DELAWARE BAY AND ADJACENT WATERS
BENTHIC COMMUNITY ASSESSMENT

SUBMITTED TO

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
OFFICE OF OCEAN RESOURCES CONSERVATION AND ASSESSMENT
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INTRODUCTION

The Delaware River, Delaware Bay and adjacent waters were sampled during September, 1997. One goal of this sampling effort was benthic community characterization. National Oceanic and Atmospheric Administration (NOAA) personnel collected the samples and laboratory and data analysis were performed by Barry A. Vittor & Associates, Inc. (BVA).

METHODS

Sample Collection And Handling

A Young dredge (area = 0.04 m^2) was used to collect bottom samples at each of 81 sites in the Delaware River, Delaware Bay and adjacent waters. Macroinfaunal samples were sieved through a 0.5–mm mesh screen and preserved with 10% formalin on ship. Macroinfaunal samples were transported to the BVA laboratory in Mobile, Alabama.

Sediment Analysis

Sediment texture was determined at half-phi intervals using the hydrometer technique for fractions smaller than 44 µm and nested sieves for larger particle fractions. Texture parameters computed included percent gravel, sand, silt and clay. Total organic carbon (TOC) content was measured as ash-free dry weight expressed as a percentage.

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 taxa not previously encountered 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 site and strata. These data were reduced to a data summary report for each site, which included a taxonomic species list and benthic community parameters information. Archive data files of species identification and enumeration were prepared.

The QA/QCs report for the Delaware Bay and adjacent waters samples is given in the Appendix.

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., taxa abundance, taxa composition and taxa diversity indices) during initial data reduction, followed by pattern and classification analysis for delineation of taxa assemblages. Since taxa are distributed along environmental gradients, there are generally no distinct boundaries between communities. However, the relationships between habitats and taxa 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 site and the total number of individuals per square meter (= density). Taxa richness is reported as the total number of taxa represented in a given site 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 between strata. Data for total density were variously transformed and tested for normality (Shapiro-Wilk W; SAS Institute, 1995). Data which could not be normalized with standard transformations [e.g. ln(x+1), √(x+1)] were analyzed using non-parametric methods (SAS Institute, 1995).

Faunal Similarities

Cluster analysis was performed on the faunal data to examine between-site differences at the Delaware Bay sites and to compare faunal composition of each site within the study area. Both normal and inverse cluster 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 clustering (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.

Cluster analysis of both station collections (normal analysis) and taxa (inverse analysis) was performed using the average linkage method (SAS Institute 1997). In this method, the distance between two clusters is the average distance between pairs of observations, one in each cluster. Taxa used in these analyses were selected according to their percent abundance in the assemblage. Total densities for each of the selected taxa at a given station were ln transformed [x=ln(x+1)] before the analyses.

HABITAT CHARACTERISTICS

Sediment data for the 81 sites and 22 strata are given in Table 1 and Figures 1, 2, 3 and 4. Sediment composition of the 81 sites varied considerably from 73% silt (sandy silt) at Site 3 to greater than 99% sand at nine sites with Site 47 at 99.97% (Table 1; Figures 1 and 2); however, the sediment at the majority of sites was predominantly silty sand (Figures 1 and 2). The total organic carbon (TOC) fraction of the sediment ranged from 0.09% at site 62 to 20.5% at site 89 (Table 1; Figures 3 and 4). In terms of strata, sand again dominated with 14 of the 22 strata composed of greater than 50% (Figure 5) however, the variability of sediment components of the sites within each stratum is high (Figures 6, 7, 8 and 9). Stratum 3 contained the highest percentage of sand at 94.45% (Table 1). Strata 21 and 22 contained the highest percentages of silt, 61.17% and 53.96% respectively and, conversely, the lowest percentages of sand, 6.41% and 4.55% (Table 2; Figure 5). Mean % TOC for all strata is displayed in Figure 10.

Table 1. Summary of water parameters and benthic macroinfaunal data for the Delaware Bay and adjacent waters sites and corresponding strata, September 1997.

Site No.	Strata	No. of Taxa	Density (nos./m2)	H' Diversity	J' Evenness	Temp (°C) Surface	Temp (°C) Bottom	DO (mg/l) Surface	DO (mg/l) Bottom	Salinity (ppt) Surface	Salinity (ppt) Bottom	% Gravel	% Sand	% Silt	% Clay	% TOC	Textural Description
1	19	17	6900	1.74	0.62	22.8	22.7	6.7	6.3	0.1	0.1	0	11.76	55.99	32.24	1.42	silty clay
2	19	11	4100	1.49	0.62	21.7	21.7	7.0	5.3	0.1	0.1	1.24	96.18	1.56	0	1	sand
3	19	15	7650	1.79	0.66	22.3	22.3	5.7	4.7	0.1	0.1	0	14.99	73.05	11.96	1.47	sandy silt
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		14.33	6216.67	1.67	0.63	**22.3**	22.2	6.5	5.4	0.1	0.1	0.41	40.98	43.53	14.73	1.30	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		3.06	1871.05			0.55	0.50	0.67	0.82	0	0	0.72	47.83	37.34	16.30	0.26	
4	20	16	19525	0.96	0.35	22.5	22.5	6.0	5.9	0.2	0.1	0	78.05	18.22	3.72	2.27	silty sand
5	20	6	1425	0.78	0.44	22.9	22.9	7.1	5.3	0.2	0.1	0.15	99.04	0	0	2.12	sand
6	20	10	3325	1.87	0.81	22.5	22.5	8.6	9.0	0.1	0.1	0.09	99.26	0	0	1.98	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		10.67	8091.67	1.20	0.53	**22.6**	22.6	7.2	6.7	0.1	0.1	0.08	92.12	6.07	1.24	2.12	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		5.03	9947.03			0.19	0.20	1.32	1.97	0.04	0.02	0.08	12.18	10.52	2.15	0.15	
7	1	18	13250	1.36	0.47	23.3	23.3	6.3	6.5	0.1	0.1	0	42.38	53.13	4.49	2.17	sandy silt
8	1	7	11150	0.42	0.22	23.4	23.3	5.6	4.3	0.2	0.2	0	31.35	62.49	6.16	2.03	sandy silt
9	1	7	4700	1.41	0.73	22.8	22.7	5.8	5.7	0.1	0.1	11.81	84.56	2.25	0	0.99	gravelly sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		10.67	9700	1.07	0.47	**23.2**	23.1	5.9	5.5	0.1	0.1	3.94	52.76	39.29	3.55	1.73	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		6.35	4455.61			0.33	0.35	0.35	1.10	0.04	0.04	6.82	28.08	32.42	3.19	0.64	
10	2	12	6975	1.95	0.78	23.5	23.3	5.6	5.4	0.2	0.2	0	13.24	70.48	16.28	3.13	sandy silt
11	2	11	3775	1.89	0.79	23.5	23.3	5.2	4.8	0.2	0.2	0.85	74.72	18.54	5.89	0.74	silty sand
12	2	12	6875	1.74	0.70							15.86	24.08	32.93	27.12	3.01	gravelly mud
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		11.67	5875	1.86	0.76	**23.5**	23.3	5.4	5.1	0.2	0.2	5.57	37.35	40.65	16.43	2.29	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		0.58	1819.34			0	0	0.28	0.43	0	0	8.92	32.82	26.82	10.62	1.35	
13	3	5	1875	1.07	0.67	23.6	23.6	5.3	5.3	0.2	0.2					1.02	
14	3	9	1425	1.72	0.78	23.4	23.3	4.0	5.6	0.2	0.2	1.53	89.81	5.51	0	2.62	sand
15	3	7	1475	1.29	0.66	23.5	23.6	5.4	5.3	0.3	0.2	0	99.08	0	0	0.34	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		7	1591.67	1.36	0.70	**23.5**	23.5	4.9	5.4	0.2	0.2	0.77	94.45	2.76	0	1.33	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		2	246.64			0.09	0.18	0.76	0.20	0.05	0.01	1.08	6.55	3.90	0	1.17	
16	4	13	12800	1.54	0.60							0	43.03	26.65	30.32	1.98	sandy clay
17	4	8	3300	1.48	0.71							1.09	95.98	2.05	0	0.32	sand
18	4	8	2325	1.25	0.60	23.9	23.7	6.4	6.4	0.7	0.7	0.07	84.57	12.2	0	0.46	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		9.67	6141.67	1.42	0.64	**23.9**	23.7	6.4	6.4	0.7	0.7	0.39	74.53	13.63	10.11	0.92	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		2.89	5786.86			0	0	0	0	0	0	0.61	27.87	12.36	17.51	0.92	

Table 1. Continued

Site No.	Strata	No. of Taxa	Density (nos./m2)	H' Diversity	J' Evenness	Temp (°C) Surface	Temp (°C) Bottom	DO (mg/l) Surface	DO (mg/l) Bottom	Salinity (ppt) Surface	Salinity (ppt) Bottom	% Gravel	% Sand	% Silt	% Clay	% TOC	Textural Description
19	5	8	2550	1.01	0.49	23.1	23.2	5.8	5.4	0.8	2.1	0.41	59.38	25.14	15.07	2.67	silty sand
20	5	7	5075	0.83	0.43	23.7	23.2	6.8	6.4	1.4	1.6	0	62.87	27.83	9.3	2.97	silty sand
21	5	2	400	0.48	0.70							0	34.42	40.11	25.48	0.96	clayey silt
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		5.67	2675	0.77	0.54	**23.4**	23.2	6.3	5.9	1.1	1.9	0.14	52.22	31.03	16.62	2.2	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		3.21	2340.01			0.42	0	0.75	0.71	0.42	0.35	0.24	15.52	7.98	8.20	1.08	
22	6	7	1800	1.17	0.60	23.1	23.1	6.5	3.2	2.6	3.1	0	81.65	11.39	6.97	0.38	sand
23	6	2	2900	0.55	0.80	23.2	23.2	6.3	6.2	3.4	3.5	0	4.01	44.5	51.49	3.23	clay
24	6	2	75	0.64	0.92	23.2	23.1	7.0	6.5	3.1	3.1	0	11.49	48.87	39.64	3.11	silty clay
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		3.67	1591.67	0.79	0.77	**23.2**	23.1	6.6	5.3	3.0	3.2	0	32.38	34.92	32.7	2.24	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		2.89	1423.98			0.06	0.06	0.35	1.83	0.40	0.23	0	42.83	20.49	23.06	1.61	
25	7	4	125	1.33	0.96							0	29.28	42.06	28.66	2.23	clayey silt
26	7	5	4550	0.21	0.13	19.4	19.2	7.3	7.0	4.5	4.5					1.98	
27	7	4	150	1.24	0.90	19.9	19.5	7.4	7.3	4.7	5.1	1.83	54.53	20.1	23.54	0.6	clayey sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		4.33	1608.33	0.93	0.66	**19.7**	19.4	7.3	7.2	4.6	4.8	0.92	41.91	31.08	26.1	1.60	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		0.58	2547.59			0.35	0.21	0.05	0.19	0.14	0.42	1.29	17.85	15.53	3.62	0.88	
28	8	11	1650	1.36	0.57	19.6	19.4	7.5	7.5	6.0	6.0	0	61.65	24.18	14.17	0.74	silty sand
29	8	7	1800	1.20	0.62	19.9	19.5	7.2	7.1	7.5	7.5	0	18.63	52.03	29.34	3.28	clayey silt
30	8	14	2500	1.99	0.76	20.0	19.9	7.4	7.4	7.1	7.1	0.22	61.24	21.16	17.37	2.44	silty sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		10.67	1983.33	1.52	0.65	**19.8**	19.6	7.4	7.3	6.9	6.9	0.07	47.17	32.46	20.29	2.15	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		3.51	453.69			0.21	0.26	0.14	0.17	0.78	0.78	0.13	24.72	17.02	8.00	1.29	
31	9	3	300	0.82	0.75	20.4	19.7	6.9	6.4	7.6	7.8	0.51	44.44	33.78	21.27	0.52	clayey sand
32	9	10	2925	1.27	0.55							0	5.77	50.81	43.42	2.21	silty clay
33	9	5	625	0.95	0.59							0	39.91	43.89	16.2	1.98	sandy silt
34	9	13	1800	2.25	0.88	20.1	19.8	6.8	6.7	11.2	11.7	0.16	36.04	44.01	19.79	1.32	sandy silt
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		7.75	1412.50	1.32	0.69	**20.3**	19.8	6.8	6.6	9.4	9.8	0.17	31.54	43.12	25.17	1.51	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		4.57	1196.61			0.21	0.1	0.09	0.21	2.55	2.76	0.24	17.52	7.02	12.35	0.76	
35	10	4	300	1.20	0.86	19.7	19.7	7.0	6.9	8.3	8.3	0.57	86.76	8.76	3.92	0.27	sand
36	10	15	1450	2.23	0.82	21.3	21.3	7.3	7.0	12.0	12.1	0	43.36	33.06	23.58	1.5	clayey sand
37	10	16	4275	2.02	0.73	20.1	19.5	7.0	7.0	13.6	13.7	0	30.26	50.72	19.02	0.84	sandy silt
38	10	15	2200	1.96	0.72	19.7	19.4	7.2	7.0	14.9	14.9	0.25	66.08	13.47	20.2	0.75	clayey sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		12.5	2056.25	1.85	0.78	**20.2**	20.0	7.1	7.0	12.2	12.3	0.21	56.62	26.50	0.21	0.84	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		5.69	1672.87			0.76	0.89	0.15	0.05	2.86	2.87	0.27	24.96	19.27	0.27	0.51	
39	11	7	1250	1.12	0.57	22.7	22.7	7.1	7.1	13.1	13.8	2.98	95.22	0	0	1.07	sand
40	11	16	7225	1.37	0.49							1.26	61.92	17.37	19.45	1.08	silty sand
41	11	19	3525	2.30	0.78	21.9	21.9	7.2	7.1	20.0	20.2	1.96	90.59	6.18	0	0.42	sand
42	11	27	22400	1.25	0.38	28.5	21.8	7.3	8.0	20.2	20.4	1.2	52.59	23.02	23.19	0.6	clayey sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		17.25	8600	1.51	0.56	**24.37**	22.13	7.22	7.39	17.77	18.13	1.85	75.08	11.64	10.66	0.79	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		8.26	9523.81			3.60	0.49	0.11	0.49	4.04	3.75	0.83	21.02	10.45	12.40	0.33	

