DISPOSAL AREA MONITORING SYSTEM

ANNUAL REPORT

1980

VOLUME II

BIOLOGICAL OBSERVATIONS

DAMOS CONTRIBUTION # 17

Edited by:

Robert W. Morton Carolyn A. Karp

Submitted to:

New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

Submitted by:

Science Applications Inc.
Ocean Science & Technology Division
202 Thames Street
Newport, RI 02840

SCIENCE APPLICATIONS, INC.

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S.Y. Feng

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6.0 MUSSEL WATCH PROGRAM

6.0 Mussel Watch Program

6.1 Introduction

The monitoring of heavy metal uptake by mussel populations at the New England disposal sites continued during 1980, however, this portion of the DAMOS program suffered drastically from the administrative and funding problems discussed earlier and a significant hiatus in sampling occurred during the second half of 1979. After resumption of the program in early 1980, the priorities of the New England Division required that major emphasis be placed at active disposal areas and, therefore, higher frequency sampling operations were concentrated at the Portland, New London and Central Long Island Sound disposal sites.

The data provided in this report are compared with earlier results but are also analyzed as a separate data set, since additional insight into the bioaccumulation of heavy metals by mussels may be gained by the more frequent sampling undertaken in 1980.

6.2 Materials and Methods

The methods used during the 1980 sampling period were essentially the same as those reported in previous DAMOS reports (DAMOS Annual Report, Vol.II, 1979) except that more frequent sampling was initiated at a fewer number of disposal sites. During the first half of 1980, sampling was conducted on a monthly basis to determine whether the rate of uptake of heavy metals was correlated with the mussels' reproductive state.

Modiolus modiolus were obtained from the Bulwark Shoal

Reference station and placed in the Portland disposal area approximately 200 m north of the designated dumping point (Figure 6.3-1). An identical number of mussels were caged at the Bulwark Shoal site to provide reference data.

Mytilus edulis collected from Latimers Light were again used to stock the in-situ platforms at both the New London and Central Long Island Sound Disposal sites. At the New London site a reference platform was established east of the disposal site in Fishers Island Sound and two stations were established in the vicinity of the dredged material (Figure 6.3-2). At the Central Long Island Sound site four stations were established (Figure 6.3-3). These included a reference station, a platform associated with both the Stamford/New Haven North and South disposal mounds and a station north of the site designated for disposal of Norwalk dredged material.

After the mussel cages were retrieved, shellfish from individual bags were either refrigerated for trace metal analysis, or shucked and fixed in buffered formalin for histological examination. Two or more subsamples, each consisting of four individual Modiolus or eight Mytilus from each station, were prepared for trace metal determination. Animals were cleaned, measured, shucked, weighed, and homogenized prior to lyophilization. A 0.8 g portion of each freeze-dried subsample was digested for six hours at 50°C with concentrated nitric acid and diluted to 50 ml with distilled deionized water. Each digested sample was passed through a pre-cleaned glass fiber filter to remove any refractory material and then was stored in an acid-cleaned polyethylene vial.

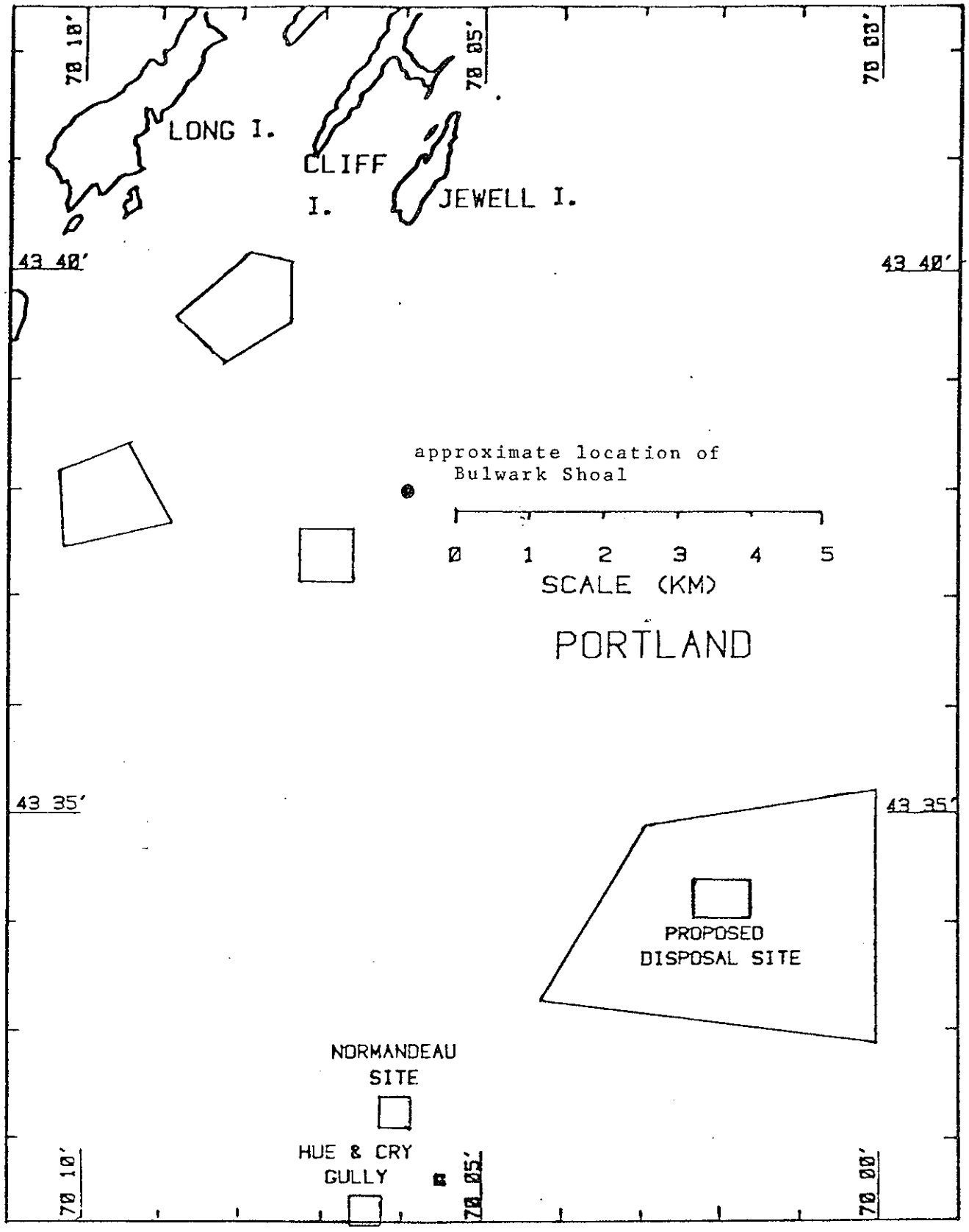

Figure 6.3-1 Map of Portland Disposal Area

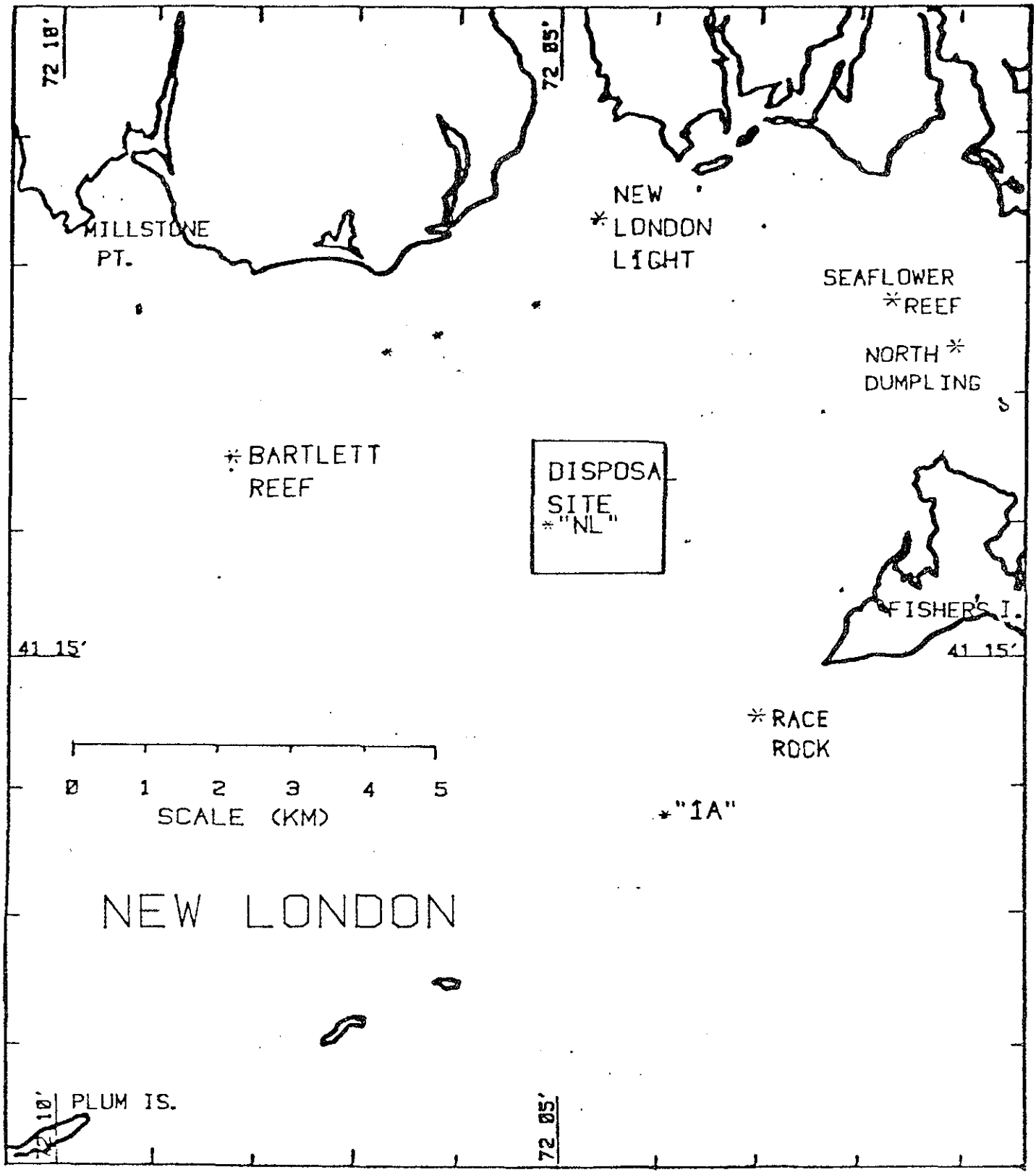

Figure 6.3-2 Map of New London Disposal Area

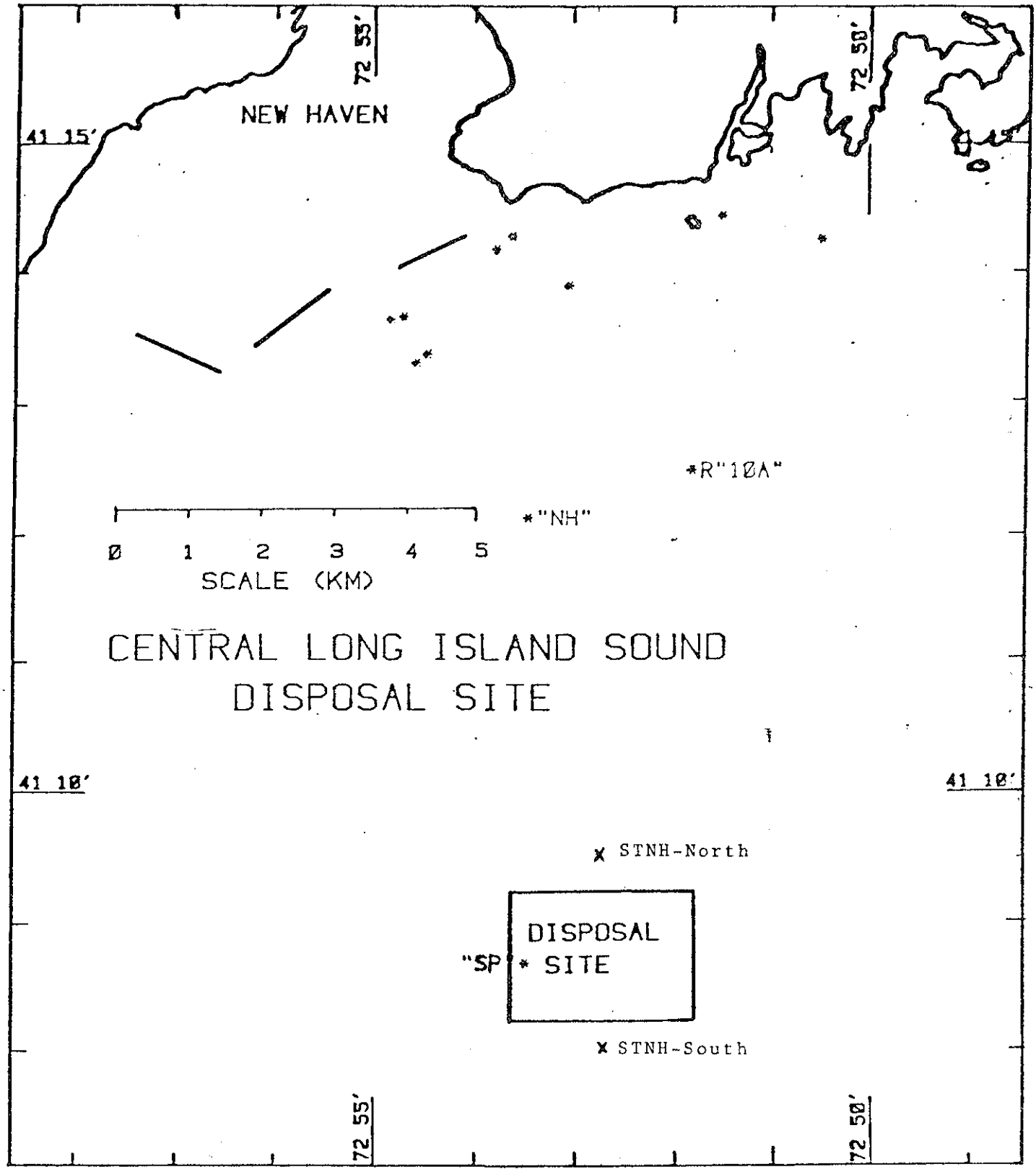

Figure 6.3-3 Map of Central Long Island Sound Disposal Area

The samples were analyzed using flame atomic absorption spectrophotometry (Instrumentation Laboratory 151) for copper, zinc and iron; flameless atomic absorption spectrophotometry (Perkin-Elmer 5000 and HGA-500 Furnace) for cadmiun, chromium, nickel, lead, cobalt and vanadium; and cold vapor absorption spectrophotometry (Perkin-Elmer MAS-50 Mercury Analyzer) for mercury. Extreme care was taken during both the preparative and analytical stages to avoid trace metal contamination.

Results were corrected for blank values and calibrated by comparison with similarly prepared metal standards. The data were interpreted and plotted using a Hewlett-Packard System 45 computer and 9872A plotter.

6.3 Results and Discussion

The data obtained during the 1980 sampling period are presented in Tables 6.3-1, 2 and 3 for the Portland, New London and Central Long Island Sound disposal sites, respectively. Baseline data for Latimers Light are included in Table 6.3-2 under New London, but should be considered for interpretation of Central Long Island Sound data as well.

Comparison of the 1980 data with previous results is provided in Figures 6.3-4, 5 and 6. In general, the heavy metal concentrations in mussels during this time are consistent with previous measurements, however, the variability between sample replicates appears to be somewhat lower. Since disposal operations were either underway or recently terminated at all these sites during this sample period, the lack of a significant change in the overall level of metals is a finding of some

TABLE 6.3-1 Concentrations of heavy metals in Modiolus modiolus, Portland Disposal Site 1980 (ppm)

a. Bulwark Shoals Reference Site

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Hi	Zn	V
4/11/80	$\bar{X}$	7.48	0.81	0.27	27.42	130.55	0.158	1.74	222.49	6.97
	S.D.	1.61	0.22	0.09	4.68	15.10	0.036	0.40	53.27	1.99
	n	8	8	8	8	8	8	8	8	8
5/08/80	$\bar{X}$	6.78	0.77	0.44	31.09	131.11	0.188	2.59	265.61	6.01
	S.D.	0.66	0.27	0.06	3.76	15.73	0.024	0.40	71.67	0.31
	n	3	3	3	3	3	3	3	3	3
6/03/80	$\bar{X}$	11.51	0.75	0.52	34.53	116.74	0.308	2.40	292.84	5.56
	S.D.	2.30	0.18	0.10	9.35	7.03	0.044	0.73	67.13	2.14
	n	8	8	8	8	8	8	8	8	8
7/01/80	$\bar{X}$	13.32	0.75	0.55	33.93	96.11	0.293	3.39	304.98	4.92
	S.D.	2.29	0.10	0.09	5.41	3.77	0.022	0.48	101.55	2.60
	n	3	3	3	3	3	3	3	3	3

b. Portland Disposal Site

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Ni	Zn	V
5/08/80	$\bar{X}$	11.96	0.50	0.57	30.77	132.91	0.263	2.26	265.49	5.90
	S.D.	1.16	0.13	0.06	5.78	7.21	0.018	0.34	41.27	0.43
	n	3	3	3	3	3	3	3	3	3
6/30/80	$\bar{X}$	13.03	1.47	0.67	36.39	179.13	0.291	3.44	275.78	6.83
	S.D.	1.82	0.36	0.06	12.06	9.02	0.048	0.77	39.16	0.21
	n	3	3	3	3	3	3	3	3	3
7/01/80	$\bar{X}$	9.87	1.23	0.43	33.93	206.90	0.232	3.20	245.94	5.33
	S.D.	2.04	0.09	0.25	3.61	29.04	0.030	0.60	45.39	1.22
	n	3	3	3	3	3	3	3	3	3

TABLE 6.3-2 Concentrations of heavy metals in Mytilus edulis, New London Disposal Site 1980 (ppm)

a. Latimers Light Reference Station

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Ni	Zn	V
4/17/80	$\bar{X}$	1.40	6.96	0.58	7.73	220.92	0.122	4.26	119.79	2.23
	S.D.	0.28	4.15	0.28	0.51	20.48	0.010	1.83	8.98	0.18
	n	3	3	3	3	3	3	3	3	3
5/14/80	$\bar{X}$	1.28	4.05	0.26	8.03	211.78	0.140	4.13	104.11	1.51
	S.D.	0.14	3.20	0.10	0.01	14.96	0.017	0.50	9.01	0.08
	n	3	3	3	3	3	3	3	3	3
6/19/80	$\bar{X}$	1.06	2.97	0.24	7.28	213.59	0.130	2.29	103.23	< 0.3
	S.D.	0.06	0.50	0.05	0.01	20.43	0.013	0.66	17.54	
	n	3	3	3	3	3	3	3	3	3
7/16/80	$\bar{X}$	0.82	0.86	0.23	6.68	131.42	0.143	0.95	109.10	0.81
	S.D.	0.05	0.09	0.04	0.52	14.48	0.025	0.51	11.79	0.02
	n	3	3	3	3	3	3	3	3	3

b. New London Reference Station (Fisher's Island Sound)

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Ni	Zn	V
4/17/80	$\bar{X}$	1.12	7.23	0.60	8.33	210.56	0.103	4.34	104.13	3.06
	S.D.	0.05	0.81	0.04	0.51	16.32	0.003	0.25	9.08	0.12
	n	3	3	3	3	3	3	3	3	3
5/14/80	$\bar{X}$	1.27	3.36	0.17	8.63	160.78	0.132	2.09	98.90	1.53
	S.D.	0.03	0.31	0.05	0.52	22.72	0.006	0.33	9.00	0.16
	n	3	3	3	3	3	3	3	3	3
6/19/80	$\bar{X}$	0.95	2.37	0.34	8.49	162.55	0.118	1.95	97.33	< 0.3
	S.D.	0.10	0.41	0.00	2.07	15.88	0.010	0.43	10.10	
	n	3	3	3	3	3	3	3	3	3
7/18/80	$\bar{X}$	0.71	0.87	0.28	7.57	128.88	0.127	1.17	99.29	0.95
	S.D.	0.50	0.16	0.02	1.03	19.62	0.025	0.15	14.74	0.20
	n	3	3	3	3	3	3	3	3	3

TABLE 6.3-2. Concentrations of heavy metals in Mytilus edulis, New London Disposal Site 1980 (ppm) (Continued)

c. New London Disposal Site (Station D-1)

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Ni	Zn	V
4/17/80	$\bar{X}$	1.53	3.36	0.38	10.42	316.59	0.160	2.99	145.79	3.42
	S.D.	0.18	0.41	0.06	0.52	21.69	0.013	0.37	23.92	0.26
	n	3	3	3	3	3	3	3	3	3
5/14/80	$\bar{X}$	1.74	6.85	0.36	9.22	272.67	0.158	4.17	124.94	1.33
	S.D.	0.24	1.69	0.01	0.52	19.06	0.003	0.99	15.68	0.18
	n	3	3	3	3	3	3	3	3	3
6/19/80	$\bar{X}$	1.21	5.91	0.49	8.47	364.42	0.147	4.79	111.02	< 0.3
	S.D.	0.28	5.90	0.19	0.52	47.14	0.006	4.10	8.98	
	n	3	3	3	3	3	3	3	3	3
7/16/80	$\bar{X}$	0.99	2.20	0.41	8.18	208.15	0.153	2.97	122.96	1.11
	S.D.	0.11	0.11	0.04	0.00	19.51	0.003	0.42	18.18	0.21
	n	3	3	3	3	3	3	3	3	3

d. New London Disposal Site (Station D-3)

Sampling Date		Cd	Cr	Co	Cu	Fe	Hg	Ni	Zn	V
5/2/80*	$\bar{X}$	1.65	2.82	0.70	10.10	272.67	0.143	5.14	145.60	2.38
	S.D.	0.18	1.97	0.53	0.52	43.83	0.003	3.58	32.48	0.10
	n	3	3	3	3	3	3	3	3	3
5/14/80	$\bar{X}$	2.01	7.64	0.46	9.51	298.72	0.150	5.13	130.09	1.66
	S.D.	0.12	1.38	0.05	0.51	37.62	0.013	0.96	8.99	0.15
	n	3	3	3	3	3	3	3	3	3

*The platform was not located during April 17, 1980 sampling trip; however, it was retrieved on May 2, 1980.

