HUDSON/RARITAN BAY ESTUARY
BENTHIC COMMUNITY ASSESSMENT

SUBMITTED TO

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Hudson-Raritan Bay Estuary was sampled during September 1991. One aspect of this study was benthic community characterization, which was accomplished via sample collection by National Oceanic and Atmospheric Administration (NOAA) personnel and laboratory and data analysis by Barry A. Vittor & Associates, Inc. (BVA).

METHODS

Sample Collection And Handling

A Young dredge (area = 0.04 m^2) was used to collect replicate bottom samples at each of 72 stations in the Hudson-Raritan Bay Estuary. Macroinfaunal samples were sieved through a 0.5–mm mesh screen and preserved with 10% formalin on ship. Macroinfaunal samples were transported to Vittor & Associate's laboratory in Mobile, Alabama.

Macroinfaunal Sample Analysis

In the laboratory of BVA, benthic samples were inventoried, rinsed gently through a 0.5 mm mesh sieve to remove preservatives and sediment, stained with Rose Bengal, and stored in 70% isopropanol solution until processing. Sample material (sediment, detritus, organisms) was placed in white enamel trays for sorting under Wild M-5A dissecting microscopes. All macroinvertebrates were carefully removed with forceps and placed in labelled glass vials containing 70% isopropanol. Each vial represented a major taxonomic group (e.g. Polychaeta, Mollusca, Arthropoda). All sorted macroinvertebrates were identified to the lowest practical identification level (LPIL), which in most cases was to species level unless the specimen was a juvenile, damaged, or otherwise unidentifiable. The number of individuals of each taxon, excluding fragments, was recorded. A voucher collection was prepared, composed of representative individuals of each species not previously encountered in samples from the region.

DATA ANALYSIS

All data generated as a result of laboratory analysis of macroinfauna samples were first coded on data sheets. Enumeration data were entered for each species according to station and

replicate. These data were reduced to a data summary report for each station, which included a taxonomic species list and benthic community parameters information. Archive data files of species identification and enumeration were prepared.

The QA/QC reports for the Hudson-Raritan samples are given in Appendix A.

The analytical methodologies utilized for this study were similar to those used in other benthic community characterization reports prepared for NOAA. Macroinfaunal characterization involves an evaluation of several biological community structure parameters (e.g., species abundance, species composition and species diversity indices) during initial data reduction, followed by pattern and classification analysis for delineation of taxa assemblages. Since species are distributed along environmental gradients, there are generally no distinct boundaries between communities. However, the relationships between habitats and species assemblages often reflect the interactions of physical and biological factors and indicate major ecological trends.

Assemblage Structure

Several numerical indices were chosen for analysis and interpretation of the macroinfaunal data. Selection was based primarily on the ability of the index to provide a meaningful summary of data, as well as the applicability of the index to the characterization of the benthic community. Infaunal abundance is reported as the total number of individuals per station and the total number of individuals per square meter (= density). Taxa richness is reported as the total number of taxa represented in a given station collection.

Taxa diversity, which is often related to the ecological stability and environmental "quality" of the benthos, was estimated by the Pielou's Index (Pielou, 1966), according to the following formula:

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

where, S = is the number of taxa in the sample,
i = is the i'th taxa in the sample, and
p_i = is the number of individuals of the i'th taxa divided by the total number of individuals in the sample.

Taxa diversity within a given community is dependent upon the number of taxa present (taxa richness) and the distribution of all individuals among those taxa (equitability or evenness). In order to quantify and compare faunal equitability to taxa diversity for a given area, Pielou's Index J' (Pielou, 1966) was calculated as J' = H'/*ln* S, where *ln* S = H'_{max}, or the maximum possible diversity, when all taxa are represented by the same number of individuals; thus, J' = H' /H'_{max}.

Macroinfaunal data were graphically and statistically analyzed to identify any differences in density and number of taxa per replicate between stations. Data for total density were ln(x+1) transformed to meet normality assumptions (Shapiro-Wilk W; SAS Institute, 1995). Transformed density data and taxa data were analyzed using a one-way ANOVA (SAS Institute, 1995).

Numerical classification analysis (Boesch 1977) was performed on the faunal data to examine within- and between- stations differences at the Sabine Lake stations and to compare faunal composition at each station within the site. Both normal and inverse classification analyses were used in this study. Normal analysis (sometimes called Q-analysis) treats samples as individual observations, each being composed of a number of attributes (i.e. the various taxa from a given sample). Normal analysis is instructive in helping to ascertain community structure and to infer specific ecological conditions between sampling stations from the relative distributions of species. Inverse classification (termed R-analysis) is based on taxa as individuals, each of which is characterized by its relative abundance in the various samples. This type of analysis is commonly used to identify species groupings with particular habitats or environmental conditions.

Classification analysis of both station collections (normal analysis) and taxa (inverse analysis) was performed using the Czekanowski quantitative index of faunal similarity (Field and MacFarlane 1968). This index is computationally equivalent to the Bray-Curtis similarity measure (Bray and Curtis 1957). The value of the similarity index is 1.0 when two samples are identical and 0 when no taxa are in common. Hierarchical clustering of similarity values is achieved using

the group-average sorting strategy (Lance and Williams 1967) and displayed in the form of dendograms.

Both similarity classification and cluster analysis were performed using the microcomputer package, “Community Analysis System 5.0” (Bloom 1994), as modified for use in Vittor & Associate's benthic data management program. Taxa used in these analyses were selected according to their percent abundance and percent frequency. Total densities for each of the selected taxa at a given station were ln-transformed [x=ln(x+1)] for the analysis.

BENTHIC COMMUNITY CHARACTERIZATION

Faunal Composition, Abundance, And Community Structure

Table 1 provides a complete phylogenetic listing for all stations as well as data on taxa abundance and station occurrence. Four Microsoft ™Excel 5.0 (Macintosh version) spreadsheets are being provided separately to NOAA which include: raw data on taxa abundance and density by replicate, a complete taxonomic listing with station abundance and occurrence and QA/QC comments, a major taxa table with overall taxa abundance, and an assemblage parameter table including data on mean number of taxa, mean density, taxa diversity and taxa evenness by station.

A total of 30,099 organisms, representing 129 taxa, were identified from the 72 stations (Table 2). Polychaetes were the most numerous organisms present representing 48.0% of the total assemblage, followed in abundance by bivalves (23.1%), amphipods (16.7%) and oligochaetes (8.6%). Polychaetes represented 54.3% of the total number of taxa followed by amphipods (11.6%), bivalves (10.9%), other malacostracan taxa (7.8%) and gastropods (7.0%) (Table 2). The percentage abundance of the major taxa at the 72 stations is given in Table 3.

The dominant taxa collected from the samples were the polychaete, *Mediomastus* LPIL, the malacostracan, *Ampelisca abdita*, Bivalvia (LPIL) and the polychaete, *Streblospio benedicti* representing 17.3%, 14.3%, 12.7%, and 9.0% of the total number of individuals, respectively (Table 1). The polychaetes, *Mediomastus* (LPIL) and *Hypereteone heteropoda* were the most

Table 1. Abundance and distribution of taxa for the Hudson-Raritan stations, September 1991. Taxa above the shaded line were included in the classification analysis.