Table 1. continued

Site No.	Strata	No. of Taxa	Density (nos./m2)	H' Diversity	J' Evenness	Temp (°C) Surface	Temp (°C) Bottom	DO (mg/l) Surface	DO (mg/l) Bottom	Salinity (ppt) Surface	Salinity (ppt) Bottom	% Gravel	% Sand	% Silt	% Clay	% TOC	Textural Description
43	12	31	9275	2.16	0.63							2.46	59.41	18.65	19.47	0.65	silty sand
44	12	42	31625	1.94	0.52							12.89	76.95	8.42	0	0.72	gravelly sand
45	12	15	700	2.41	0.89							0.09	99.09	0	0	0.78	sand
46	12	17	2100	2.01	0.71							0	98.97	0	0	0.71	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		26.25	10925.00	2.13	0.69							3.86	83.61	6.77	4.87	0.72	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		12.69	14302.02									6.13	19.20	8.86	9.74	0.05	
47	13	13	2300	1.46	0.57							0	99.97	0	0	0.24	sand
48	13	14	1075	2.21	0.84	21.8	21.8	7.2	7.5	27.1	27.1	0.03	61.18	6.97	31.82	0.37	sandy clay
49	13	10	1425	1.50	0.65	22.2	21.6	10.2	8.3	27.5	29.0	1.93	97.94	0	0	0.23	sand
50	13	23	18750	1.26	0.40							3.15	72.78	14.8	9.27	0.67	silty sand
51	13	9	3725	1.01	0.46	21.5	21.5	9.6	9.6	26.0	25.9	0	99.78	0	0	0.12	sand
52	13	16	850	2.55	0.92							0.57	98.58	0	0	0.19	sand
53	13	10	275	2.27	0.99	22.0	21.4	10.2	6.8	29.0	29.4	0	96.25	0	0	0.32	sand
54	13	15	2000	2.22	0.82							0	97.52	0	0	0.26	sand
55	13	18	3550	1.56	0.54							0.03	97.35	0	0	0.45	sand
56	13	15	8100	2.07	0.77	20.6	20.9	9.8	6.9	30.4	30.1	0	31.93	43.07	25	2.97	clayey silt
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		14.30	4205.00	1.81	0.70	**21.64**	21.45	9.40	7.83	27.98	28.30	0.57	85.33	6.48	6.61	0.582	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		4.22	5578.78			0.66	0.36	1.24	1.17	1.72	1.74	1.09	23.00	13.75	11.96	0.85	
57	14	14	39175	1.49	0.56	22.0	22.0	10.7	10.4	20.9	20.8	1.85	90.34	5.74	0	1.93	sand
58	14	29	59700	1.00	0.30							0.35	91.07	6.6	0	2.03	sand
59	14	15	1175	2.10	0.78	21.5	21.5	10.5	6.8	26.1	25.8	0.62	95.71	0	0	0.63	sand
60	14	21	34200	0.70	0.23							0	80.67	13.94	5.39	1.23	sand
61	14	9	675	1.85	0.84	21.7	21.7	10.5	7.7	26.2	26.6	0.24	98.42	0	0	0.57	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		17.6	26985.00	1.43	0.54	**21.74**	21.75	10.58	8.29	24.37	24.38	0.61	91.24	5.26	1.08	1.28	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		7.67	25638.33			0.23	0.21	0.13	1.87	3.04	3.16	0.73	6.78	5.76	2.41	0.69	
62	15	20	1275	2.56	0.85	22.2	21.9	7.0	7.0	31.2	31.2					0.09	
63	15	32	4575	2.56	0.74							11.75	87.87	0	0	0.58	gravelly sand
64	15	4	350	0.90	0.65	23.6	23.5	7.1	6.9	26.6	27.7	0	99.07	0	0	0.07	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		18.67	2066.67	2.00	0.75	**22.9**	22.7	7.0	6.9	28.9	29.5	5.88	93.47	0	0	0.25	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		14.05	2220.97			1.01	1.13	0.09	0.10	3.27	2.50	8.31	7.92	0	0	0.29	
65	16	4	975	0.91	0.65	23	22.8	6.79	6.9	27.2	27.6	4.77	94.68	0	0	0.15	sand
66	16	41	17600	2.53	0.68							24.12	73.51	1.93	0	0.51	gravelly sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		22.50	9287.50	1.72	0.67	**23**	22.8	6.79	6.9	27.2	27.6	14.45	84.10	0.97	0	0.33	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		26.16	11755.65			0	0	0	0	0	0	13.68	14.97	1.36	0	0.25	
67	17	34	7225	2.77	0.79							35.81	61.99	1.45	0	0.42	sandy gravel
68	17	18	2050	1.99	0.69							0.31	98.76	0	0	0.21	sand
69	17	14	1125	2.20	0.83							0	99.53	0	0	0.22	sand
70	17	9	1125	1.34	0.61							0	99.81	0	0	0.13	sand
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		18.75	2881.25	2.08	0.73							9.03	90.02	0.36	0	0.25	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		10.81	2928.48									17.85	18.69	0.73	0	0.12	

Table 1. Continued

Site No.	Strata	No. of Taxa	Density (nos./m2)	H' Diversity	J' Evenness	Temp (°C) Surface	Temp (°C) Bottom	DO (mg/l) Surface	DO (mg/l) Bottom	Salinity (ppt) Surface	Salinity (ppt) Bottom	% Gravel	% Sand	% Silt	% Clay	% TOC	Textural Description
71	18	16	3550	1.79	0.65							0.76	98.45	0	0	0.11	sand
72	18	30	3675	2.67	0.79							20.25	79.57	0	0	0.1	gravelly sand
73	18	24	1675	2.90	0.91											1.21	
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		23.33	2966.67	2.46	0.78							10.51	89.01	0	0	0.47	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		7.02	1120.36									13.78	13.35	0	0	0.64	
84	21	10	2150	1.92	0.83	20.4	20.4	6.0	5.9	8.0	8.1	0	12.64	65.21	22.16	2.36	clayey silt
85	21	9	1000	0.99	0.45	20.6	20.5	6.6	6.6	7.4	7.4	0	0.17	57.13	42.7	5.85	silty clay
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		9.50	1575.00	1.46	0.64	**20.5**	20.5	6.3	6.2	7.7	7.8	0	6.41	61.17	32.43	4.105	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		0.71	813.17			0.1	0.1	0.5	0.5	0.4	0.5	0	8.82	5.71	14.52	2.47	
88	22	14	29500	1.11	0.42	20.0	19.9	5.0	4.8	19.4	19.8	0.1	9.2	55.39	35.32	5.07	silty clay
89	22	8	1850	1.44	0.69	19.6	19.6	10.6	9.6	4.4	4.4	0	1.45	39.14	59.42	20.5	clay
90	22	16	3825	1.34	0.48	20.3	20.1	4.1	4.1	19.1	19.2	0	3.01	67.36	29.63	3.9	clayey silt
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		12.67	11725.00	1.30	0.53	**20.0**	19.9	6.6	6.2	14.3	14.5	0.03	4.55	53.96	41.46	9.82	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		4.16	15425.24			0.4	0.3	3.7	3.0	8.6	8.7	0.06	4.10	14.16	15.81	9.26	
91	–	6	5550	0.76	0.42	20.2	20.0	7.7	7.4	6.2	6.2					3.45	
92	–	6	2900	0.53	0.30	25.1	25.0			4.1	4.0	0.58	89.27	6.95	0	5.85	sand
87	–	14	4150	0.99	0.38	20.5	20.5	6.2	6.4	16.6	16.7	0.1	7.81	50.96	41.14	1.75	silty clay
		Mean No. Taxa	**Mean D**	**Mean H'**	**Mean J'**	**Mean S. Temp**	**Mean B. Temp**	**Mean S. DO**	**Mean B. DO**	**Mean S. Sal**	**Mean B. Sal**	**Mean % G**	**Mean % Sand**	**Mean %Silt**	**Mean % Clay**	**Mean % TOC**	
		8.67	4200.00	0.76	0.37	**21.9**	21.8	6.9	6.9	8.97	9.0	0.34	48.54	28.96	20.57	3.68	
		S.D.	**S.D.**			**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	**S.D.**	
		4.62	1325.71			2.75	2.75	1.0	0.7	6.69	6.79	0.34	57.60	31.12	29.09	2.06	

Figure 1. Sediment composition for Delaware Bay sites 1-41, September 1997.

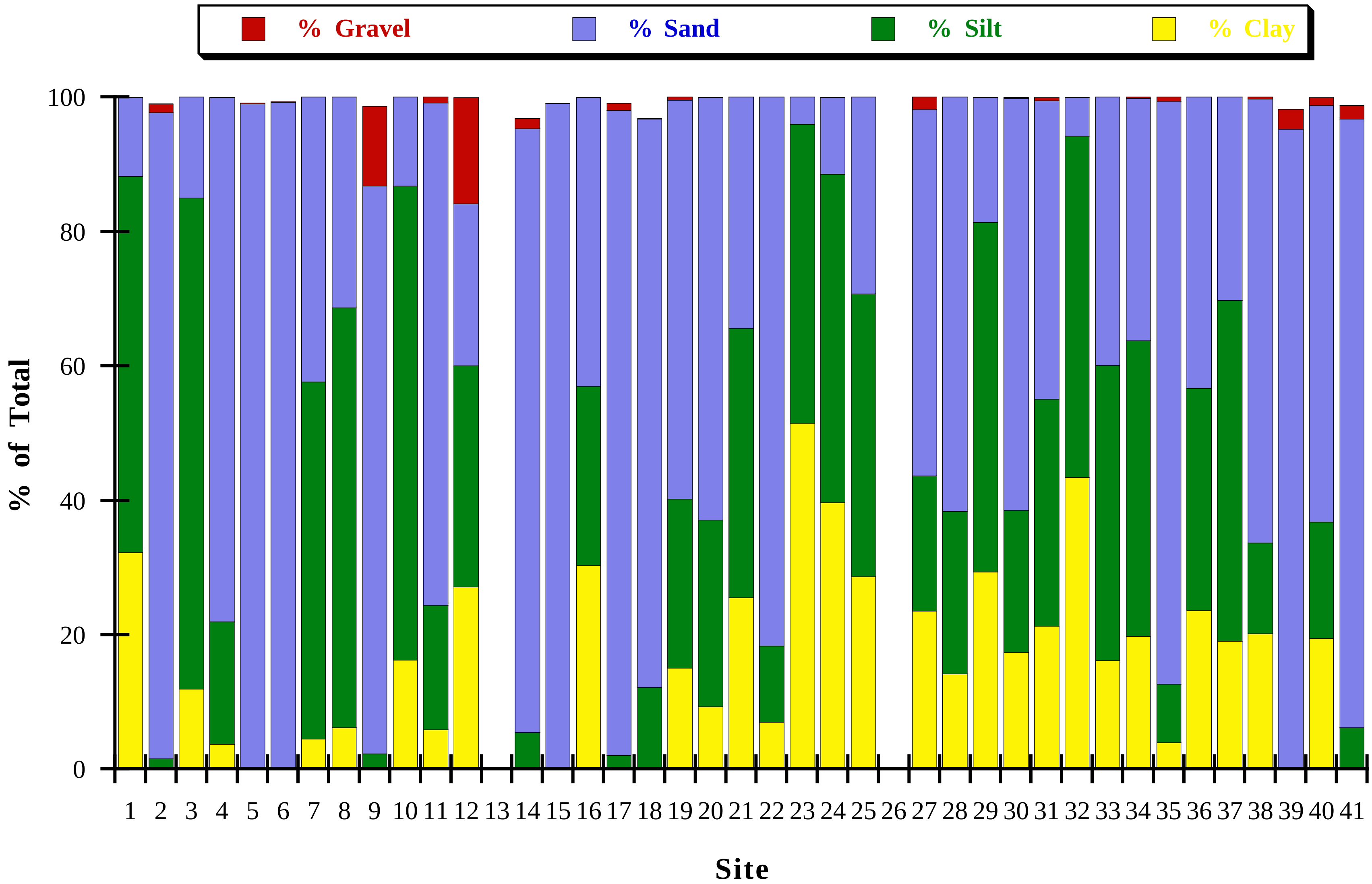


Figure 2. Sediment composition for Delaware Bay sites 42-92, September 1997.

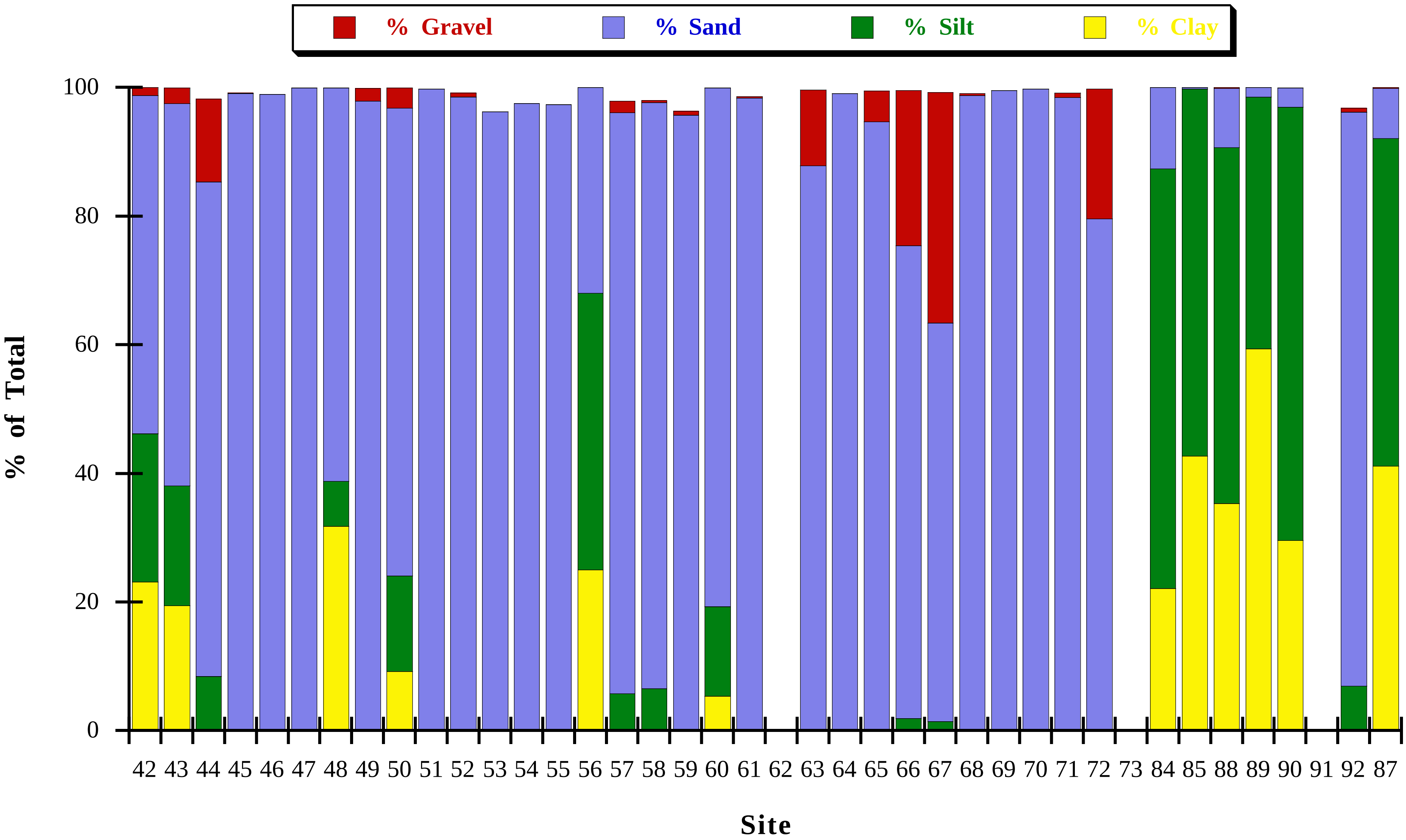


Figure 3. Percent total organic carbon (TOC) content of the sediment for Delaware Bay and adjacent waters sites 1-41, September 1997.