6/19/80	$\bar{X}$	1.24	6.84	0.32	8.48	284.33	0.143	5.33	132.87	< 0.3
	S.D.	0.18	0.53	0.03	0.52	36.33	0.010	0.75	5.98	
	n	3	3	3	3	3	3	3	3	
7/16/80	$\bar{X}$	1.68	3.51	0.44	9.38	338.89	0.175	8.21	164.90	1.41
	S.D.	0.27	0.74	0.03	0.51	53.91	0.013	4.46	7.00	0.25
	n	3	3	3	3	3	3	3	3	3

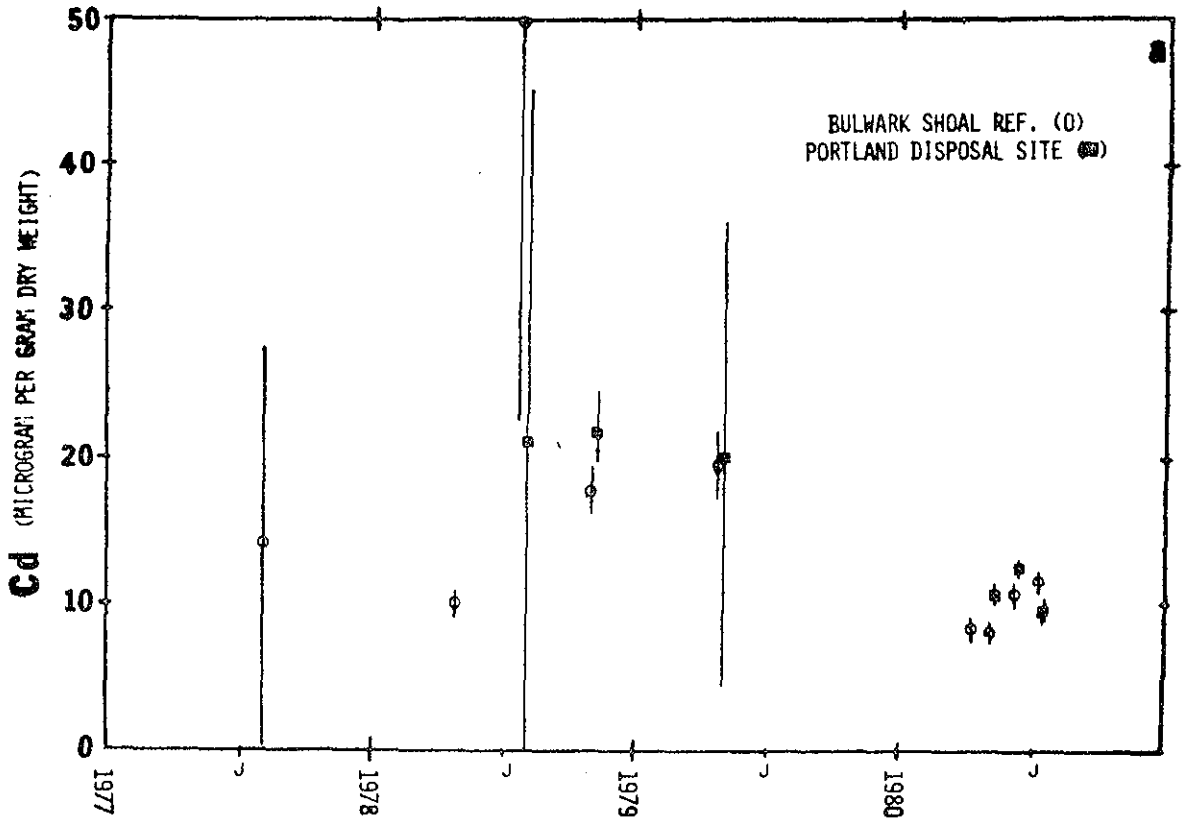

FIGURE 6.3-4A CONCENTRATION OF CADMIUM IN M. MODIOLUS - PORTLAND AREA

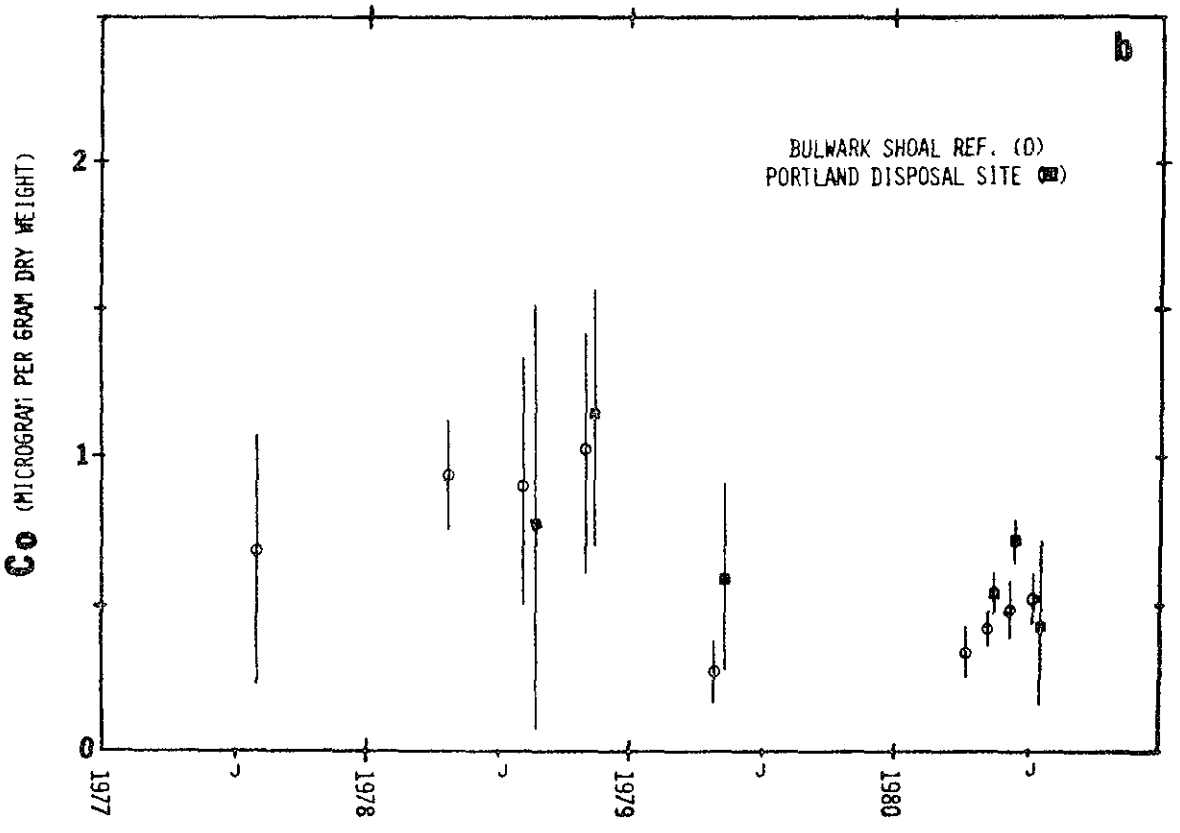

FIGURE 6.3-4B CONCENTRATION OF COBALT IN M. MODIOLUS - PORTLAND AREA

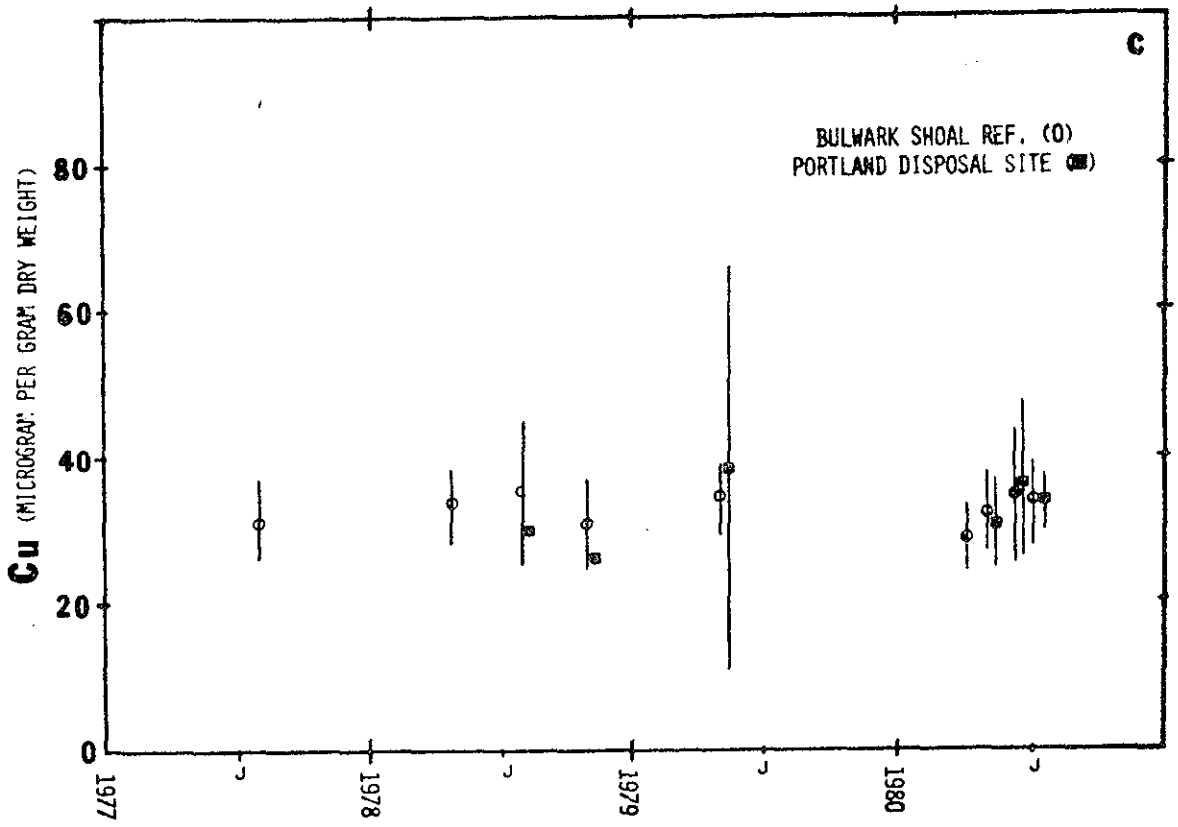

FIGURE 6.3-4c CONCENTRATION OF COPPER IN M. MODIOLUS - PORTLAND AREA

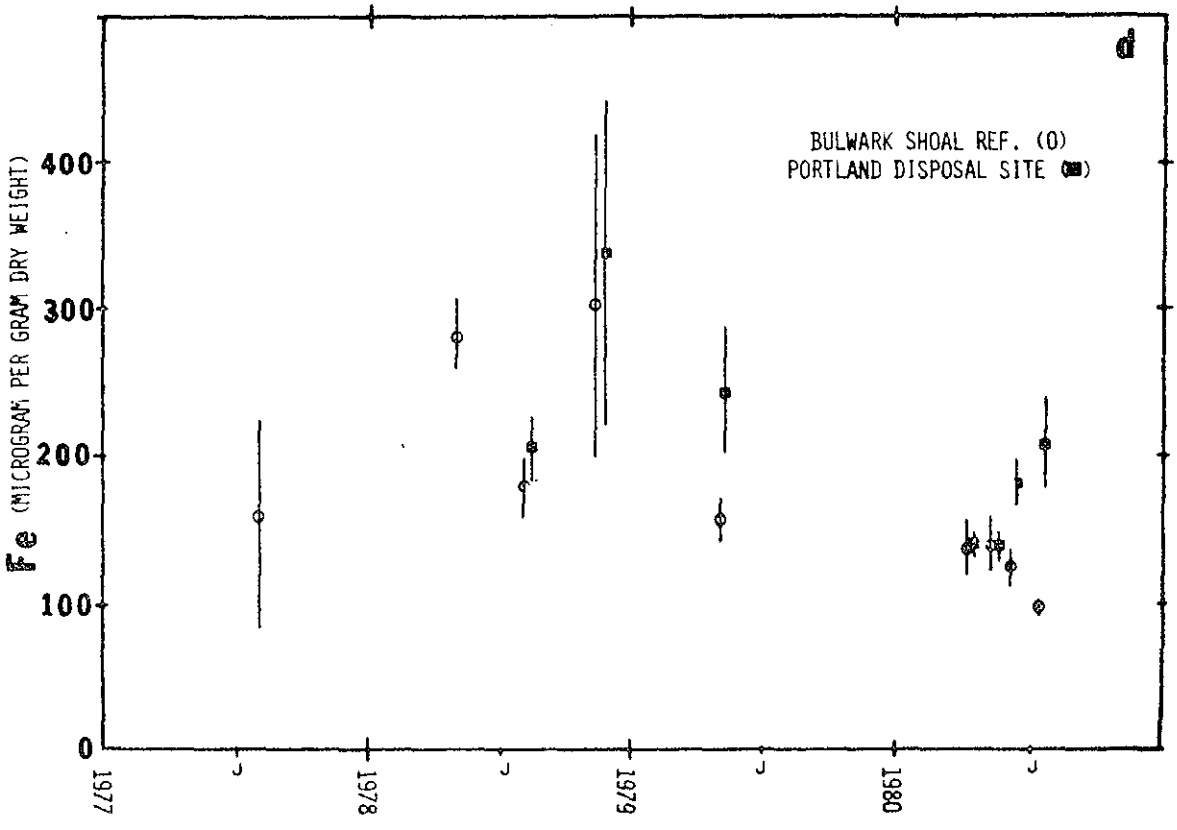

FIGURE 6.3-4D CONCENTRATION OF IRON IN M. MODIOLUS - PORTLAND AREA

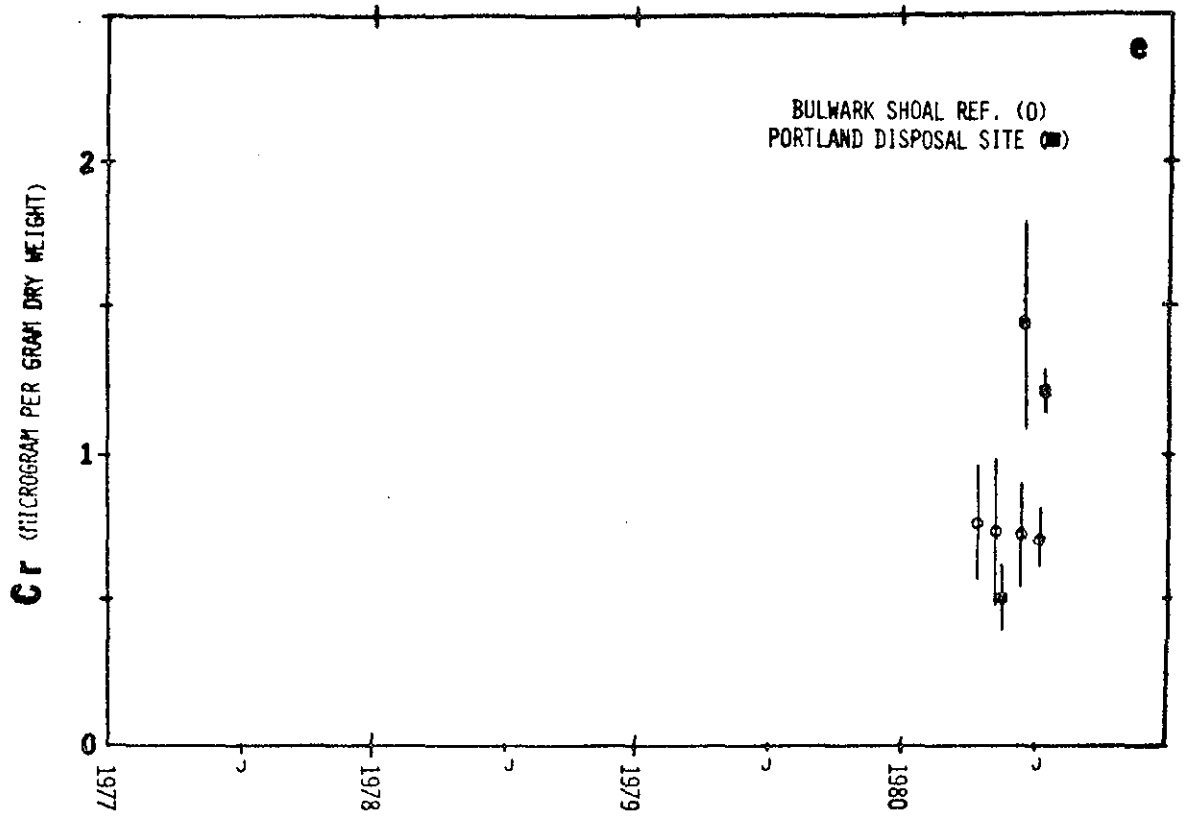

FIGURE 6.3-4E CONCENTRATION OF CHROMIUM IN M. MODIOLUS - PORTLAND AREA

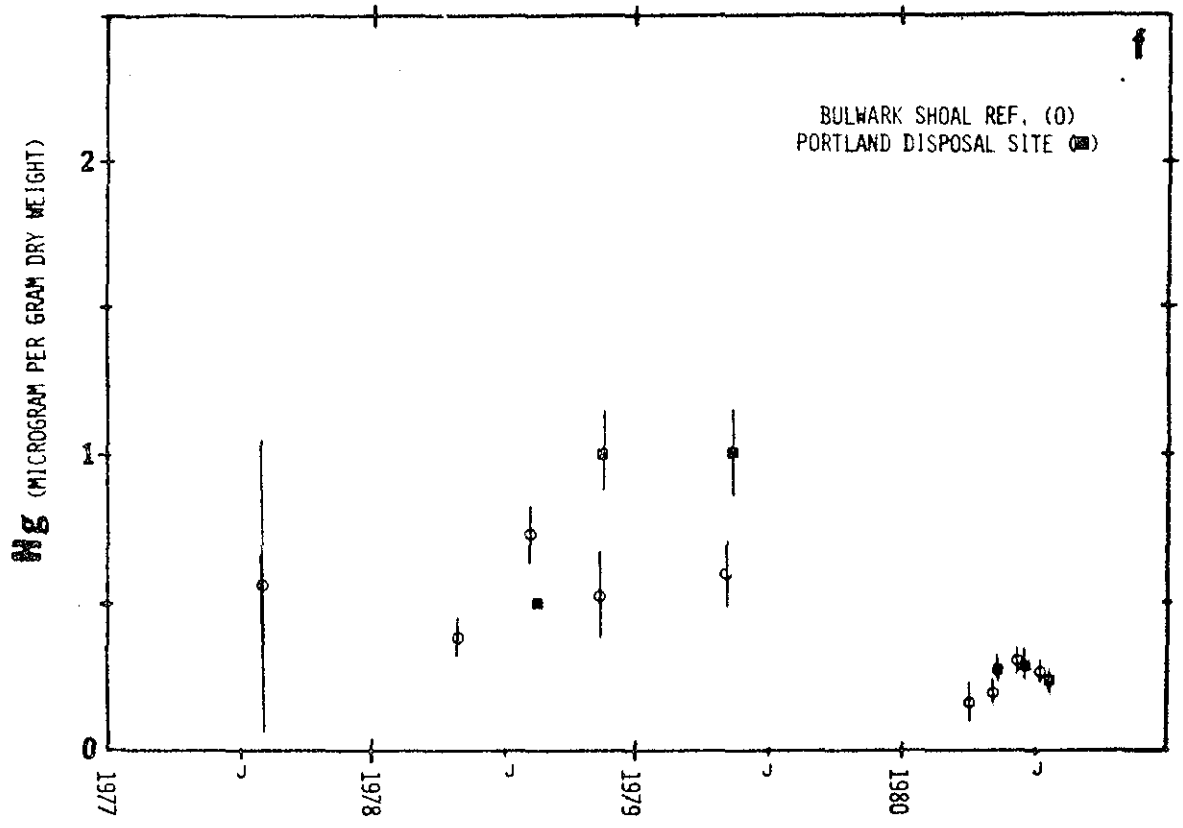

FIGURE 6.3-4F CONCENTRATION OF MERCURY IN M. MODIOLUS - PORTLAND AREA

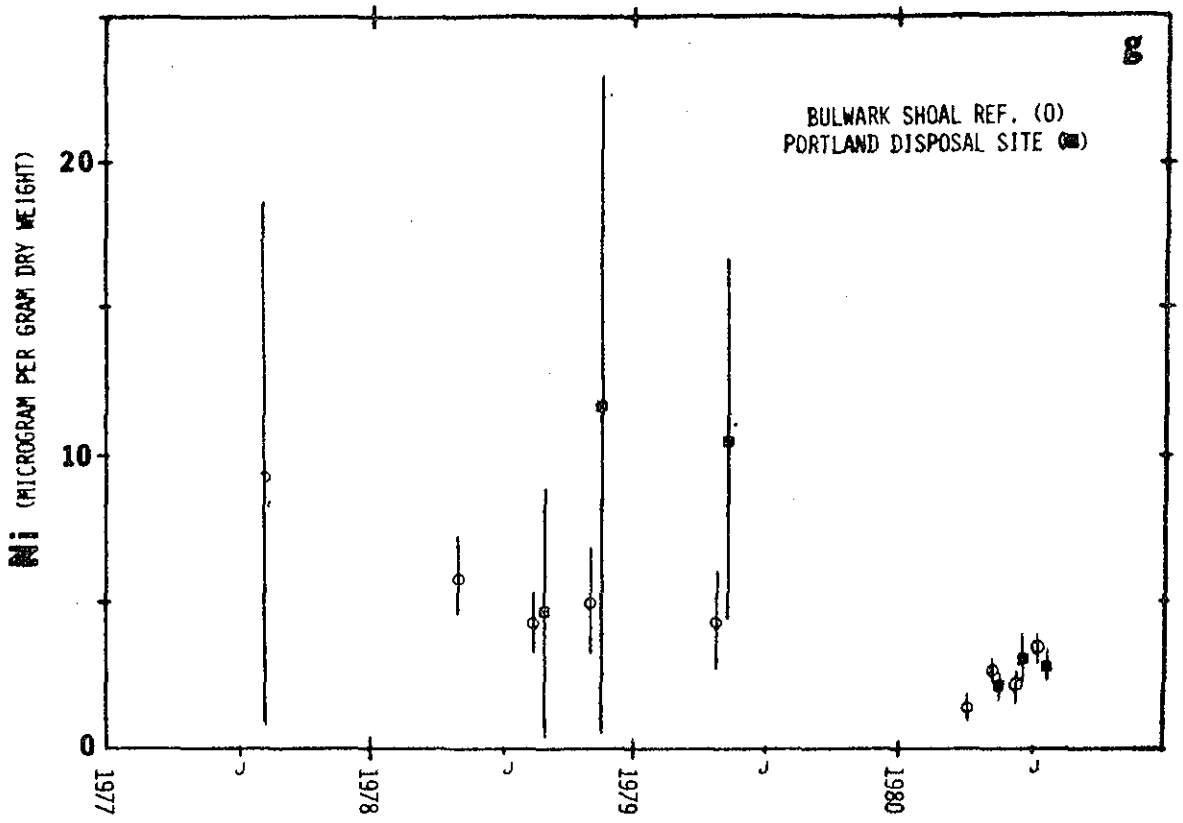

FIGURE 6.3-4G CONCENTRATION OF NICKEL IN M. MODIOLUS - PORTLAND AREA

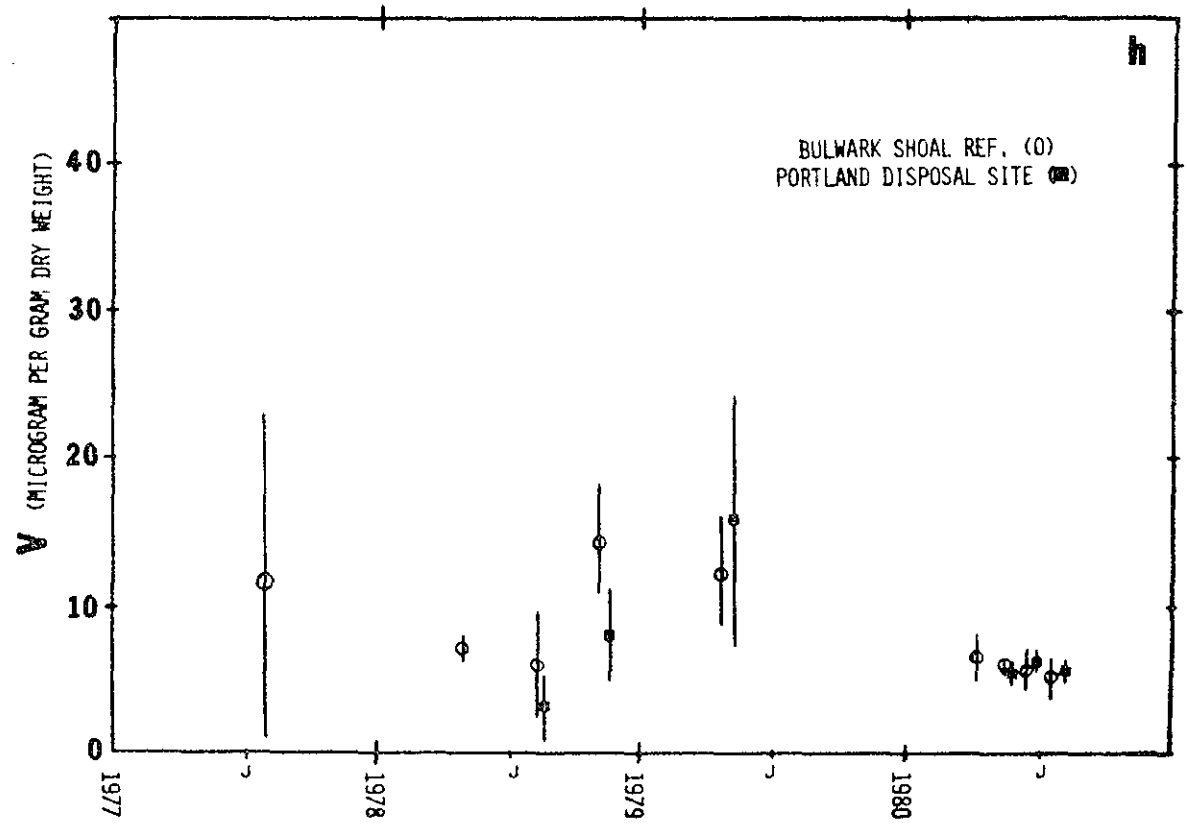

FIGURE 6.3-4H CONCENTRATION OF VANADIUM IN M. MODIOLUS - PORTLAND AREA

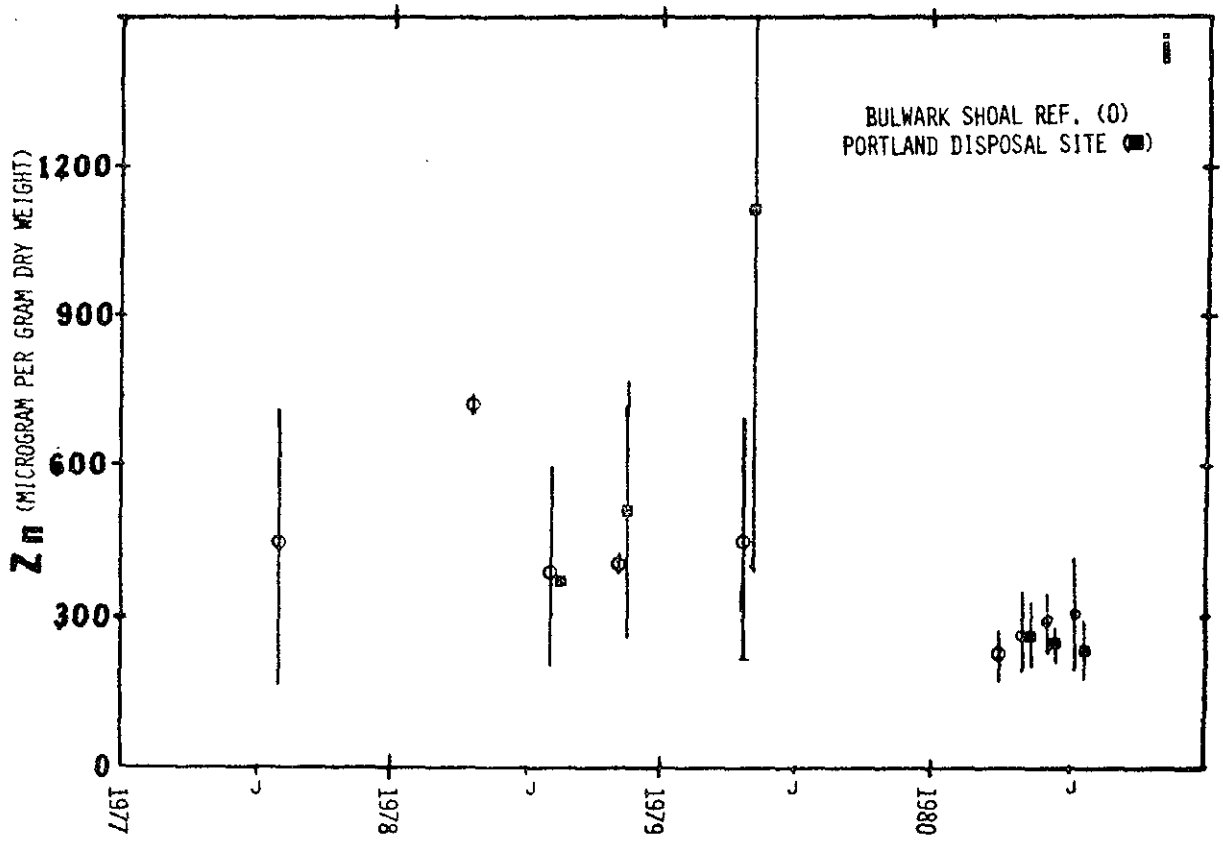

FIGURE 6.3-4: CONCENTRATION OF ZINC IN M. MODIOLUS - PORTLAND AREA

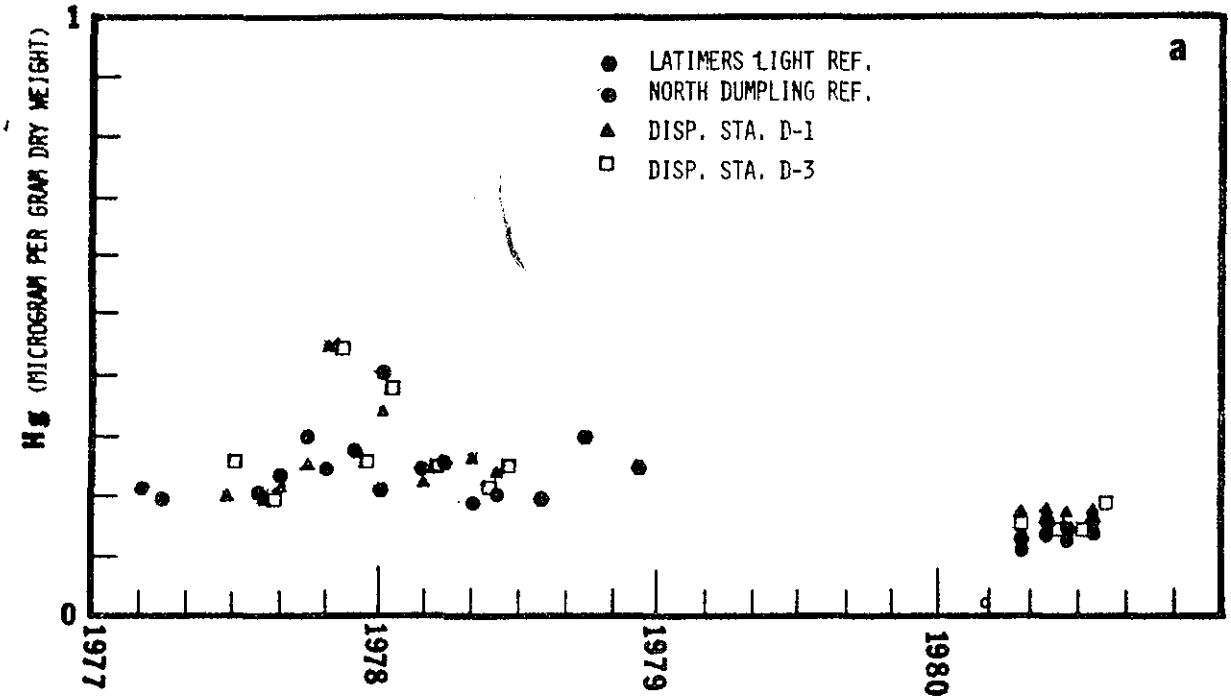

FIGURE 6.3-5A CONCENTRATION OF MERCURY IN MYTILUS EDULIS - NEW LONDON AREA

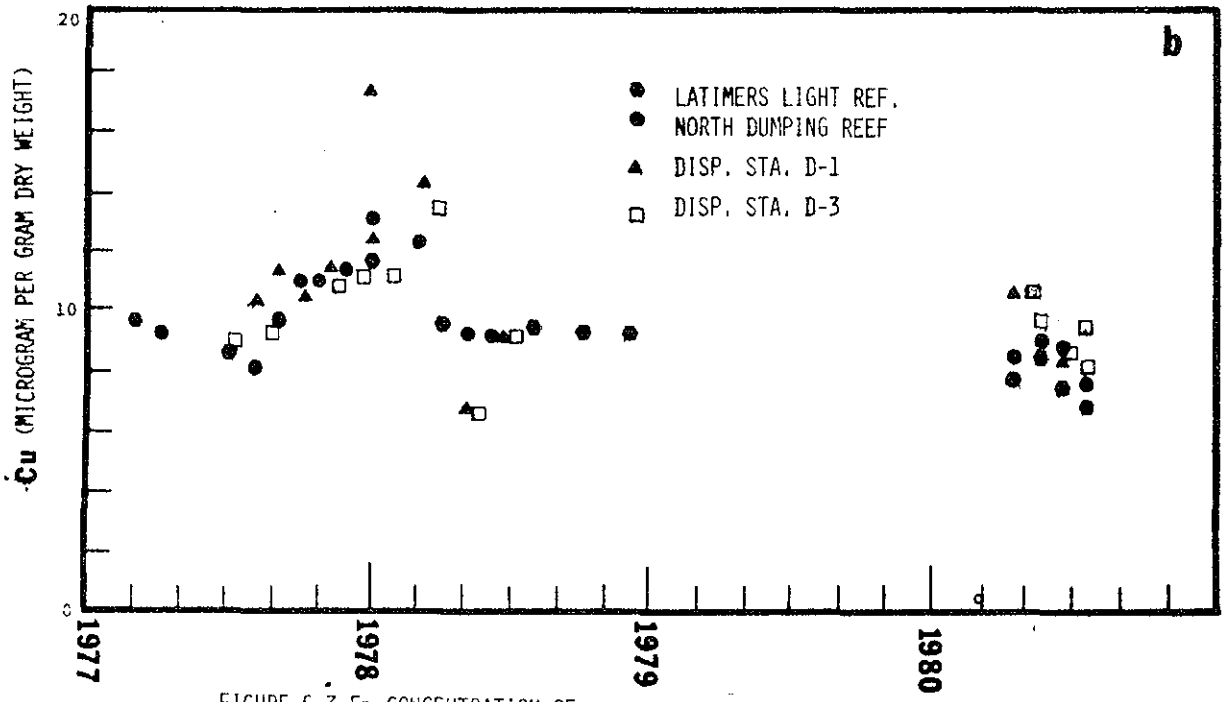

FIGURE 6.3-5B CONCENTRATION OF COPPER IN MYTILUS EDULIS - NEW LONDON AREA

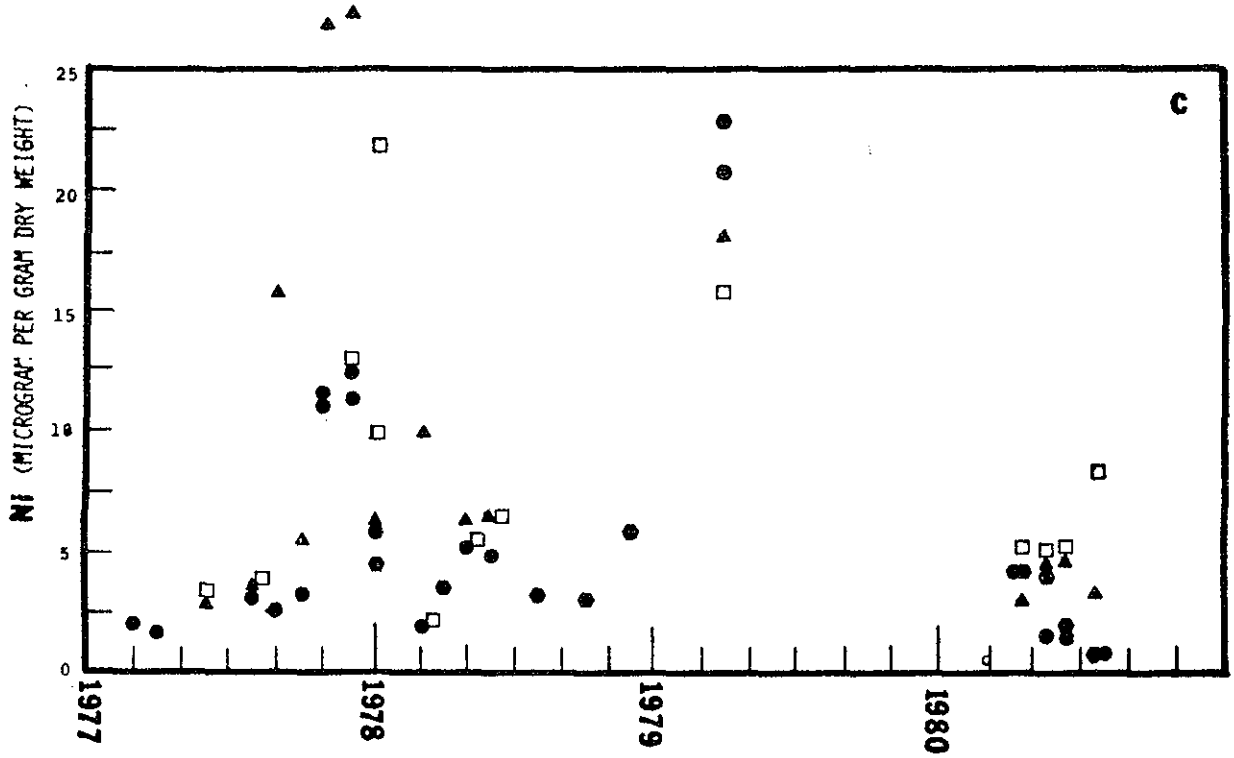

FIGURE 6.3-5c CONCENTRATION OF NICKEL IN MYTILUS EDULIS - NEW LONDON AREA

importance. Additional work is currently underway to define these temporal trends statistically.

The data obtained during 1980 were also treated as a single data set and analyzed statistically with a two way analysis of variance to determine whether spatial and temporal variations in the trace metal concentration were significant.

6.3.1 Portland Disposal Area

Table 6.3.1-1 summarizes the results of ANOVA for Modiolus modiolus deployed at the Bulwark Shoal Reference and Portland Disposal stations. Neither temporal nor spatial variation is apparent in the concentrations of Cu, Zn and V. The concentrations of Cr and Fe, on the other hand, show significant temporal and spatial variation. The level of Cr was relatively stable (0.75 to 0.81 ppm) at Bulwark Shoal between April and July samples, but showed a definite increasing trend (0.50 to 1.23 ppm) at the Portland disposal site. While a 132 to 207 ppm increase in Fe was observed at the Portland Disposal site, a reduction of 130 to 95 ppm was noted at the reference station (Bulwark Shoal). There was a significant increase over time in the concentrations of Cd, Co, Hg and Ni at both stations.

In order to graphically depict the spatial and temporal variations discussed above, a discriminant function analysis was also performed on the data. The computer program used to perform this analysis was obtained from the Biomedical Computer Program P-Series, Health Sciences Computing Facility (UCLA), and run at the University of Connecticut Computer Center using an IBM System 370 computer.

Table 6.3.1-1. Summary of Two-Way Analysis of Variance (ANOVA) on trace metal concentrations found in Modiolus modiolus deployed at Bulwark Shoal reference site and Portland, Maine, disposal site from Aplril to July, 1980.

Heavy Metal		F	P
Cd	Stations	1.10	0.304
	Dates	10.11	0.0002
Cr	Stations	6.72	0.016
	Dates	6.78	0.0019
Co	Stations	1.38	0.251
	Dates	12.77	<0.00001
Cu	Stations	0.00	0.971
	Dates	1.87	0.162
Fe	Stations	67.46	<0.00001
	Dates	4.24	0.016
Hg	Stations	0.20	0.658
	Dates	22.59	<0.00001
Ni	Stations	0.28	0.603
	Dates	9.83	<0.00001
Zn	Stations	0.22	0.640
	Dates	1.52	0.236
V	Stations	0.26	0.612
	Dates	1.29	0.302

Degrees of freedom (d.f.) for most metals are 1, 23 for "Stations" and 3, 23 for "Dates" except for Hg which are 1, 22 and 3, 22.

The metal concentrations were the variables entered into the discriminant functions for this analysis. The mussels collected from a given station on a given date composed a group, and each replicate sample from a group was considered a separate case.

The program performed a multiple group discriminant analysis, and the variables used to compute the linear classification functions were chosen in a stepwise manner. At each step the variable that added the most to the separation of the groups was entered into the classification functions. The program only used complete cases in all computations; if a value for any variable in a case was missing, the entire case was omitted from all calculations.

At step 0, no variables had been entered into the discriminant function, and an F-to-enter was printed for each variable. The F-to-enter for each variable corresponded to the F statistic computed for the groups analyzed. At step 1, the variable with the highest F-to-enter was entered into the discriminant functions; that variable discriminated best between groups. The program continued to add variables until all of the variables that passed the test criterion (F>4.0) were entered.