Taxa	Phylum	Class	No. of Individuals	% of Total	Cumulative %	Station Occur.	% Station Occur.	Comment
Mediomastus (LPIL)	A	Poly	5214	17.32	17.32	60	83.3	anterior portions only, probably *M . ambiseta* , pygidium needed for species ID
Ampelisca abdita	Ar	Mala	4308	14.31	31.64	31	43.1	
Bivalvia (LPIL)	M	Biva	3811	12.66	44.30	52	72.2	specimen decalcified
Streblospio benedicti	A	Poly	2710	9.00	53.30	48	66.7	
Mediomastus ambiseta	A	Poly	1622	5.39	58.69	50	69.4	
Oligochaeta (LPIL)	A	Olig	1572	5.22	63.91	36	50.0	marine and some estuarine specimens only identified to class
Mytilus edulis	M	Biva	1527	5.07	68.99	21	29.2	
Mulinia lateralis	M	Biva	1430	4.75	73.74	27	37.5	
Tubificidae (LPIL)	A	Olig	1006	3.34	77.08	30	41.7	sexually immature
Polydora cornuta	A	Poly	755	2.51	79.59	19	26.4	
Leucon americanus	Ar	Mala	704	2.34	81.93	32	44.4	
Ampharetidae (LPIL)	A	Poly	596	1.98	83.91	26	36.1	missing identification characters and/or immature
Leitoscoloplos (LPIL)	A	Poly	522	1.73	85.64	42	58.3	anterior segments only, abdominal segments necessary for species ID
Asabellides oculata	A	Poly	521	1.73	87.37	28	38.9	
Ampelisca (LPIL)	Ar	Mala	500	1.66	89.03	8	11.1	juvenile specimen or missing characters
Hypereteone heteropoda	A	Poly	406	1.35	90.38	57	79.2	
Cirratulidae (LPIL)	A	Poly	401	1.33	91.71	26	36.1	anterior fragment, posterior needed for species ID
Spio setosa	A	Poly	338	1.12	92.84	18	25.0	
Tharyx acutus	A	Poly	290	0.96	93.80	15	20.8	
Nephtyidae (LPIL)	A	Poly	209	0.69	94.49	14	19.4	specimen immature and/or damaged
Sabellaria vulgaris	A	Poly	167	0.55	95.05	13	18.1	
Unciola serrata	Ar	Mala	148	0.49	95.54	15	20.8	
Mactridae (LPIL)	M	Biva	116	0.39	95.93	2	2.8	juvenile specimen
Eumida sanguinea	A	Poly	90	0.30	96.23	14	19.4	
Edotia triloba	Ar	Mala	88	0.29	96.52	26	36.1	
Gastropoda (LPIL)	M	Gast	77	0.26	96.77	29	40.3	crushed and/or immature specimen
Eusarsiella zostericola	Ar	Ostr	72	0.24	97.01	18	25.0	
Streptosyllis sp.B	A	Poly	63	0.21	97.22	15	20.8	
Nereis succinea	A	Poly	54	0.18	97.40	22	30.6	
Phyllodocidae (LPIL)	A	Poly	49	0.16	97.56	22	30.6	
Heteromastus filiformis	A	Poly	48	0.16	97.72	14	19.4	
Corophium tuberculatum	Ar	Mala	46	0.15	97.88	19	26.4	
Oxyurostylis smithi	Ar	Mala	43	0.14	98.02	16	22.2	
Leitoscoloplos robustus	A	Poly	42	0.14	98.16	16	22.2	
Spionidae (LPIL)	A	Poly	41	0.14	98.30	14	19.4	
Pectinaria gouldii	A	Poly	37	0.12	98.42	19	26.4	
Rhynchocoela (LPIL)	R		32	0.11	98.52	16	22.2	
Tellina (LPIL)	M	Biva	28	0.09	98.62	10	13.9	
Nereis (LPIL)	A	Poly	26	0.09	98.70	14	19.4	
Glycera americana	A	Poly	23	0.08	98.78	12	16.7	
Polygordius (LPIL)	A	Poly	23	0.08	98.86	1	1.4	
Capitellidae (LPIL)	A	Poly	22	0.07	98.93	13	18.1	
Actiniaria (LPIL)	Cn	Anth	19	0.06	98.99	7	9.7	
Oxyurostylis (LPIL)	Ar	Mala	19	0.06	99.06	2	2.8	
Harmothoe imbricata	A	Poly	17	0.06	99.11	11	15.3	
Capitella capitata	A	Poly	15	0.05	99.16	5	6.9	
Unciola (LPIL)	Ar	Mala	12	0.04	99.20	6	8.3	
Ilyanassa trivittata	M	Gast	11	0.04	99.24	6	8.3	
Nereididae (LPIL)	A	Poly	9	0.03	99.27	5	6.9	
Nucula proxima	M	Biva	9	0.03	99.30	4	5.6	
Podarkeopsis levifuscina	A	Poly	8	0.03	99.33	7	9.7	
Leitoscoloplos acutus	A	Poly	8	0.03	99.35	2	2.8	
Paranaitis speciosa	A	Poly	8	0.03	99.38	4	5.6	
Polynoidae (LPIL)	A	Poly	8	0.03	99.41	5	6.9	
Corophium (LPIL)	Ar	Mala	7	0.02	99.43	2	2.8	
Tellinidae (LPIL)	M	Biva	6	0.02	99.45	2	2.8	
Ascidiacea (LPIL)	C	Asci	6	0.02	99.47	1	1.4	
Spiochaetopterus oculatus	A	Poly	5	0.02	99.49	3	4.2	
Nephtys picta	A	Poly	5	0.02	99.50	1	1.4	
Travisia parva	A	Poly	5	0.02	99.52	1	1.4	
Leitoscoloplos fragilis	A	Poly	5	0.02	99.53	2	2.8	
Phyllodoce arenae	A	Poly	5	0.02	99.55	5	6.9	
Streptosyllis (LPIL)	A	Poly	5	0.02	99.57	4	5.6	
Tubificoides heterochaetus	A	Olig	5	0.02	99.58	1	1.4	
Rictaxis punctostriatus	M	Gast	5	0.02	99.60	2	2.8	
Xanthidae (LPIL)	Ar	Mala	5	0.02	99.62	4	5.6	
Ampharete acutifrons	A	Poly	4	0.01	99.63	2	2.8	
Microphthalmus (LPIL)	A	Poly	4	0.01	99.64	3	4.2	
Nephtys incisa	A	Poly	4	0.01	99.66	2	2.8	
Orbiniidae (LPIL)	A	Poly	4	0.01	99.67	4	5.6	
Polydora (LPIL)	A	Poly	4	0.01	99.68	4	5.6	
Solenidae (LPIL)	M	Biva	4	0.01	99.70	3	4.2	
Lyonsia hyalina	M	Biva	4	0.01	99.71	2	2.8	

Table 1 continued:

Taxa	Phylum	Class	No. of Individuals	% of Total	Cumulative %	Station Occur.	% Station Occur.
Elasmopus levis	Ar	Mala	4	0.01	99.72	3	4.2
Hesionidae (LPIL)	A	Poly	3	0.01	99.73	3	4.2
Microphthalmus aberrans	A	Poly	3	0.01	99.74	3	4.2
Dipolydora socialis	A	Poly	3	0.01	99.75	2	2.8
Sabellidae (LPIL)	A	Poly	3	0.01	99.76	2	2.8
Yoldia (LPIL)	M	Biva	3	0.01	99.77	1	1.4
Acteocina canaliculata	M	Gast	3	0.01	99.78	2	2.8
Cyathura polita	Ar	Mala	3	0.01	99.79	1	1.4
Cyathura burbancki	Ar	Mala	3	0.01	99.80	2	2.8
Hydrozoa (LPIL)	Cn	Hydr	2	0.01	99.81	1	1.4
Cirriformia (LPIL)	A	Poly	2	0.01	99.82	1	1.4
Pherusa (LPIL)	A	Poly	2	0.01	99.82	2	2.8
Podarke obscura	A	Poly	2	0.01	99.83	1	1.4
Maldanidae (LPIL)	A	Poly	2	0.01	99.84	2	2.8
Laeonereis culveri	A	Poly	2	0.01	99.84	2	2.8
Aricidea catherinae	A	Poly	2	0.01	99.85	1	1.4
Sigambra tentaculata	A	Poly	2	0.01	99.86	2	2.8
Apoprionospio pygmaea	A	Poly	2	0.01	99.86	2	2.8
Proceraea cornuta	A	Poly	2	0.01	99.87	1	1.4
Crepidula (LPIL)	M	Gast	2	0.01	99.88	2	2.8
Ceratopogonidae (LPIL)	Ar	Inse	2	0.01	99.88	2	2.8
Phoronis (LPIL)	Ph		1	0.003	99.89	1	1.4
Flabelligeridae (LPIL)	A	Poly	1	0.003	99.89	1	1.4
Pherusa plumosa	A	Poly	1	0.003	99.89	1	1.4
Glycera (LPIL)	A	Poly	1	0.003	99.90	1	1.4
Travisia (LPIL)	A	Poly	1	0.003	99.90	1	1.4
Diopatra cuprea	A	Poly	1	0.003	99.90	1	1.4
Lepidonotus sublevis	A	Poly	1	0.003	99.91	1	1.4
Harmothoe (LPIL)	A	Poly	1	0.003	99.91	1	1.4
Paraprionospio pinnata	A	Poly	1	0.003	99.91	1	1.4
Prionospio steenstrupi	A	Poly	1	0.003	99.92	1	1.4
Spiophanes bombyx	A	Poly	1	0.003	99.92	1	1.4
Exogone (LPIL)	A	Poly	1	0.003	99.92	1	1.4
Terebellidae (LPIL)	A	Poly	1	0.003	99.93	1	1.4
Pectinaria (LPIL)	A	Poly	1	0.003	99.93	1	1.4
Sabellariidae (LPIL)	A	Poly	1	0.003	99.93	1	1.4
Mytilus (LPIL)	M	Biva	1	0.003	99.94	1	1.4
Mercenaria mercenaria	M	Biva	1	0.003	99.94	1	1.4
Myidae (LPIL)	M	Biva	1	0.003	99.94	1	1.4
Mya (LPIL)	M	Biva	1	0.003	99.95	1	1.4
Nassariidae (LPIL)	M	Gast	1	0.003	99.95	1	1.4
Ilyanassa (LPIL)	M	Gast	1	0.003	99.95	1	1.4
Odostomia (LPIL)	M	Gast	1	0.003	99.96	1	1.4
Scaphandridae (LPIL)	M	Gast	1	0.003	99.96	1	1.4
Limnoria (LPIL)	Ar	Mala	1	0.003	99.96	1	1.4
Parametopella cypris	Ar	Mala	1	0.003	99.97	1	1.4
Gammarus (LPIL)	Ar	Mala	1	0.003	99.97	1	1.4
Microdeutopus anomalus	Ar	Mala	1	0.003	99.97	1	1.4
Microdeutopus (LPIL)	Ar	Mala	1	0.003	99.98	1	1.4
Melitidae (LPIL)	Ar	Mala	1	0.003	99.98	1	1.4
Melita nitida	Ar	Mala	1	0.003	99.98	1	1.4
Elasmopus (LPIL)	Ar	Mala	1	0.003	99.99	1	1.4
Paracaprella tenuis	Ar	Mala	1	0.003	99.99	1	1.4
Paguridae (LPIL)	Ar	Mala	1	0.003	99.99	1	1.4
Procladius (LPIL)	Ar	Inse	1	0.003	100.00	1	1.4
Collembola (LPIL)	Ar	Inse	1	0.003	100.00	1	1.4

TAXA KEY

Phylum

A = Annelida

Class

Olig = Oligochaeta
Poly = Polychaeta

Ar = Arthropoda

Inse = Insecta
Mala = Malacostraca
Ostr = Ostracoda

C = Chordata

Asci = Ascidiacea

Cn = Cnidaria

Anth = Anthozoa
Hydr = Hydrozoa

M = Mollusca

Biva = Bivalvia
Gast = Gastropoda

Ph = Phoronida

R = Rhynchocoela

Table 2. Summary of abundance of major taxonomic groups for the Hudson-Raritan study, September 1991.