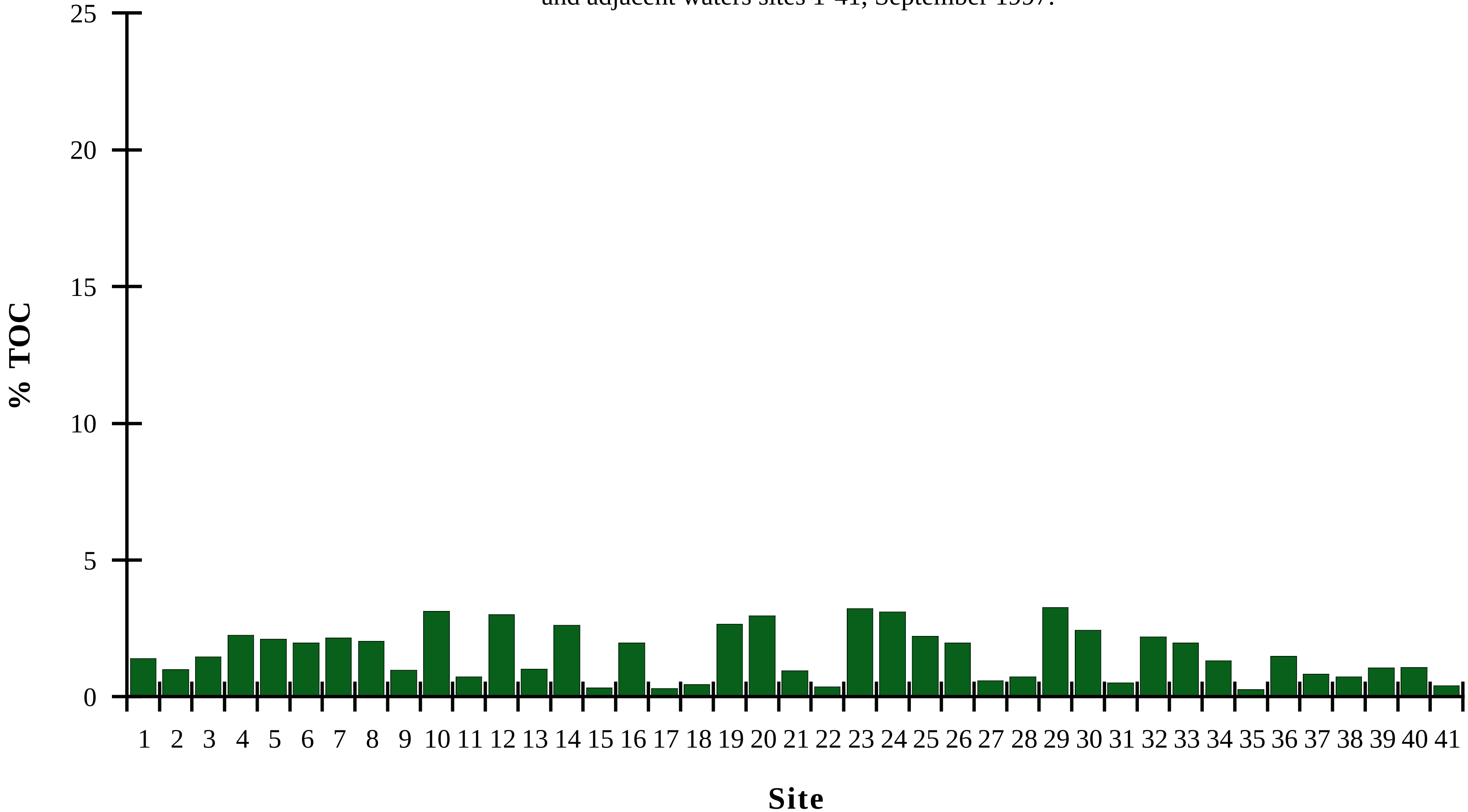


Figure 4. Percent total organic carbon (TOC) content of sediments for Delaware Bay and adjacent waters sites 42-92, September 1997.

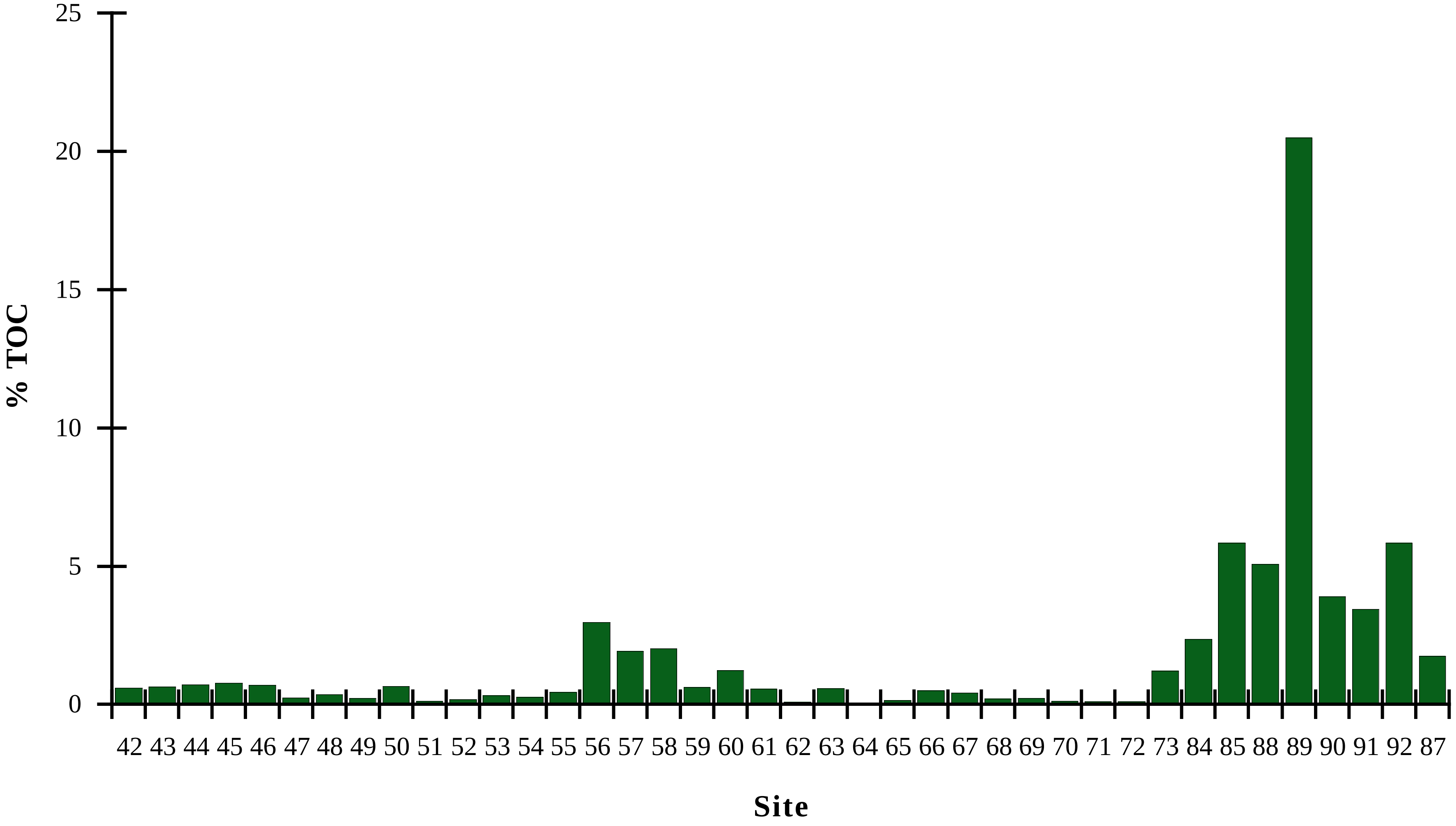


Figure 5. Sediment composition of the Delaware Bay and adjacent waters strata, September 1997.

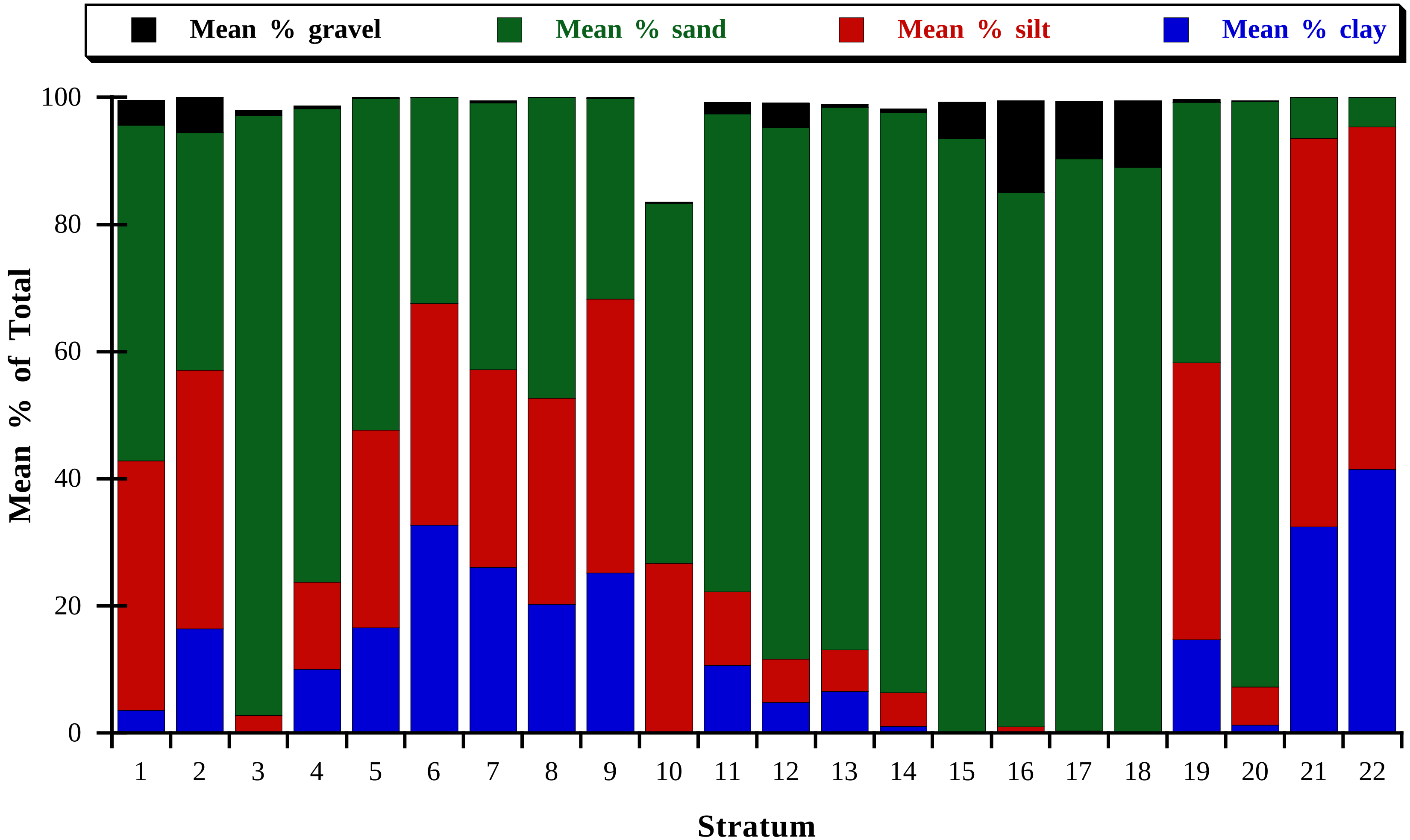


Figure 6. Mean % gravel of the Delaware Bay and adjacent waters strata, September 1997.

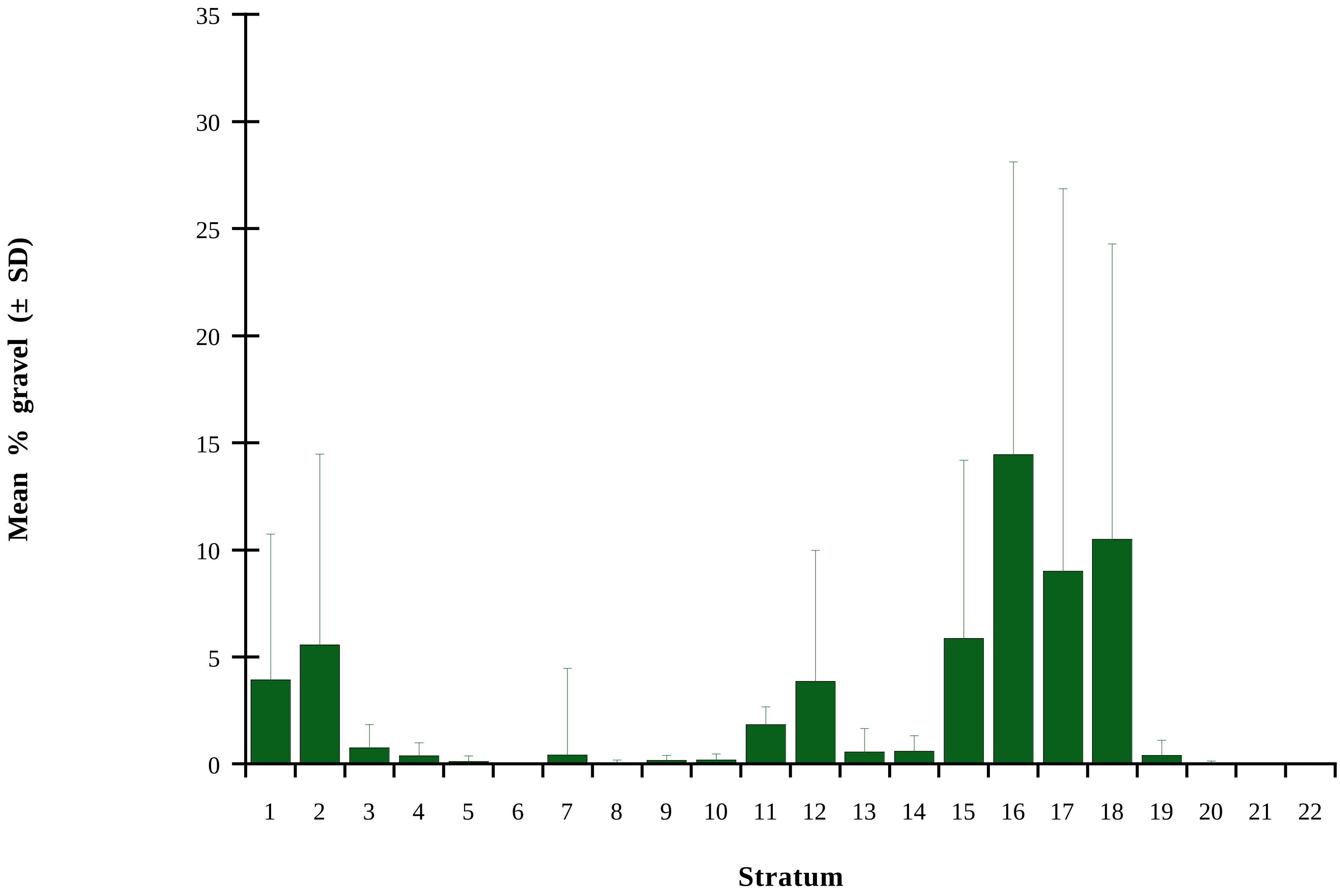


Figure 7. Mean % sand of the Delaware Bay and adjacent waters strata, September 1997.

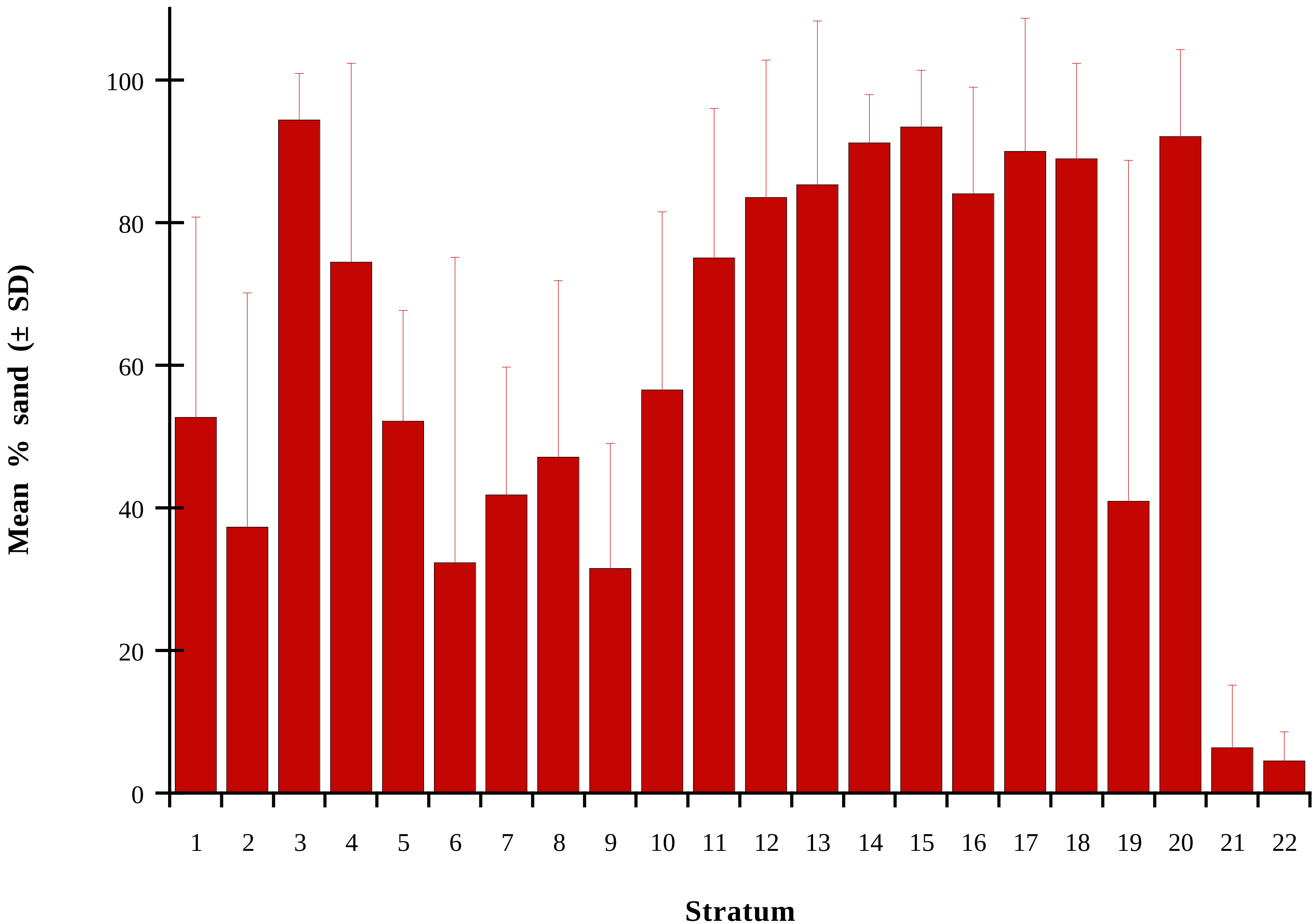


Figure 8. Mean % silt of the Delaware Bay and adjacent waters strata, September 1997.

