuals	202	218	151	105	97	180	319	395	238			
	total number of taxa	6	7	7	9	7	8	9	6	9			
	mean number of individuals	190.3			127.3			317.3					
	mean number of taxa	6.7			8.0			8.0					
	TOTAL # OF TAXA	**9**			**10**			**11**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**571**			**382**			**952**			**N.D.**		

TABLE B-23

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN3 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN3			TN3			TN3			TN3	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	207	208	209	372	373	374	493	494	495	674	675	676
	Date	6/15/1987			9/15/1987			11/16/1987			2/29/1988		
	Time	11:46	11:48	11:50	11:25	11:26	11:29	12:54	12:56	12:58	12:51	12:54	12:56
	Tidal Stage	Low + 5			Low + 1			Low + 1			High + 5.5		
	Depth	7 ft			3 ft			5 ft			2-3 ft		
	Salinity (0/00) surface	11			6			5			2		
	bottom							5			2		
	Temp (oC) surface	26.5			25			10			6.7		
	bottom							10			6.1		
	air	33			21						5		
	D.O. (mg/L) surface	3.7			2.5			4.2			8.2		
	bottom							5.2			9.6		
	pH surface	7.6			7.5			8.8			7.7		
	bottom							9			7.6		
	Secchi (cm)	60			100			70			70		
Polychaeta	Laeoneries culveri				12	8	21						
	Streblospio benedicti							1					
	Hypaniola florida		2	5				1					
Oligochaeta	Oligochaeta	6	11	22	11	20	25	78	29	59	102	75	74
Gastropoda	Hydrobia totteni	1	3	4	68	20	25	1	1	6	2	6	4
Bivalvia	Macoma balthica	1											
Amphipoda	Gammarus mucronatus		1										
Caridean Shrimp	Palaemonetes pugio							1	1	1			
True Crabs	Rithropanopeus harrisii							1					
Insecta	Chironomidae	12	13	18				1					
Echinodermata	Holothuroidea							7					
	total number of individuals	20	30	49	91	48	71	91	31	66	104	81	78
	total number of taxa	4	5	4	3	3	3	8	3	3	2	2	2
	mean number of individuals	33.0			70.0			62.7			87.7		
	mean number of taxa	4.3			3.0			4.7			2.0		
	TOTAL # OF TAXA	**6**			**3**			**8**			**2**		
	TOTAL # OF INDIVIDUALS	**99**			**210**			**188**			**263**		

TABLE B-24

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN4 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN4			TN4			TN4			TN4	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	66	67	68	384	385	386	520	521	522	645	646	647
	Date	4/1/1987			9/15/1987			11/23/1987			2/23/1988		
	Time	12:20	12:30	12:35	12:23	12:26	12:28	12:37	12:40	12:43	12:40	12:45	12:50
	Tidal Stage	High			Low + 2			High + 2			Low + 4.5		
	Depth	5 ft			3-5 ft			6 ft			3 ft		
	Salinity (0/00) surface	0			5			4			3		
	bottom	0			7			4			3		
	Temp (oC) surface	14			26			7			6.9		
	bottom	14			25			7			6.4		
	air	5			21			9			10.5		
	D.O. (mg/L) surface	6.8			2.9			7			8.2		
	bottom	6.8			2.4			7.2			8.6		
	pH surface	7.7			7.4			7.4			7.6		
	bottom	7.7			7.4			7.6			7.6		
	Secchi (cm)				100			40			50		
Polychaeta	Streblospio benedicti				2	2	2						
	Hypaniola florida				1	1	1						
Oligochaeta	Oligochaeta	2	1		61	66	26	66	115	75			
Gastropoda	Hydrobia totteni	3	4	4	180	158	190	18	7	11	**SORTED**		
Bivalvia	Congeria leucophaeta	1										**BUT**	
Mysidacea	Neomysis americana									1	**NEVER**		
Caridean Shrimp	Palaemonetes pugio								1		**IDENTIFIED**		
Insecta	Chironomidae	1			2	5	3	1	5	2			
	total number of individuals	7	5	4	246	232	222	85	128	89			
	total number of taxa	4	2	1	5	5	5	3	4	4			
	mean number of individuals	5.3			233.3			100.7					
	mean number of taxa	2.3			5.0			3.7					
	TOTAL # OF TAXA	**4**			**5**			**5**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**16**			**700**			**302**			**N.D.**		