Taxa	Total No. Indivs.	% Total	Total No. Taxa	% Total
Annelida				
Polychaeta	14436	48.0	70	54.3
Oligochaeta	2583	8.6	3	2.3
Mollusca				
Bivalvia	6942	23.1	14	10.9
Gastropoda	102	0.3	9	7.0
Arthropoda				
Malacostraca				
Amphipoda	5033	16.7	15	11.6
Other Malacostraca	939	3.1	10	7.8
Insecta	4	0.0	3	2.3
Miscellaneous	60	0.2	5	3.9
TOTAL	**30099**		**129**	

Table 3. Percent abundance of major taxa for the Hudson-Raritan stations, September 1991.

Station	Phylum	Total No. of Taxa	% Taxa	Total No. of Individuals	% Individuals
1A	Annelida	9	60.0	140	88.6
1A	Mollusca	3	20.0	3	1.9
1A	Arthropoda	3	20.0	15	9.5
1A	Miscellaneous	0	0.0	0	0.0
	TOTAL	15		158	
1B	Annelida	10	76.9	28	71.8
1B	Mollusca	1	7.7	5	12.8
1B	Arthropoda	2	15.4	6	15.4
1B	Miscellaneous	0	0.0	0	0.0
	TOTAL	13		39	
1C	Annelida	6	66.7	20	87.0
1C	Mollusca	1	11.1	1	4.3
1C	Arthropoda	1	11.1	1	4.3
1C	Miscellaneous	1	11.1	1	4.3
	TOTAL	9		23	
2A	Annelida	5	62.5	21	33.9
2A	Mollusca	1	12.5	1	1.6
2A	Arthropoda	1	12.5	39	62.9
2A	Miscellaneous	1	12.5	1	1.6
	TOTAL	8		62	
2B	Annelida	6	66.7	58	64.4
2B	Mollusca	0	0.0	0	0.0
2B	Arthropoda	1	11.1	29	32.2
2B	Miscellaneous	2	22.2	3	3.3
	TOTAL	9		90	
2C	Annelida	2	50.0	6	17.1
2C	Mollusca	0	0.0	0	0.0
2C	Arthropoda	1	25.0	28	80.0
2C	Miscellaneous	1	25.0	1	2.9
	TOTAL	4		35	
3A	Annelida	8	80.0	153	93.9
3A	Mollusca	1	10.0	2	1.2
3A	Arthropoda	1	10.0	8	4.9
3A	Miscellaneous	0	0.0	0	0.0
	TOTAL	10		163	
3B	Annelida	8	80.0	190	62.7
3B	Mollusca	1	10.0	1	0.3
3B	Arthropoda	1	10.0	112	37.0
3B	Miscellaneous	0	0.0	0	0.0
	TOTAL	10		303	

3C	Annelida	4	66.7	23	65.7
3C	Mollusca	1	16.7	5	14.3
3C	Arthropoda	1	16.7	7	20.0
3C	Miscellaneous	0	0.0	0	0.0
	TOTAL	6		35	
4A	Annelida	7	77.8	311	88.1
4A	Mollusca	2	22.2	42	11.9
4A	Arthropoda	0	0.0	0	0.0
4A	Miscellaneous	0	0.0	0	0.0
	TOTAL	9		353	
4B	Annelida	10	71.4	140	63.6
4B	Mollusca	2	14.3	78	35.5
4B	Arthropoda	2	14.3	2	0.9
4B	Miscellaneous	0	0.0	0	0.0
	TOTAL	14		220	
4C	Annelida	5	71.4	40	24.1
4C	Mollusca	2	28.6	126	75.9
4C	Arthropoda	0	0.0	0	0.0
4C	Miscellaneous	0	0.0	0	0.0
	TOTAL	7		166	
5A	Annelida	10	52.6	92	47.9
5A	Mollusca	6	31.6	73	38.0
5A	Arthropoda	3	15.8	27	14.1
5A	Miscellaneous	0	0.0	0	0.0
	TOTAL	19		192	
5B	Annelida	12	70.6	133	79.2
5B	Mollusca	1	5.9	12	7.1
5B	Arthropoda	4	23.5	23	13.7
5B	Miscellaneous	0	0.0	0	0.0
	TOTAL	17		168	
6A	Annelida	9	42.9	428	28.0
6A	Mollusca	8	38.1	1087	71.1
6A	Arthropoda	4	19.0	13	0.9
6A	Miscellaneous	0	0.0	0	0.0
	TOTAL	21		1528	
6B	Annelida	13	59.1	355	40.2
6B	Mollusca	6	27.3	510	57.8
6B	Arthropoda	3	13.6	18	2.0
6B	Miscellaneous	0	0.0	0	0.0
	TOTAL	22		883	
6C	Annelida	10	50.0	203	39.0
6C	Mollusca	6	30.0	284	54.6
6C	Arthropoda	4	20.0	33	6.3
6C	Miscellaneous	0	0.0	0	0.0
	TOTAL	20		520	

Table 3 continued:

7A	Annelida	13	72.2	134	18.7
7A	Mollusca	2	11.1	569	79.6
7A	Arthropoda	3	16.7	12	1.7
7A	Miscellaneous	0	0.0	0	0.0
	TOTAL	18		715	
7B	Annelida	12	54.5	381	32.2
7B	Mollusca	4	18.2	782	66.1
7B	Arthropoda	5	22.7	19	1.6
7B	Miscellaneous	1	4.5	1	0.1
	TOTAL	22		1183	
7C	Annelida	24	64.9	1145	47.0
7C	Mollusca	6	16.2	1273	52.2
7C	Arthropoda	6	16.2	15	0.6
7C	Miscellaneous	1	2.7	4	0.2
	TOTAL	37		2437	
8A	Annelida	6	75.0	42	93.3
8A	Mollusca	1	12.5	2	4.4
8A	Arthropoda	1	12.5	1	2.2
8A	Miscellaneous	0	0.0	0	0.0
	TOTAL	8		45	
8B	Annelida	12	66.7	85	90.4
8B	Mollusca	3	16.7	6	6.4
8B	Arthropoda	3	16.7	3	3.2
8B	Miscellaneous	0	0.0	0	0.0
	TOTAL	18		94	
8C	Annelida	17	68.0	547	97.9
8C	Mollusca	3	12.0	6	1.1
8C	Arthropoda	5	20.0	6	1.1
8C	Miscellaneous	0	0.0	0	0.0
	TOTAL	25		559	
9A	Annelida	13	65.0	266	90.8
9A	Mollusca	4	20.0	23	7.8
9A	Arthropoda	3	15.0	4	1.4
9A	Miscellaneous	0	0.0	0	0.0
	TOTAL	20		293	
9B	Annelida	7	50.0	175	91.6
9B	Mollusca	3	21.4	6	3.1
9B	Arthropoda	4	28.6	10	5.2
9B	Miscellaneous	0	0.0	0	0.0
	TOTAL	14		191	
9C	Annelida	21	61.8	375	78.0
9C	Mollusca	4	11.8	25	5.2
9C	Arthropoda	7	20.6	74	15.4
9C	Miscellaneous	2	5.9	7	1.5
	TOTAL	34		481	

Table 3 continued:

10A	Annelida	12	80.0	55	90.2
10A	Mollusca	1	6.7	4	6.6
10A	Arthropoda	2	13.3	2	3.3
10A	Miscellaneous	0	0.0	0	0.0
	TOTAL	15		61	
10B	Annelida	20	74.1	705	92.9
10B	Mollusca	2	7.4	24	3.2
10B	Arthropoda	5	18.5	30	4.0
10B	Miscellaneous	0	0.0	0	0.0
	TOTAL	27		759	
10C	Annelida	23	71.9	1352	95.7
10C	Mollusca	2	6.3	14	1.0
10C	Arthropoda	6	18.8	46	3.3
10C	Miscellaneous	1	3.1	1	0.1
	TOTAL	32		1413	
11A	Annelida	4	66.7	10	76.9
11A	Mollusca	0	0.0	0	0.0
11A	Arthropoda	2	33.3	3	23.1
11A	Miscellaneous	0	0.0	0	0.0
	TOTAL	6		13	
11B	Annelida	21	75.0	351	93.4
11B	Mollusca	3	10.7	8	2.1
11B	Arthropoda	4	14.3	17	4.5
11B	Miscellaneous	0	0.0	0	0.0
	TOTAL	28		376	
11C	Annelida	16	69.6	515	96.3
11C	Mollusca	2	8.7	4	0.7
11C	Arthropoda	5	21.7	16	3.0
11C	Miscellaneous	0	0.0	0	0.0
	TOTAL	23		535	
12A	Annelida	16	55.2	305	92.4
12A	Mollusca	3	10.3	7	2.1
12A	Arthropoda	10	34.5	18	5.5
12A	Miscellaneous	0	0.0	0	0.0
	TOTAL	29		330	
12B	Annelida	12	75.0	78	84.8
12B	Mollusca	3	18.8	13	14.1
12B	Arthropoda	1	6.3	1	1.1
12B	Miscellaneous	0	0.0	0	0.0
	TOTAL	16		92	
12C	Annelida	9	81.8	49	86.0
12C	Mollusca	0	0.0	0	0.0
12C	Arthropoda	2	18.2	8	14.0
12C	Miscellaneous	0	0.0	0	0.0
	TOTAL	11		57	

Table 3 continued:

13A	Annelida	19	67.9	430	27.4
13A	Mollusca	3	10.7	1089	69.4
13A	Arthropoda	5	17.9	49	3.1
13A	Miscellaneous	1	3.6	2	0.1
	TOTAL	28		1570	
13B	Annelida	9	69.2	305	97.4
13B	Mollusca	2	15.4	3	1.0
13B	Arthropoda	1	7.7	4	1.3
13B	Miscellaneous	1	7.7	1	0.3
	TOTAL	13		313	
13C	Annelida	7	70.0	136	94.4
13C	Mollusca	1	10.0	4	2.8
13C	Arthropoda	2	20.0	4	2.8
13C	Miscellaneous	0	0.0	0	0.0
	TOTAL	10		144	
14C	Annelida	5	62.5	26	78.8
14C	Mollusca	3	37.5	7	21.2
14C	Arthropoda	0	0.0	0	0.0
14C	Miscellaneous	0	0.0	0	0.0
	TOTAL	8		33	
15A	Annelida	17	77.3	341	59.1
15A	Mollusca	1	4.5	231	40.0
15A	Arthropoda	4	18.2	5	0.9
15A	Miscellaneous	0	0.0	0	0.0
	TOTAL	22		577	
15C	Annelida	14	63.6	714	81.2
15C	Mollusca	4	18.2	160	18.2
15C	Arthropoda	4	18.2	5	0.6
15C	Miscellaneous	0	0.0	0	0.0
	TOTAL	22		879	
16A	Annelida	11	64.7	192	85.0
16A	Mollusca	4	23.5	27	11.9
16A	Arthropoda	1	5.9	4	1.8
16A	Miscellaneous	1	5.9	3	1.3
	TOTAL	17		226	
16B	Annelida	13	65.0	134	78.8
16B	Mollusca	3	15.0	20	11.8
16B	Arthropoda	4	20.0	16	9.4
16B	Miscellaneous	0	0.0	0	0.0
	TOTAL	20		170	
16C	Annelida	7	70.0	61	14.8
16C	Mollusca	2	20.0	13	3.2
16C	Arthropoda	1	10.0	338	82.0
16C	Miscellaneous	0	0.0	0	0.0
	TOTAL	10		412	

Table 3 continued:

17C	Annelida	4	57.1	22	59.5
17C	Mollusca	2	28.6	6	16.2
17C	Arthropoda	1	14.3	9	24.3
17C	Miscellaneous	0	0.0	0	0.0
	TOTAL	7		37	
18C	Annelida	3	100.0	9	100.0
18C	Mollusca	0	0.0	0	0.0
18C	Arthropoda	0	0.0	0	0.0
18C	Miscellaneous	0	0.0	0	0.0
	TOTAL	3		9	
19A	Annelida	4	66.7	16	80.0
19A	Mollusca	1	16.7	1	5.0
19A	Arthropoda	1	16.7	3	15.0
19A	Miscellaneous	0	0.0	0	0.0
	TOTAL	6		20	
19B	Annelida	8	80.0	51	96.2
19B	Mollusca	0	0.0	0	0.0
19B	Arthropoda	2	20.0	2	3.8
19B	Miscellaneous	0	0.0	0	0.0
	TOTAL	10		53	
19C	Annelida	2	66.7	12	85.7
19C	Mollusca	0	0.0	0	0.0
19C	Arthropoda	0	0.0	0	0.0
19C	Miscellaneous	1	33.3	2	14.3
	TOTAL	3		14	
20C	Annelida	10	90.9	83	96.5
20C	Mollusca	0	0.0	0	0.0
20C	Arthropoda	1	9.1	3	3.5
20C	Miscellaneous	0	0.0	0	0.0
	TOTAL	11		86	
21A	Annelida	11	73.3	211	70.1
21A	Mollusca	1	6.7	62	20.6
21A	Arthropoda	3	20.0	28	9.3
21A	Miscellaneous	0	0.0	0	0.0
	TOTAL	15		301	
21C	Annelida	9	75.0	43	55.8
21C	Mollusca	1	8.3	11	14.3
21C	Arthropoda	2	16.7	23	29.9
21C	Miscellaneous	0	0.0	0	0.0
	TOTAL	12		77	
22A	Annelida	10	62.5	70	77.8
22A	Mollusca	2	12.5	6	6.7
22A	Arthropoda	3	18.8	13	14.4
22A	Miscellaneous	1	6.3	1	1.1
	TOTAL	16		90	

Table 3 continued:

22B	Annelida	8	50.0	117	92.9
22B	Mollusca	5	31.3	5	4.0
22B	Arthropoda	3	18.8	4	3.2
22B	Miscellaneous	0	0.0	0	0.0
	TOTAL	16		126	
22C	Annelida	9	60.0	64	73.6
22C	Mollusca	3	20.0	15	17.2
22C	Arthropoda	3	20.0	8	9.2
22C	Miscellaneous	0	0.0	0	0.0
	TOTAL	15		87	
23C	Annelida	14	70.0	273	54.9
23C	Mollusca	2	10.0	16	3.2
23C	Arthropoda	3	15.0	196	39.4
23C	Miscellaneous	1	5.0	12	2.4
	TOTAL	20		497	
24C	Annelida	11	55.0	308	44.4
24C	Mollusca	2	10.0	10	1.4
24C	Arthropoda	5	25.0	373	53.7
24C	Miscellaneous	2	10.0	3	0.4
	TOTAL	20		694	
25A	Annelida	14	77.8	55	22.9
25A	Mollusca	0	0.0	0	0.0
25A	Arthropoda	4	22.2	185	77.1
25A	Miscellaneous	0	0.0	0	0.0
	TOTAL	18		240	
25B	Annelida	10	62.5	17	9.4
25B	Mollusca	3	18.8	12	6.7
25B	Arthropoda	3	18.8	151	83.9
25B	Miscellaneous	0	0.0	0	0.0
	TOTAL	16		180	
25C	Annelida	10	62.5	45	14.9
25C	Mollusca	3	18.8	8	2.6
25C	Arthropoda	3	18.8	249	82.5
25C	Miscellaneous	0	0.0	0	0.0
	TOTAL	16		302	
26C	Annelida	14	60.9	136	31.0
26C	Mollusca	3	13.0	16	3.6
26C	Arthropoda	5	21.7	286	65.1
26C	Miscellaneous	1	4.3	1	0.2
	TOTAL	23		439	
27C	Annelida	11	61.1	59	14.1
27C	Mollusca	3	16.7	16	3.8
27C	Arthropoda	4	22.2	342	82.0
27C	Miscellaneous	0	0.0	0	0.0
	TOTAL	18		417	

Table 3 continued:

28A	Annelida	11	61.1	354	57.6
28A	Mollusca	4	22.2	34	5.5
28A	Arthropoda	2	11.1	225	36.6
28A	Miscellaneous	1	5.6	2	0.3
	TOTAL	18		615	
28B	Annelida	9	60.0	315	42.9
28B	Mollusca	2	13.3	10	1.4
28B	Arthropoda	3	20.0	403	54.9
28B	Miscellaneous	1	6.7	6	0.8
	TOTAL	15		734	
28C	Annelida	12	66.7	509	54.6
28C	Mollusca	3	16.7	7	0.8
28C	Arthropoda	2	11.1	414	44.4
28C	Miscellaneous	1	5.6	2	0.2
	TOTAL	18		932	
29C	Annelida	17	63.0	719	65.3
29C	Mollusca	5	18.5	173	15.7
29C	Arthropoda	4	14.8	208	18.9
29C	Miscellaneous	1	3.7	1	0.1
	TOTAL	27		1101	
30C	Annelida	13	72.2	378	43.3
30C	Mollusca	2	11.1	46	5.3
30C	Arthropoda	3	16.7	449	51.4
30C	Miscellaneous	0	0.0	0	0.0
	TOTAL	18		873	
31C	Annelida	12	70.6	103	72.5
31C	Mollusca	2	11.8	2	1.4
31C	Arthropoda	3	17.6	37	26.1
31C	Miscellaneous	0	0.0	0	0.0
	TOTAL	17		142	
32C	Annelida	10	76.9	275	97.5
32C	Mollusca	1	7.7	3	1.1
32C	Arthropoda	2	15.4	4	1.4
32C	Miscellaneous	0	0.0	0	0.0
	TOTAL	13		282	
33A	Annelida	8	57.1	632	54.4
33A	Mollusca	3	21.4	3	0.3
33A	Arthropoda	2	14.3	525	45.2
33A	Miscellaneous	1	7.1	1	0.1
	TOTAL	14		1161	
33B	Annelida	9	50.0	434	54.0
33B	Mollusca	4	22.2	15	1.9
33B	Arthropoda	4	22.2	352	43.8
33B	Miscellaneous	1	5.6	3	0.4
	TOTAL	18		804	
33C	Annelida	10	62.5	459	51.6
33C	Mollusca	3	18.8	5	0.6
33C	Arthropoda	2	12.5	425	47.8
33C	Miscellaneous	1	6.3	1	0.1
	TOTAL	16		890	

widely distributed taxa being found at 83% and 79% of the stations, respectively. The distribution of taxa representing > 5% of the total assemblage at each station is given in Table 4.

Station mean density and mean number of taxa data are given in Table 5. Mean densities ranged from 75 organisms·m^{-2} (SD = 43) at Station 18C to 20,308 organisms·m^{-2} (SD = 5115) at Station 7C (Table 5). The mean number of taxa per replicate ranged from 1 taxa·rep^{-1} at Station 19C to 22.3 taxa·rep^{-1} at Station 7C (Table 5).

ANOVA analyses were performed on transformed density data and taxa richness data for the Hudson/Raritan stations. ANOVA results for density data are given in Table 6. There were highly significant differences in mean densities and number of taxa between the Hudson/Raritan stations.

Taxa diversity and evenness for the Hudson/Raritan stations are given in Table 5. Taxa diversity (H') varied considerably and ranged from 0.7 at Station 2C to 2.4 at Station 12B. Taxa evenness (J') also exhibited considerable variation and ranged from 0.31 at Station 25B to 0.93 at Station 3C (Table 5).

Numerical Classification Analysis

Normal (station) and inverse (species) classification analyses were performed on the Hudson/Raritan data set and displayed as dendrograms (Figs. 1 and 2). Selection of the species included in the analyses was based on a minimum representation of 0.26% of total individuals. Count data for the 24 taxa selected were included in a matrix of station and species groups (Table 7). These taxa accounted for 96.8% of the total macroinfaunal assemblage.

Numerical classification of the 72 stations can be interpreted at a three-group level (≈ 14 – 20% level of similarity). Group A contained Station 8 and was dominated by two taxa, *Eusarsiella absens* and *Acteocina bidentata*, which were either absent or had low densities at the remaining stations. Group B was represented by Stations 17, 18 and 20; Group C contained Stations 2, 4, 7, 42, and 45 which had the highest station densities; and Group D contained Stations 47, 40, 41 and 48 (Table 7; Fig. 1).

Table 4. Percent abundance of dominant taxa (> 5% of the total) for the Hudson-Raritan stations, September 1991.

Taxa	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	6A	6B	6C	7A	7B	7C
Elasmopus (LPIL)																				
Cyathura polita																				
Laeonereis culveri																				
Tellina (LPIL)																				
Nephtys picta																				
Aricidea catherinae																				
Nephtyidae (LPIL)											14.5		9.9	15.5						
Mactridae (LPIL)												43.4	22.9							
Ampelisca (LPIL)																				
Rhynchocoela (LPIL)																				
Leucon americanus	8.2	12.8		62.9	32.2	80.0		37.0	20.0				6.3							
Leitoscoloplos robustus																				
Oligochaeta (LPIL)				8.1		8.6	41.1	27.1	17.1											
Tubificidae (LPIL)	46.8	12.8	30.4		31.1					19.0					5.2					
Streblospio benedicti	25.3	7.7	26.1	21.0	23.3	8.6	13.5	6.9	28.6		24.1	13.3	22.9	36.3	6.3	10.8	18.1		5.2	5.6
Ampharetidae (LPIL)													5.2			11.9		5.7	5.2	6.7
Asabellides oculata														10.1						7.2
Mulinia lateralis									14.3		34.5				34.7	43.9	10.4	25.2		
Bivalvia (LPIL)		12.8								9.9		32.5	12.0	7.1	35.6	12.5	42.9	54.4	65.8	51.3
Ampelisca abdita														9.5						
Mediomastus (LPIL)							26.4	23.4		31.4	11.8					8.4			10.2	11.4
Mediomastus ambiseta										28.9	6.8				10.2		6.7			
Leitoscoloplos (LPIL)																				
Hypereteone heteropoda		5.1							17.1											
Cirratulidae (LPIL)																				
Tharyx acutus																				
Sabellaria vulgaris							5.5													
Spio setosa																				
Mytilus edulis																				
Polydora cornuta																				
Edotia triloba																				
Unciola serrata																				
Oxyurostylis smithi													6.8							
Heteromastus filiformis	5.1	15.4	8.7																	
Spionidae (LPIL)		17.9	13.0																	

Table 4 continued:

Taxa	8A	8B	8C	9A	9B	9C	10A	10B	10C	11A	11B	11C	12A	12B	12C	13A	13B	13C	14C	15A	15C
Elasmopus (LPIL)										7.7											
Cyathura polita																					
Laeonereis culveri																					
Tellina (LPIL)																			9.1		
Nephtys picta																			15.2		
Aricidea catherinae																			6.1		
Nephtyidae (LPIL)																			30.3		
Mactridae (LPIL)																					
Ampelisca (LPIL)																					
Rhynchocoela (LPIL)																					
Leucon americanus										15.4											
Leitoscoloplos robustus																					
Oligochaeta (LPIL)		5.3		7.2					30.4	30.8				10.9	19.3		15.3	14.6		42.6	47.6
Tubificidae (LPIL)			7.5				13.1				24.5	16.1	26.4			6.0			24.2		
Streblospio benedicti	40.0	41.5	74.4	58.7		22.0	6.6	32.7	9.1	30.8	21.8	44.3	45.5	9.8			21.1	28.5			
Ampharetidae (LPIL)		8.5				7.3	6.6														6.0
Asabellides oculata				6.5			31.1			7.7	9.6										5.5
Mulinia lateralis														12.0	12.3						
Bivalvia (LPIL)				6.1			6.6												9.1		
Ampelisca abdita																					
Mediomastus (LPIL)	17.8						6.6							17.4	7.0	6.0	49.5	45.8			12.7
Mediomastus ambiseta														15.2			8.3				
Leitoscoloplos (LPIL)	15.6													8.7	47.4						
Hypereteone heteropoda	15.6										5.9										
Cirratulidae (LPIL)									21.3												
Tharyx acutus							14.8		15.4												
Sabellaria vulgaris																7.6					
Spio setosa									6.5	7.7	20.2	20.6		6.5							
Mytilus edulis																68.7				40.0	17.4
Polydora cornuta		24.5			83.2	28.3		45.3													
Edotia triloba																					
Unciola serrata						12.1															
Oxyurostylis smithi																					
Heteromastus filiformis																					
Spionidae (LPIL)				5.5																	

Table 4 continued:

Taxa	16A	16B	16C	17C	18C	19A	19B	19C	20C	21A	21C	22A	22B	22C	23C	24C	25A	25B	25C	26C
Elasmopus (LPIL)																				
Cyathura polita						15.0														
Laeonereis culveri						5.0														
Tellina (LPIL)																				
Nephtys picta																				
Aricidea catherinae																				
Nephtyidae (LPIL)																				
Mactridae (LPIL)																				
Ampelisca (LPIL)																7.1	26.7			24.1
Rhynchocoela (LPIL)								14.3												
Leucon americanus			82.0	24.3						8.6	19.5	5.6								
Leitoscoloplos robustus				8.1																
Oligochaeta (LPIL)	11.1			29.7		30.0		71.4												
Tubificidae (LPIL)		14.7			33.3		58.5		23.3											
Streblospio benedicti	13.3	21.8			55.6		7.5													
Ampharetidae (LPIL)																				
Asabellides oculata																				
Mulinia lateralis	5.8			8.1						20.6	14.3			5.7						
Bivalvia (LPIL)		8.8		8.1		5.0								10.3						
Ampelisca abdita											10.4	7.8			37.6	46.0	47.9	82.8	80.8	39.9
Mediomastus (LPIL)	11.5								33.7	34.6	33.8	16.7	16.7	25.3	36.6	27.5	11.3		7.9	22.1
Mediomastus ambiseta									5.8	12.6		7.8		14.9		11.2				
Leitoscoloplos (LPIL)	27.0	17.6	7.0	16.2					16.3	16.9	7.8	35.6	61.9	12.6	8.2					
Hypereteone heteropoda	6.6	8.8		5.4		10.0	17.0					5.6		6.9						
Cirratulidae (LPIL)	7.5																			
Tharyx acutus	5.3																			
Sabellaria vulgaris																				
Spio setosa						35.0	5.7	14.3												
Mytilus edulis																				
Polydora cornuta					11.1															
Edotia triloba		5.9																		
Unciola serrata																				
Oxyurostylis smithi																				
Heteromastus filiformis																				
Spionidae (LPIL)																				