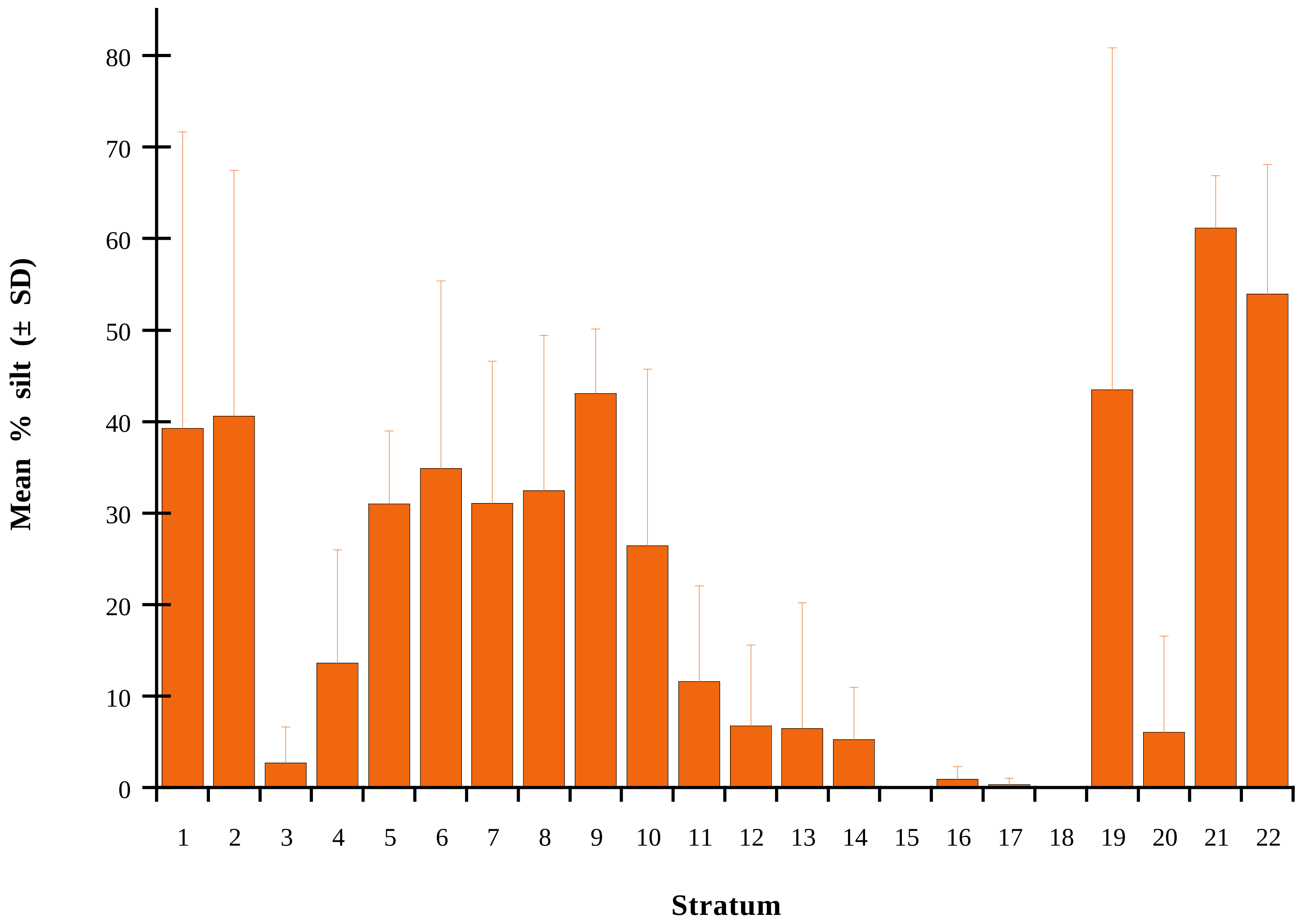


Figure 9. Mean % clay of the Delaware Bay and adjacent waters strata, September 1997.

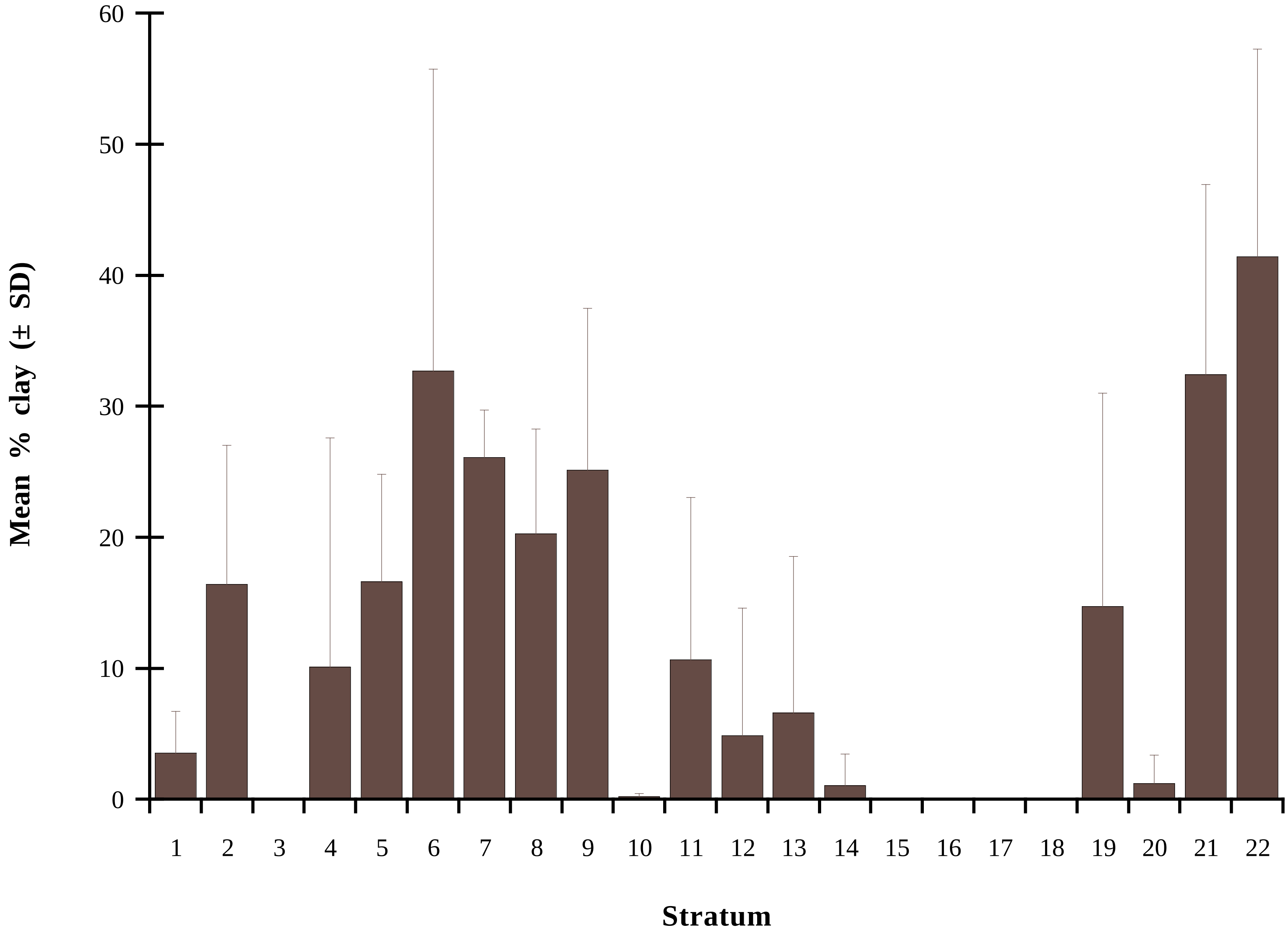


Table 2. Abundance and distribution of taxa for the Delaware Bay and adjacent waters sites, September 1997.

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Ampelisca abdita	Ar	Mala	3887	19.377	19.377	20	24.7	
Tubificidae (LPIL)	A	Olig	3587	17.881	37.258	50	61.7	sexually immature
Mediomastus (LPIL)	A	Poly	2090	10.419	47.677	22	27.2	anterior portions only, probably *M. ambiseta* , pygidium needed
Leucon americanus	Ar	Mala	1162	5.793	53.470	20	24.7	
Limnodrilus hoffmeisteri	A	Olig	1006	5.015	58.485	23	28.4	
Sabellaria vulgaris	A	Poly	969	4.831	63.315	8	9.9	
Streblospio benedicti	A	Poly	800	3.988	67.303	12	14.8	
Oligochaeta (LPIL)	A	Olig	389	1.939	69.242	19	23.5	marine and some estuarine specimens only identified to class.
Gammarus tigrinus	Ar	Mala	348	1.735	70.977	10	12.3	
Cyathura polita	Ar	Mala	284	1.416	72.393	33	40.7	
Glycinde solitaria	A	Poly	244	1.216	73.609	11	13.6	
Tellina agilis	M	Biva	205	1.022	74.631	18	22.2	
Chiridotea tuftsi	Ar	Mala	191	0.952	75.583	14	17.3	
Polydora cornuta	A	Poly	175	0.872	76.456	6	7.4	
Chironomidae (LPIL)	Ar	Inse	168	0.837	77.293	13	16.0	immature and/or damaged specimen
Dipolydora socialis	A	Poly	161	0.803	78.096	8	9.9	
Acteocina canaliculata	M	Gast	161	0.803	78.898	13	16.0	
Rhepoxynius hudsoni	Ar	Mala	154	0.768	79.666	14	17.3	
Gemma gemma	M	Biva	151	0.753	80.419	9	11.1	
Lysianopsis alba	Ar	Mala	144	0.718	81.137	2	2.5	
Polypedilum (LPIL)	Ar	Inse	142	0.708	81.844	14	17.3	immature and/or damaged specimen
Edotia triloba	Ar	Mala	138	0.688	82.532	15	18.5	
Aricidea (LPIL)	A	Poly	122	0.608	83.141	10	12.3	missing identification characters
Tellina (LPIL)	M	Biva	121	0.603	83.744	16	19.8	due to small size, external and internal characters are not apparent.
Corophium tuberculatum	Ar	Mala	115	0.573	84.317	8	9.9	
Almyracuma proximoculi	Ar	Mala	102	0.508	84.826	6	7.4	
Corbicula manilensis	M	Biva	98	0.489	85.314	6	7.4	
Aricidea catherinae	A	Poly	98	0.489	85.803	5	6.2	
Heteromastus filiformis	A	Poly	97	0.484	86.286	13	16.0	
Corophium lacustre	Ar	Mala	97	0.484	86.770	3	3.7	
Quistadrilus multisetosus	A	Olig	93	0.464	87.233	9	11.1	
Rhynchocoela (LPIL)	R		93	0.464	87.697	26	32.1	no identifible characters.
Cirratulidae (LPIL)	A	Poly	87	0.434	88.131	15	18.5	anterior fragment, posterior needed for specis ID.
Crepidula plana	M	Gast	85	0.424	88.554	5	6.2	
Marenzellaria viridis	A	Poly	77	0.384	88.938	10	12.3	
Polygordius (LPIL)	A	Poly	71	0.354	89.292	13	16.0	genus is lowest identification level
Paracaprella tenuis	Ar	Mala	70	0.349	89.641	3	3.7	
Protohaustorius sp.B	Ar	Mala	65	0.324	89.965	4	4.9	
Mulinia lateralis	M	Biva	61	0.304	90.269	10	12.3	
Pisidium compressum	M	Biva	54	0.269	90.538	3	3.7	
Sphaerium (LPIL)	M	Biva	54	0.269	90.808	6	7.4	
Mitrella lunata	M	Gast	52	0.259	91.067	6	7.4	
Polypedilum halterale group	Ar	Inse	51	0.254	91.321	4	4.9	

Table 2. Continued

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Polypedilum illinoense group	Ar	Inse	47	0.234	91.555	7	8.6	
Nucula proxima	M	Biva	46	0.229	91.785	6	7.4	
Odostomia (LPIL)	M	Gast	43	0.214	91.999	8	9.9	
Spionidae (LPIL)	A	Poly	43	0.214	92.213	11	13.6	
Unciola serrata	Ar	Mala	41	0.204	92.418	4	4.9	
Ascidiacea (LPIL)	C	Asci	41	0.204	92.622	5	6.2	
Pseudunciola obliquua	Ar	Mala	40	0.199	92.822	1	1.2	
Tanaissus psammophilus	Ar	Mala	40	0.199	93.021	5	6.2	
Capitellidae (LPIL)	A	Poly	38	0.189	93.210	12	14.8	
Laeonereis culveri	A	Poly	35	0.174	93.385	4	4.9	
Leitoscoloplos robustus	A	Poly	35	0.174	93.559	6	7.4	
Astarte castanea	M	Biva	34	0.169	93.729	3	3.7	
Gammarus (LPIL)	Ar	Mala	32	0.160	93.888	12	14.8	
Ampharetidae (LPIL)	A	Poly	32	0.160	94.048	11	13.6	
Eusarsiella zostericola	Ar	Ostr	31	0.155	94.202	8	9.9	
Bivalvia (LPIL)	M	Biva	30	0.150	94.352	7	8.6	
Ancylidae (LPIL)	M	Gast	30	0.150	94.501	2	2.5	
Glycera sp.D	A	Poly	29	0.145	94.646	12	14.8	
Protohaustorius wigleyi	Ar	Mala	28	0.140	94.786	5	6.2	
Cyathura burbancki	Ar	Mala	24	0.120	94.905	1	1.2	
Rhithropanopeus harrisii	Ar	Mala	22	0.110	95.015	6	7.4	
Limnodrilus udekemianus	A	Olig	22	0.110	95.125	2	2.5	
Scoletoma tenuis	A	Poly	22	0.110	95.234	2	2.5	
Hypereteone heteropoda	A	Poly	21	0.105	95.339	2	2.5	
Lyonsia hyalina	M	Biva	21	0.105	95.444	5	6.2	
Leptocheirus plumulosus	Ar	Mala	21	0.105	95.548	1	1.2	
Ferrissia (LPIL)	M	Gast	21	0.105	95.653	5	6.2	
Aricidea cerrutii	A	Poly	20	0.100	95.753	1	1.2	
Procladius (LPIL)	Ar	Inse	20	0.100	95.852	5	6.2	
Leitoscoloplos (LPIL)	A	Poly	20	0.100	95.952	9	11.1	
Nereis succinea	A	Poly	19	0.095	96.047	8	9.9	
Melita (LPIL)	Ar	Mala	19	0.095	96.142	5	6.2	
Brania wellfleetensis	A	Poly	18	0.090	96.231	3	3.7	
Parasterope pollex	Ar	Ostr	17	0.085	96.316	5	6.2	
Polycirrus eximius	A	Poly	17	0.085	96.401	2	2.5	
Cerapus tubularis	Ar	Mala	16	0.080	96.481	4	4.9	
Cryptochironomus (LPIL)	Ar	Inse	16	0.080	96.560	8	9.9	
Erichthonius brasiliensis	Ar	Mala	15	0.075	96.635	4	4.9	
Caulleriella sp.J	A	Poly	15	0.075	96.710	6	7.4	
Autolytus (LPIL)	A	Poly	15	0.075	96.785	1	1.2	
Gastropoda (LPIL)	M	Gast	15	0.075	96.859	8	9.9	
Spiochaetopterus oculatus	A	Poly	14	0.070	96.929	10	12.3	
Rictaxis punctostriatus	M	Gast	13	0.065	96.994	5	6.2	
Hydroides protulicola	A	Poly	13	0.065	97.059	2	2.5	
Ampelisca (LPIL)	Ar	Mala	13	0.065	97.124	5	6.2	
Ancinus depressus	Ar	Mala	12	0.060	97.183	7	8.6	