TABLE B-25

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN5 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN5			TN5			TN5			TN5	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	54	55	56	398	399	400	514	515	516	639	640	641
	Date	3/30/1987			9/21/1987			11/23/1987			2/23/1988		
	Time	13:05	13:15	13:20	14:13	14:15	14:17	11:47	11:54	11:56	12:05	12:11	12:!5
	Tidal Stage	High + 3			High + 4.5			High + 1			Low + 4		
	Depth				3 ft			5 ft			6-5 ft		
	Salinity (0/00) surface	3			3			0			0		
	bottom	3						1			0		
	Temp (oC) surface	16.5			21			6			9.2		
	bottom	16.5						6			8.9		
	air	15			20			10			11		
	D.O. (mg/L) surface	9			5.8			5.8			7.2		
	bottom	9						6.1			6.9		
	pH surface	7.6			7.5			7.5			7.5		
	bottom	7.6						7.5			7.5		
	Secchi (cm)	60			90			50			50		
Oligochaeta	Oligochaeta	1	3		16	12	5	2	23	10	37	27	21
Gastropoda	Hydrobia totteni				27		8			2			1
Insecta	Chaoborus sp.									1			
	Chironomidae				5	2	4	1		3			
	total number of individuals	1	3	0	48	14	17	3	23	16	37	27	22
	total number of taxa	1	1	0	3	2	3	2	1	4	1	1	2
	mean number of individuals	1.3			26.3			14.0			28.7		
	mean number of taxa	0.7			2.7			2.3			1.3		
	TOTAL # OF TAXA	**1**			**3**			**4**			**2**		
	TOTAL # OF INDIVIDUALS	**4**			**79**			**42**			**86**		

TABLE B-26

Number of Benthic Macroinvertebrates Collected in a Full Sized Ponar Grab Sampler at Location TN6 (Hackensack River)

HMDC Hackensack River Benthic Inventory

Spring 1987 to Winter 1987-88

		SPRING 1987			SUMMER 1987			AUTUMN 1987			WINTER 1987-1988		
	Site Location		TN6			TN6			TN6			TN6	
	Replicate No.	1	2	3	1	2	3	1	2	3	1	2	3
	Collection Number	51	52	53	401	402	403	505	506	507	630	631	632
	Date	3/30/1987			9/21/1987			11/23/1987			2/23/1988		
	Time	12:15	12:23	12:30	14:31	14:33	14:35	10:45	10:48	10:51	11:19	11:21	11:23
	Tidal Stage	High + 2			High + 5			High + 0			Low + 3		
	Depth	6 ft			3 ft			5 ft			4 ft		
	Salinity (0/00) surface	4			2			0			0		
	bottom	4						1			0		
	Temp (oC) surface	16.5			21			7			10.3		
	bottom	16.5						6			10.3		
	air	17			20			10			11		
	D.O. (mg/L) surface	7.2			3			5			7.2		
	bottom	7.2						6.4			7		
	pH surface	7.5			7.5			8.2			8.1		
	bottom	7.5						7.6			7.7		
	Secchi (cm)	40			70			40			50		
Oligochaeta	Oligochaeta	22	18	9	74	48	77	66	50	81	**SORTED**		
Gastropoda	Hydrobia totteni				18	30	18	20	5	3		**BUT**	
Bivalvia	Congeria leucophaeta								1		**NEVER**		
Insecta	Chironomidae				1	1	1	2		1	**IDENTIFIED**		
	total number of individuals	22	18	9	93	79	96	88	56	85			
	total number of taxa	1	1	1	3	3	3	3	3	3			
	mean number of individuals	16.3			89.3			76.3					
	mean number of taxa	1.0			3.0			3.0					
	TOTAL # OF TAXA	**1**			**3**			**4**			**N.D.**		
	TOTAL # OF INDIVIDUALS	**49**			**268**			**229**			**N.D.**		