Table 4 continued:

Taxa	27C	28A	28B	28C	29C	30C	31C	32C	33A	33B	33C
Elasmopus (LPIL)											
Cyathura polita											
Laeonereis culveri											
Tellina (LPIL)											
Nephtys picta											
Aricidea catherinae											
Nephtyidae (LPIL)											
Mactridae (LPIL)											
Ampelisca (LPIL)	29.3					10.9					
Rhynchocoela (LPIL)											
Leucon americanus											
Leitoscoloplos robustus											
Oligochaeta (LPIL)							7.7				
Tubificidae (LPIL)											
Streblospio benedicti											
Ampharetidae (LPIL)											
Asabellides oculata											
Mulinia lateralis											
Bivalvia (LPIL)					12.4	5.0					
Ampelisca abdita	52.0	36.3	54.2	44.3	14.7	39.2	24.6		44.8	40.9	47.1
Mediomastus (LPIL)	8.2	43.4	35.4	51.5	43.0	31.6	36.6	44.0	44.9	31.7	40.4
Mediomastus ambiseta		11.2	5.9		18.6	6.8	7.0	43.3	8.5	19.4	9.1
Leitoscoloplos (LPIL)							12.0				
Hypereteone heteropoda											
Cirratulidae (LPIL)											
Tharyx acutus											
Sabellaria vulgaris											
Spio setosa											
Mytilus edulis											
Polydora cornuta											
Edotia triloba											
Unciola serrata											
Oxyurostylis smithi											
Heteromastus filiformis											
Spionidae (LPIL)											

Table 5. Summary of benthic macroinvertebrate data for the Hudson-Raritan stations, September 1991.

Station	Total No. Taxa	Mean Taxa per Repl.	Total No. Indivs.	Density (nos/m^2)	Density (Std. Dev.)	H' Diversity	J' Evenness
1A	15	8.7	158	1317	831	1.66	0.61
1B	13	5.3	39	325	198	2.30	0.90
1C	9	4.0	23	192	80	1.87	0.85
2A	8	4.0	62	517	253	1.16	0.56
2B	9	6.3	90	750	328	1.56	0.71
2C	4	2.3	35	292	189	0.70	0.51
3A	10	7.3	163	1358	576	1.64	0.71
3B	10	7.0	303	2525	979	1.50	0.65
3C	6	3.7	35	292	290	1.66	0.93
4A	9	7.7	353	2942	617	1.65	0.75
4B	14	8.3	220	1833	763	1.78	0.67
4C	7	5.7	166	1383	636	1.38	0.71
5A	19	11.7	192	1600	667	2.25	0.76
5B	17	11.0	168	1400	222	2.11	0.75
6A	21	13.7	1528	12733	4160	1.65	0.54
6B	22	16.3	883	7358	2152	1.87	0.61
6C	20	14.0	520	4333	593	1.94	0.65
7A	18	9.0	715	5958	5696	1.42	0.49
7B	22	14.3	1183	9858	7105	1.37	0.44
7C	37	22.3	2437	20308	5115	1.85	0.51
8A	8	4.3	45	375	388	1.64	0.79
8B	18	8.0	94	783	472	1.90	0.66
8C	25	14.0	559	4658	1813	1.20	0.37
9A	20	11.7	293	2442	1640	1.68	0.56
9B	14	7.0	191	1592	558	0.84	0.32
9C	34	20.0	481	4008	1791	2.39	0.68
10A	15	6.3	61	508	555	2.21	0.82
10B	27	16.3	759	6325	1108	1.67	0.51
10C	32	20.7	1413	11775	3601	2.14	0.62
11A	6	1.7	13	108	104	1.61	0.90
11B	28	11.0	376	3133	225	2.21	0.66
11C	23	15.0	535	4458	1047	1.78	0.57
12A	29	14.7	330	2750	1011	1.90	0.56
12B	16	10.7	92	767	397	2.42	0.87
12C	11	5.3	57	475	416	1.66	0.69
13A	28	14.3	1570	13083	19957	1.33	0.40
13B	13	7.7	313	2608	1446	1.45	0.57
13C	10	6.3	144	1200	109	1.44	0.62
14C	8	5.0	33	275	25	1.81	0.87
15A	22	13.7	577	4808	3565	1.44	0.47
15C	22	13.0	879	7325	1772	1.71	0.55
16A	17	11.7	226	1883	402	2.30	0.81
16B	20	13.7	170	1417	526	2.40	0.80
16C	10	8.0	412	3433	1744	0.79	0.34
17C	7	5.0	37	308	170	1.77	0.91
18C	3	2.0	9	75	43	0.94	0.85
19A	6	3.3	20	167	118	1.54	0.86
19B	10	5.3	53	442	290	1.42	0.62
19C	3	1.0	14	117	115	0.80	0.72
20C	11	7.0	86	717	250	1.89	0.79
21A	15	7.7	301	2508	2286	1.78	0.66
21C	12	4.0	77	642	1111	1.94	0.78
22A	16	8.7	90	750	338	2.17	0.78
22B	16	8.0	126	1050	180	1.45	0.52
22C	15	10.3	87	725	278	2.33	0.86
23C	20	12.0	497	4142	1980	1.65	0.55
24C	20	11.7	694	5783	1242	1.53	0.51
25A	18	10.3	240	2000	350	1.57	0.54
25B	16	7.0	180	1500	492	0.86	0.31
25C	16	9.0	302	2517	936	0.90	0.32
26C	23	13.0	439	3658	967	1.68	0.54
27C	18	9.7	417	3475	250	1.39	0.48
28A	18	9.7	615	5125	3920	1.36	0.47
28B	15	8.0	734	6117	1174	1.11	0.41
28C	18	10.0	932	7767	4148	0.94	0.32
29C	27	16.7	1101	9175	3402	1.74	0.53
30C	18	11.3	873	7275	775	1.61	0.56
31C	17	9.3	142	1183	465	1.88	0.66
32C	13	8.0	282	2350	917	1.26	0.49
33A	14	8.3	1161	9675	3537	1.04	0.39
33B	18	12.0	804	6700	1627	1.43	0.49
33C	16	8.7	890	7417	2418	1.13	0.41

Table 6. ANOVA results for density and taxa differences among stations for the Hudson-Raritan stations, September 1991.

Density Results

Shapiro-Wilk W Test for Normality

W= 0.96 Prob < W = < 0.0001

ANOVA Table

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	71	371.85	5.24	**13.77**	**< 0.0001**
Error	139	52.86	0.38		
Total	210	424.71	2.02		

Taxa Results

Shapiro-Wilk W Test for Normality

W= 0.96 Prob < W = < 0.0001

ANOVA Table

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	71	4156.61	58.54	**5.75**	**< 0.0001**
Error	139	1414.17	10.17		
Total	210	5570.78	26.53		