Table 2. Continued

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Streptosyllis arenae	A	Poly	12	0.060	97.243	1	1.2	
Nereis (LPIL)	A	Poly	12	0.060	97.303	5	6.2	
Phyllodocidae (LPIL)	A	Poly	12	0.060	97.363	8	9.9	
Gillia altilis	M	Gast	11	0.055	97.418	3	3.7	
Ilyanassa trivittata	M	Gast	11	0.055	97.473	8	9.9	
Tubificoides heterochaetus	A	Olig	11	0.055	97.527	1	1.2	
Unciola (LPIL)	Ar	Mala	11	0.055	97.582	2	2.5	
Terebellidae (LPIL)	A	Poly	11	0.055	97.637	2	2.5	
Jassa falcata	Ar	Mala	10	0.050	97.687	4	4.9	
Asabellides oculata	A	Poly	10	0.050	97.737	7	8.6	
Nephtys picta	A	Poly	10	0.050	97.787	5	6.2	
Parahaustorius attenuatus	Ar	Mala	10	0.050	97.836	1	1.2	
Leptocheirus (LPIL)	Ar	Mala	10	0.050	97.886	1	1.2	
Phyllodoce arenae	A	Poly	9	0.045	97.931	5	6.2	
Spisula solidissima	M	Biva	9	0.045	97.976	2	2.5	
Crepidula maculosa	M	Gast	9	0.045	98.021	4	4.9	
Pisidium (LPIL)	M	Biva	9	0.045	98.066	3	3.7	
Goniadidae (LPIL)	A	Poly	9	0.045	98.111	4	4.9	
Sphaeriidae (LPIL)	M	Biva	9	0.045	98.156	6	7.4	
Parapionosyllis longicirrata	A	Poly	8	0.040	98.195	1	1.2	
Scoloplos rubra	A	Poly	8	0.040	98.235	1	1.2	
Deutella incerta	Ar	Mala	8	0.040	98.275	1	1.2	
Oxyurostylis smithi	Ar	Mala	8	0.040	98.315	6	7.4	
Ilyanassa obsoleta	M	Gast	8	0.040	98.355	3	3.7	
Acanthohaustorius intermedius	Ar	Mala	8	0.040	98.395	1	1.2	
Tharyx acutus	A	Poly	8	0.040	98.435	5	6.2	
Echinoidea (LPIL)	E	Echi	8	0.040	98.475	2	2.5	
Neomysis americana	Ar	Mala	7	0.035	98.509	3	3.7	
Ampelisca vadorum	Ar	Mala	7	0.035	98.544	1	1.2	
Pagurus (LPIL)	Ar	Mala	7	0.035	98.579	5	6.2	
Ceratopogonidae (LPIL)	Ar	Inse	7	0.035	98.614	4	4.9	
Mactridae (LPIL)	M	Biva	7	0.035	98.649	3	3.7	
Corophium (LPIL)	Ar	Mala	6	0.030	98.679	3	3.7	
Tubulanus (LPIL)	R		6	0.030	98.709	3	3.7	
Naididae (LPIL)	A	Olig	6	0.030	98.739	1	1.2	
Glyceridae (LPIL)	A	Poly	6	0.030	98.769	3	3.7	
Nephtyidae (LPIL)	A	Poly	6	0.030	98.799	4	4.9	
Batea catharinensis	Ar	Mala	5	0.025	98.824	2	2.5	
Mediomastus ambiseta	A	Poly	5	0.025	98.848	1	1.2	
Spiophanes bombyx	A	Poly	5	0.025	98.873	4	4.9	
Urosalpinx cinera	M	Gast	5	0.025	98.898	3	3.7	
Monoculodes edwardsi	Ar	Mala	5	0.025	98.923	4	4.9	
Serpulidae (LPIL)	A	Poly	5	0.025	98.948	2	2.5	
Actiniaria (LPIL)	Cn	Anth	5	0.025	98.973	3	3.7	
Doridella obscura	M	Gast	4	0.020	98.993	1	1.2	
Nephtys bucera	A	Poly	4	0.020	99.013	3	3.7	

Table 2. Continued

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Kurtziella cerina	M	Gast	4	0.020	99.033	2	2.5	
Marginella apicina	M	Gast	4	0.020	99.053	2	2.5	
Harmothoe extenuata	A	Poly	4	0.020	99.073	2	2.5	
Macoma balthica	M	Biva	4	0.020	99.093	3	3.7	
Nanocladius (LPIL)	Ar	Inse	4	0.020	99.113	1	1.2	
Dicrotendipes (LPIL)	Ar	Inse	4	0.020	99.133	3	3.7	
Tanytarsus (LPIL)	Ar	Inse	4	0.020	99.153	3	3.7	
Branchiostoma (LPIL)	C	Lept	4	0.020	99.172	2	2.5	
Lumbrineridae (LPIL)	A	Poly	4	0.020	99.192	2	2.5	
Nereididae (LPIL)	A	Poly	4	0.020	99.212	4	4.9	
Polynoidae (LPIL)	A	Poly	4	0.020	99.232	1	1.2	
Paguridae (LPIL)	Ar	Mala	4	0.020	99.252	2	2.5	
Xanthidae (LPIL)	Ar	Mala	4	0.020	99.272	1	1.2	
Mysidae (LPIL)	Ar	Mala	4	0.020	99.292	4	4.9	
Lepidonotus sublevis	A	Poly	3	0.015	99.307	2	2.5	
Pectinaria gouldii	A	Poly	3	0.015	99.322	3	3.7	
Crangon septemspinosa	Ar	Mala	3	0.015	99.337	3	3.7	
Cassidinidea ovalis	Ar	Mala	3	0.015	99.352	2	2.5	
Neverita duplicata	M	Gast	3	0.015	99.367	3	3.7	
Ensis directus	M	Biva	3	0.015	99.382	2	2.5	
Microprotopus raneyi	Ar	Mala	3	0.015	99.397	2	2.5	
Travisia parva	A	Poly	3	0.015	99.412	2	2.5	
Harmothoe imbricata	A	Poly	3	0.015	99.427	1	1.2	
Aricidea taylori	A	Poly	3	0.015	99.442	2	2.5	
Cirrophorus (LPIL)	A	Poly	3	0.015	99.457	2	2.5	
Chironomus (LPIL)	Ar	Inse	3	0.015	99.472	2	2.5	
Orbiniidae (LPIL)	A	Poly	3	0.015	99.487	1	1.2	
Haustoriidae (LPIL)	Ar	Mala	3	0.015	99.501	2	2.5	
Aulodrilus pigueti	A	Olig	2	0.010	99.511	1	1.2	
Euceramus praelongus	Ar	Mala	2	0.010	99.521	1	1.2	
Echinarachnius parma	E	Echi	2	0.010	99.531	2	2.5	
Drilonereis longa	A	Poly	2	0.010	99.541	1	1.2	
Bathyporeia parkeri	Ar	Mala	2	0.010	99.551	1	1.2	
Sigalion arenicola	A	Poly	2	0.010	99.561	2	2.5	
Pinnixa chaetopterana	Ar	Mala	2	0.010	99.571	2	2.5	
Cyclaspis varians	Ar	Mala	2	0.010	99.581	1	1.2	
Hydroides dianthus	A	Poly	2	0.010	99.591	1	1.2	
Microphthalmus (LPIL)	A	Poly	2	0.010	99.601	1	1.2	
Bezzia Complex (LPIL)	Ar	Inse	2	0.010	99.611	1	1.2	
Monoculodes (LPIL)	Ar	Mala	2	0.010	99.621	2	2.5	
Pinnixa (LPIL)	Ar	Mala	2	0.010	99.631	2	2.5	
Crepidula (LPIL)	M	Gast	2	0.010	99.641	2	2.5	
Maldanidae (LPIL)	A	Poly	2	0.010	99.651	2	2.5	
Paraonidae (LPIL)	A	Poly	2	0.010	99.661	2	2.5	
Syllidae (LPIL)	A	Poly	2	0.010	99.671	1	1.2	
Aoridae (LPIL)	Ar	Mala	2	0.010	99.681	1	1.2	
Melitidae (LPIL)	Ar	Mala	2	0.010	99.691	2	2.5	

Table 2. Continued

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Decapoda Reptantia (LPIL)	Ar	Mala	2	0.010	99.701	2	2.5	
Majidae (LPIL)	Ar	Mala	2	0.010	99.711	2	2.5	
Mysidacea (LPIL)	Ar	Mala	2	0.010	99.721	1	1.2	
Synaptidae (LPIL)	E	Holo	2	0.010	99.731	1	1.2	
Lineidae (LPIL)	R		2	0.010	99.741	2	2.5	
Placobdella papillifera	A	Hiru	1	0.005	99.746	1	1.2	
Apoprionospio pygmaea	A	Poly	1	0.005	99.751	1	1.2	
Bhawania heteroseta	A	Poly	1	0.005	99.756	1	1.2	
Glycera americana	A	Poly	1	0.005	99.761	1	1.2	
Grubeosyllis clavata	A	Poly	1	0.005	99.766	1	1.2	
Monticellina dorsobranchialis	A	Poly	1	0.005	99.771	1	1.2	
Nematonereis hebes	A	Poly	1	0.005	99.776	1	1.2	
Parougia caeca	A	Poly	1	0.005	99.781	1	1.2	
Sigambra bassi	A	Poly	1	0.005	99.786	1	1.2	
Americhelidium americanum	Ar	Mala	1	0.005	99.791	1	1.2	
Pleusymtes glaber	Ar	Mala	1	0.005	99.796	1	1.2	
Pagurus pollicaris	Ar	Mala	1	0.005	99.801	1	1.2	
Anomia simplex	M	Biva	1	0.005	99.806	1	1.2	
Microphthalmus hartmanae	A	Poly	1	0.005	99.811	1	1.2	
Neopanope sayi	Ar	Mala	1	0.005	99.816	1	1.2	
Laevapex fuscus	M	Gast	1	0.005	99.821	1	1.2	
Dero digitata	A	Olig	1	0.005	99.826	1	1.2	
Libinia dubia	Ar	Mala	1	0.005	99.831	1	1.2	
Loimia medusa	A	Poly	1	0.005	99.835	1	1.2	
Nephtys incisa	A	Poly	1	0.005	99.840	1	1.2	
Eupleura caudata	M	Gast	1	0.005	99.845	1	1.2	
Cirrophorus ilvana	A	Poly	1	0.005	99.850	1	1.2	
Cirrophorus lyra	A	Poly	1	0.005	99.855	1	1.2	
Aricidea wassi	A	Poly	1	0.005	99.860	1	1.2	
Aricidea suecica	A	Poly	1	0.005	99.865	1	1.2	
Magelona papillicornis	A	Poly	1	0.005	99.870	1	1.2	
Rheotanytarsus (LPIL)	Ar	Inse	1	0.005	99.875	1	1.2	
Prionospio (LPIL)	A	Poly	1	0.005	99.880	1	1.2	
Polydora (LPIL)	A	Poly	1	0.005	99.885	1	1.2	
Ovalipes (LPIL)	Ar	Mala	1	0.005	99.890	1	1.2	
Cerapus (LPIL)	Ar	Mala	1	0.005	99.895	1	1.2	
Cyathura (LPIL)	Ar	Mala	1	0.005	99.900	1	1.2	
Eusarsiella (LPIL)	Ar	Ostr	1	0.005	99.905	1	1.2	
Oecetis (LPIL)	Ar	Inse	1	0.005	99.910	1	1.2	
Turbonilla (LPIL)	M	Gast	1	0.005	99.915	1	1.2	
Chaetopteridae (LPIL)	A	Poly	1	0.005	99.920	1	1.2	
Aeginellidae (LPIL)	Ar	Mala	1	0.005	99.925	1	1.2	
Amphipoda (LPIL)	Ar	Mala	1	0.005	99.930	1	1.2	
Ischyroceridae (LPIL)	Ar	Mala	1	0.005	99.935	1	1.2	
Oedicerotidae (LPIL)	Ar	Mala	1	0.005	99.940	1	1.2	
Phoxocephalidae (LPIL)	Ar	Mala	1	0.005	99.945	1	1.2	
Pleustidae (LPIL)	Ar	Mala	1	0.005	99.950	1	1.2	

Table 2. Continued

Taxon Name	Phylum	Class	No. of Individuals	% Total	Cummulative %	Station Occurrence	Station % Occurrence	Comments
Bodotriidae (LPIL)	Ar	Mala	1	0.005	99.955	1	1.2	
Decapoda Natantia (LPIL)	Ar	Mala	1	0.005	99.960	1	1.2	
Callianassidae (LPIL)	Ar	Mala	1	0.005	99.965	1	1.2	
Anthuridae (LPIL)	Ar	Mala	1	0.005	99.970	1	1.2	
Ostracoda (LPIL)	Ar	Ostr	1	0.005	99.975	1	1.2	
Holothuroidea (LPIL)	E	Holo	1	0.005	99.980	1	1.2	
Arcidae (LPIL)	M	Biva	1	0.005	99.985	1	1.2	
Cardiidae (LPIL)	M	Biva	1	0.005	99.990	1	1.2	
Columbellidae (LPIL)	M	Gast	1	0.005	99.995	1	1.2	
Hydrobiidae (LPIL)	M	Gast	1	0.005	100.000	1	1.2	