At each step, the program computed linear classification functions which were used to assign cases into groups. The output included two matrices: (1) the classification matrix in which each case was assigned to a group according to the classification functions, and (2) the jack-knifed classification matrix in which each case was assigned to a group according to the classification functions computed for all data <u>except</u> that for the case being

classified.

Each case was plotted as a function of two canonical variables. The first canonical variable was the linear combination of variables entered into the discriminant functions that best discriminated among the groups. The second canonical variable was the next best linear combination of variables for differentiating between the groups, and was orthogonal to the first.

Fe and Hg were the variables that discriminated best among groups. The classification matrix was 80%. Figure 6.3.1-1 illustrates graphically the sampling, temporal and spatial variability of the trace metal data from Modiolus modiolus collected from Bulwark Shoal and the Portland disposal station. The size of the circumscribed areas is an indication of the degree of scattering (variance) within groups. There was considerable overlap of Bulwark Shoal (April and May) and Portland disposal station (April) samples indicating a high degree of similarity. This was expected since the mussels used to stock the two stations were obtained from a single source. As time passed, however, the two groups of mussels became spatially and temporally more distinct. It may be significant to note that in June 1980, concentrations of all heavy metals were higher at the disposal site than at Bulwark Shoals with the exception of Hg and Zn (Table 6.3-1). In July, however, concentrations of Cd, Co, Hg, Ni and Zn were lower at the disposal site while only Cr and Fe concentrations were higher. The mean Cu concentration was 33.93 ppm at both sites in July. These relative concentrations, and the three-fold difference in Fe (discriminating variable)

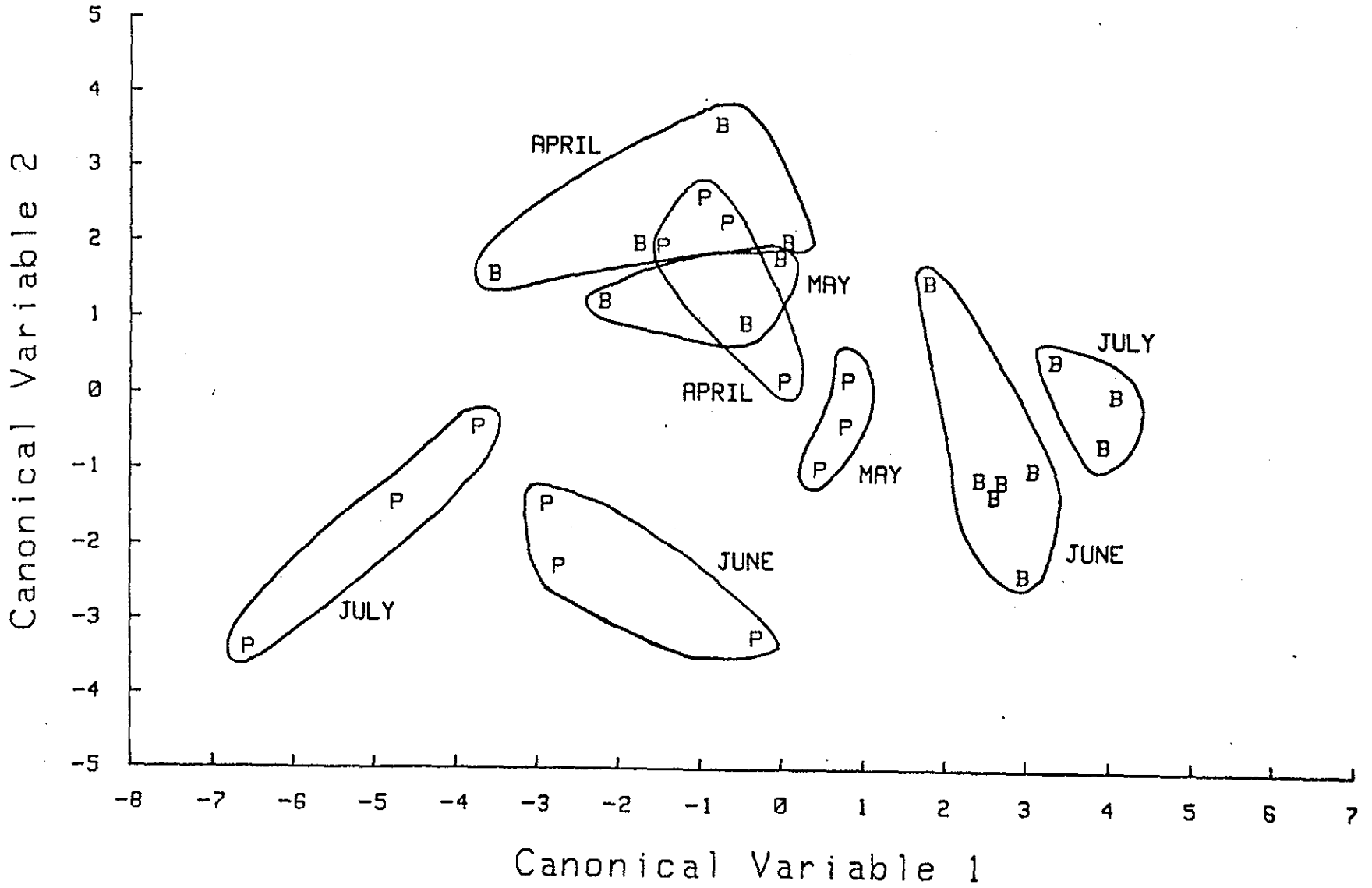

Figure 6.3.1-1. Plot of discriminant scores derived from trace metals in Modiolus modiolus maintained at Bulwark Shoal (B) and Portland disposal site (P), Maine.

concentrations between Bulwark Shoals and Portland in July, may explain the location of groups in Figure 6.3.1-1.

6.3.2 New London Disposal Area

The two-way analysis of variance for all four New London stations revealed the following pattern of spatial and temporal variations of trace metals in Mytilus edulis (See Table 6.3.2-1 & 2). The concentrations of Cd, Co, Cu, Fe, Hg, Zn and V showed significant spatial and temporal variations. In general, higher concentrations of these trace metals were found at the disposal site stations (D1 and D3), than at the reference site stations (Latimers Light and Fishers Island Sound). For example, Hg concentrations ranged between 0.143 and 0.175 ppm at the disposal site stations while they varied between 0.103 and 0.143 ppm at the reference stations.

The concentrations of these metals showed significant decreases at all four stations between April and July collections. Exceptions to this generalization were Station D1 which showed no apparent change in Co (0.38-0.41 ppm), and Station D3 where increases were found in Fe (272 to 338 ppm) and Zn (146 to 164 ppm). While the level of Hg remained relatively unchanged at Station D1, it tended to increase with time at Latimers Light, Fishers Island Sound and Station D3.

At the reference station, Cr concentrations in Mytilus edulis decreased steadily over time from 7.23 to 0.886 ppm. Cr concentrations were found to be generally higher at the disposal sites, reaching a peak of 6 to 7 ppm during the months of May and June (Table 6.3-2).

Table 6.3.2-1. Summary of Two-Way ANOVA on trace metal concentrations found in *Mytilus edulis* deployed at the reference stations: Latimers Light and Fishers Island Sound, and the New London disposal site: D1 and D3, Connecticut, from April to July, 1980.

Heavy Metal		F	P
Cd	Stations	32.46	<0.00001
	Dates	26.51	<0.00001
Cr	Stations	1.69	0.188
	Dates	7.02	0.0009
Co	Stations	7.60	0.0006
	Dates	7.61	0.0006
Cu	Stations	17.58	<0.00001
	Dates	7.20	0.0008
Fe	Stations	63.38	<0.00001
	Dates	9.08	0.0002
Hg	Stations	19.64	<0.00001
	Dates	5.00	0.0059
Ni	Stations	8.33	0.0003
	Dates	0.46	0.7095
Zn	Stations	20.00	<0.0001
	Dates	3.67	0.0223
V	Stations	10.43	0.0001
	Dates	569.97	<0.00001

Degrees of freedom (d.f.) for all heavy metals are 3, 32 for "Stations" and 3,32 for "Dates".

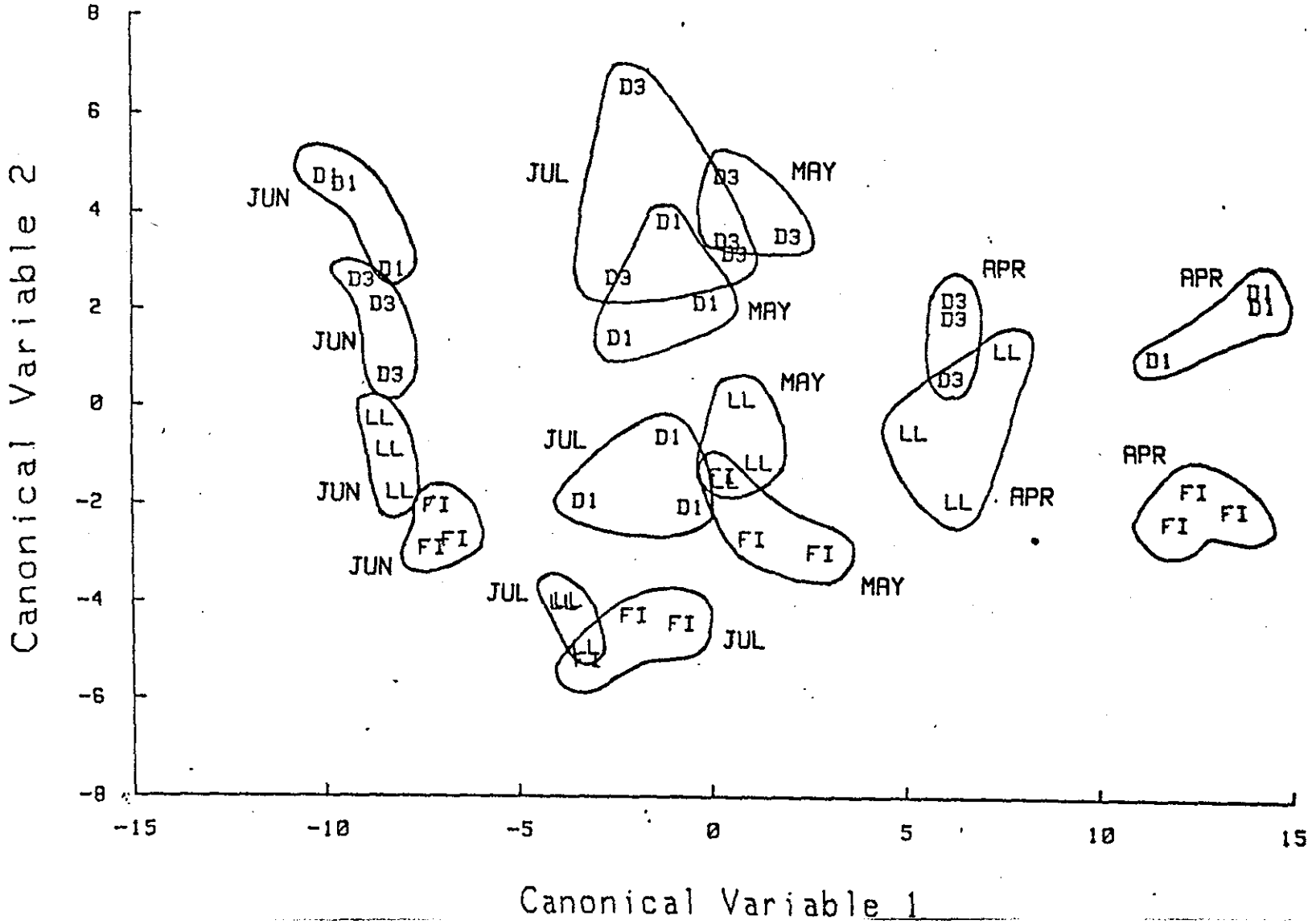

Figure 6.3.2-1. Plot of discriminant scores derived from trace metals in Mytilus edulis maintained at the reference stations: Latimers Light (LL) and Fishers Island Sound (FI) and the New London disposal stations: D1 and Dw

The most significant variation in Ni concentration was spatial rather than temporal. At the two reference stations the concentrations varied from 1 to 4 ppm, while at the two disposal site stations the levels ranged from 3 to 5 ppm and 5 to 8 ppm for stations D1 and D3, respectively.