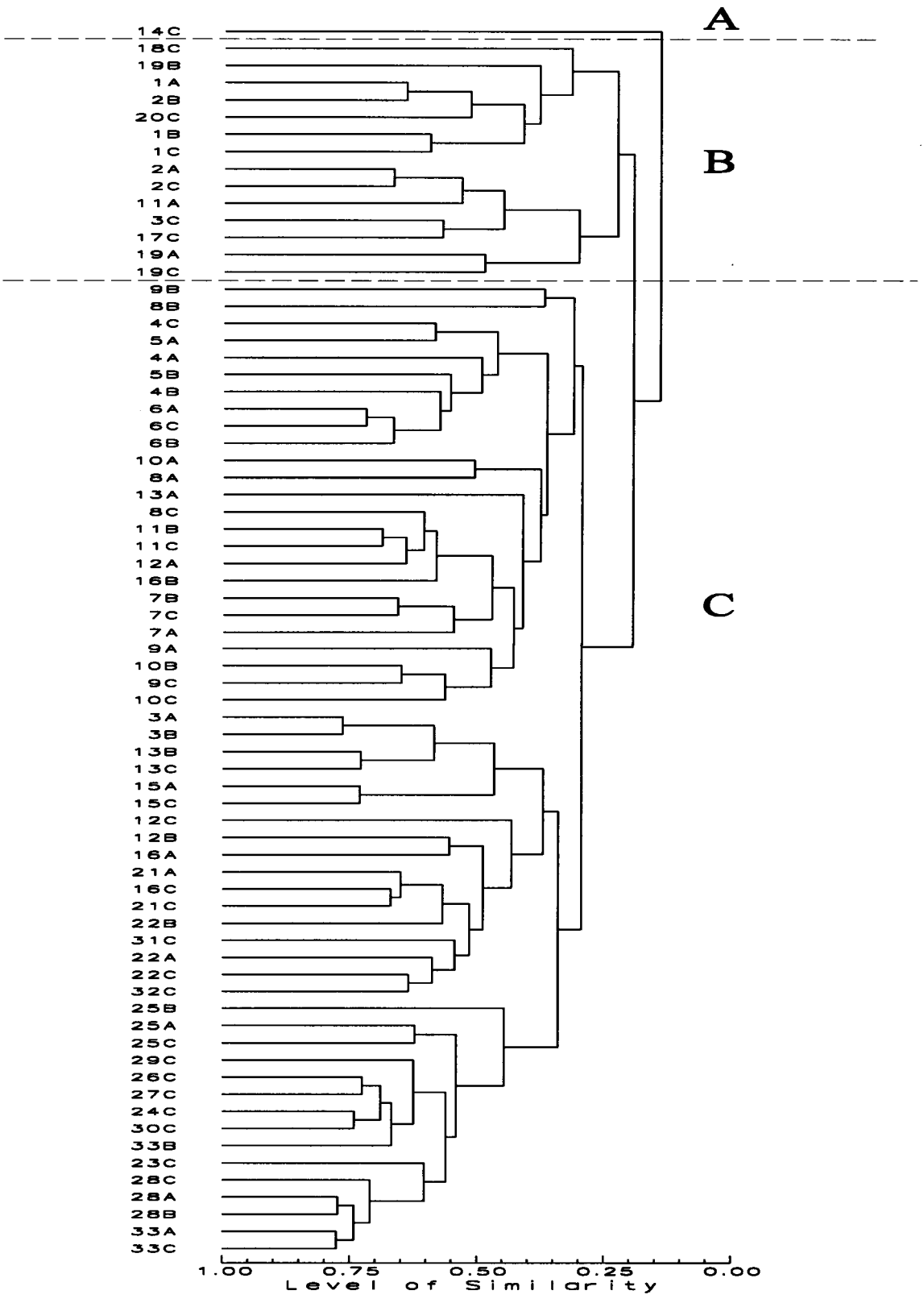

Figure 1. Normal (station) classification analysis for the Hudson-Raritan stations, September 1991. Large, bolded letters (A, B, C) denote station groupings.

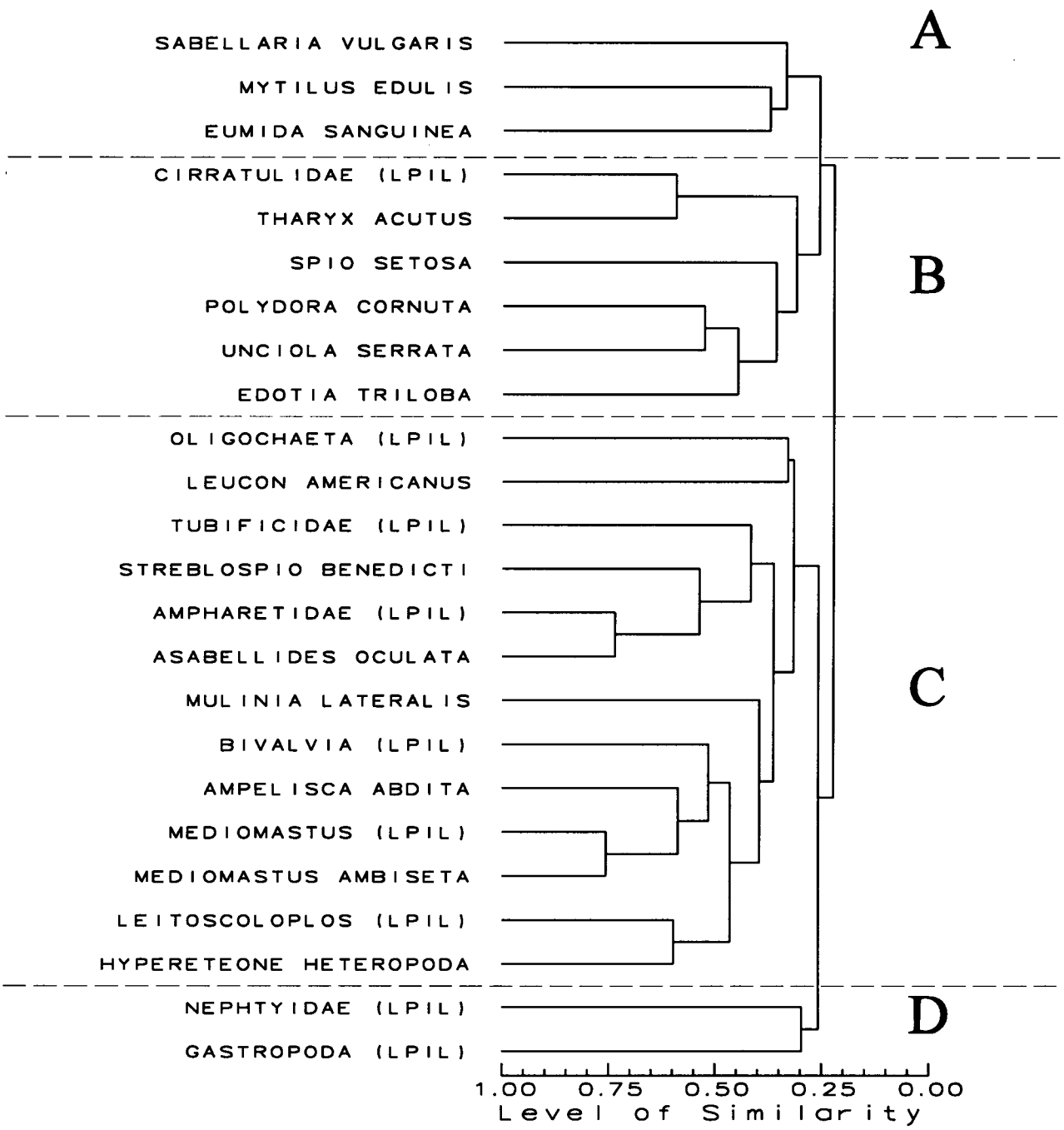

Figure 2. Inverse (species) classification analysis for the Hudson-Raritan stations, September 1991. Large, bolded letters (A, B, C, D) denote species groupings.

Table 7. Data matrix for the Hudson/Raritan stations and species groups compiled from classification analysis dendrograms.

Taxa	**14C**	**18C**	**19B**	**1A**	**2B**	**20C**	**1B**	**1C**	**2A**	**2C**	**11A**	**3C**	**17C**	**19A**	**19C**	**9B**	**8B**	**4C**
Sabellaria Vulgaris						1											1	
Mytilus Edulis				1														
Eumida Sanguinea																	1	
Cirratulidae (LPIL)																		
Tharyx Acutus																		
Spio Setosa			3			2					1			7	2			
Polydora Cornuta		1														159	23	
Unciola Serrata																5	1	
Edotia Triloba				1			1									2	1	
Oligochaeta (LPIL)							1		5	3	4	6	11	6	10		5	
Leucon Americanus				13	29	3	5	1	39	28	2	7	9					
Tubificidae (LPIL)	8	3	31	74	28	20	5	7										
Streblospio Benedicti		5	4	40	21	4	3	6	13	3	4	10				1	39	22
Ampharetidae (LPIL)																2	8	4
Asabellides Oculata											1					7		
Mulinia Lateralis												5	3					
Bivalvia (LPIL)	3						5	1	1				3	1		4	1	54
Ampelisca Abdita																	1	
Mediomastus (LPIL)	1			4	3	29			1									3
Mediomastus Ambiseta				2		5											1	4
Leitoscoloplos (LPIL)						14	1						6				3	
Hypereteone Heteropoda			9	1	3	2	2					6	2	2		3		
Nephtyidae (LPIL)	10																	7
Gastropoda (LPIL)	1															1	1	

Table 7 continued:

Taxa	5A	4A	5B	4B	6A	6C	6B	10A	8A	13A	8C	11B	11C	12A	16B	7B	7C	7A	9A
Sabellaria Vulgaris										120	6	2							
Mytilus Edulis										1079				4	1				1
Eumida Sanguinea							1			30				1					
Cirratulidae (LPIL)	1					1				8	1		2		3	2	40	1	4
Tharyx Acutus			2					9			2	1			2		35		
Spio Setosa												76	110	5	4				
Polydora Cornuta								1			11	10	10	14	1		1		3
Unciola Serrata										24	1	5		1			1		
Edotia Triloba								1			1	9	3	2	10	5	1	2	
Oligochaeta (LPIL)				8			23											26	21
Leucon Americanus	12		1	1	10	7	8					2	8	4	3	1	1		
Tubificidae (LPIL)		67	3		79	9		8		94	42	92	86	87	25	49	112		
Streblospio Benedicti	44	12	61	53	96	94	95	4	18	19	416	82	237	150	37	62	136	13	172
Ampharetidae (LPIL)	10		2	1	11	9	105	4	1		6		2	2	1	62	164	41	11
Asabellides Oculata	3		17		4	20	8	19	1	8	20	36	4	4		20	176	30	19
Mulinia Lateralis				76	530	54	388					1			4	1	16	180	
Bivalvia (LPIL)	23	35	12	2	544	223	110	4	2	9	3	5	3	2	15	778	1251	389	18
Ampelisca Abdita	2		16	1	1	5	9				1					1			
Mediomastus (LPIL)	4	111	8	26	30	13	74	4	8	94	11	2	7	5	5	121	278	3	3
Mediomastus Ambiseta		102	6	15	156	35	10	1		36	5	1	9	8	6	28	84		
Leitoscoloplos (LPIL)								1	7	2	6	5	14		30	4	25	2	
Hypereteone Heteropoda	8		3		2		8	2	7	1	14	22	24	12	15	28	43	10	3
Nephtyidae (LPIL)	19	15	26	32	47	20	26					1	2				1		
Gastropoda (LPIL)	1	7			3	3				1	2	2		1		2	1		