Taxa Key

A = Annelida
- Hiru = Hirudinea
- Olig = Oligochaeta
- Poly = Polychaeta

Ar = Arthropoda
- Inse = Insecta
- Mala = Malacostraca
- Ostr = Ostracoda

C = Chordata
- Asci = Ascidiacea
- Lept = Leptocardia

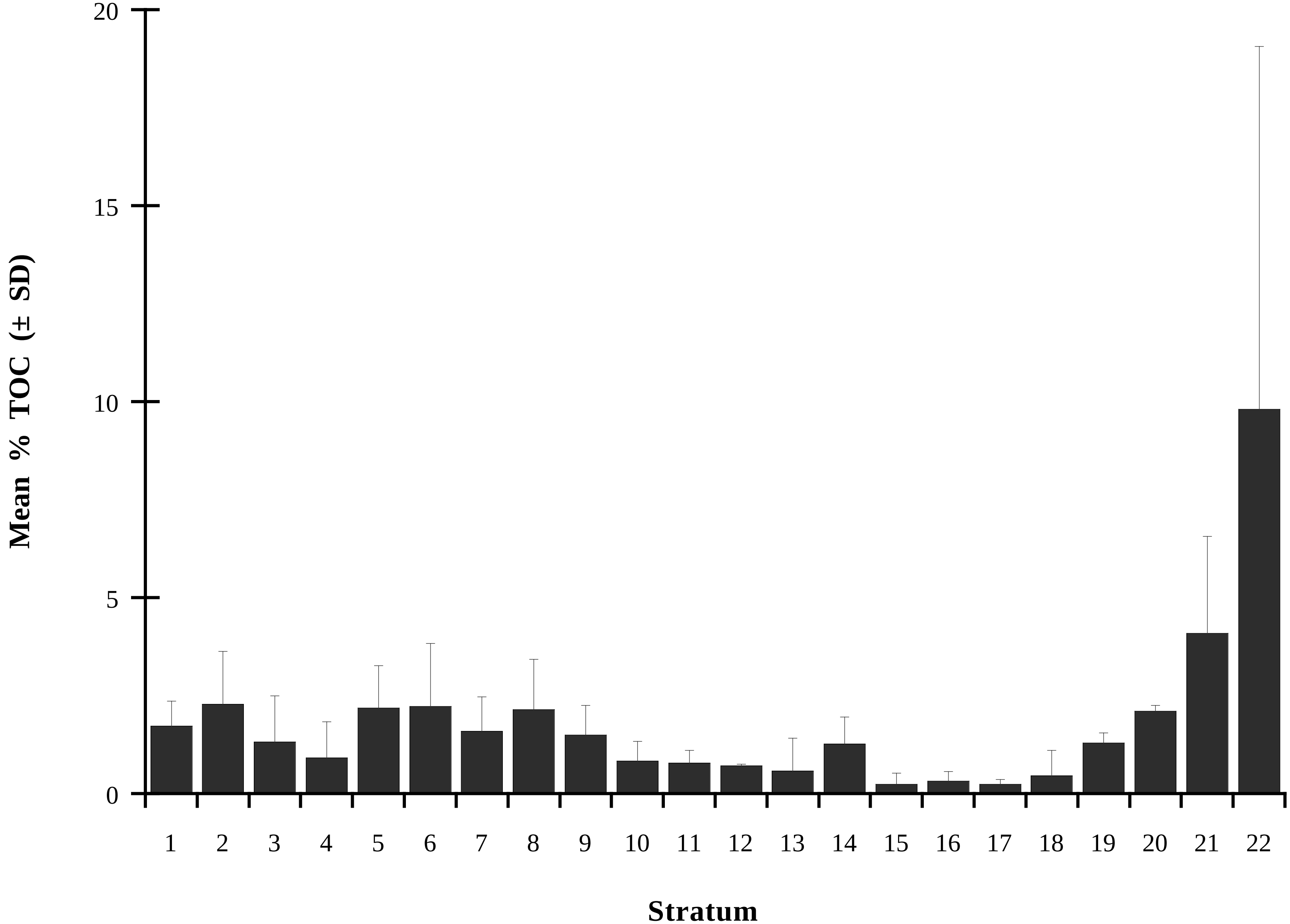
Cn = Cnidaria
- Anth = Anthozoa

E = Echinodermata
- Echi = Echinoidea
- Holo = Holothuroidea

M = Mollusca
- Biva = Bivalvia
- Gast = Gastropoda

R = Rhynchocoela

Figure 10. Mean % total organic carbon (TOC) of the Delaware Bay and adjacent waters strata, September 1997.



BENTHIC COMMUNITY CHARACTERIZATION

Faunal Composition, Abundance, And Community Structure

Table 2 provides a complete phylogenetic listing for all sites as well as data on taxa abundance and site 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 20,060 organisms, representing 239 taxa, were identified from the 81 sites (Table 3). Polychaetes were the most numerous taxa present representing 34.7% of the total assemblage, followed in abundance by malacostracans (31.4%) and gastropods (9.6%). Malacostracans represented 36.1% of the total number of individuals followed by polychaetes (28.0%), oligochaetes (25.5%), and bivalves (4.6%) (Table 3).

The dominant taxa collected from the samples was the amphipod, *Ampelisca abdita* which accounted for 19.38% of all individuals, but occurred at only 24.7% of the sites (Table 2). The next most abundant taxon was the oligochaete Family Tubificidae at 17.88% of allindividuals identified (Table 2). This taxa was also the most widespread occurring at 61.7% of the sites (Table 2). The polychaete genus *Mediomastus* accounted for 10.42% of all individuals and was identified at 27.2% of the sites (Table 2). All other taxa accounted for less than 6.0% of the total number of individuals. The isopod, *Cyathura polita*, Rhynchocoela (LPIL), the oligochaete *Limnodrilus hoffmeisteri*, the cumacean *Leucon americanus* and the class Oligochaeta (LPIL) were the next most widespread occurring at 40.7%, 32.1%, 28.4%, 24.7% and 23.5% respectively (Table 3). The distribution of dominant taxa representing >10% of the total assemblage at each site is given in Table 4.

Table 3. Summary of abundance of major taxonomic groups for the Delaware Bay and adjacent waters sites, September, 1997.

TAXA	Total No. Taxa	% Total	Total No. Individuals	% Total
Annelida				
Polychaeta	83	34.7	5607	28.0
Oligochaeta	9	3.8	5117	25.5
Hirudinea	1	0.4	1	< 0.1
Arthropoda				
Malacostraca	75	31.4	7246	36.1
Insecta	14	5.9	470	2.3
Ostracoda	4	1.7	50	0.2
Mollusca				
Bivalvia	20	8.4	919	4.6
Gastropoda	23	9.6	486	2.4
Other Taxa	10	4.2	164	0.8
TOTAL	239		20060	

Table 4. Percentage abundance of dominant taxa (>10%) for the Delaware Bay and adjacent waters sites, September 1997.

Site No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Strata	*19*	*19*	*19*	*20*	*20*	*20*	*1*	*1*	*1*	*2*	*2*	*2*	*3*	*3*	*3*	*4*	*4*	*4*
RHYNCHOCOELA																		
Rhynchocoela (LPIL)																		
Lineidae (LPIL)																		
ANNELIDA																		
Polychaeta																		
Capitellidae (LPIL)																		
Heteromastus filiformis																		
Mediomastus (LPIL)																		
Cirratulidae (LPIL)																		
Glycera sp.D																		
Glycinde solitaria																		
Laeonereis culveri																		
Aricidea catherinae																		
Aricidea cerrutii																		
Aricidea (LPIL)																		
Spionidae (LPIL)																		
Polydora cornuta																		
Streblospio benedicti																		
Dipolydora socialis																		
Marenzellaria viridis																		
Parapionosyllis longicirrata																		
Brania wellfleetensis																		
Polygordius (LPIL)																		
Sabellaria vulgaris																		
Oligochaeta																		
Oligochaeta (LPIL)																		
Tubificidae (LPIL)	45.7	14.0	36.9	77.3	80.7	15.0	59.4	89.0	31.9	16.1		16.4	38.7			17.0	12.9	44.1
Limnodrilus hoffmeisteri	23.6		25.2	11.5		19.5	21.5		34.6	33.7		43.6	49.3		10.2			40.9
Quistadrilus multisetosus			12.1															
MOLLUSCA																		
Bivalvia																		
Bivalvia (LPIL)																		
Tellina agilis																		
Tellina (LPIL)																		
Gemma gemma																		
Astarte castanea																		
Pisidium compressum			12.4															
Corbicula manilensis		51.8																
Gastropoda																		
Acteocina canaliculata																		
Crepidula plana																		
ARTHROPODA																		
Malacostraca																		
Cyathura polita		18.9				13.5					25.2							
Chiridotea tuftsi															62.7		50.0	
Corophium tuberculatum																		
Corophium lacustre																14.3		
Corophium (LPIL)																		
Ampelisca abdita																		
Ampelisca vadorum																		
Gammarus tigrinus																51.2		
Leptocheirus plumulosus																		
Leptocheirus (LPIL)																		
Pseudunciola obliquua																		
Rhepoxynius hudsoni																		
Haustoriidae (LPIL)																		
Protohaustorius sp.B																		
Parahaustorius attenuatus																		
Lysianopsis alba																		
Leucon americanus																		
Almyracuma proximoculi										20.1	25.8							
Tanaissus psammophilus																		
Insecta																		
Ceratopogonidae (LPIL)																		
Chironomidae (LPIL)						27.1					17.2	14.9		19.3			13.6	
Polypedilum halterale group														33.3				
Polypedilum (LPIL)						15.8			23.4					26.3			12.9	

Table 4. continued

Strata	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	9
Site No.	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**
RHYNCHOCOELA																
Rhynchocoela (LPIL)																
Lineidae (LPIL)									16.7							
ANNELIDA																
Polychaeta																
Capitellidae (LPIL)																
Heteromastus filiformis																
Mediomastus (LPIL)																
Cirratulidae (LPIL)																
Glycera sp.D																
Glycinde solitaria																
Laeonereis culveri																
Aricidea catherinae																
Aricidea cerrutii																
Aricidea (LPIL)																
Spionidae (LPIL)						33.3			50.0							
Polydora cornuta																
Streblospio benedicti																
Dipolydora socialis											63.9			64.1	72.0	
Marenzellaria viridis							20.0						25.0			
Parapionosyllis longicirrata																
Brania wellfleetensis																
Polygordius (LPIL)																
Sabellaria vulgaris																
Oligochaeta																
Oligochaeta (LPIL)																
Tubificidae (LPIL)	50.0	59.1	18.8	61.1	75.9	66.7	40.0	96.2		59.1		36.0				18.1
Limnodrilus hoffmeisteri	43.1	37.9		22.2	24.1											
Quistadrilus multisetosus																
MOLLUSCA																
Bivalvia																
Bivalvia (LPIL)																
Tellina agilis																
Tellina (LPIL)																
Gemma gemma																
Astarte castanea																
Pisidium compressum																
Corbicula manilensis																
Gastropoda																
Acteocina canaliculata																
Crepidula plana																
ARTHROPODA																
Malacostraca																
Cyathura polita									16.7	19.7	13.9		66.7		12.0	
Chiridotea tuftsi			81.3				20.0									
Corophium tuberculatum																
Corophium lacustre														16.2		
Corophium (LPIL)									16.7							
Ampelisca abdita																
Ampelisca vadorum																
Gammarus tigrinus																
Leptocheirus plumulosus												21.0				
Leptocheirus (LPIL)												10.0				
Pseudunciola obliquua																
Rhepoxynius hudsoni																
Haustoriidae (LPIL)																
Protohaustorius sp.B																
Parahaustorius attenuatus																
Lysianopsis alba																
Leucon americanus																20.8
Almyracuma proximoculi																
Tanaissus psammophilus																
Insecta																
Ceratopogonidae (LPIL)							20.0									
Chironomidae (LPIL)																
Polypedilum halterale group																
Polypedilum (LPIL)																

Table 4. Continued

	Strata																	
	10	***10***	***10***	***10***	***11***	***11***	***11***	***11***	***12***	***12***	***12***	***12***	***13***	***13***	***13***	***13***	***13***	***13***
	Site No.																	
	35	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
RHYNCHOCOELA																		
Rhynchocoela (LPIL)	15.3										10.7							
Lineidae (LPIL)																		
ANNELIDA																		
Polychaeta																		
Capitellidae (LPIL)														20.9				
Heteromastus filiformis		15.5			66.0						14.3							
Mediomastus (LPIL)							27.0									59.1		
Cirratulidae (LPIL)																		
Glycera sp.D														14.0				
Glycinde solitaria							14.9											
Laeonereis culveri																		
Aricidea catherinae																		
Aricidea cerrutii																		
Aricidea (LPIL)																		
Spionidae (LPIL)																		
Polydora cornuta									17.5									
Streblospio benedicti			18.1															
Dipolydora socialis																		
Marenzellaria viridis	50.0	17.2	22.2															
Parapionosyllis longicirrata																		
Brania wellfleetensis																		
Polygordius (LPIL)																		20.6
Sabellaria vulgaris									44.2	55.7								
Oligochaeta																		
Oligochaeta (LPIL)																		
Tubificidae (LPIL)		22.4	30.4	27.3		25.6												
Limnodrilus hoffmeisteri																		
Quistadrilus multisetosus																		
MOLLUSCA																		
Bivalvia																		
Bivalvia (LPIL)																		
Tellina agilis												15.5		20.9				11.8
Tellina (LPIL)											10.7			16.3	15.8			
Gemma gemma																	69.1	
Astarte castanea				34.1														
Pisidium compressum																		
Corbicula manilensis																		
Gastropoda																		
Acteocina canaliculata							14.2				25.0							
Crepidula plana																		
ARTHROPODA																		
Malacostraca																		
Cyathura polita		10.3			18.0													
Chiridotea tuftsi	25.0	13.8																
Corophium tuberculatum												42.9						
Corophium lacustre																		
Corophium (LPIL)																		
Ampelisca abdita							12.1	72.5								27.2		
Ampelisca vadorum																		
Gammarus tigrinus																		
Leptocheirus plumulosus																		
Leptocheirus (LPIL)																		
Pseudunciola obliquua																		
Rhepoxynius hudsoni													62.0				18.8	11.8
Haustoriidae (LPIL)																		
Protohaustorius sp.B													13.0		56.1			
Parahaustorius attenuatus																		
Lysianopsis alba																		
Leucon americanus	16.7					54.7												
Almyracuma proximoculi																		
Tanaissus psammophilus																		
Insecta																		
Ceratopogonidae (LPIL)																		
Chironomidae (LPIL)																		
Polypedilum halterale group																		
Polypedilum (LPIL)																		

Table 4. Continued

	Strata																	
	13	***13***	***13***	***13***	***14***	***14***	***14***	***14***	***14***	***15***	***15***	***15***	***16***	***16***	***17***	***17***	***17***	***17***
	Site No.																	
	53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
RHYNCHOCOELA																		
Rhynchocoela (LPIL)									11.1									
Lineidae (LPIL)																		
ANNELIDA																		
Polychaeta																		
Capitellidae (LPIL)																		
Heteromastus filiformis																		
Mediomastus (LPIL)		21.3	63.4	20.1	20.2	20.9												
Cirratulidae (LPIL)											19.7							
Glycera sp.D																		
Glycinde solitaria																		
Laeonereis culveri																		
Aricidea catherinae															19.4			
Aricidea cerrutii																		
Aricidea (LPIL)															15.6			
Spionidae (LPIL)																		
Polydora cornuta																		
Streblospio benedicti																		
Dipolydora socialis																		
Marenzellaria viridis																		
Parapionosyllis longicirrata										15.7								
Brania wellfleetensis										23.5								
Polygordius (LPIL)																	31.1	
Sabellaria vulgaris																		
Oligochaeta																		
Oligochaeta (LPIL)														30.3				
Tubificidae (LPIL)					14.1												11.1	
Limnodrilus hoffmeisteri																		
Quistadrilus multisetosus																		
MOLLUSCA																		
Bivalvia																		
Bivalvia (LPIL)																	15.6	
Tellina agilis							40.4		11.1							37.8		53.3
Tellina (LPIL)	18.2	16.3							40.7		26.2							
Gemma gemma													30.8					28.9
Astarte castanea																		
Pisidium compressum																		
Corbicula manilensis																		
Gastropoda																		
Acteocina canaliculata																		
Crepidula plana				18.5														
ARTHROPODA																		
Malacostraca																		
Cyathura polita																		
Chiridotea tuftsi													61.5					
Corophium tuberculatum																		
Corophium lacustre																		
Corophium (LPIL)																		
Ampelisca abdita						70.2		84.9										
Ampelisca vadorum							14.9											
Gammarus tigrinus																		
Leptocheirus plumulosus																		
Leptocheirus (LPIL)																		
Pseudunciola obliquua																		
Rhepoxynius hudsoni									11.1							25.6		
Haustoriidae (LPIL)												14.3						
Protohaustorius sp.B		25.0																
Parahaustorius attenuatus												71.4						
Lysianopsis alba														18.3				
Leucon americanus				23.8	50.1													
Almyracuma proximoculi																		
Tanaissus psammophilus																		
Insecta																		
Ceratopogonidae (LPIL)																		
Chironomidae (LPIL)																		
Polypedilum halterale group																		
Polypedilum (LPIL)																		

Table 4. Continued

	Strata 18	*18*	*18*	*21*	*21*	*22*	*22*	*22*	*NA*	*NA*	*NA*
	Site No. 71	**72**	**73**	**84**	**85**	**88**	**89**	**90**	**91**	**92**	**87**
RHYNCHOCOELA											
Rhynchocoela (LPIL)											
Lineidae (LPIL)											
ANNELIDA											
Polychaeta											
Capitellidae (LPIL)											
Heteromastus filiformis											
Mediomastus (LPIL)						29.8					
Cirratulidae (LPIL)			13.4								
Glycera sp.D											
Glycinde solitaria											
Laeonereis culveri									14.0		
Aricidea catherinae											
Aricidea cerrutii		13.6									
Aricidea (LPIL)											
Spionidae (LPIL)								16.3			
Polydora cornuta											
Streblospio benedicti						57.2					
Dipolydora socialis											
Marenzellaria viridis											
Parapionosyllis longicirrata											
Brania wellfleetensis											
Polygordius (LPIL)			11.9								
Sabellaria vulgaris											
Oligochaeta											
Oligochaeta (LPIL)				12.8							
Tubificidae (LPIL)				12.8	77.5		51.4	64.7	77.9	87.9	
Limnodrilus hoffmeisteri							18.9				
Quistadrilus multisetosus											
MOLLUSCA											
Bivalvia											
Bivalvia (LPIL)				12.8							
Tellina agilis	44.4										
Tellina (LPIL)											
Gemma gemma											
Astarte castanea											
Pisidium compressum											
Corbicula manilensis											
Gastropoda											
Acteocina canaliculata											
Crepidula plana											
ARTHROPODA											
Malacostraca											
Cyathura polita											
Chiridotea tuftsi											
Corophium tuberculatum											
Corophium lacustre											
Corophium (LPIL)											
Ampelisca abdita											79.5
Ampelisca vadorum											
Gammarus tigrinus							13.5				
Leptocheirus plumulosus											
Leptocheirus (LPIL)											
Pseudunciola obliquua		27.2									
Rhepoxynius hudsoni											
Haustoriidae (LPIL)											
Protohaustorius sp.B											
Parahaustorius attenuatus											
Lysianopsis alba											
Leucon americanus				36.0							
Almyracuma proximoculi											
Tanaissus psammophilus	21.1										
Insecta											
Ceratopogonidae (LPIL)											
Chironomidae (LPIL)											
Polypedilum halterale group											
Polypedilum (LPIL)											

Station mean density and mean number of taxa data are given in Table 1 and Figures 11 and 12. Mean densities ranged from 1412.5 organisms·m^{-2} at Stratum 9 to 26985.0 organisms·m^{-2} at Stratum 14 (Table 1; Figure 11). The mean number of taxa per replicate ranged from 3.67 at Stratum 6 to 26.25 at Stratum 12 (Table 1; Figure 12).