Using V, Fe, Cd and Co as the most discriminating variables, discriminant function analysis of the New London data resulted in a classification matrix of 93%, producing certain easily recognizable groupings (Figure 6.3.2-1). During April the concentrations of the trace metals in mussels formed three distinct clusters: D3 and Latimers Light; D1; and Fishers Island Sound. May and July data tended to cluster in the same region of the plot and formed two distinct groups. The New London Disposal stations, D1-May, D-3 May and July formed a cluster toward the top of the plot, indicating higher metal concentrations. The Latimers Light and Fishers Island Sound reference samples from May, and station D1-July formed a second cluster in mid-range. June metal concentrations in Mytilus produced four discrete clusters - D1, D3, Latimers Light, and Fishers Island Sound, in vertical descending order. The July data from Latimers Light and Fishers Island Sound Reference stations overlapped and formed a cluster.

The plot of discriminant function scores indicates a relatively steady decline in metal concentrations and variability from April through July in both groups of reference samples. This corresponded to a generally steady increase in metal concentration at stations D1 and D3 from April through June. In July, concentrations increased at D3 and decreased at D1. It is also significant to note that the disposal site stations are generally

located in the upper left and right quadrant, reflecting higher metal concentrations than were found at the reference sites.

6.3.3 Central Long Island Sound Disposal Area

Since the New Haven reference station was not located during the July sampling trip, the data for the Central Long Island Sound disposal site were treated as if there were two complete data sets: (A) New Haven North Pile (NHN), New Haven South Pile (NHS) and New Haven Norwalk Pile (NHO) (April through July); and (B) New Haven Reference (NHR), NHN, NHS and NHO (April through June). Summaries of two-way ANOVA are presented in Tables 6.3.3-1 and 2. Neither spatial nor temporal variations were detected for Cd, Cr and Ni in cases A and B. With the exception of Fe, differences between stations were not significant for most of the trace metals examined regardless of whether the Stamford material was covered with clean sand, or silt. However, temporal variations in Co, Cu, Hg, Zn and V were significant for both cases A and B. Based on the three or four months of available data, it is difficult to explain the observed fluctuation of these trace metals with time.

Fe was the only trace metal which exhibited both significant spatial and temporal variations ($P<<0.004$). The observed spatial variations at NHN, NHS and NHO may be a function of whether the Stamford sediment was covered by clean sand, New Haven silt, or not covered, as well as the chemical character of the dredge material. In July, after the Stamford dredge material at NHN and NHS has been capped, there appeared to be a significant

Table 6.3.3-1. Summary of Two-Way ANOVA on trace metal concentrations found in *Mytilus edulis* deployed at the Central Long Island Sound disposal site: New Haven North pile, New Haven South pile, and New Haven Norwalk pile, from April to July, 1980.

Heavy Metal		F	P
Cd	Stations	1.07	0.359
	Dates	1.14	0.354
Cr	Stations	2.53	0.103
	Dates	2.06	0.136
Co	Stations	0.24	0.788
	Dates	13.92	<0.00001
Cu	Stations	0.70	0.507
	Dates	11.78	0.00001
Fe	Stations	9.90	0.0009
	Dates	10.44	0.0002
Hg	Stations	0.39	0.682
	Dates	6.09	0.0038
Ni	Stations	1.12	0.345
	Dates	2.37	0.099
Zn	Stations	1.38	0.273
	Dates	3.84	0.024
V	Stations	1.03	0.375
	Dates	156.39	<0.00001

Degrees of freedom (d.f.) for all heavy metals are 2, 21 for "Stations" and 3, 21 for "Dates".

Table 6.3.3-2. Summary of Two-Way ANOVA on trace metal concentrations found in Mytilus edulis deployed at the Central Long Island Sound disposal site: New Haven Reference station, New Haven North pile, New Haven South pile and New Haven Norwalk pile from April to June 1980.

Heavy Metal		F	P
Cd	Stations	0.34	0.799
	Dates	1.05	0.367
Cr	Stations	3.12	0.048
	Dates	1.46	0.256
Co	Stations	0.34	0.799
	Dates	14.24	0.0001
Cu	Stations	0.03	0.992
	Dates	9.80	0.0011
Fe	Stations	6.20	0.0038
	Dates	15.99	0.0001
Hg	Stations	3.18	0.0462
	Dates	22.25	<0.00001
Ni	Stations	1.34	0.2905
	Dates	2.01	0.1598
Zn	Stations	0.77	0.5248
	Dates	5.26	0.0146
V	Stations	0.88	0.468
	Dates	705.47	<0.00001

Degrees of freedom (d.g.) for all metals are 3,20 for "Stations" and 2,20 for"Dates".

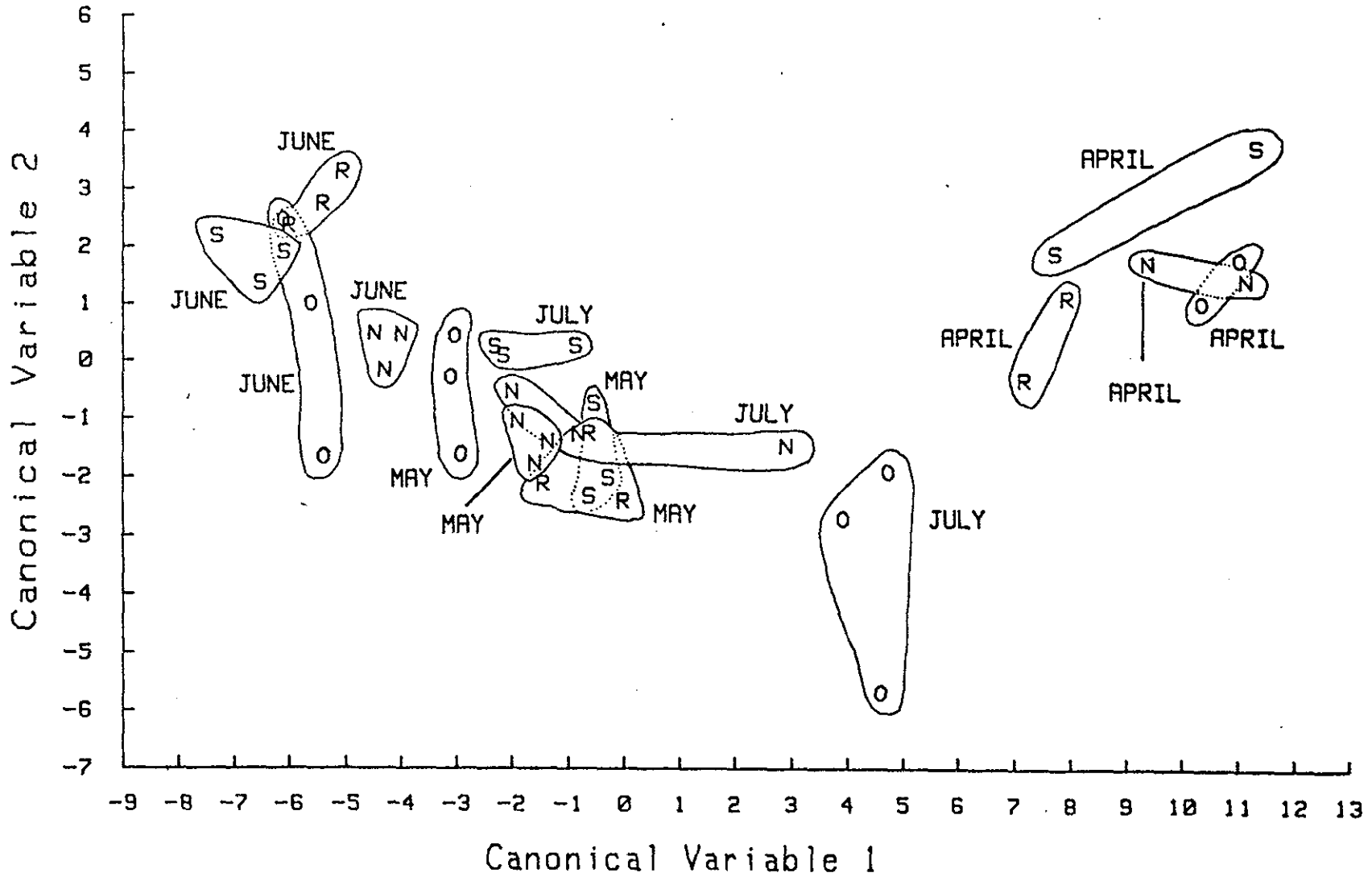

Figure 6.3.3-1. Plot of discriminant scores derived from trace metals in Mytilus edulis maintained at the Central Long Island Sound disposal site: New Haven Reference Station (R), New Haven North Pile Station (N), New Haven South Pile Station (S) and New Haven Norwalk Pile Station (O), Connecticut.

reduction in Fe concentration at both sites. At NHO where no disposal activity occurred during the period of study, Fe levels remained relatively stable.

The concentrations of V, Hg, Fe, Co and Cu were determined as being the most discriminating variables for the separation of groups. The discriminant analysis, which resulted in a classification matrix of 78%, confirmed the conclusions reached by applying two-way analysis of variance. The various stations sampled during April, May and June show the least amount of scattering (Figure 6.3.3-1) and overlap to some extent, indicating a degree of similarity. In July, however, there is a clear-cut separation of the areas designated as NHS, NHN and NHO, suggesting a considerable degree of dissimilarity despite the fact that the mussels were all collected from Latimers Light.

6.4 PCB Levels at New London Disposal Site

In addition to the measurement of heavy metal concentrations in mussels at various sites, a specific program to evaluate the uptake of polychlorinated biphenyls (PCB's) by Mytilus edulis was undertaken at the New London Disposal Site. The mussels used for this program were also collected at Latimer's Light and maintained on the same platforms as those used for heavy metal analysis at the New London site (Section 6.3.2)

6.4.1 Methods and Materials

The mussels were prepared for gas chromatographic analysis by extracting lyophilized tissue for three hours with nanograde petroleum ether (Mallinckrodt Inc. St. Louis, MO) in a

soxhlet apparatus. The crude extract was concentrated with Kuderna-Danish apparatus, and interfering substances were removed by liquid chromatopraphy with a Florosil (Fisher Scientific Co. Fair Lawn, NJ) packed column. The extract was eluted with nanograde hexane (Mallinckrodt) and concentrated before injection into the gas chromatograph.

The samples were analyzed with a Hewlett Packard 7620A gas chromatograph equipped with an Ni^{63} electron capture detector and a 6 foot by 4 mm (i.d.) glass column packed with 3% OV-1 on 100/120 mesh Gas Chrom Q (Applied Science Labs, State College, PA). The analyses were done isothermally (injection port temperature - 190°C, detector temperature - 300°C) and required about 45 minutes for the final compounds to elute. The carrier gas was a mixture of 95% argon and 5% methane. The signal from the chromatograph was digitized with a Varian CDS-111C chromatography data system.

The concentrations of PCBs in the mussel samples were calculated according to the method described by Webb & McCall (1973). The sample chromatographs were divided into three separate areas based on the retention times of the peaks relative to DDE. The chromatographs which had been generated for three Aroclor standards (Aroclors 1242, 1254 and 1260) were then compared to the sample peaks. Therefore, it was possible to calculate the concentrations of the three Aroclors in the samples and a one-way analysis of variance was used to test for differences among the mean levels of Aroclor in the samples.

Further statistical analysis included two-way analysis of variance and stepwise regression procedures. For the

two-way ANOVAs, the mussel samples were classified by station and sampling period (during and after dredging). The data for the pre-dredging period were not included in the two-way ANOVAs because no samples were available for disposal sites 2 and 3. The two-way ANOVAs were used to determine whether the mean PCB levels in the mussels from the five monitoring stations, during and after dredging and between stations, were significantly different.

A stepwise multiple regression analysis was used to study the influence of two independent variables on the mussels' total PCB body burden. The independent variables examined were the volume of material dumped, and the rate of discharge of the Thames River. Measurements of these two variables were collected during the month prior to collection of the mussel samples. This was done based on the assumption that the mussels would display a lag response to the influence of river inflow and dredge material disposal.

This analysis uses a forward stepping algorithm to enter the independent variable that has the highest absolute correlation with the dependent variable into a regression equation. It then sequentially adds variables based on their partial correlation coefficients, and at each step re-examines the variables that previously have been incorporated into the equation. If the contribution of any variable is rendered insignificant by the susequent addition of other independent variables, it is removed from the model.

Data for the volume of material dredged and dumped (10^3 yds^3 +/-10%) were obtained from the U.S. Army Corps of Engineers, Waltham, MA. Information on the rate of Thames River

discharge (ft^3/sec) was obtained from the U.S. Department of the Interior, Geological Survey, Hartford, CT.

6.4.2 Results

The levels of the PCBs in the mussels from the five monitoring populations are presented in Table 6.4.2-1. The mean levels of the peaks classified as Aroclors 1242, 1254 and 1260 differed significantly and a comparison of the means indicated that the concentration of 1254 was highest, with 1242 intermediate and 1260 lowest (Figure 6.4.2-1). It should be noted, however, that analyses of composite standards showed that the Webb & McCall procedure consistently overestimated the amount of 1254 relative to the two other Aroclors.

The total PCB and Aroclor concentrations were higher during disposal than after the completion of the project (Table 6.4.2-1). Of the five populations which were monitored, only disposal site 3 did not have higher PCB levels during disposal. For the other stations, the pattern of elevated levels of PCBs during the dredging operation was consistent for all three Aroclors as well as for the total PCB body burdens. The differences in the levels of 1254 and total PCBs during the two sampling periods were statistically significant, but the differences in the levels of 1242 and 1260 were not significant (Table 6.4.2-2). In addition, the two-way ANOVAs clearly showed that there were no significant differences among the five populations' total PCB or Aroclor concentrations.

Linear regression analyses showed that the total PCB levels in the mussels increased linearly with both the volume

TABLE 6.4.2-1

Total PCB and Aroclor concentrations in Mytilus edulis.
Concentrations are expressed in ng PCB/g dry tissue.

Type of PCB	Dumpsite 1		Dumpsite 2		Dumpsite 3		Seaside		North Dumpling	
	During	After	During	After	During	After	During	After	During	After
Total PCB	804	587	687	505	515	589	714	513	695	482
Aroclor 1242	360	216	226	195	208	296	283	177	250	138
Aroclor 1254	410	360	428	297	293	256	403	321	416	321
Aroclor 1260	34	11	34	13	13	37	28	14	28	24

During dredging: Jul. 77-Jun. 78.
After dredging: Jul. 78-Apr. 79.

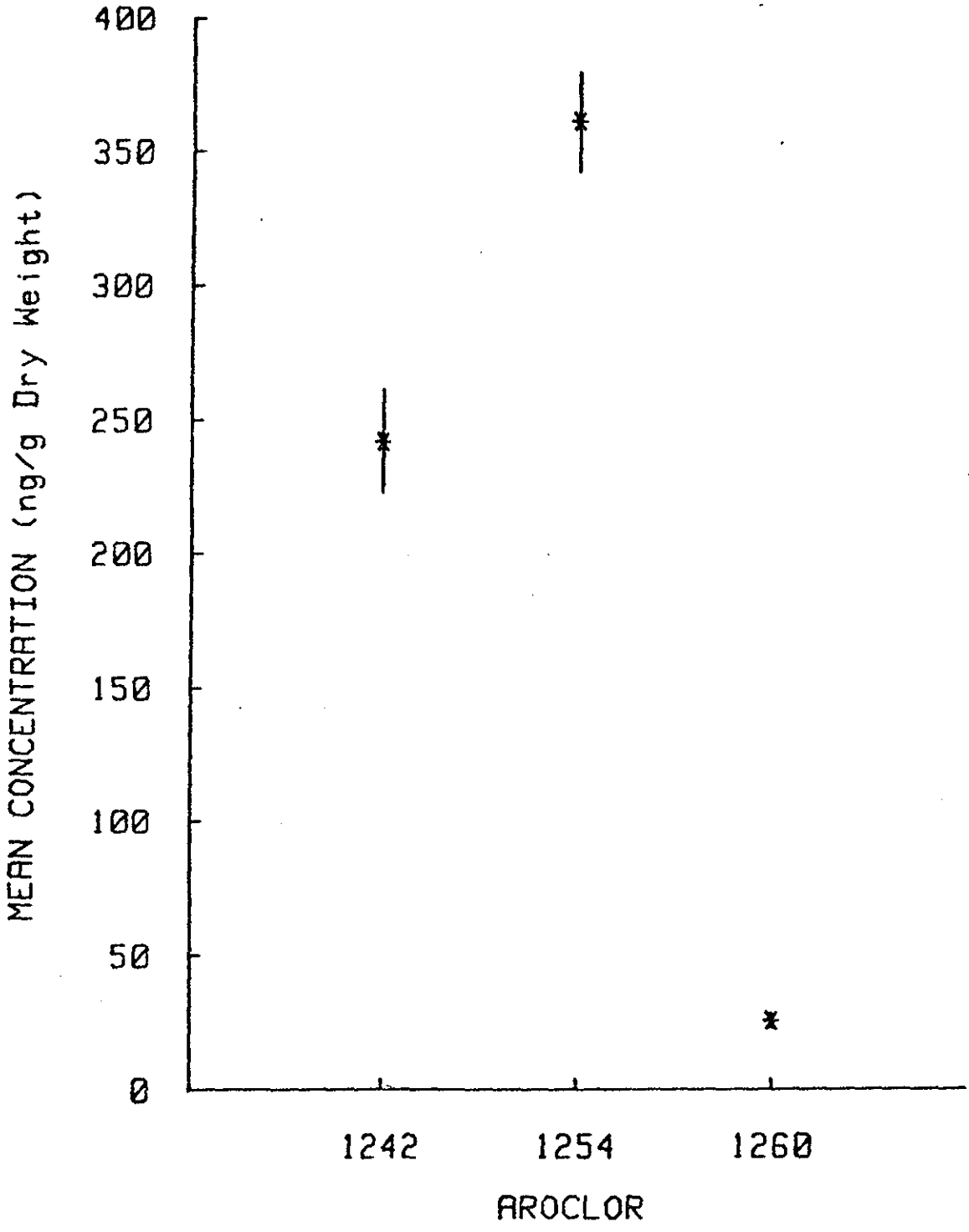

Figure 6.4.2-1 Mean concentrations of Aroclor in Mytilus edulis

TABLE 6.4.2-2

Summary of the Two-Way ANOVA for 4 dependent variables. Data for each dependent variable were grouped by: (1) station and (2) sampling period.

Grouping Variable	Dependent Variable			
	Total PCB	Aroclor 1242	Aroclor 1254	Aroclor 1260
Station[1]	F = 0.37, n.s.[3]	F = 0.58, n.s.	F = 0.92, n.s.	F = 0.12, n.s.
Sampling Period[2] (During or After)	F = 3.51, p = 0.07	F = 1.94, n.s.	F = 3.60, p 0.07	F = 1.75, n.s.

1. Degrees of freedom for station means = 4,34.
2. Degrees of freedom for sampling period means = 1, 34.
3. n.s. = not significant.

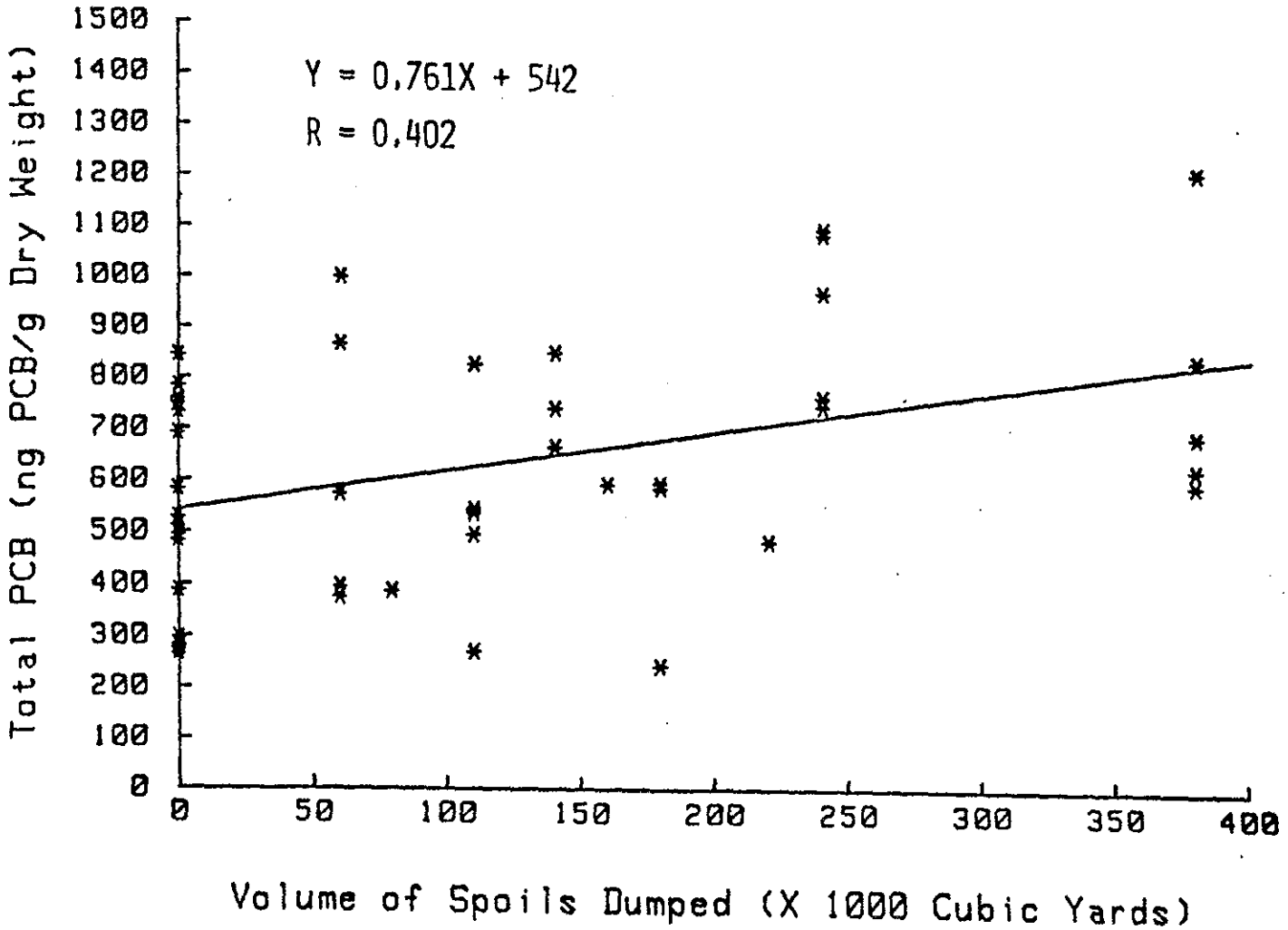

Figure Figure 6.4.2-2 PCB concentrations in Mytilus edulis versus volume of spoils dumped.