Table 7 continued:

Taxa	10B	9C	10C	3A	3B	13B	13C	15A	15C	12C	12B	16A	21A	16C	21C	22B	31C	22A
Sabellaria Vulgaris		13	1	9									1		1	5	4	3
Mytilus Edulis	7	7	11	2		2	4	231	153		1					1		
Eumida Sanguinea	15	10															3	
Cirratulidae (LPIL)	1	1	301					3				17	1		1	2	1	
Tharyx Acutus			218									12	2			1		1
Spio Setosa	12		92					8	5		6							2
Polydora Cornuta	344	136	33								2						1	
Unciola Serrata	17	58	27					2	2									
Edotia Triloba	4	3	14								1	4	1			1		
Oligochaeta (LPIL)		19	429	67	82	48	21	246	418	11	10	25	2	13	1	4	11	
Leucon Americanus				8	112		1						26	338	15	2		5
Tubificidae (LPIL)	23																	
Streblospio Benedicti	248	106	129	22	21	66	41	18	38	1	9	30		3	1			
Ampharetidae (LPIL)	7	35	23					27	53		4							
Asabellides Oculata	11	22	31			4	2	1	48	1	3							
Mulinia Lateralis										7	11	13	62	12	11	1	1	4
Bivalvia (LPIL)	17	12	3						2		1	8						2
Ampelisca Abdita									1						8	1	35	7
Mediomastus (LPIL)	1	1	33	43	71	155	66	14	112	4	16	26	104	7	26	21	52	15
Mediomastus Ambiseta			5	2	2	26	4	1	18	1	14	3	38	3	2		10	7
Leitoscoloplos (LPIL)		1	2			2		4	2	27	8	61	51	29	6	78	17	32
Hypereteone Heteropoda	17	2	16	4	4		1	7	8		4	15	7	4	2	2	1	5
Nephtyidae (LPIL)																		
Gastropoda (LPIL)		1							1			3				1		

Table 7 continued:

Taxa	**22C**	**32C**	**25B**	**25A**	**25C**	**29C**	**26C**	**27C**	**24C**	**30C**	**33B**	**23C**	**28C**	**28A**	**28B**	**33A**	**33C**
Sabellaria Vulgaris																	
Mytilus Edulis					1	16	1	1					1	2			
Eumida Sanguinea				6		6	3	5		1	7				1		
Cirratulidae (LPIL)	2	2				2		1	1				1				1
Tharyx Acutus		2				1			1					1			
Spio Setosa												1	1			1	
Polydora Cornuta	2	2	1														
Unciola Serrata			1		2		1										
Edotia Triloba			1			2	3		1	12					2		
Oligochaeta (LPIL)		7			3							3	7	7	2		7
Leucon Americanus	1											2					
Tubificidae (LPIL)	2		2			11	8	2	5	20	4						
Streblospio Benedicti									1								
Ampharetidae (LPIL)						1											
Asabellides Oculata						1											
Mulinia Lateralis	5		1			5					2			29	7	1	
Bivalvia (LPIL)	9	3	8	5	3	137	8	13	8	44	11	2	5	2	3	1	3
Ampelisca Abdita	4	3	149	115	244	162	175	217	319	342	329	187	413	223	398	520	419
Mediomastus (LPIL)	22	124	6	27	24	473	97	34	191	276	255	182	480	267	260	521	360
Mediomastus Ambiseta	13	122		1	3	205	8	6	78	59	156	22	7	69	43	99	81
Leitoscoloplos (LPIL)	11	7	2			1	1	2	2	2		41	5	2	4	1	1
Hypereteone Heteropoda	6	7	1	4	5		1	2	17	3	5	12	1	2	2	5	2
Nephtyidae (LPIL)						2								1			
Gastropoda (LPIL)	1				4	9	7	2	2	2	1	14	1	1			1

Classification of the 24 taxa at the 72 stations could be interpreted at a four–group level (≈ 23-26% similarity; Table 7 and Fig. 6). Group A was represented the single taxa, *Eusarsiella absens* which was found in high densities only at Station 8 (Table 7). Group B included three taxa found in high densities at three stations. Group C included the remaining taxa found across the remaining stations (Table 7; Fig. 2).

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APPENDIX

QUALITY CONTROL REWORKS

Client/Project: NOAA

Work Assignment Title: Hudson Raritan, 1991

Work Assignment Number: C-2-47 Task Number: 2

Sorting Results:

Sample #	% Accuracy
19B-R-3	100%
10A-R-3	100%
6C-R-5	100%
20C-R-3	100%
12A-R-1	100%
4A-R-3	100%
18C-R-3	100%
19B-R-1	100%
8B-R-2	81% (see additional QCs)
3B-R-3	100%
9C-R-2	100%
17C-R-5	100%
4B-R-1	100%
32C-R-4	100%
1C-R-4	100%
2A-R-3	100%
7A-R-2	100%
8A-R-5	100%
11A-R-1	100%
19C-R-5	100%
1B-R-3	100%

Taxonomy Results:

Sample #	Taxa	% Accuracy
6C-R-1	Crust./Moll.	100%
4A-R-2	Crust./Moll.	95%
1C-R-2	Crust./Moll.	100%
6A-R-2	Crust./Moll.	98%
10A-R-1	Crust./Moll.	100%
7C-R-5	Crust./Moll.	98%
13A-R-2	Crust./Moll.	95%
24C-R-5	Crust./Moll.	97%
29C-R-4	Crust./Moll.	96%
20C-R-4	Crust./Moll.	100%
21C-R-3	Crust./Moll.	97%
16C-R-1	Crust./Moll.	99%
15C-R-3	Crust./Moll.	98%

Taxonomy Results continued:

28C-R-2	Crust./Moll.	99%
32C-R-3	Crust./Moll.	100%
22B-R-1	Crust./Moll.	100%
33A-R-1	Crust./Moll.	99%
25C-R-3	Crust./Moll.	100%
16A-R-3	Crust./Moll.	100%
28A-R-5	Crust./Moll.	98%
7C-R-1	Poly./Misc.	100%
16B-R-1	Poly./Misc.	97%
11C-R-1	Poly./Misc.	99%
6A-R-4	Poly./Misc.	100%
2B-R-4	Poly./Misc.	100%
7B-R-4	Poly./Misc.	98%
7C-R-2	Poly./Misc.	99%
24C-R-4	Poly./Misc.	99%
8C-R-4	Poly./Misc.	97%
25C-R-3	Poly./Misc.	100%
15C-R-3	Poly./Misc.	99%
16A-4	Poly./Misc.	99%
32C-4	Poly./Misc.	95%
3A-R-2	Poly./Misc.	96%
1B-1	Poly./Misc.	100%
5A-1	Poly./Misc.	97%
11A-R-3	Poly./Misc.	100%
9A-R-1	Poly./Misc.	98%
10C-R-2	Poly./Misc.	99%
23C-R-4	Poly./Misc.	100%
21A-R-1	Poly./Misc.	99%

Description of outstanding issues or deficiencies which may affect data quality: None

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Signature of QA Officer or Reviewer Date

ADDITION QUALITY CONTROL REWORKS

Client/Project: NOAA

Work Assignment Title: Hudson Raritan, 1991

Work Assignment Number: C-2-47 Task Number: 2

Department: Sorting

Personnel: SLW

Reasons requiring reworks: Accuracy rate for sample 8B-R-2 was below acceptable rate of 95%. All samples sorted by this technician were reworked.

Results of reworks:

Sample #	% Accuracy
7B-R-3	95%
10A-R-5	100%
12A-R-3	100%
20C-R-4	100%
29C-R-4	95%

Description of outstanding issues or deficiencies which may affect data quality: None

All individuals in reworks were sorted correctly.

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Signature of QA Officer or Reviewer Date

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QUALITY ASSURANCE STATEMENT

Client/Project: NOAA

Work Assignment Title: Hudson Raritan, 1991

Work Assignment Number: C-2-47 Task Number: 2

Description of Data Set or Deliverable: 213 Benthic macroinvertebrate samples collected in March, April and May of 1991; modified Van Veen grab

Description of audit and review activities: Judged accuracy rates were well above standard levels for sorting and taxonomy. Laboratory QC reports were completed. Copies of reports and QC results follow (see attachments.) All taxonomic data were entered into computer and printed. This list was checked for accuracy against original taxonomic data sheets.

Description of outstanding issues or deficiencies which may affect data quality: None

_____

Signature of QA Officer or Reviewer Date

_____

Signature of Project Manager Date