ANOVA analyses were performed on natural log transformed density and taxa abundance data for the Delaware Bay and adjacent waters strata. ANOVA and post-hoc test results for these two parameters are given in Tables 5 and 6.

Density and taxa abundance data were compared to various physical parameters using non-parametric correlation analyses. There was a significant positive correlation between strata mean density data and mean taxa per strata (Table 7). Also, TOC and density showed a significant positive correlation (Table 7). There were additional significant correlations between various physical parameters: % gravel + sand was inversely correlated with TOC; and % silt + clay was positively correlated with TOC (Table 7).

Taxa diversity and evenness are given in Table 1 and Figure 13. Taxa diversity (H') ranged from 0.77 at Stratum 5 to 2.46 at Stratum 18. Taxa evenness (J') values ranged from 0.14 at Stratum 1 to 0.78 at Strata 10 and 18 (Table 1; Figure 13).

Cluster Analysis

Normal (stations) and inverse (species) cluster analyses were performed on the Delaware Bay and adjacent waters data set and displayed as dendrograms (Figures 14 and 15). Selection of the species included in the analyses was based on a minimum representation of 0.3% of total individuals which encompassed 39 taxa. These taxa accounted for 90.3% of the macroinfaunal assemblage collected.

Numerical clustering of the 81 sites can be interpreted at a five-group level at a 10% level of similarity (Figure 14). One group contained only Site 64 with a macroinfaunal assemblage dominated by the amphipod, *Parahaustorius attenuatus (*Table 5*).* A second group contained 20

Figure 11. Mean macroinfaunal densities for the Delaware Bay and adjacent waters strata, September 1997.

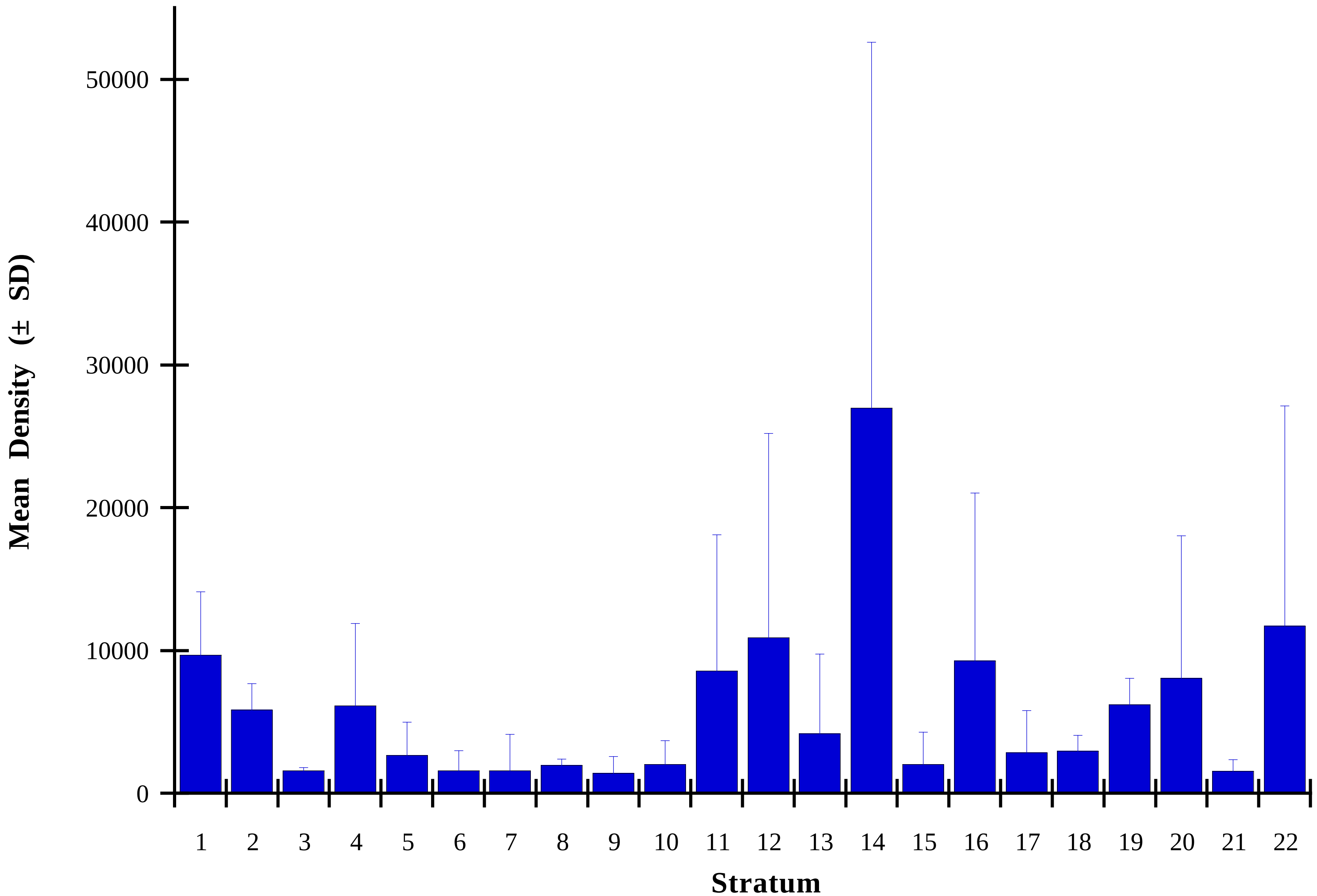


Figure 12. Mean number of macroinvertebrate taxa of the Delaware Bay and adjacent waters strata, September 1997.

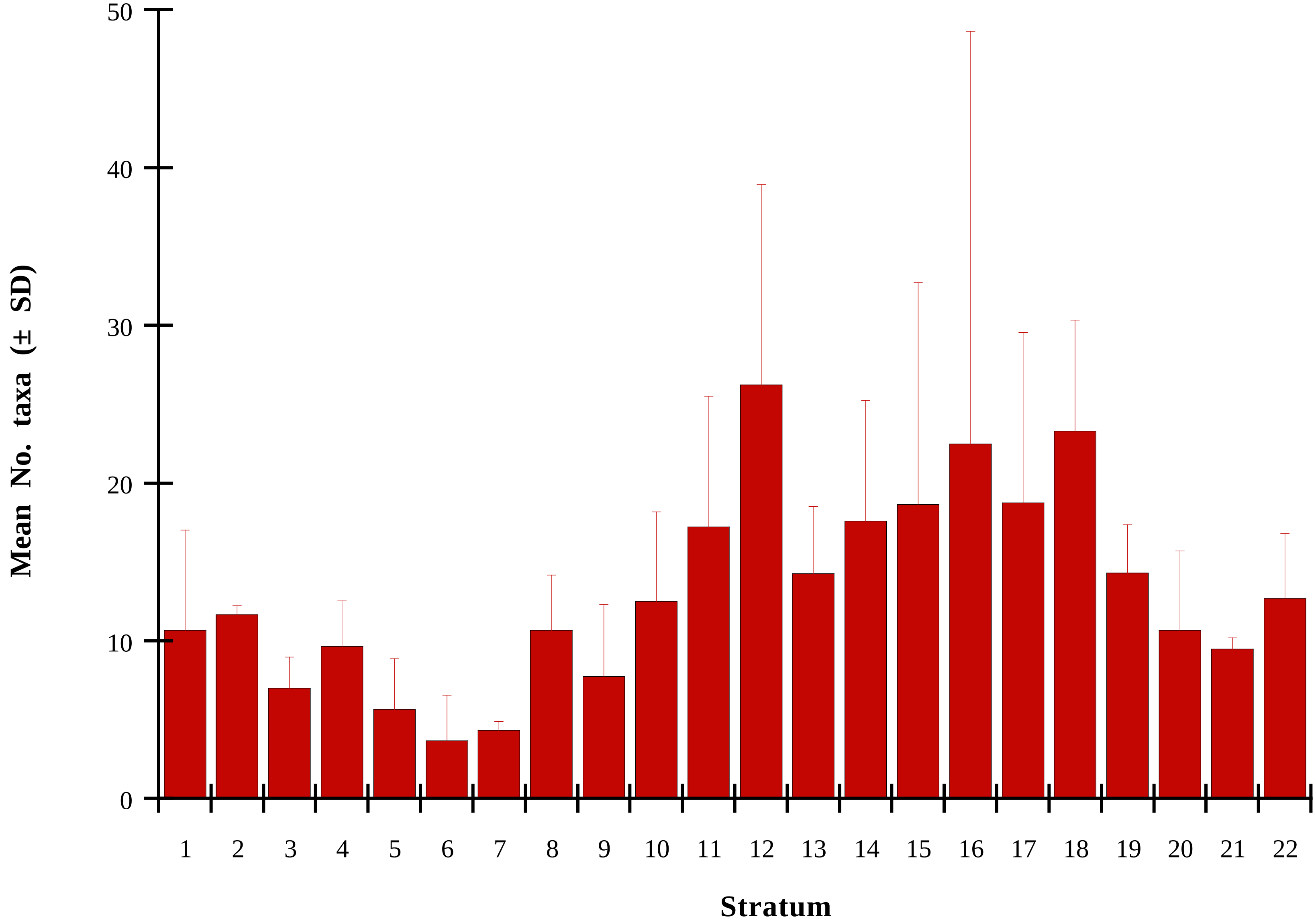


Table 5. ANOVA and post-hoc comparison results for density differences among sites for the Delaware Bay and adjacent waters samples, September 1997.

Shapiro-Wilk W test for normality

W=0.98 Prob < W=0.55

ANOVA Table

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	22	47.7	2.17	1.37	0.17
Error	58	91.51	1.58		
Total	80	139.21	1.74		

Table 5. Continued

	12	**18**	**17**	**14**	**11**	**15**	**19**	**13**	**16**	**22**	**2**	**10**	**8**	**20**	**1**	**21**	**4**	**23**	**3**	**9**	**5**	**7**	**6**
12		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*	*	*	*	*	*	*	*
18			ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	*	*	*	*	*	*	*
17				ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
14					ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
11						ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*	*
15							ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
19								ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
13									ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*	*
16										ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
22											ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
2												ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
10													ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
8														ns	ns	ns	ns	ns	ns	ns	ns	ns	*
20															ns	ns	ns	ns	ns	ns	ns	ns	*
1																ns	ns	ns	ns	ns	ns	ns	*
21																	ns	ns	ns	ns	ns	ns	*
4																		ns	ns	ns	ns	ns	*
23																			ns	ns	ns	ns	ns
3																				ns	ns	ns	ns
9																					ns	ns	ns
5																						ns	ns
7																							ns
6																							

Table 6. ANOVA and post-hoc comparison results for taxa differences among sites for the Delaware Bay and adjacent waters samples, September 1997.

Shapiro-Wilk W test for normality

W=0.97 Prob < W=0.17

ANOVA Table

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	22	14.64	0.67	2.85	0.0008
Error	58	13.55	0.23		
Total	80	28.19	0.35		

Table 6. Continued

	14	1	19	22	2	11	4	12	20	16	23	18	13	17	8	5	3	21	10	15	9	6	7
14		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	*	*	*	*	*
1			ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*	*
19				ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
22					ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
2						ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
11							ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*	*
4								ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
12									ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
20										ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
16											ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
23												ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	*
18													ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
13														ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
17															ns	ns	ns	ns	ns	ns	ns	ns	ns
8																ns	ns	ns	ns	ns	ns	ns	ns
5																	ns	ns	ns	ns	ns	ns	ns
3																		ns	ns	ns	ns	ns	ns
21																			ns	ns	ns	ns	ns
10																				ns	ns	ns	ns
15																					ns	ns	ns
9																						ns	ns
6																							ns
7																							

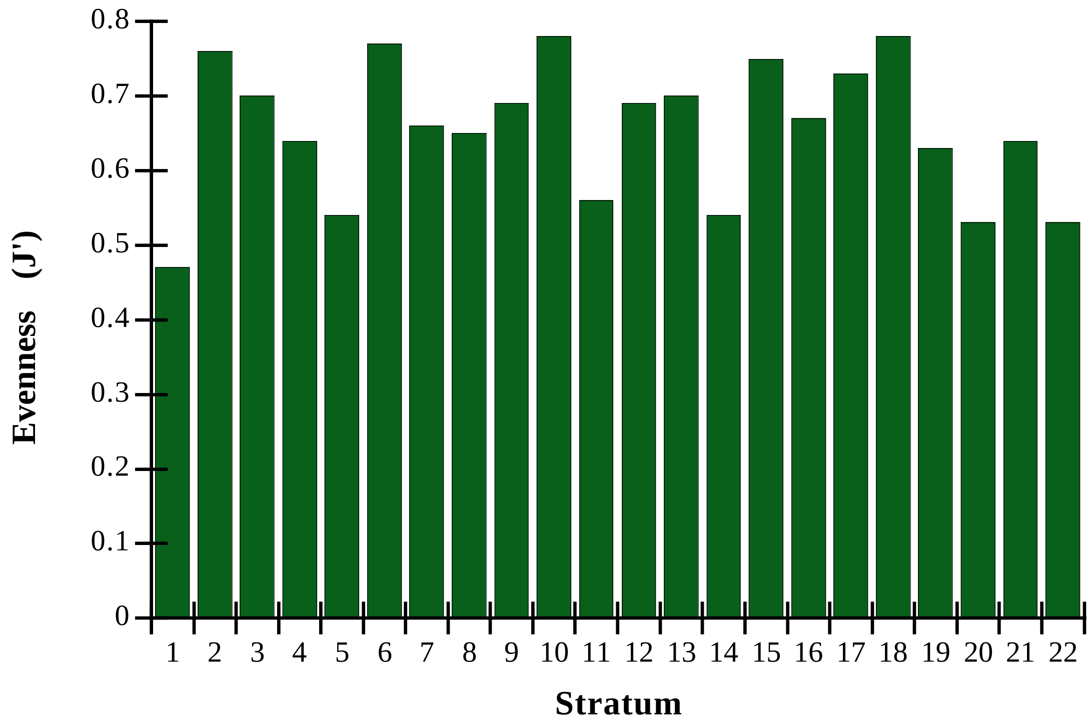
*= a significant difference between strata