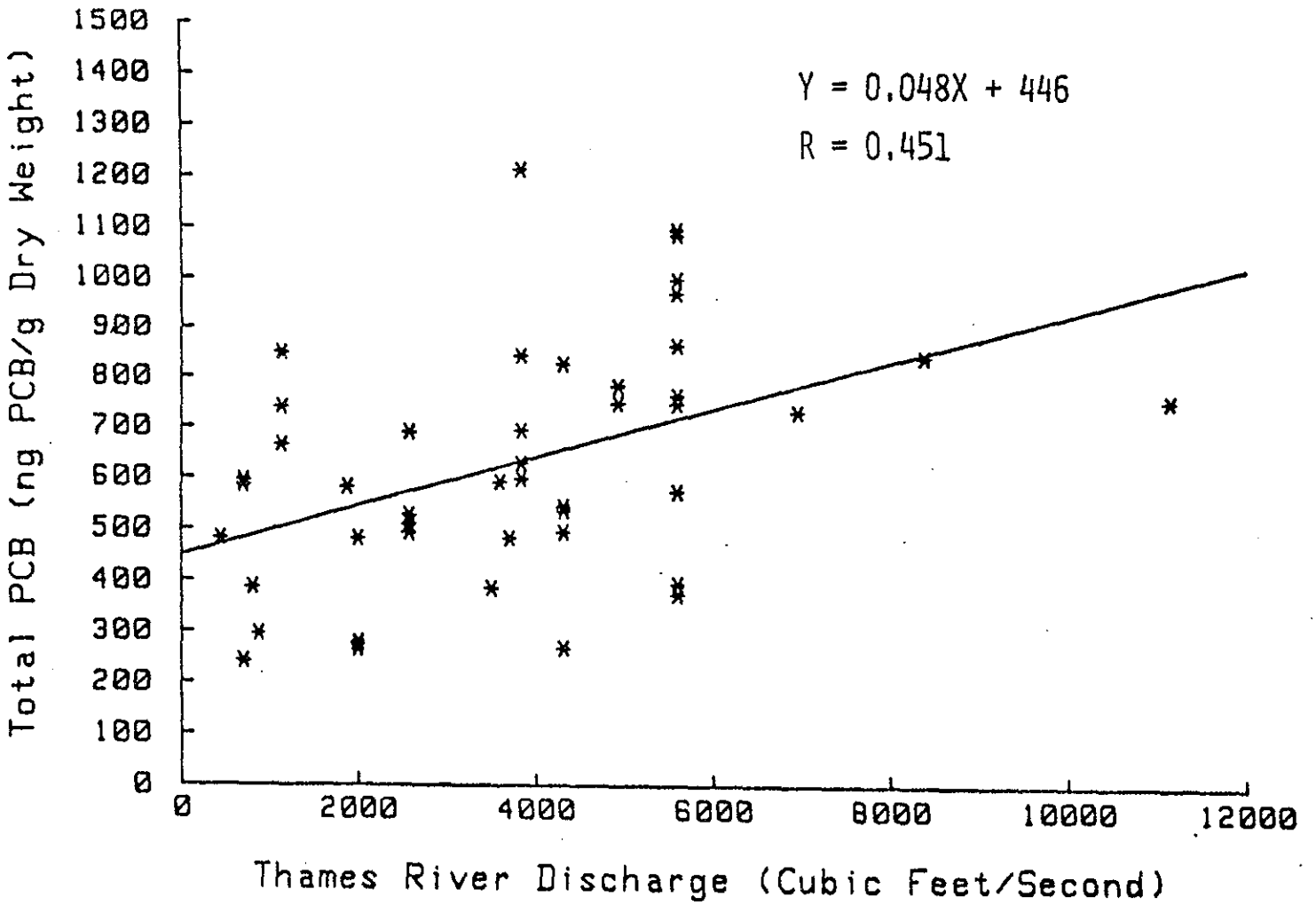

Figure 6.4.2-3 PCB concentrations in Mytilus edulis versus Thames River discharge.

TABLE 6.4.2-3

Stepwise regression analyses. The response of total PCB and Aroclor levels in Mytilus edulis to river discharge and the volume of spoils dumped.

Dependent Variable	Independent Variables				Total R^2
	River Discharge		Volume Dumped		
	F-to-remove	R^2	F-to-remove	R^2	
Total PCB	12.21	.19	11.42	.17	.36
Aroclor 1242	10.84	.18	8.99	.11	.29
Aroclor 1254	6.02	.11	6.52	.12	.23
Aroclor 1260	not entered*		not entered*		---

*The computer did not enter either river discharge or the volume of spoils dumped into a regression equation for Aroclor 1260 because there was no significant relationship between the variables.

of dredged material dumped (Figure 6.4.2-2) and the inflow from the Thames River (Figure 6.4.2-3). Stepwise multiple regression analysis (Table 6.4.2-3) showed that both of the independent variables contributed significantly to the changes in the body burdens of Aroclors 1242, 1254 and total PCBs. Further inspection of the regression models indicated that the magnitudes of the contributions of the two independent variables were equal. Conversely, the body burdens of Aroclor 1260 evidently were not related either to river discharge or the dredging/disposal operations.

6.4.3 Discussion

The main objective of this monitoring program was to determine whether the disposal of dredged material would increase the levels of PCBs in experimental field populations of mussels that were deployed on or near the New London disposal site. Although PCB concentrations in the mussel tissues showed a positive correlation with the volume of dredged material, this relationship also existed for samples at the reference sites (Seaside, North Dumpling), which were presumably unaffected by disposal. In addition, the body burden of PCBs in experimental and reference samples were not significantly different, and concentrations fluctuated in the same manner at all sites. Although regression analyses indicated that temporal changes in PCB body burdens were equally influenced by the volume of dredge material and river discharge, these factors accounted for only 36% of the variance in PCB levels. Without information on the relative contribution of sediment bound PCBs to the environment

via disposal of dredged material, river discharge, or other sources, no positive correlation of PCB levels in mussels with disposal operations can now be made.

PCBs are known to be strongly sorbed to suspended material (Pavlou & Dexter, 1979), phytoplankton (Harding & Phillips, 1978) and clay mineral particles (Chytalo, 1979). Since mussels are suspension feeders that non-selectively ingest particles greater than 2 μm in diameter (Foster-Grant, 1975), the PCBs associated with these particles would presumably be, at least partially, biologically available. Therefore, a model that accounts for PCB levels in mussel tissue must include the suspension or resuspension of fine-grained material.

Riverine discharge has been suggested to be a major source of PCBs for other estuarine ecosystems (Pavlou & Dexter, 1979), therefore, it is possible that PCBs associated with fluvial material are eventually incorporated into the tissues of the mussels. Analyses performed in this study indicated a positive correlation between the rate of discharge from the Thames River and PCB levels in the mussels, although it accounted for only 19% of the total variance. Since the suspended material load in Long Island Sound is strongly influenced by windstress and storm events (Bohlen, 1975) these meteorological processes may also contribute to the temporal changes in PCB body burdens.

Suspended material concentrations in Long Island Sound normally range from 2 to 7 mg/l (Riley, 1959). At these concentrations, mussels ingest most of the particles larger than 2 μm although some may be rejected as pseudofeces in the upper part of the range (Widdow et al., 1978). Thus, the changes in the

character of the suspended material field caused by the combination of disposal operations, river discharge, and storm and wind-driven current may have been responsible in part for the variability in the PCB concentrations in the mussels.

Based on this information, we propose a probable mechanism for PCB uptake by mussels. PCBs are associated with particulate material which is ingested by the animals; as the particles are processed in the digestive system, the PCBs eventually reach equilibrium with the tissues. From there, the PCBs may be transported to other tissues in which other processes, including direct partitioning, may affect concentrations. Preliminary results from our Marine Sciences Laboratory at Noank, CT (Arimoto, unpuplished) support this uptake mechanism. PCBs have been found to be most highly concentrated in the digestive tissues of the animals, and fecal material has been shown to have levels equal to those of the digestive tissues.

Although the PCB levels in mussels increased during the disposal operations, the increase was transient and the levels remained relatively low. Clearly more information on the response of the suspended material field to dumping, river discharge, and storms, and on the mechanisms of PCB uptake are required to fully assess the effects of dredge material disposal on the PCB levels in mussels.

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7.0 BENTHIC BIOLOGY

7.0 Benthic Biology

7.1 Introduction

This is the third summary paper in a series of reports on benthic fauna at 15 active, retired, or proposed disposal sites, and 8 associated reference sites studied as part of the DAMOS program between Rockland, ME, and Norwalk, CT. The location of each of these sites is shown in Figure 7.1-1. As a result of changing interests and priorities, greater emphasis was placed on the Central Long Island Sound disposal site (CLIS) during the 1978-79 project year while sampling at some previously examined sites was discontinued. Table 7.1-1 provides a summary of the sites studied under this program and the dates on which benthic samples were obtained.

This report contains a presentation and discussion of benthic biological data collected between November 1978 and August 1979. These data were examined for their similarity to previously collected data and an attempt was made to assess whether observed population fluctuations were attributable to natural variation or environmental stress associated with the disposal of dredged material.

Benthic biological sampling resumed in March 1980 at three sites: Portland, New London and Central Long Island Sound. Taxonomic identification on these samples has been completed, however, these data have not yet been analyzed. These results will appear in subsequent reports.

7.2 Materials and Methodology

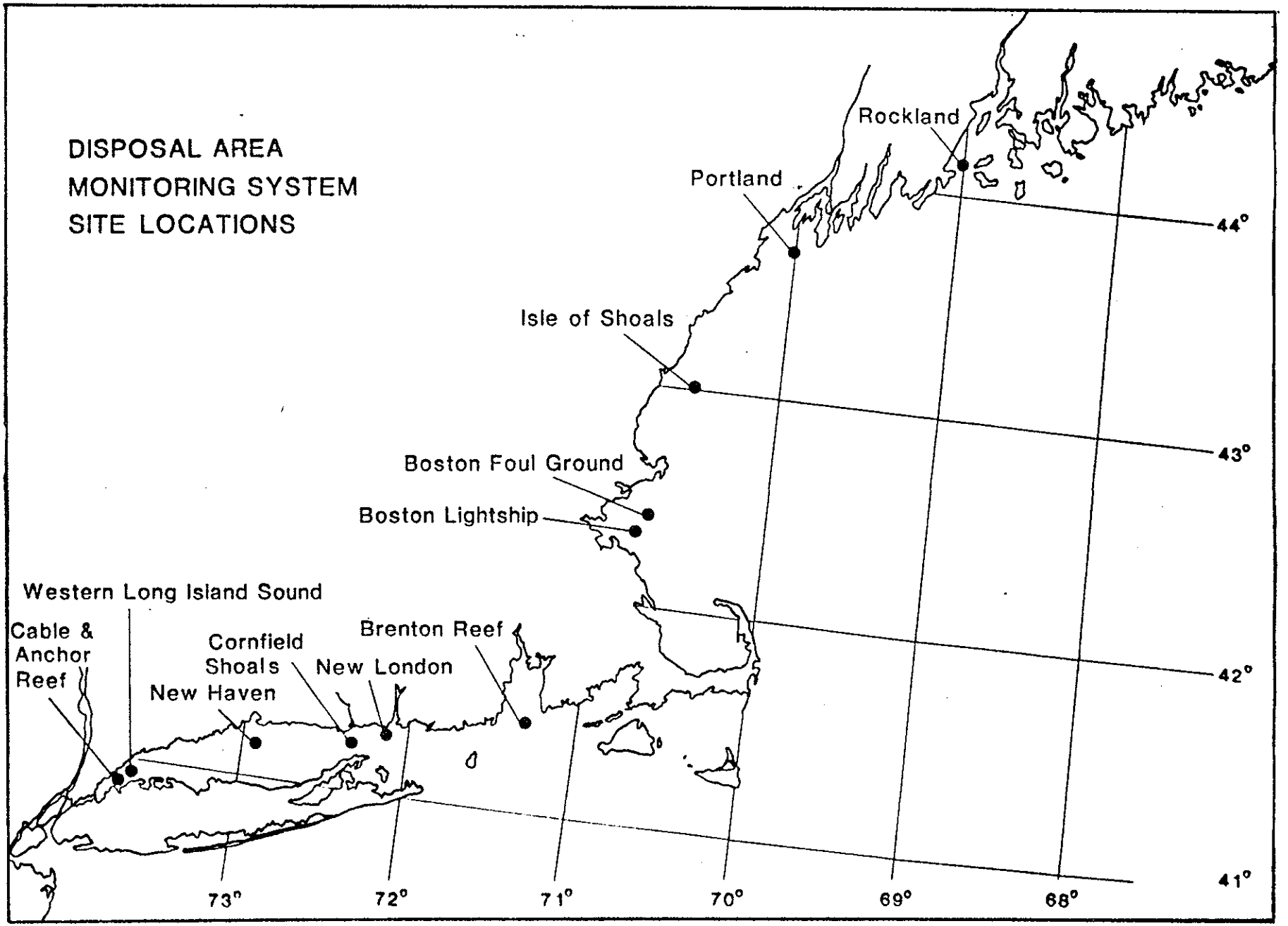
DISPOSAL AREA
MONITORING SYSTEM
SITE LOCATIONS
Rockland
Portland
Isle of Shoals
Boston Foul Ground
Boston Lightship
Western Long Island Sound
Cable &
Anchor
Reef
Cornfield
Shoals
New Haven
New London
Brenton Reef
44°
43°
42°
41°
73°
72°
71°
70°
69°
68°

FIGURE 7.1-1

TABLE 7.1-1
SITES AND DATES OF BENTHIC SAMPLING

		WINTER 1978 - 79	SPRING-SUMMER 1979	FALL 1979
01	ROCKLAND D.S.	11/16/78 (3)	06/13/79 (5)	-
02	ROCKLAND CANYON	11/16/78 (3)	-	
03	PORTLAND D.S.	11/19/78 (3)	06/10/79 (5)	-
04	ISLES OF SHOALS D.S.	12/08/78 (3)	06/08/79 (5)	-
05	BOSTON FOUL GRD.	12/06/78 (3)	06/06/79 (5)	-
06	BOSTON LIGHTSHIP	12/06/78 (3)	06/06/79 (5)	-
07	BRENTON REEF D.S.	12/11/78 (3)	05/30/79 (5)	-
08	BRENTON REEF REF.	12/11/78 (3)	05/30/79 (5)	-
09	NEW LONDON D.S. (C-6)	01/28/79 (5)	05/12/79 (5)	-
10	NEW LONDON REF. (F-8)	01/28/79 (5)	05/23/79 (5)	-
11	CORNFIELD SHOAL D.S.	01/27/79 (5)	-	-
12	CORNFIELD SHOAL REF.	01/27/79 (5)	-	-
13	NEW HAVEN D.S.	01/19/79 (5)	05/21/79 (5)	-
14	NEW HAVEN REF. (NW CONTR)	01/26/79 (5)	05/21/79 (5)	-
15	CABLE & ANCHOR D.S.	01/23/79 (5)	-	-
16	W.L.I.S. D.S. (PROPOSED)	01/23/79 (5)	-	-
17	CAR & WLIS REF.	01/23/79 (5)	-	-
18	W.L.I.S. D.S. (PROPOSED)	-	05/18/79 (5)	-
19	GREEN'S LEDGE	01/23/79 (5)	05/18/79 (5)	-
20	STAMFORD-NEW HAVEN SOUTH D.S.	01/26/79 (5)	-	08/09/79 (5)
21	STAMFORD-NEW HAVEN NORTH D.S.	03/21/79 (5)	-	-
22.	STAMFORD-NEW HAVEN SOUTH, 1000 M EAST	01/26/79 (5)	05/21/79 (5)	08/09/79 (5)
23.	STAMFORD-NEW HAVEN SOUTH, 1000 M WEST	01/26/79 (5)	05/22/79 (5)	08/09/79 (5)

Previous reports have discussed the sampling procedures implemented which the early portion of the DAMOS program when an anchor dredge was the principle sampling device used for obtaining benthic biological samples. However, a decision was made in 1978 to change to a Smith-McIntyre grab sampler in order to allow sampling of a uniform surface area and thus provide a more meaningful comparison between samples.

All samples obtained after January, 1979, were collected with a Smith-McIntyre grab. Data presented for samples prior to that date were obtained with an anchor dredge, and therefore, comparisons between sampling years must be considered tenuous (see DAMOS Annual Data Report, 1979, Vol.II, for discussion of anchor dredge versus Smith-McIntyre grab). Benthic samples collected for biological analysis were sieved on site through a 1.0 mm mesh screen and preserved in 10% seawater-formalin solution. These samples were then sorted, and organisms were identified to lowest possible taxa with binocular (dissecting and compound) microscopes at the Harold Edgerton Research Laboratory (New England Aquarium).

Prior to January, 1979, three replicate samples were collected at each station; at least five replicate samples were collected from each station on all subsequent surveys. Four statistics were calculated for each sample in order to characterize the benthic population and provide a basis for comparison between replicates at a given station and between different stations. These statistics are:

- N - the total number of individuals
- S - the total number of species
- H'- the Shannon-Weaver diversity index

- J'- the equitability index

The following sections will describe the classification of benthic populations at the various DAMOS sampling sites using these statisitical parameters. Additional work is being conducted with computer software which will supply numerical classification of a variety of variables including grain size, heavy metal concentrations and percent organics in order to assess which parameters significantly influence biological distributions and composition. The results of this effort will be described in detail in future reports.

7.3 Results

A summary of results obtained over the entire DAMOS project is presented in Tables 7.3-1 and 7.3-2. However, a more detailed examination of the data by geographic region will be presented in subsequent sections.

Table 7.3-1 presents the four statistical population parameters for all samples obtained under the DAMOS program; Table 7.3-2 provides the mean value and 95% confidence limits for each parameter at each station. Figures 7.3-1, 2 and 3 are a graphical summary of the statistics compiled in Tables 7.3-1 and 2. They illustrate the variation of the three population parameters (N, S, H') both spatially between sites, and temporally between sampling periods at each site. The variability between replicates at each sampling station is described by the 95% confidence interval which is depicted by the length of the bar on either side of a given data point.

Figure 7.3-4 displays the relationships between the

TABLE 7.3-1. Summary of population statistics by sample, November 1978 - August 1979. Number of individuals (N), number of species (S), Shannon-Weaver's index of diversity (H'), and the equitability index (J') are shown.

ROCKLAND DISPOSAL SITE

DATE	SAMPLE #	N	S	H'	J'
11/78	1	41	13	1.95	0.76
	2	71	16	1.98	6.72
	3	114	15	1.61	0.59
6/79	1	72	15	2.24	0.83
	2	106	23	2.34	0.75
	3	194	28	2.32	0.70
	4	114	16	2.19	0.79
	5	54	15	2.34	0.87

PORTLAND DISPOSAL SITE

11/78	1	18	11	2.18	0.91
	2	59	32	3.09	0.89
	3	89	35	2.97	0.84
6/79	1	156	49	3.28	0.83
	2	235	49	3.04	0.78
	3	180	56	3.30	0.82
	4	211	56	3.22	0.80
	5	141	49	3.34	0.86

ISLE OF SHOALS DISPOSAL SITE

12/78	1	106	24	4.24	1.33
	2	108	27	2.75	0.83
	3	144	34	2.92	0.83
6/79	1	360	35	1.98	0.56
	2	313	42	2.05	0.55
	3	239	26	1.35	0.42
	4	569	37	1.41	0.39
	5	247	29	2.09	0.62

BOSTON FOUL GROUND

12/78	1	90	22	2.54	0.82
	2	58	17	2.44	0.86
	3	62	20	2.58	0.86
6/79	1	80	22	2.32	0.75
	2	105	22	1.96	0.63
	3	110	28	2.18	0.65
	4	138	29	2.36	0.70
	5	202	26	1.37	0.42

TABLE 7.3-1 (cont.)

DATE	SAMPLE #	N	S	H'	J'
BOSTON LIGHTSHIP					
12/78	1	79	26	2.67	0.82
	2	88	23	2.58	0.82
	3	120	25	2.49	0.77
6/79	1	425	38	1.83	0.50
	2	472	31	1.28	0.37
	3	602	35	1.30	0.37
	4	357	36	1.66	0.46
	5	263	30	1.74	0.51
BRENTON REEF DISPOSAL SITE					
12/78	1	32	11	1.51	0.63
	2	36	15	2.45	0.91
	3	43	11	1.58	0.66
	1	41	14	2.19	0.83
	2	71	18	2.31	0.80
	3	132	15	1.45	0.53
	4	34	16	2.22	0.80
	5	41	12	1.87	0.75
BRENTON REEF REFERENCE SITE					
12/78	1	2699	39	0.73	0.20
	2	1316	38	1.03	0.28
	3	2816	33	0.75	0.21
	1	856	40	1.52	0.41
	2	1270	45	1.18	0.31
	3	1540	46	0.97	0.25
	4	1593	45	0.95	0.25
	5	1529	53	1.10	0.28

TABLE 7.3-1 (Cont.)

DATE	SAMPLE #	N	S	H'	J'
NEW LONDON DISPOSAL SITE					
1/79	1	88	25	1.90	0.59
	2	31	8	1.73	0.83
	3	76	21	1.71	0.56
	4	65	12	1.92	0.77
	5	130	20	1.53	0.51
NEW LONDON DISPOSAL SITE (C-6)					
5/79	1	93	19	2.20	0.75
	2	109	21	2.14	0.70
	3	134	17	1.64	0.58
	4	206	31	2.27	0.66
	5	132	29	2.16	0.64
NEW LONDON REFERENCE SITE (F-8)					
1/79	1	361	41	2.00	0.54
	2	231	28	1.77	0.53
	3	519	37	2.08	0.58
	4	235	36	2.07	0.58
	5	598	36	1.46	0.41
5/79	1	145	33	2.14	0.61
	2	341	41	2.00	0.54
	3	317	31	1.65	0.48
	4	242	36	2.04	0.57
	5	269	38	2.13	0.58
CORNFIELD SHOAL DISPOSAL SITE					
1/79	1	6	5	1.56	0.97
	2	3	2	0.64	0.92
	3	6	4	1.24	0.90
	4	6	5	1.56	0.97
	5	6	3	0.87	0.79
CORNFIELD SHOAL REFERENCE SITE					
1/79	1	12	5	1.15	0.71
	2	6	6	1.20	0.67
	3	11	6	1.42	0.79
	4	16	6	1.38	0.77
	5	12	8	1.49	0.72
NEW HAVEN DISPOSAL SITE					
1/79	1	104	19	2.00	0.68
	2	148	21	2.10	0.69
	3	120	28	2.27	0.68
	4	193	28	2.10	0.63
	5	108	24	2.56	0.81

TABLE 7.3-1 (Cont.)

DATE	SAMPLE #	N	S	H'	J'
NEW HAVEN DISPOSAL SITE					
5/79	1	42	14	2.16	0.82
	2	74	26	2.71	0.83
	3	86	30	2.99	0.88
	4	184	35	2.59	0.73
	5	114	30	2.76	0.81
NEW HAVEN REFERENCE (NW CONTROL)					
1/79	1	15	5	0.95	0.59
	2	25	6	1.22	0.68
	3	20	7	1.47	0.76
	4	24	7	1.19	0.61
	5	21	5	0.57	0.35
5/79	1	29	6	1.16	0.65
	2	27	4	1.01	0.73
	3	260	11	0.97	0.41
	4	118	16	1.76	0.63
	5	114	17	2.02	0.71
STAMFORD-NEW HAVEN NORTH DISPOSAL POINT					
3/79	1	44	10	2.09	0.91
	2	17	8	1.79	0.86
	3	41	9	1.59	0.72
	4	30	8	1.82	0.88
	5	16	5	1.04	0.65
STAMFORD-NEW HAVEN SOUTH DISPOSAL POINT					
1/79	1	47	18	1.91	0.66
	2	41	11	1.66	0.69
	3	44	7	1.35	0.69
	4	39	6	1.11	0.62
	5	53	9	1.46	0.67
8/79	1	9	7	1.89	0.97
	2	7	5	1.55	0.96
	3	9	7	1.89	0.97
	4	5	3	0.95	0.87
	5	4	3	1.04	0.95
1/79	1	36	10	1.92	0.83
	2	18	7	1.73	0.69
	3	25	8	1.37	0.66
	4	51	11	1.95	0.81
	5	42	10	1.56	0.68

TABLE 7.3-1 (Cont.)

DATE	SAMPLE #	N	S	H'	J'
5/79	1	36	9	1.48	0.67
	2	32	7	1.54	0.79
	3	35	9	1.86	0.85
	4	65	17	2.32	0.82
	5	36	10	1.94	0.84
8/79	1	165	14	1.79	0.68
	2	37	9	1.60	0.73
	3	58	11	1.94	0.81
	4	107	19	1.79	0.60
	5	124	10	1.45	0.63
STAMFORD-NEW HAVEN SOUTH 1000M WEST					
1/79	1	42	12	1.91	0.77
	2	36	13	1.68	0.65
	3	41	14	2.19	0.83
	4	23	10	1.75	0.76
	5	28	9	1.62	0.74
5/79	1	43	12	2.04	0.82
	2	39	15	2.40	0.89
	3	37	10	1.96	0.85
	4	30	10	1.85	0.80
	5	25	10	1.84	0.80
8/79	1	225	21	1.69	0.55
	2	132	13	1.60	0.62
	3	145	14	1.58	0.60
	4	138	13	1.42	0.56
	5	145	12	1.46	0.59
CABLE AND ANCHOR REEF DISPOSAL SITE					
1/79	1	28	12	1.98	0.80
	2	49	15	2.30	0.85
	3	30	10	1.75	0.76
	4	44	13	2.09	0.82
	5	26	11	1.88	0.78
PROPOSED WESTERN L.I.S. DISPOSAL SITE					
1/79	1	15	2	0.25	0.35
	2	9	3	0.68	0.62
	3	20	10	1.08	0.47
	4	19	5	0.81	0.50
	5	10	3	0.63	0.58

TABLE 7.3-1 (cont.)