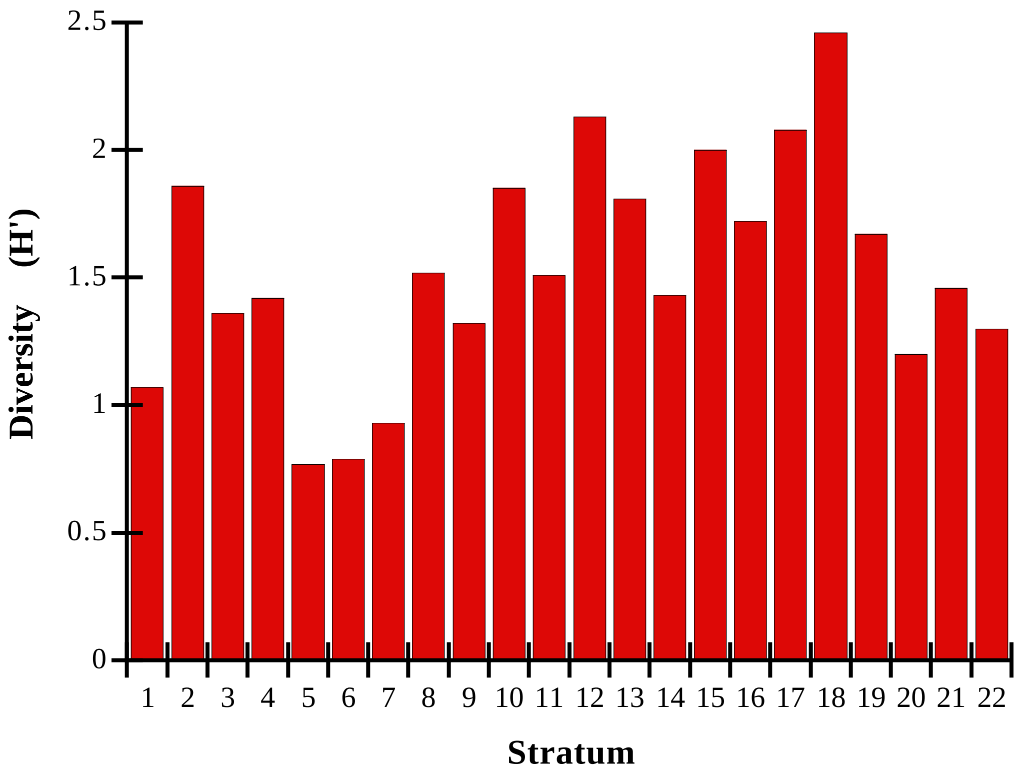
Table 7. Spearman Rho correlation coefficients for the Delaware Bay and adjacent waters sites, September 1997.

Variable	By Variable	Correlation	Probability	sign
Density	No. Taxa	0.5411	<.0001	*
TOC	No. Taxa	-0.2109	0.0588	ns
TOC	Density	0.2765	0.0125	*
% gravel+sand	No. Taxa	0.1598	0.1542	ns
% gravel+sand	Density	-0.1240	0.2702	ns
% gravel+sand	TOC	-0.6559	<.0001	*
% silt+clay	No. Taxa	-0.1189	0.2905	ns
% silt+clay	Density	0.1920	0.0860	ns
% silt+clay	TOC	0.6540	<.0001	*

* = significant correlation; ns = not significant

Figure 13. Taxa diversity (H') and taxa eveness (J') of the Delaware Bay and adjacent waters strata, September 1997.





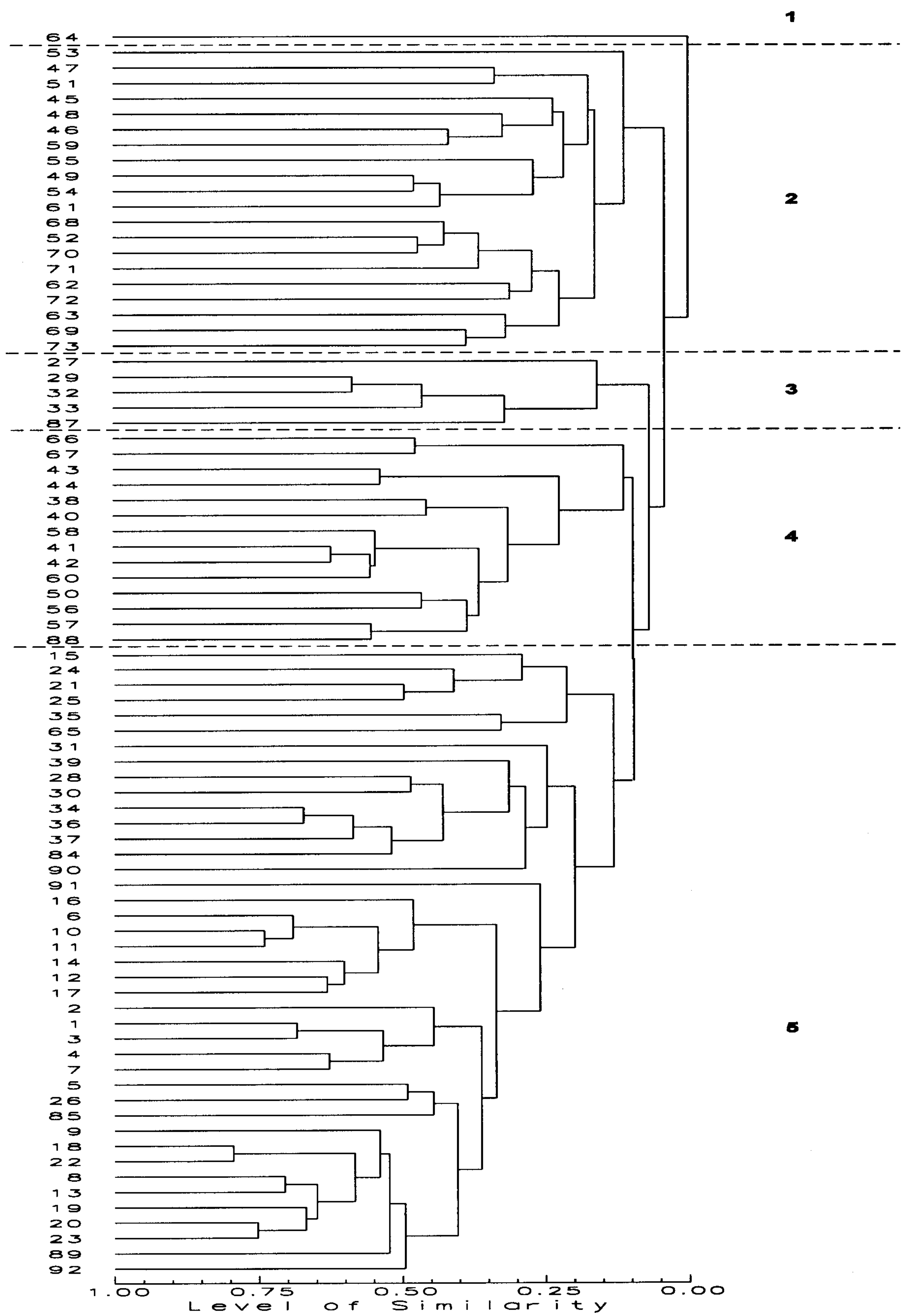


Figure 14. Normal (station) classification analysis for the Delaware Bay and adjacent waters sites, September 1997. Large, bolded numbers (1, 2, 3, 4, 5) denote site groupings.

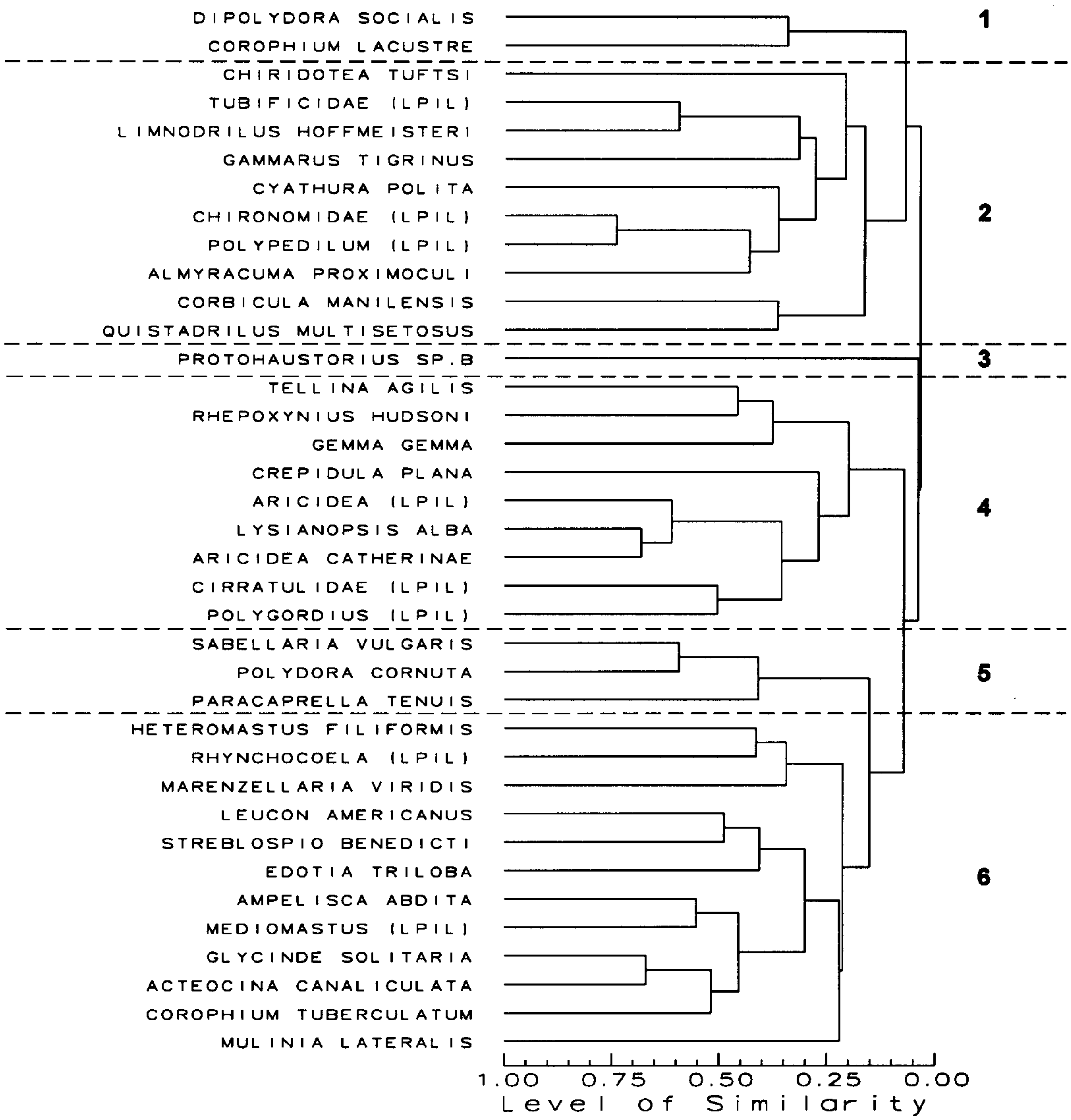


Figure 15. Inverse (taxa) classification analysis for the Delaware Bay and adjacent waters sites, September 1997. Large, bolded numbers (1, 2, 3, 4, 5, 6) denote taxa groupings.

sites, three of which accounted for 100% of the sites within Stratum 18. The remaining sites in this group were from adjacent strata. Stratum 12 was represented by two of the four sites (45 and 46), while 80% of the sites within Stratum 13 were clustered in this group (Figure 14). Stratum 14 was represented by sites 59 and 61 which accounted for only 40% of its total. Sites within Strata 15 and 17 were also in this group and account for 66.6% and 75.0% of these strata respectively. Group 3 was the smallest, containing only 5 sites which represented Strata 7, 8 and 9. These sites accounted for only 33.3%, 33.3% and 50.0% of their respective strata. Group 4 contained 14 sites, representing Strata 10, 11, 12, 13, 14, 16, 17 and 22. No Strata were represented as a whole in this group, with the highest percentage being 75.0% of the total sites of Stratum 14. Group 5 was the largest group containing 41 of the 81 sites sampled. Strata 1, 2, 3, 4, 5, 6, 19, 20 and 21 were represented by 100% of the sites within these strata. The sites within these strata were dominated by the oligochaete family Tubificidae and also contained most of the insect taxa identified in the samples. Strata 7, 8, 9 and 10 were represented by 66.6%, 66.6%, 50.0% and 75.0% of their total sites in Group 5.

Clustering of the 39 taxa at the 81 sites was interpreted at a six–group level at a 15% level of similarity (Figure 15). The three largest groups (2, 4 and 6) consisted of taxa which can be separated by salinity gradients and sediment textures. Group 2 contained 10 taxa which are predominantly found in freshwater. Three of these were the only oligochaetes represented in the analysis. This group also contained the only 2 insect taxa. The presence of these taxa is indicative of freshwater and silty sediments; this is supported by the presence of *Gammarus tigrinus*, an amphipod restricted to fresh and low salinity waters. Group 4 contained 9 taxa which could be classified as marine. The bivalve species *Tellina agilis* and *Gemma gemma* are typically found in higher salinity, sandy environments. The polychaete family Cirratulidae and the polychaete genus *Aricidea* are predominantly marine as is the archiannelid genus *Polygordius*. Group 6 contained 12 taxa which are typically found in estuaries. These taxa are able to tolerate a wide range of salinities and prefer silty sediments. This group had a more diverse taxonomic assemblage with seven orders represented. Estuaries typically have a higher taxonomic diversity than freshwater or marine systems and are subject to varying salinities and sediment types. The remaining Groups in the analysis had 2, 1 and 3 taxa respectively. The two species in Group 1 were the polychaete *Dipolydora socialis* and the amphipod *Corophium lacustre,* both of which are esturine. Group 3 contained only *Protohaustorius* sp. B, a strictly marine amphipod that prefers sandy sediments. Group 5 contained three species which are typically marine. *Sabellairia vulgaris* is a tube-dwelling polychaete found in sandy sediments. The caprellid *Paracaprella tenuis* is usually found associated with hydroids which are typically restricted to marine systems.

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APPENDIX

BARRY A. VITTOR & ASSOCIATES, INC.
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QUALITY CONTROL REWORKS

Client/Project NOAA
Work Assignment Title Delaware Bay 1997

Work Assignment Number FE-97-18-DB Task Number 5

Sorting Results:

Sample #	% Accuracy
14	100%
18	100%
38	100%
31	100%
59	100%
61	100%
29	100%
47	100%
62	100%
5	100%
27	100%

Taxonomy Results:

Sample #	Taxa	% Accuracy
38	Crust./Moll.	100%
61	Crust./Moll.	100%
42	Crust./Moll.	98%
2	Crust./Moll.	99%
25	Crust./Moll.	100%
43-2	Crust./Moll.	97%
14	Crust./Moll.	100%
59	Crust./Moll.	97.3%
67-3	Poly./Misc.	98.3%
60	Poly./Misc.	98.7%
33	Poly./Misc.	100%
30	Poly./Misc.	100%
44	Poly./Misc.	98.2%
29	Poly./Misc.	98.2%
65	Poly./Misc.	100%

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

Carl Mobley 10/6/98

Signature of QA Officer or Reviewer Date

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QUALITY ASSURANCE STATEMENT

Client/Project NOAA

Work Assignment Title Delaware Bay 1997

Work Assignment Number FE-97-18-DB Task Number 5

Description of Data Set or Deliverable: 81 Benthic macroinvertebrate samples collected in July and August of 1997; Young Dredge grabs.

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 QC results follow (see attachment.) 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

10/6/98

Signature of QA Officer or Reviewer Date

Barry A. Vittor 10-6-98

Signature of Project Manager Date