DATE	SAMPLE #	N	S	H'	J'
CAR & WLIS REFERENCE					
1/79	1	59	15	2.11	0.78
	2	23	12	2.03	0.82
	3	12	5	1.15	0.71
	4	28	6	1.41	0.79
	5	15	7	1.58	0.81
WLIS DISPOSAL SITE (ACTUAL)					
5/79	1	63	6	1.09	0.61
	2	36	3	0.66	0.60
	3	63	4	0.90	0.65
	4	41	5	1.08	0.67
	5	28	5	0.95	0.59
GREEN'S LEDGE					
5/79	1	36	11	2.03	0.85
	2	10	4	1.09	0.70
	3	32	8	1.42	0.68
	4	20	10	1.99	0.86
	5	51	5	0.92	0.57

Table 7.3-2. Summary of species distribution at six stations in the Gulf of Maine. The number of samples is indicated by n. Mean number of individuals ($\bar{N}$), mean number of species ($\bar{S}$), Shannon-Weaver's index of diversity ($\bar{H}'$), equitability index ($\bar{J}'$), and the 95% confidence intervals of these means (in parentheses) are shown.

Station	Date	n	$\bar{N}$		$\bar{S}$		$\bar{H}'$		$\bar{J}'$	
Rockland D.S.	Nov 78	3	75	(0-161)	15	(11-18)	1.85	(1.36-2.34)	0.69	(0.48-0.90)
	Jun 79	5	108	(40-176)	19	(12-26)	2.29	(2.20-2.38)	0.79	(0.70-0.87)
Portland D.S.	Nov 78	3	55	(0-138)	26	(0-57)	2.75	(1.16-3.89)	0.88	(0.79-0.97)
	Jun 79	5	185	(136-234)	52	(47-57)	3.24	(3.09-3.39)	0.82	(0.78-0.86)
Isle of Shoals D.S.	Dec 78	3	119	(69-169)	28	(16-40)	3.30	(1.39-5.21)	1.00	(0.32-1.68)
	Jun 79	5	346	(176-516)	34	(26-42)	1.78	(1.33-2.23)	0.51	(0.38-0.63)
Boston Foul Ground	Dec 78	3	70	(29-111)	20	(14-26)	2.52	(2.36-2.68)	0.85	(0.80-0.90)
	Jun 79	5	127	(68-186)	25	(21-29)	2.04	(1.54-2.54)	0.63	(0.47-0.80)
Boston Lightship	Dec 78	3	96	(46-146)	25	(21-28)	2.58	(2.37-2.79)	0.81	(0.74-0.58)
	Jun 79	5	424	(264-584)	34	(30-38)	1.56	(1.23-1.89)	0.44	(0.36-0.53)

TABLE 7.3-2 (Cont.) Summary of species distribution at two stations in Rhode Island Sound

Station	Date	n	$\bar{N}$	$\bar{S}$	$\bar{H}'$	$\bar{J}'$
Brenton Reef D.S.	Dec 78	3	37 (23-51)	12 (7-18)	1.85 (0.56-3.14)	0.73 (0.36-1.10)
	May 79	5	64 (13-115)	15 (12-18)	2.01 (1.57-2.45)	0.74 (0.59-0.89)
Brenton Reef Ref	Dec 78	3	2277 (204-4350)	37 (29-45)	0.84 (0.42-1.26)	0.23 (0.13-0.33)
	May 79	5	1358 (971-1745)	46 (40-52)	1.14 (0.85-1.43)	0.30 (0.21-0.39)

Table 7.3-2 (Cont.). Summary of species distribution at fifteen stations in Long Island Sound.

Station	Date	n	$\bar{N}$		$\bar{S}$		$\bar{H}'$		$\bar{J}'$	
New London D.S.	Jan 79	5	78	(28-128)	17	(8-27)	1.76	(1.54-1.98)	0.65	(0.46-0.84)
	May 79	5	135	(80-190)	23	(15-31)	2.08	(1.76-2.40)	0.67	(0.59-0.74)
New London Ref.	Jan 79	5	389	(159-619)	36	(29-42)	1.88	(1.51-2.25)	0.53	(0.43-0.63)
	May 79	5	263	(166-360)	36	(31-41)	1.99	(1.74-2.24)	0.56	(0.49-0.62)
Cornfield Shoals D.S.	Jan 79	5	5	(3-8)	4	(2-6)	1.17	(0.6 -1.74)	0.91	(0.81-1.01)
Cornfield Shoals Ref.	Jan 79	5	11	(6-16)	6	(5-8)	1.33	(1.12-1.54)	0.73	(0.66-0.80)
New Haven D.S.	Jan 79	5	135	(83-186)	24	(18-30)	2.21	(1.90-2.52)	0.70	(0.60-0.80)
	May 79	5	100	(32-168)	27	(17-37)	2.64	(2.25-3.03)	0.81	(0.74-0.89)
New Haven Ref. (NW Control)	Jan 79	5	21	(16-26)	6	(5-7)	1.08	(0.61-1.55)	0.60	(0.39-0.81)
	May 79	5	110	(0-230)	11	(4-18)	1.38	(0.77-1.99)	0.63	(0.46-0.79)
STNH-North D.S.	Mar 79	5	30	(12-48)	8	(5-11)	1.66	(1.12-2.20)	0.80	(0.65-0.95)
STNH-South D.S.	Jan 79	5	45	(37-52)	10	(4-17)	1.50	(1.08-1.92)	0.67	(0.63-0.71)
	Aug 79	5	7	(4-10)	5	(2-8)	1.46	(0.89-2.03)	0.94	(0.89-0.99)

Table 7.3-2 (Cont.). Summary of species distribution at fifteen stations in Long Island Sound.

Station	Date	n	$\bar{N}$	$\bar{S}$	$\bar{H}'$	$\bar{J}'$
STNH-South	Jan 79	5	34 (16-53)	9 (7-11)	1.70 (1.37-2.03)	0.77 (0.63-0.91)
1000 M East	May 79	5	41 (24-58)	10 (5-15)	1.83 (1.40-2.26)	0.79 (0.71-0.88)
	Aug 79	5	98 (33-163)	13 (8-18)	1.71 (1.47-1.95)	0.69 (0.59-0.79)
STNH-South	Jan 79	5	34 (23-46)	12 (9-15)	1.83 (1.51-2.15)	0.75 (0.67-0.83)
1000 M West	May 79	5	35 (26-44)	11 (8-14)	2.02 (1.73-2.31)	0.83 (0.78-0.88)
	Aug 79	5	157 (109-205)	15 (10-20)	1.55 (1.41-1.69)	0.58 (0.55-0.62)
CAR D.S.	Jan 79	5	35 (21-50)	12 (10-15)	2.00 (1.71-2.29)	0.80 (0.76-0.84)
Proposed WLIS D.S.	Jan 79	5	15 (8-22)	5 (0-9)	0.69 (0.27-1.11)	0.51 (0.36-0.66)
CAR & WLIS Ref.	Jan 79	5	27 (1-54)	9 (3-15)	1.65 (1.08-2.22)	0.78 (0.72-0.84)
Actual WLIS D.S.	May 79	5	46 (26-66)	5 (4-6)	0.94 (0.73-1.15)	0.62 (0.57-0.67)
Green's Ledge	May 79	5	30 (10-50)	8 (4-12)	1.49 (0.85-2.13)	0.75 (0.60-0.90)

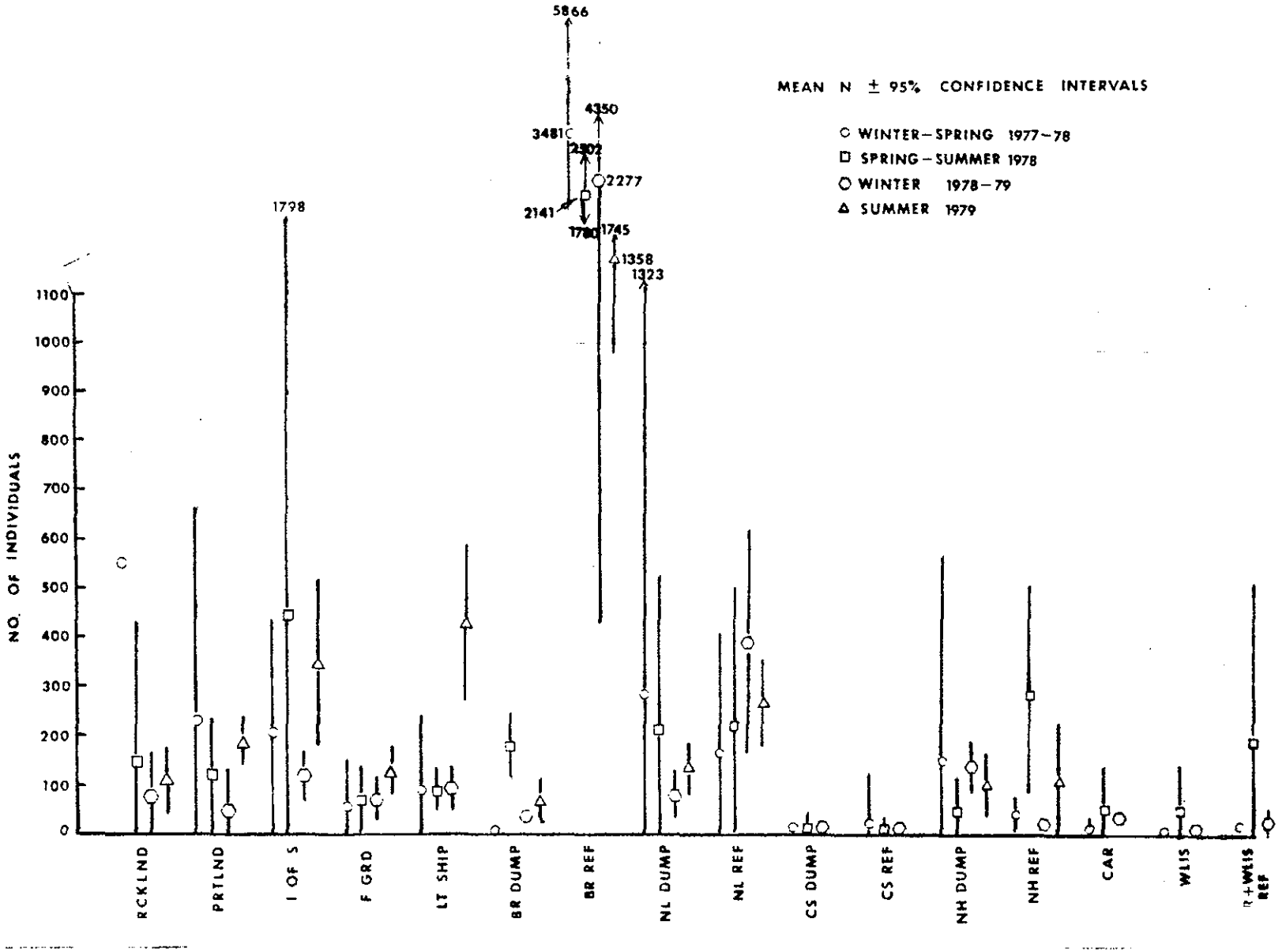

FIGURE 7.3-1. Distribution of mean number of individuals ($\overline{N}$) by station and sampling date.

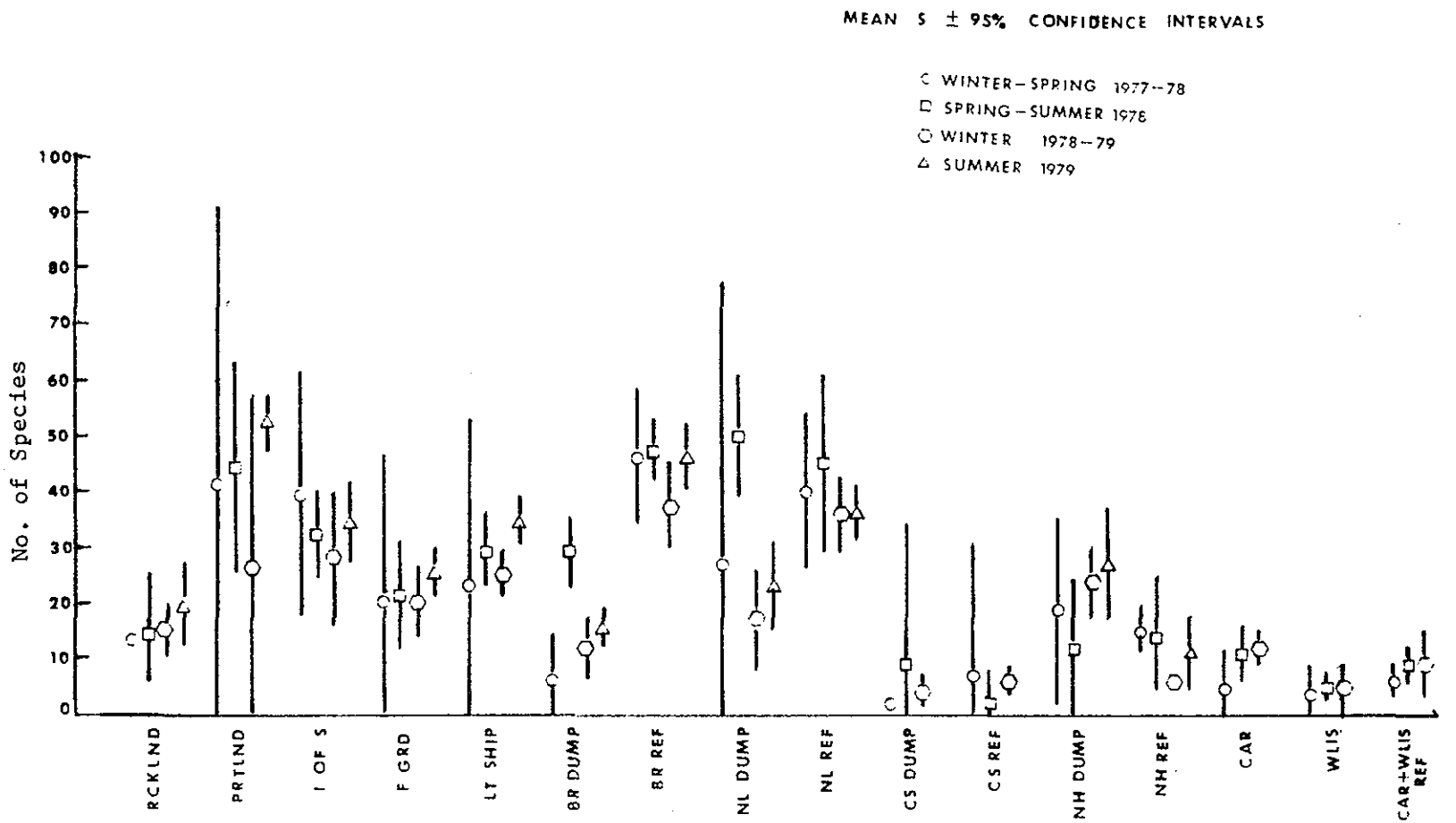

FIGURE 7.3-2. Distribution of mean number of species ($\bar{S}$) by station and sampling date.

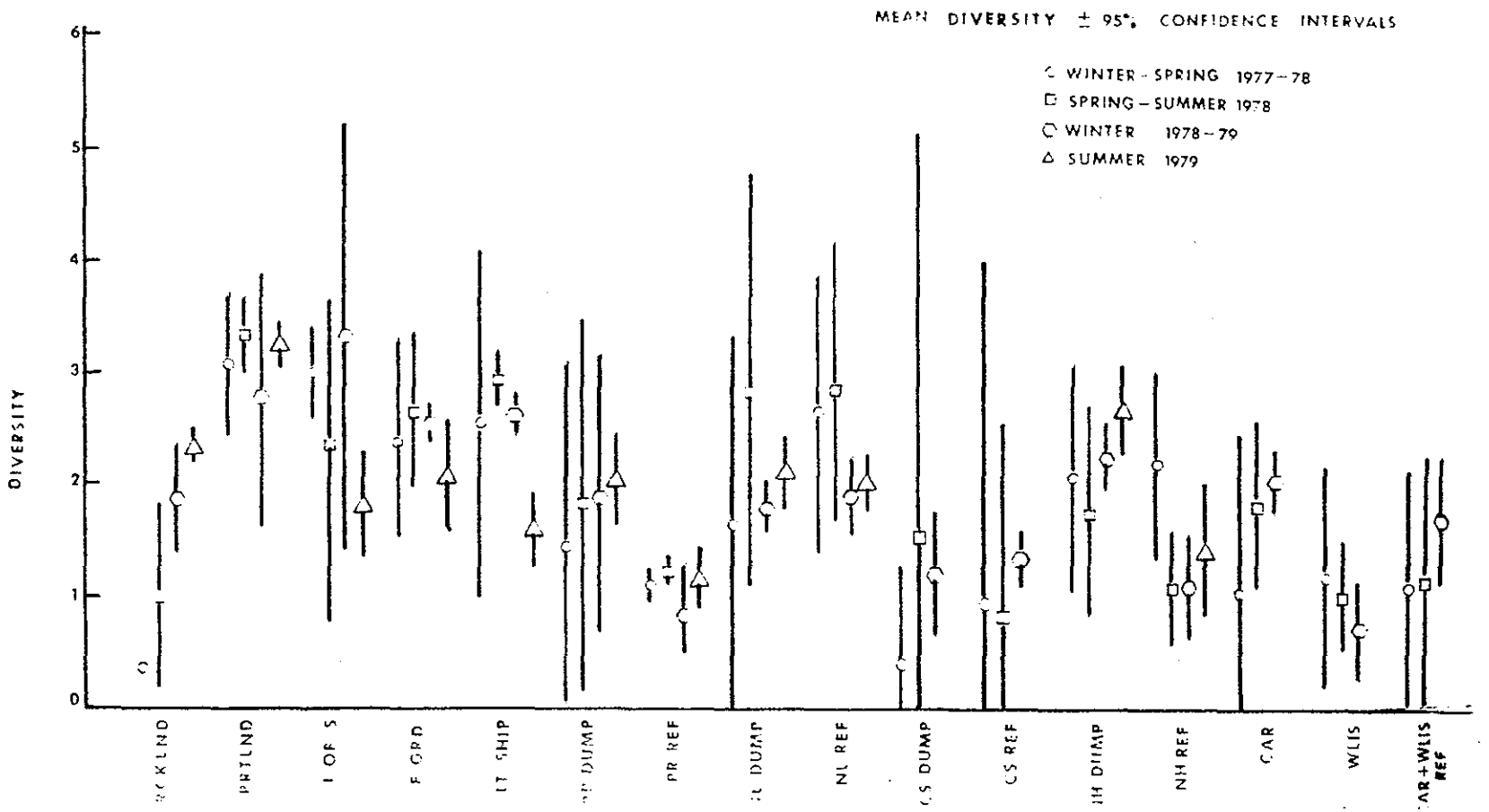

FIGURE 7.3-3. Distribution of mean diversity ($\bar{H}'$) by station and sampling date.

three population parameters (N, S, H') and indicates maxima, minima and overall variability of these statistics at all disposal sites in the New England area. Figure 7.3-5 illustrates the percent contribution of the three common phyla (Annelida, Mollusca, Arthropoda) to the biological recovery at each site for all sampling periods. Although these data will be discussed in terms of specific regions, some general observations can be made. Figure 7.3-1, which displays the mean number of individuals ($\bar{N}$) collected at each station during four DAMOS cruises (through August 1979), illustrates several features which appear to be typical of benthic biological investigations.

Immediately obvious is the large number of individuals collected at the Brenton Reef Reference site. Considering only the winter 1978-1979 and summer 1979 sampling periods, $\bar{N}$ at Brenton Reef Reference ranges between 6 and 1000 times greater than $\bar{N}$ found at any other site during the same period. However, 85% of the total number of individuals found at Brenton Reef during the winter 1978-79 cruise, and 80% of the summer 1979 total, were comprised by a single species, Ampelisca agassizi. Although found in only 10% of all the samples collected during these two periods, Ampelisca agassizi constituted 36% of the total number of indivduals. Approximately 230 species contributed to the remaining 64%.

The finding of a single species, or a few species, dominating an assemblage is common; this distribution is referred to as 'contagious' or clumped. 'Clumping' can be a sporadic event - occurring seasonally, or signalling a reproductive climax. However, it tends to be a reasonably predictable feature of the

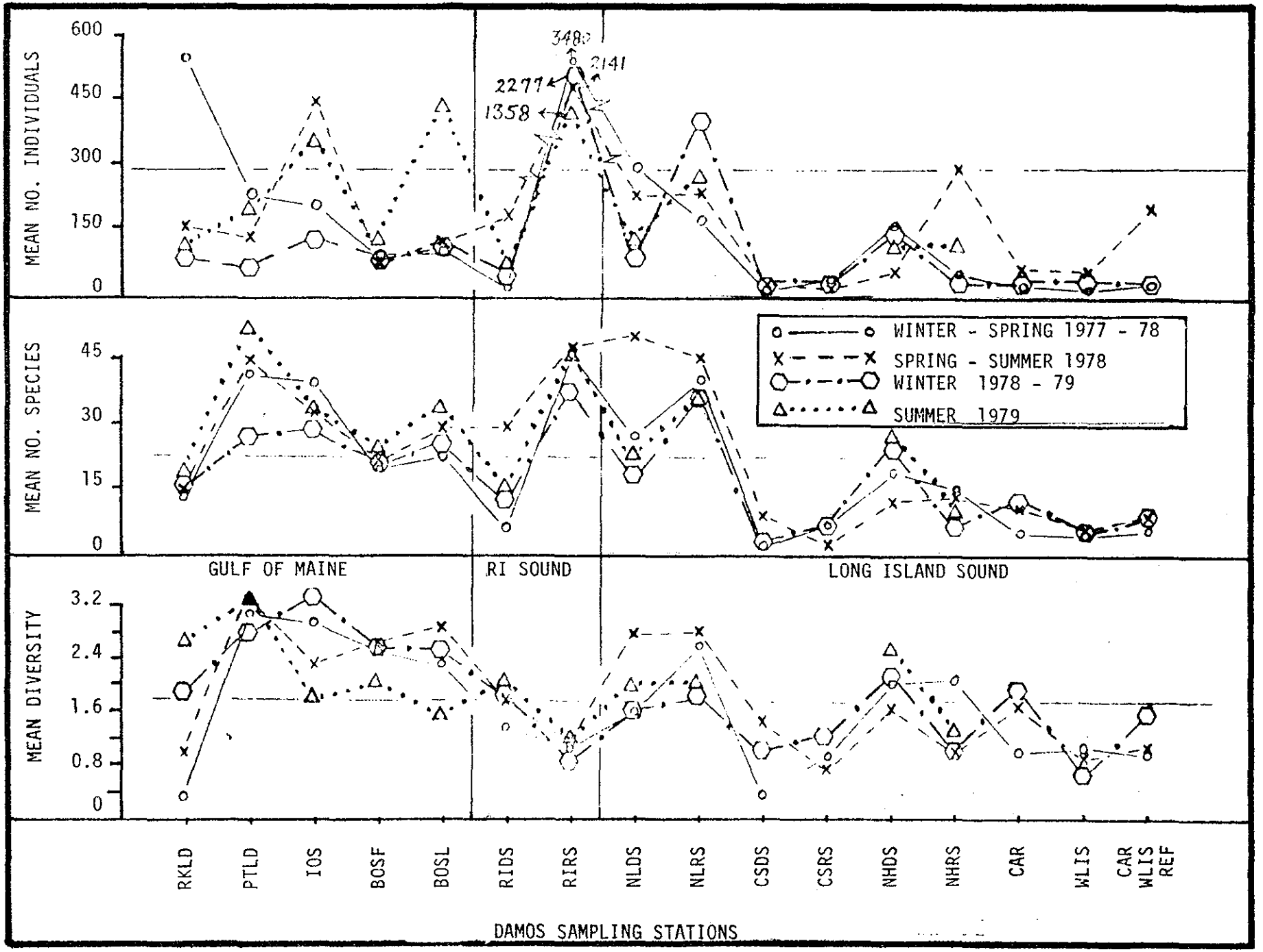

FIGURE 7.3-4. Relationship between $\bar{N}$ and $\bar{S}$, and $\bar{H}'$ between stations

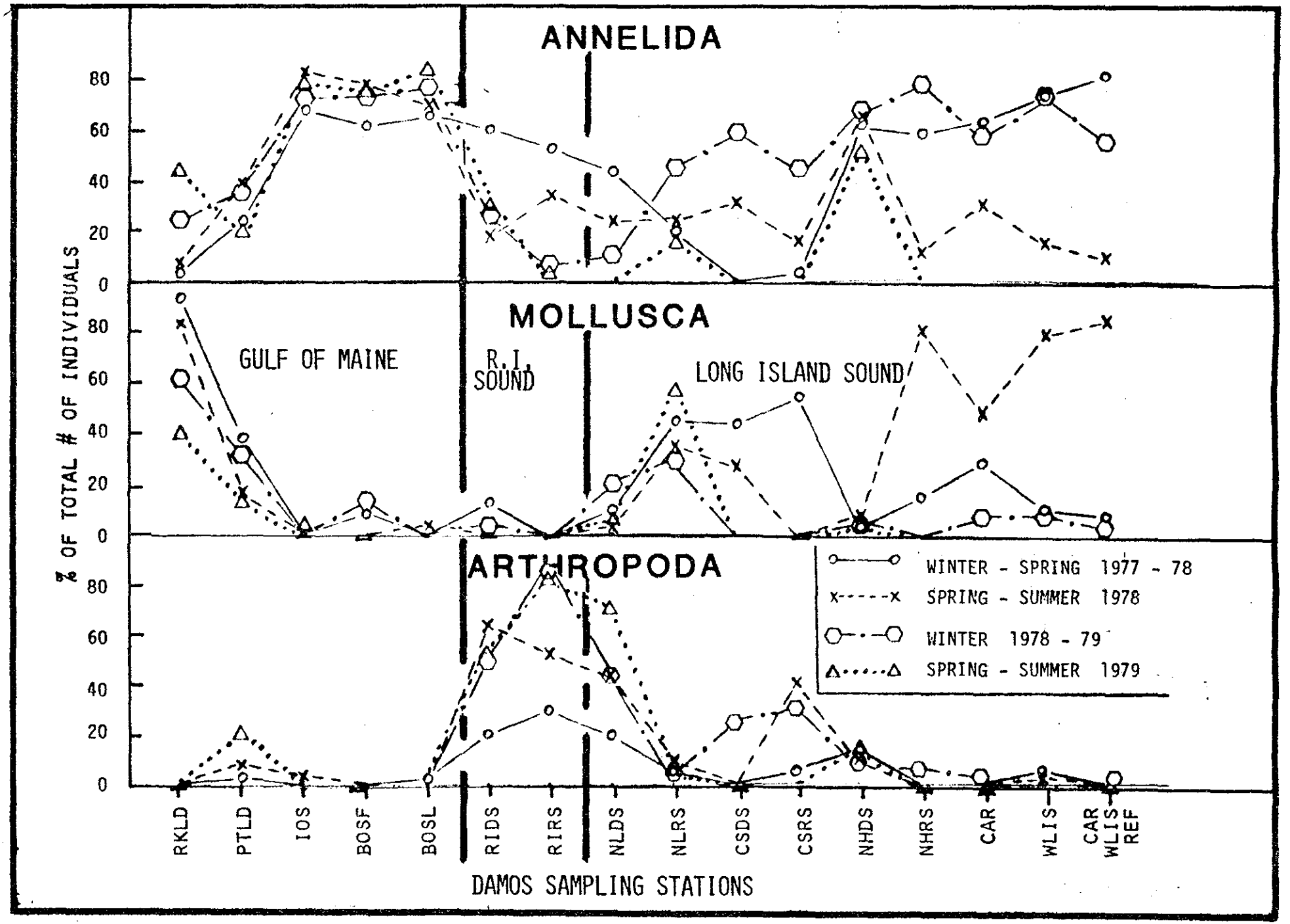

FIGURE 7.3-5 **DISTRIBUTION OF INDIVIDUALS BY PHYLA**

benthic environment; logically, where the 'dominant' species can efficiently translate a reliable food resource into reproductive energy rather than metabolic maintenance.

Since the equitability index (J') measures the evenness of N to S distribution, the degree of numerical dominance of a sample by a few species determines the value of J'. However, another property of population growth is that as N increases, new species are added at a logarithmic (slower) rate. Because of the non-linear relationship between population size and number of species, both J' and H' prove to be sample-size dependent. Figure 7.3-4 clearly displays the correlation between sample size and H'. The samples with the largest $\bar{N}$ tend to result in the lowest H'. Since J' and H' are generally interpreted as indicators of 'environmental health', this property of these indices should be noted.

Another common feature of benthic investigations is the high variability in population size (N) between replicates (Figure 7.3-1). The mean number of individuals ($\bar{N}$) collected at a particular station is obtained by averaging N from two, three, or five replicate samples while the variability in that value is determined by calculating the standard deviation of each mean over a 95% confidence interval. For the data presented here, the standard deviation of replicate samples often exceeds the value of the mean. This finding of population heterogeneity is common in benthic biological sampling and may be a function of local differences in micro-climate, habitat or resource. There are no simple solutions for reducing the variability between replicates (decreasing σ and σ^2). Some improvement may be obtained

by increasing the number of replicates, increasing the sample size or by decreasing the screen size through which the samples are sieved. In order to evaluate the potential for obtaining more homogeneous results between replicates, ten replicate samples were collected from each station during the DAMOS 1980 surveys at Portland, New London and Central Long Island Sound. However, the costs of analysis may prohibit such an approach for future monitoring.

Figures 7.3-2, 3 and 4 display a general trend of decreasing $\bar{S}$ and $\bar{H}'$ over the entire study area from the Gulf of Maine to the westernmost stations in Long Island Sound. If it is assumed, however, that there are no significant differences between stations where the 95% confidence intervals overlap, the apparent differences between stations illustrated in these figures may not be statistically significant.

7.3.1 Gulf of Maine

Examination of the Gulf of Maine data is complicated by the use of different sampling gear between 1978 and 1979. The anchor dredge was used routinely until January 1979 when it was replaced by the Smith-McIntyre grab sampler. The Smith-McIntyre is designed to quantitatively sample a 0.1 m^2 surface area to a variable depth dependent upon substrate consistency. The anchor dredge is a semi-quantitative collecting device intended to sample along transects (variable surface area) to a variable depth. Although significant differences occur in species composition and population size at various stations between 1978 and 1979, and within 1979, it is not presently possible to distinguish

environmental causes from sampling bias'.

A master species list for samples obtained during the winter of 1978-79 is presented in Table 7.3.1-1 and a list of the predominant species for that sampling period is provided in Table 7.3.1-2. The distribution of phyla, species and number of individuals at each of the five disposal sites is presented in Table 7.3.1-3, and data on the relative abundance of predominant species and diversity of the benthos at each site are included in Appendix 7.1. A similar presentation of data is also provided for the data obtained during the summer of 1979. Table 7.3.1-4 presents the master species list; 7.3.1-5, the predominant species list; 7.3.1-6, the distribution of phyla, species and numbers of individuals, while the numeric density data are included in Appendix 7.2.

Three stations were sampled in the northern Gulf of Maine during 1979. These were located at Rockland 'Canyon', and the Rockland and Portland Disposal sites. Disposal has been documented at the Rockland Disposal site and reported but not substantiated, at Rockland 'Canyon'. Although disposal ceased at Rockland in 1974, the disposal site supported substantially smaller populations than the Rockland 'Canyon' site. Differences between winter 1978-79 data and summer 1979 data may be seasonal, although again, the change in sampling methodology and the viability of the 'Canyon' as a reference station makes comparison difficult.

There are also apparent differences in population size and composition between winter 1978-79 and summer 1979 collections at all three disposal sites south of Portland. Neither the Isle

Table 7.3.1-1 Master Species list and species occurrence in samples taken in the Gulf of Maine, Winter 1978-79

	Species	Occurrence/ 18 Samples	No. Individuals
	Phylum CNIDARIA		
	Class Hydrozoa		
1.	Eudendrium sp.	1	1+
2.	Halecium sp.	1	1+
3.	Thuiaria sp.	1	1+
	Class Anthozoa		
4.	Cerianthus borealis	1	1
5.	Edwardsia elegans	9	20
6.	Edwardsia sp.	1	1
	Phylum RHYNCHOCOELA		
7.	Amphiporus sp.	3	4
8.	Cerebratulus sp.	8	13
9.	Micrura sp.	11	29
10.	Tubulanus pellucidus	2	2
11.	RHYNCHOCOEL sp.	3	4
	Phylum MOLLUSCA		
	Class Aplacophora		
12.	Chaetoderma nitidulum	4	9
	Class Gastropoda		
13.	Alvania pelagica	1	1
14.	Anachis lafresnayi	1	1
15.	Natica pusilla	1	1
16.	Retusa obtusa	1	1
	Class Pelecypoda		
17.	Arctica islandica	1	2
18.	Astarte borealis	2	2
19.	Astarte subaequilatera	2	4
20.	Astarte (subaequilatera)	1	1
21.	Astarte undata	2	4
22.	Astarte (undata)	5	31
23.	Astarte sp.	1	3
24.	Cerastoderma pinnulatum	2	2
25.	Cyclocardia borealis	3	8
26.	Macoma (balthica)	1	2
27.	Mulinia lateralis	1	1
28.	Nucula delphinodonta	4	8
29.	Nucula proxima	7	752
30.	Nucula tenuis	6	9
31.	Nuculana tenuisulcata	4	5
32.	Periploma fragile	4	7
33.	Pitar morrhuana	2	2
34.	Spisula sp.	2	7

Table 7.3.1-1 (cont.)

	Species	Occurrence/ 18 Samples	No. Individuals
35.	Thyasira insignis	9	27
36.	Thyasira sp.	1	9
37.	Yoldia lucida	2	5
38.	Yoldia sapotilla	12	86
39.	Yoldia thraeciaeformis	3	5
	Phylum ANNELIDA		
	Class Polychaeta		
40.	Ampharete acutifrons	1	1
41.	Ampharete arctica	16	94
42.	Amphicteis gunneri	1	1
43.	Amphitrite cirrata	1	1
44.	Amphitritinae sp.	1	1
45.	Asychis elongata	4	13
46.	Capitella capitata	2	2
47.	Chaetozone setosa	3	5
48.	Cirratulid sp.	3	23
49.	Drilonereis sp.	1	1
50.	Enipo gracilis	2	2
51.	Eteone trilineata	1	1
52.	Euclymene collaris	1	1
53.	Eyclymene sp.	5	14
54.	Goniada maculata	9	26
55.	Hartmania moorei	2	3
56.	Heteromastus filiformis	7	10
57.	Laonice cirrata	6	8
58.	Lumbrineris fragilis	14	67
59.	Lumbrineris tenuis	1	1
60.	Maldane sarsi	5	15
61.	Melinna cristata	6	29
62.	Myriochele heeri	5	14
63.	Nephtys ciliata	1	1
64.	Mephtys incisa	15	71
65.	Nephtys paradoxa	1	1
66.	Nereis grayi	1	1
67.	Nereis succinea	1	1
68.	Nicomache lumbricalis	5	7
69.	Ninoe nigripes	15	87
70.	Notocirrus spiniferus	1	1
71.	Ophioglycera gigantea	1	1
72.	Pectinaria gouldii	1	1
73.	Pherusa plumosa	1	1
74.	Phyllodoce maculata	1	1
75.	Pista cristata	2	3
76.	Polycirrus sp.	2	2
77.	Potamilla neglecta	2	2

Table 7.3.1-1 (cont.)

	Species	Occurrence/ 18 Samples	No. Individuals
78.	Potamilla reniformis	1	1
79.	Praxillella gracilis	9	64
80.	Praxillura ornata	1	2
81.	Prionospio malmgreni	2	3
82.	Rhodine loveni	3	11
83.	Scalibregma inflatum	5	8
84.	Scolelepis sp.	1	1
85.	Scoloplos acutus	9	29
86.	Spio filicornis	8	33
87.	Sternaspis scutata	13	180
88.	Streblosoma spiralis	2	9
89.	Terebellides stroemi	6	10
90.	Terebellid sp.	1	1
91.	Tharyx acutus	5	11
92.	Tharyx sp.	3	3
93.	Thelepus cincinnatus	1	1
94.	Trichobranchus glacialis	7	19
95.	Trochochaeta watsoni	1	1
	Phylum ARTHROPODA		
	Class Crustacea		
	Order Isopoda		
96.	Calathura branchiata	1	1
	Order Amphipoda		
97.	Byblis serrata	3	3
98.	Casco bigelowi	2	2
99.	Haploops tubicola	4	4
100.	Hippomedon propinquus	1	1
101.	Leptocheirus pinquis	2	3
102.	Melita dentata	1	1
103.	Unciola irrorata	1	1
	Order Decopoda		
104.	Eualus pusiolus	1	1
	Phylum BRACHIOPODA		
105.	Terebratulina septentrionalis	1	1
	Phylum SIPUNCULIDA		
106.	Phascolion strombi	4	5
	Phylum ECHINODERMATA		
	Class Stelleroidea		
107.	Ctenodiscus crispatus	7	17
108.	Ophiopholis aculeata	2	2
109.	Pedicellaster typicus	1	1
	Class Holothuroidea		

Table 7.3.1-1 (cont.)

	Species	Occurrence/ 18 Samples	No. Individuals
110.	Havelockia (scabra)	1	2
111.	Molpadia oolitica	3	7
112.	Pentamera sp.	1	1
	Phylum CHAETOGNATHA		
113.	Saggita (elegans)	1	1
	Phylum CHORDATA		
114.	Bostrichobranchus pilularis	1	1

PREDOMINANT SPECIES LIST. GULF OF MAINE - WINTER 1978 -79.

Table 7.3.1-2

Total No. Phyla : 10
Total No. Species : 114
Total No. Individuals: 2028+

Predominant Species List

Species	Phylum	Feeding Type	Occurrence/ 18 Samples	Total No. Individuals	Total	Cumul. %
Nucula proxima	M	DF	7	752	37.1	37.1
Sternaspis scutata	A	DF	13	180	8.9	46.0
Ampharete arctica	A	SDF	16	94	4.6	50.6
Ninoe nigripes	A	P	15	87	4.3	54.9
Yoldia sapotilla	M	DF	12	86	4.2	59.1
Nephtys incisa	A	DF	15	71	3.5	62.6
Lumbrineris fragilis	A	P	14	67	3.3	65.9
Praxillella gracilis	A	DF	9	64	3.2	69.1

A ; Annelida
M : Mollusca
DF : Deposit Feeder
SDF: Surface Deposit Feeder
P : Predator

TABLE 7.3.1-3

DATA SUMMARY (TOTAL DISTRIBUTION): GULF OF MAINE
WINTER 1978-79 COLLECTION

	Rockland Canyon			Rockland Disposal			Portland Disposal		
	1	2	3	1	2	3	1	2	3
No. Species/Sample	22	9	18	13	16	15	11	32	35
No. Individuals/Sample	542	69	170+	41	71	114	18	59	89
No. Phyla/Station		5			6			9	
No. Species/Station		30			27			57	
No. Individuals/Station		781+			226			166	

	Isle of Shoals Disposal			Boston Lightship			Boston Foul Ground		
	1	2	3	1	2	3	1	2	3
No. Species/Sample	24	27	34	26	23	25	22	17	20
No. Individuals/Sample	106	108	144	79	88+	120	90+	58	62
No. Phyla/Station		7			8			6	
No. Species/Station		47			43			35	
No. Individuals/Station		358			287+			210+	

Table 7.3.1-4 Master Species list and species occurrence in samples taken in the Gulf of Maine, Summer 1979

	Species	Occurrence/ 25 Samples	No. Individuals
	Phylum CNIDARIA		
	Class Hydrozoa		
1.	Calycella syringa	1	1+
2.	Campanularid sp.	1	1+
3.	Dicoryne flexuosa	1	1+
4.	Thuiaria sp.	1	1+
	Class Anthozoa		
5.	ANTHOZOAN sp. (dev'g)	1	1
6.	Ceriantharian sp.	4	4
7.	Edwardsia elegans	10	20
8.	Edwardsia sp.	1	1
9.	Stomphia coccinea	1	1
	Phylum RHYNCHOCOELA		
10.	Cerebratulus sp.	12	16
11.	Micrura sp.	17	51
12.	Tubulanus sp.	7	7
13.	RHYNCHOCOEL sp.	1	3
	Phylum NEMATODA		
14.	NEMATODE sp.	1	2
15.	NEMATODE sp. (parasitic)	1	1
	Phylum MOLLUSCA		
	Class Aplacophora		
16.	Chaetoderma nitidulum	12	22
	Class Polyplacophora		
17.	Tonicella ruber	1	1
	Class Gastropoda		
18.	Alvania pelagica	2	2
19.	Buccinum undatum	1	1
20.	Colus pygmaeus	2	2
21.	Lunatia triseriata	1	1
22.	Lunatia sp.	1	3
23.	Nassarius trivittatus	1	2
24.	Propebela concinnula	2	2
	Class Scaphopoda		
25.	Dentalium entale	1	1
	Class Pelecypoda		
26.	Astarte subaequilatera	1	1
27.	Astarte undata	4	18
28.	Astarte undata (A)	9	66
29.	Cerastoderma pinnulatum	3	7
30.	Crenella decussata	2	3
31.	Cyclocardia borealis	6	30
32.	Lyonsia arenosa	1	1
33.	Macoma calcarea	6	11

Table 7.3.1-4 (cont.)

	Species	Occurrence/ 25 Samples	No. Individuals
34.	Mya arenaria (juv.)	1	2
35.	Nucula delphinodonta	1	1
36.	Nucula proxima	5	139
37.	Nucula tenuis	10	20
38.	Nuculana tenuisulcata	7	8
39.	Periploma papyratium	12	24
40.	Tellinid sp.	+	+
41.	Thyasira insignis	18	88
42.	Yoldia lucida	9	22
43.	Yoldia sapotilla	10	55
44.	Yoldia thracieformis	5	7
45.	PELECYPOD sp. A	4	13
	Phylum ANNELIDA Class Polychaeta		
46.	Ampharete acutifrons	4	5
47.	Ampharete arctica	23	506
48.	Ampharetid sp.	1	1
49.	Amphitrite affinis	1	1
50.	Amphitrite cirrata	1	1
51.	Ancistrosyllis groenlandica	2	3
52.	Antinoella sarsi	2	2
53.	Apistobranchus tullbergi	1	1
54.	Arcteobia anticostiensis	1	1
55.	Aricidea quadrilobata	3	4
56.	Brada villosa	1	1
57.	Capitella capitata	5	15
58.	Caulleriella fillariensis	1	1
59.	Ceratocephale loveni	1	1
60.	Chaetozone setosa	12	40
61.	*Chone infundibuliformis*	1	1
62.	Clymenella zonalis	5	11
63.	Cossura longocirrata	1	1
64.	Diopatra cuprea	1	1
65.	Diplocirrus hirsutus	9	17
66.	Drilonereis longa	1	1
67.	Drilonereis magna	2	2
68.	Enipo gracilis	2	3
69.	Euchone elegans	2	2
70.	Euclymene collaris	1	1
71.	Euclymenaine sp.	10	20
72.	Goniada maculata	10	32
73.	Gyptis vittata	1	1
74.	Harmathoe extenuata	2	2
75.	Harmathoe imbricata	3	3
76.	Hartmania moorei	4	6

Table 7.3.1-4 (cont).

	Species	Occurrence/ 25 Samples	No. Individuals
77.	Heteromastus filiformis	13	61
78.	Laonice cirrata	4	7
79.	Lumbriclymeme cylindricauda	5	7
80.	Lumbrineris fragilis	16	29
81.	Lumbrineris impatiens	3	4
82.	Lumbrineris tenuis	2	2
83.	Maldane sarsi	13	211
84.	Maldanid sp.	1	1
85.	Melinna cristata	10	14
86.	Myriochele heeri	19	73
87.	Nephtys ciliata	1	1
88.	Nephtys incisa	21	64
89.	Nephtys paradoxa	3	3
90.	Nereis grayi	3	3
91.	Nicomache lumbricalis	6	10
92.	Ninoe nigrippes	22	66
93.	Notocirrus spiniferus	1	1
94.	Onuphis conchylega	2	2
95.	Ophelina accuminata	2	2
96.	Owenia fusiformis	1	1
97.	Paraonis gracilis	7	10
98.	Petaloproctus tenuis	1	1
99.	Pholoe minuta	6	9
100.	Phyllodoce maculata	1	1
101.	Pista cristata	7	13
102.	Polycirrus sp.	1	2
103.	Polydora concharum	2	16
104.	Polydora ligni	4	10
105.	Polydora socialis	+	+
106.	Praxillella gracilis	13	30
107.	Praxillella praetermissa	2	2
108.	Prionospio malmgreni	17	39
109.	Rhodine loveni	3	10
110.	Sabella crassicornis	1	1
111.	Scalibregma inflatum	12	45
112.	Scoloplos acutus	12	65
113.	Spio filicornis (A)	17	2578
114.	Spiochaetopterus oculata	1	1
115.	Spiophanes wigleyi	5	8
116.	Sternaspis scutata	23	407
117.	Streblosoma spiralis	4	4
118.	Syllis cornuta	4	11
119.	Syllis gracilis	2	2
120.	Terebella lapidaria	3	6
121.	Terebellides stroemi	9	12
122.	Tharyx acutus	10	15

Table 7.3.1-4 (cont).

	Species	Occurrence/ 25 Samples	No. Individuals
123.	Tharyx sp.	7	17
124.	Theleppus cincinnatus	3	6
125.	Trichobranchus glacialis	7	16
126.	Trochochaeta multisetosa	6	19
127.	Trochochaeta watsoni	1	1
	Class Oligochaeta		
128.	Tubificid sp.	2	2
	Class Hirudinea		
129.	Platybdella sp.	1	2
	Phylum SIPUNCULIDA		
130.	Golfingia minuta	3	7
131.	Phascolion strombi	4	18
132.	SIPUNCULID sp.	1	18
	Phylum ARTHROPODA		
	Class Crustacea		
	Subclass Ostracoda		
133.	Cylindroleberis mariae	2	3
	Subclass Cirrepedia		
134.	Balanus balanus		
	Subclass Malacostraca		
	Order Cumacea		
135.	Diastylis polita	4	6
136.	Diastylis sculpta	3	5
137.	Eudorella emarginata	6	8
138.	Eudorella pusilla	2	2
139.	Leptocuma minor	1	1
140.	Leptostylis longimana	3	3
141.	Petalosarsia declivis	1	1
	Order Isopoda		
142.	Calathura branchiata	4	25
	Order Amphipoda		
143.	Acanthostephia sp.	1	1
144.	Aceroides sp.	3	8
145.	Aeginina longicornis	7	16
146.	Ampelisca abdita	1	1
147.	Ampelisca macrocephala	2	2
148.	Anonyx sarsi	1	2
149.	Argissa hamatipes	2	2
150.	Arrhis phyllonyx	1	1
151.	Byblis serrata	8	14
152.	Casco bigelowi	4	7
153.	Dyopedos porrectus	4	5
154.	Erichthonius rubricornis	4	5
155.	Haploops tubicola	14	217

Table 7.3.1-4 (Cont).

	Species	Occurrence/ 25 Samples	No. Individuals
156.	Harpinia propinqua	9	15
157.	Hippomedon propinquus	5	7
158.	Leptocheirus pinguis	3	3
159.	Melita dentata	3	3
160.	Metopa sp.	1	2
161.	Monoculodes intermedius	1	1
162.	Monoculodes packardi	1	1
163.	Monoculodes tesselatus	2	4
164.	Monoculodes sp.	1	1
165.	Orchomenella minuta	1	1
166.	Parathemisto gaudichaudi	2	2
167.	Paroediceros lyncaeus	1	1
168.	Photis macrocoxa	1	1
169.	Tiron spiniferum	2	2
170.	Stenopleustes inermis	1	2
171.	Unicola inermis	1	4
172.	Unicola irrorata	3	5
	Order Mysidacea		
173	Erythrops erythrophthalma	2	2
	Order Decapoda		
174.	Eualus pusiolus	1	1
175.	Pagurus arcuatus	1	1
	Phylum ECHINODERMATA		
	Class Stelleroidea		
176.	Amphipholis squamata	5	13
177.	Ctenodiscus crispatus	11	22
178.	Ophiocantha bidentata	6	9
179.	Ophiopholis aculeata	2	4
180.	Ophiura robusta	2	4
181.	Ophiura sarsi	5	7
182.	OPHIUROID sp.	1	1
	Class Holothuroidea		
183.	Havelockia scabra	1	1
184.	Molpadia oolitica	4	7
185.	Pentamera sp.	1	1
	Phylum CHORDATA		
186.	Macrozoarces americanus	1	1

PREDOMINANT SPECIES LIST. GULF OF MAINE - SUMMER 1978-79

Table 7.3.1-5

Total No. Phyla : 9
Total No. Species : 184
Total No. Individuals: 5945+

Predominant Species List

Species	Phylum	Feeding Type	Occurrence/ 25 Samples	Total No. Individuals	% Total	Cumul. %
Spio filicornis (A)	A	SDF	17	2758	46.4	46.4
Ampharete arctica	A	SDF	23	506	8.5	54.9
Sternaspis scutata	A	DF	23	407	6.8	61.7
Haploops tubicola	Ar	SF	14	217	3.6	65.3
Maldane sarsi	A	DF	13	211	3.5	68.8
Nucula Proxima	M	DF	5	139	2.3	71.1
Thyasira insignis	M	SF	18	88	1.5	72.6
Myriochele Heeri	A	DF	19	73	1.2	73.8
Astarte undata (A)	M	SF	9	66	1.1	74.9
Ninoe nigripes	A	P,DF	22	66	1.1	76.0
Scoloplos acutus	A	DF	12	65	1.1	77.1
Nephtys incisa	A	DF	21	64	1.1	78.1

A : Annelida
Ar : Arthropoda
M : Mollusca
R : Rhynchocoela

DF : Deposit Feeder
SDF : Surface Deposit Feeder
SF : Suspension Feeder
P : Predator

TABLE 7.3.1-6

DATA SUMMARY (TOTAL DISTRIBUTION): GULF OF MAINE
SUMMER 1979 COLLECTION

	Rockland Disposal					Portland Disposal					Isle of Shoals				
	1	2	3	3	5	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	15	23	28	16	15	49	49	56	56	49	35	42	26	37	29
No. Individuals/Samples	72	106	194+	114	54	156	235	180+	211	141	360	313+	239	569	247
No. Phyla/Station			7					7					7		
No. Species/Station			46					107					78		
No. Individuals/Station			540+					923+					1728+		

	Boston Lightship					Boston Foul Ground				
	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	38	31	35	36	30	22	22	28	29	26
No. Individuals/Sample	425	472	602	354	263	80	105	110	138	202
No. Phyla/Station			7					6		
No. Species/Station			72					59		
No. Individuals/Station			2119					635		

of Shoals nor Boston Lightship sites have received significant amounts of dredged material in recent years, however, the Boston Foul Ground is an active disposal site for periodic disposal of both "clean" and contaminated dredge material.

Based on the data obtained, several observations can be made concerning the benthic populations at the disposal sites in the Gulf of Maine. With the exception of the Boston Foul Ground, the northern sites, in general, support larger and more diverse populations than stations examined south of Cape Cod. The Boston Foul Ground, located in approximately 80m of water in Stellwagen Basin, most clearly resembles the Long Island Sound stations in terms of population size.

These statements are complicated by the fact that distinct assemblages occur north and south of Cape Cod, so differences in species composition may be strictly a function of geography and substrate since many of the Gulf of Maine sites contain a higher percentage of glacially-derived sand and gravel than the southern sites, which are typically composed of fine-grained silt and clays.

7.3.2 Rhode Island Sound

Only one set of samples was obtained at the Brenton Reef Disposal site during the 1978-79 study period. The sampling operation occurred on 30 May, 1979, and resulted in the Master Species List provided in Table 7.3.2-1. The predominant species list is presented in Table 7.3.2-2, the distribution of phyla, species and individuals appears in Table 7.3.2-3. The numeric density data for both the disposal site and reference station are

provided in Appendix 7.3.

This area represents a situation where significant differences exist between the disposal site and reference sample populations. The overall mean number of individuals collected from the Brenton Reef Reference site is almost 32 times the overall mean number of individuals found at the disposal site. Furthermore, the overall mean number of species at the reference site is nearly three times the number found at the dumpsite. In an effort to determine the reason for this large discrepancy, a comparison of a number of station characteristics was made. The two stations are separated by slightly more than one mile, and generally speaking, water quality, thermal structure and overall hydrographic regimes are very similar. Depth of water at the disposal site is about 27.5 meters versus about 32 meters at the Reference site. Grain size analyses of sediment samples collected at each station indicate that although the disposal site sediments are slightly less sorted, the grain size distribution curves are similar and have been classified as either "silty-sand" or "silty medium-fine sand" by the Corps of Engineers. In view of the between-station similarities in the above mentioned characteristics it is difficult to explain such large discrepancies in the benthic populations. Therefore, a between-station comparison of heavy metal concentrations, percent volatile solids and oil and grease content was made of sediment samples collected between March 1978 and May 1979. This comparison is shown in Table 7.3.2-4.

In general, the heavy metal concentrations in the sediments collected at the disposal site in March-April 1978 and

Table 7.3.2.-1 Master Species list and species occurrence in samples taken in Rhode Island Sound, Summer 1979

	Species	Occurrence/ 6 Samples	No. Individuals
	Phylum CNIDARIA		
	Class Hydrozoa		
1.	Eudendrium sp.	1	1+
2.	HYDROZOAN sp.	1	1+
	Class Anthozoa		
3.	Ceriantheopsis americanus	2	10
4.	Edwardsia elegans	4	18
5.	Metridium senile	1	1
	Phylum RHYNCHOCOELA		
6.	Amphiporus sp.	1	1
7.	Cerebratulus sp.	1	1
8.	Micrura sp.	3	6
	Phylum MOLLUSCA		
	Class Pelecypoda		
9.	Arctica islandica	1	1
10.	Cerastoderma pinnulatum	4	4
11.	Ensis directus	2	2
12.	Mya arenaria	1	6
13.	Nucula proxima	2	2
14.	Nucula tenuis	1	2
15.	Periploma papyratium	1	26
16.	Pitar morrhuana	2	6
17.	Tellina versicolor	1	2
18.	Thracia conradi	1	2
	Phylum ANNELIDA		
	Class Polychaeta		
19.	Aglaophamus circinata	3	4
20.	Ampharete arctica	4	189
21.	Asychis elongata	3	5
22.	Chone infundibuliformis	3	41
23.	Cirratulid sp.	2	3
24.	Clymenella torquata	2	68
25.	Drilonereis longa	3	3
26.	Euclymene sp.	2	4
27.	Eteone longa	1	1
28.	Glycera americana	1	1
29.	Laonice cirrata	2	2
30.	Lumbriclymene cylindricauda	1	1
31.	Lumbrineris fragilis	5	8
32.	Lumbrineris tenuis	4	7
33.	Maldanid sp.	2	2
34.	Nephtys incisa	4	64

Table 7.3.2.-1 (cont.)

	Species	Occurrence/ 6 Samples	No. Individuals
35.	Nereis accuminata	1	1
36.	Nereis grayi	1	1
37.	Ninoe nigripes	5	248
38.	Ophelina accuminata	2	3
39.	Paranaitis speciosa	1	1
40.	Pherusa affinis	4	22
41.	Scalibregma inflatum	6	21
42.	Scoloplos acutus	2	7
43.	Sternaspis scutata	1	1
44.	Sthenelais limicola	1	2
45.	Tharyx acutus	1	1
	Phylum ARTHROPODA		
	Class Crustacea		
	Order Cumacea		
46.	Diastylis quadrispinosa	2	6
47.	Diastylis sculpta	3	11
48.	Eudorella emarginata	3	14
	Order Isopoda		
49.	Cirolana polita	2	2
50.	Edotea montosa	1	2
51.	Ptilanthura tenuis	1	1
	Order Amphipoda		
52.	Ampelisca agassizi	3	5798
53.	Anonyx sarsi	1	1
54.	Byblis serrata	2	3
55.	Casco bigelowi	2	2
56.	Dyopedos porrecta	2	2
57.	Harpinia propinqua	3	24
58.	Harpinia cruncata	2	9
59.	Hippomedon serratus	1	3
60.	Leptocheirus pinguis	6	42
61.	Orchomenella groenlandica	1	2
62.	Photis macrocoxa	1	1
63.	Phoxocephalus holbolli	1	1
64.	Unicola irrorata	6	204
	Order Mysidacea		
65.	Neomysis americana	1	2
	Order Decapoda		
66.	Cancer borealis	1	1
	Phylum BRYOZOA		
67.	Dendrobeania murrayana	1	1+
68.	Hippoporina sp.	1	1+

Table 7.3.2.-1 (cont.)

	Species	Occurrence/ 6 Samples	No. Individuals
	Phylum ECHINODERMATA		
	Class Stelleroidea		
69.	Ophiopholis aculeata	2	6

PREDOMINANT SPECIES LIST. RHODE ISLAND SOUND - SUMMER 1979
TABLE 7.3.2-2

Total No. Phyla : 6
Total No. Species : 87
Total No. Individuals: 6788

Brenton Reef Reference

Species	Phylum	Feeding Type	Occurrence/ 5 Samples	Total No. Individuals	Total	Cumul. %
Ampelisca agassizi	Ar	SF	5	5424	79.9	79.9
Unciola irrorata	Ar	DF	5	190	2.8	82.7
Leptocheirus pinguis	Ar	DF	5	184	2.7	85.4
Ninoe nigripes	A	P	5	123	1.8	87.2
Eudorella pusilla	Ar	SF	5	122	1.8	89.0
Periploma papyratium	M	SF	5	102	1.5	90.5

Total No. Phyla : 6
Total Nol Species : 47
Total No. Individuals: 319+

Brenton Reef Disposal

Cirolana polita	Ar	DF	3	100	31.3	31.3
Scalibregma inflatum	A	DF	4	48	15.0	46.4
Pseudunciola obliqua	Ar	DF	2	28	8.8	55.2
Lumbrineris fragilis	A	P	4	21	6.6	61.8

No other species present at this site contributed significantly to the total number of individuals.

A : Annelida
Ar : Arthropoda
M : Mollusca
DF : Deposit Feeder
SF : Suspension Feeder

TABLE 7.3.2-3

DATA SUMMARY (TOTAL DISTRIBUTION): RHODE ISLAND SOUND
SUMMER 1979 COLLECTION

	Brenton Reef Reference					Brenton Reef Dumpsite				
	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	40	45	46	45	53	14	18	15	16	12
No. Individuals/Sample	856	1270	1540	1593	1529	41+	71+	132	34+	41
No. Phyla/Station			6					6		
No. Species/Station			87					47		
No. Individuals/Station			6788					319+		

TABLE 7.3.2-4 HEAVY METALS ANALYSIS - BRENTON REEF DISPOSAL SITE & REFERENCE
(CONCENTRATIONS IN PPM AND REPRESENT THE MEAN OF THREE REPLICATES)

STATION #	Cd	Co	Cr	Cu	Fe_4 ($x10^4$)	Hg	Ni	Pb	Zn	%Vol Sol	O/G $x10^3$ ppm
					MAR-APR 1978						
BR. REEF D.S.	.24	5.0	14	6.0	1.4	.01	29	7.2	31	4.1	-
BR. REEF REF.	.12	2.4	7.2	2.6	.61	.01	11	8.4	17	1.6	2.2
					JULY-AUG 1978						
BR. REEF D.S.	.12	3.9	24	11	.94	.03	8.7	13	36	8.3	.27
BR. REEF REF	.12	1.9	13	2.5	.54	0	4.2	8.9	17	2.3	.34
					NOV-DEC 1978						
BR. REEF D.S.	.12	2.1	8.4	2.7	.46	.02	4.9	5.7	9.4	3.5	2.1
BR. REEF REF	.12	1.6	13	2.1	.42	.02	3.0	3.1	12	8.8	NIL
					MAY - 1979						
BR. REEF D.S.	.25	2.1	5.6	1.6	.33	.001	2.7	7.0	8.3	1.6	0
BR. REEF REF.	.33	2.9	16	3.2	.68	.02	3.8	10	21	3.5	0

in July-August 1978 were 2 to 2.5 times that at the reference site. However, during November-December 1978, heavy metal concentrations were somewhat higher at the reference site and during May 1979 certain heavy metal concentrations were almost three times higher than at the disposal site. The extreme fluctuations in these sediment chemistry data over time and space suggest that a correlation between population and heavy metal distributions is invalid. There is no explanation beyond biological variability for the extreme differences in population observed at the two stations at this time.

7.3.3 Long Island Sound

Benthic samples were obtained from the Long Island Sound area during the winter of 1978-79 and the summer of 1979. However, due to changes in priorities and a particular emphasis on the disposal of dredged material from Stamford and New Haven harbors at the Central Long Island Sound Disposal area, the sampling programs at the Cornfield Shoals and Cable and Anchor Reef disposal sites were halted after the winter sampling period.

A master species list for the winter of 1978-79 is presented in Table 7.3.3-1 and the predominant species are shown in Table 7.3.3-2; the distribution of phyla, species and individuals at each station is presented in Table 7.3.3-3 and the numeric density data are included as Appendix 7.4. A similar presentation is provided for the summer data. The master species list, list of predominant species, distribution data and the numeric density data are presented in Tables 7.3.3-4, 7.3.3-5, 7.3.3-6 and Appendix 7.5, respectively.

Table 7.3.3-1 Master Species list and species occurrence in samples taken in Long Island Sound, Winter 1978-79

	Species	Occurrence/ 65 Samples	No. Individuals
	Phylum PORIFERA		
1.	Hymeniacidon heliophila	1	1+
	Phylum CNIDARIA		
	Class Hydrozoa		
2.	Clytia sp.	1	1+
3.	Corymorpha pendula	5	5
4.	Corymorpha sp.	1	1
5.	Eudendrium sp.	1	1+
6.	Garveia (groenlandica)	1	1+
7.	Halecium sp.	2	2+
8.	Hybocodon prolifer	1	2
9.	Sertularella sp.	1	1+
10.	Thuiaria sp.	11	11+
11.	Tubularia sp.	4	4+
12.	HYDROZOAN sp.	10	10+
	Class Anthozoa		
13.	Astrangia danae	1	1+
14.	Ceriantheopsis americanus	29	88
15.	Edwardsia elegans	11	15
16.	Haloclava producta	4	5
	Phylum NEMATODA		
17.	NEMATODE sp.	5	10
	Phylum PLATYHELMINTHES		
18.	Notoplana sp.	1	5
19.	PLATYHELMINTH sp.	2	3
	Phylum RHYNCHOCOELA		
20.	Cerebratulus sp.	5	6
21.	Micrura sp.	7	9
22.	Tubulanus pellucidus	2	3
23.	Tubulanus sp.	4	6
24.	RHYNCHOCOEL sp.	4	4
	Phylum MOLLUSCA		
	Class Gastropoda		
25.	Anachis lafresnayi	1	1
26.	Catriona aurantia	1	1
27.	Crepidula fornicata	2	3
28.	Crepidula plana	1	14
29.	Mitrella lunata	2	4
30.	Nassarius trivittatus	8	14
31.	Polinices duplicatus	1	1

Table 7.3.3-1 (cont.)

	Species	Occurrence/ 65 Samples	No. Individuals
	Class Pelecypoda		
32.	Astarte subaequilatera	1	1
33.	Dacrydium vitreum	4	85
34.	Ensis directus	1	2
35.	Macoma tenta	7	37
36.	Macoma sp.	1	1
37.	Mulinia lateralis	11	18
38.	Mya (arenaria)	1	1
39.	Mytilus edulis	5	594
40.	Nucula proxima	12	31
41.	Pandora sp.	1	1
42.	Pitar morrhuana	11	21
43.	Tellinid sp.	1	1
44.	Yoldia limatula	3	3
45.	Yoldia lucida	1	2
46.	Yoldia sapotilla	1	1
	Phylum ANNELIDA		
	Class Polychaeta		
47.	Aglaophamus circinata	2	2
48.	Ampharete arctica	22	117
49.	Ancistrosyllis groenlandica	1	1
50.	Arabellid sp.	1	1
51.	ARCHIANNELID sp.	7	47
52.	Aricidea (neosuecica)	1	1
53.	Asabellides oculata	9	13
54.	Asychis elongata	5	5
55.	Autolytus sp.	1	1
56.	Capitella capitata	4	26
57.	Caulleriella fillariensis	7	696
58.	Cirratulid sp.	2	2
59.	Cirrophorus sp.	1	1
60.	Clymenella torquata	6	28
61.	Clymenella zonalis	6	27
62.	Diplocirrus hirsutus	3	15
63.	Drilonereis longa	3	4
64.	Drilonereis sp.	1	1
65.	Eteone heteropoda	2	3
66.	Eteone longa	1	1
67.	Eteone (longa)	1	1
68.	Euclymene collaris	18	154
69.	Euclymeninae sp.	1	1
70.	Eulalia viridis	1	1
71.	Glycera americana	13	16
72.	Harmathoe extenuata	7	23
73.	Harmathoe imbricata	4	17
74.	Lepidonotus squamatus	5	7
75.	Lepidonotus (sublevis)	1	2

Table 7.3.3-1 (cont.)

	Species	Occurrence/ 65 Samples	No. Individuals
76.	Loimia medusa	4	6
77.	Lumbrineris fragilis	8	11
78.	Lumbrineris tenuis	5	83
79.	Maldane sarsi	1	1
80.	Marphysa bellii	1	1
81.	Mediomastus ambiseta	5	14
82.	Melinna cristata	21	117
83.	Myriochele heeri	2	2
84.	Nephtys incisa	53	557
85.	Nereis accuminata	3	3
86.	Nereis (zonata)	4	10
87.	Ninoe nigripes	15	26
88.	Notomastus luridus	1	3
89.	Ophelia bicornis	5	8
90.	Ophioglycera gigantea	1	1
91.	Owenia fusiformis	4	11
92.	Paranaitis speciosa	5	5
93.	Paraonis gracilis	4	4
94.	Pectinaria gouldii	13	19
95.	Pherusa affinis	25	57
96.	Pholoe minuta	6	37
97.	Phyllodoce arenae	5	15
98.	Phyllodoce maculata	3	4
99.	Polycirrus (eximius)	3	9
100.	Polycirrus medusa	2	2
101.	Polycirrus sp.	3	7
102.	Polydora ligni	15	260
103.	Potamilla reniformis	2	13
104.	Praxillella gracilis	1	1
105.	Prionospio malmgreni	4	9
106.	Sabellaria vulgaris	2	19
107.	Scalibregma inflatum	1	1
108.	Scolelepis squamata	7	25
109.	Scoloplos armiger	1	1
110.	Sigambra tentaculata	4	5
111.	Spio (filicornis)**	2	2
112.	Spionid sp.	1	1
113.	Spiophanes bombyx	1	1
114.	Streblospio benedicti	5	14
115.	Syllis cornuta	4	4
116.	Terebellid sp.	1	1
117.	Tharyx sp.	3	3
	Phylum SIPUNCULIDA		
118.	Phascolion strombi	1	1

Table 7.3.3-1 (cont.)

	Species	Occurrence/ 65 Samples	No. Individuals
	Phylum ARTHROPODA		
	Class Crustacea		
	Subclass Copepoda		
119.	Calanus sp.	1	1
	Subclass Malacostraca		
	Order Isopoda		
120.	Chiridotea sp.	1	1
	Order Amphipoda		
121.	Acanthohaustorius millsi	4	12
122.	Aeginina longicornis	2	4
123.	Ampelisca abdita	7	13
124.	Ampelisca vadorum	9	112
125.	Caprellid sp.	1	1
126.	Corophium insidiosum	2	4
127.	Dyopedos porrecta	1	1
128.	Erichthonius rubricornis	2	2
129.	Gammarus annulatus	4	19
130.	Gammarus lawrencianus	7	14
131.	Jassa falcata	1	2
132.	Leptocheirus pinguis	13	85
133.	Maera danae	3	9
134.	Parahaustorius attenuatus	1	1
135.	Parahaustorius holmesii	2	2
136.	Phoxocephalus holbolli	5	101
137.	Pontogeneia inermis	1	2
138.	Protohaustorius (deichmannae)	1	1
139.	Protohaustorius wigleyi	1	1
140.	Siphonoecetes sp.	1	1
141.	Stenopleustes gracilis	1	1
142.	Trichophoxus epistomus	1	2
143.	Unciola irrorata	10	61
	Order Mysidacea		
144.	Heteromysis formosa	1	1
145.	Mysidopsis bigelowi	2	7
146.	Neomysis americana	3	4
	Order Decapoda		
147.	Callianassa atlantica	2	2
148.	Cancer irroratus	2	2
149.	Cancer (irroratus)	1	1
150.	Dichelopandalus leptoceras	1	1
151.	Eualus pusiolus	1	3
152.	Hexapanopeus angustifrons (?)	1	1
153.	Pagurus longicarpus	2	1
154.	Pagurus pollicaris	1	1
155.	Pinnixa chaetopterana	5	5
156.	Pinnixa sayana	1	1
157.	Pinnotheres maculatus	1	1
158.	Pinnotheres ostreum	4	6

Table 7.3.3-1 (cont.)

	Species	Occurrence/ 65 Samples	No. Individuals
159.	Upogebia affinis	5	10
	Phylum BRYOZOA		
160.	Aetea sp.	1	1+
161.	Aeverrillia armata	1	1+
162.	Aeverrillia setigera	1	1+
163.	Bicellariella ciliata	4	4+
164.	Bowerbankia imbricata	1	1+
165.	Bugula turrita	5	5+
166.	Callopora aurita	4	4+
167.	Callopora craticula	1	1+
168.	Cleidochasma contractum	1	1+
169.	Cribrilina pjnctata	1	1+
170.	Cryptosula pallasiana	1	1+
171.	Electra sp.	1	1+
172.	Hippoporina sp.	3	3+
173.	Hippothoa hyalina	1	1+
174.	Membranipora tenuis	6	6+
175.	Membranipora tuberculata	1	1+
176.	Microporella ciliata	4	4+
177.	Parasmittina sp.	1	1+
	Phylum PHORONIDA		
178.	Phoronis architecta	28	89
	Phylum ECHINODERMATA		
	Class Stelleroidea		
179.	Asterias forbesii	3	4
180.	Amphipholis squamata	5	18
	Class Holothuroidea		
181.	Caudina arenata	1	1
	Phylum HEMICHORDATA		
182.	Saccoglossus kowalevskii	10	23
	Phylum CHORDATA		
183.	Tautogolabrus adsperus (cunner)	1	1

PREDOMINANT SPECIES LIST. LONG ISLAND SOUND - WINTER 1978-79

TABLE 7.3.3-2

Total No. Phyla: 14
Total No. Species: 183
Total No. Individuals: 4297

Species	Phylum	Feeding Type	Occurrence/ 65 Samples	Total No. Individuals	% Total	Cumul. %
Caulleriella fillariensis	A	SF	7	696	16.2	16.2
Mytilus edulis	M	SF	5	594	13.8	30.0
Nephtys incisa	A	DF	53	557	13.0	43.0
Polydora ligni	A	SDF	15	260	6.1	49.0
Euclymene collaris	A	DF	18	154	3.6	52.6
Ampharete arctica	A	SDF	22	117	2.7	55.4
Melinna cristata	A	SDF	21	117	2.7	58.1
Ampelisca vadorum	Ar	SF	9	112	2.6	60.7
Phoxocephalus holbolli	Ar	SF	5	101	2.4	63.0
Phoronis architecta	P	SF	28	89	2.1	65.1
Cerianthus (borealis)	C	SF	29	88	2.0	67.2

A: Annelida
C: Cnidaria
M: Mollusca
P: Phoronida

DF: Deposit Feeder
SDF: Surface Deposit Feeder
SF: Suspension Feeder

TABLE 7.3.3-3

DATA SUMMARY (TOTAL DISTRIBUTION): LONG ISLAND SOUND
WINTER 1978-79 COLLECTION

	Cornfield Shoals Reference					Cornfield Shoals Disposal					New London Reference (F-8)					New London Disposal (C-6)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Species/Sample	5	6	6	6	8	5	2	4	5	3	41	28	37	36	36	25	8	21	12	20
Individuals/Sample	12+	6+	11	16+	12+	6	3	6	6	6	361+	231+	519+	235+	598+	88+	31	76+	65	130+
Phyla Station			6					3					9					8		
Species/Station			18					16					76					48		
Individuals/Station			57+					27					1944+					390+		

	CAR-WLIS Reference					CAR Disposal					Green Ledge Disposal				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Species/Sample	15	12	5	6	7	12	15	10	13	11	2	3	10	5	3
Individuals/Sample	59+	23+	12+	28	15	28	49+	30	44	26	15	9	20+	19	10
Phyla/Station			5					8					6		
Species/Station			25					33					15		
Individuals/Station			137+					177+					73+		

Continued....

TABLE 7.3.3-3

DATA SUMMARY (TOTAL DISTRIBUTION): LONG ISLAND SOUND
WINTER 1978-79 COLLECTION, continued

	New Haven Reference					New Haven Disposal					Stamford-New Haven North				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Species/Sample	5	6	7	7	4	19	21	28	28	24	10	8	9	8	5
Individuals/Sample	15	25	20	24	21	104	148+	120+	193+	108+	44	17	41	30	16
Phyla/Station			5					10					6		
Species/Station			17					52					20		
Individuals/Station			105					673+					148		

	Stamford-New Haven - 1					Stamford-New Haven - 6					Stamford-New Haven - 7				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Species/Sample	17	11	7	6	9	10	7	7	11	10	12	13	14	10	9
Individuals/Sample	47+	41+	44	39+	53	36	18	25	51	42+	42+	36	41	23	28+
Phyla/Station			7					6					9		
Species/Station			26					24					32		
Individuals/Station			224+					172+					170+		

Table 7.3.3-4 Master Species list and species occurrence in samples taken in Long Island Sound, Summer 1979

	Species	Occurrence/ Samples	No. Individuals
	Phylum PORIFERA		
1.	Hymeniacidon heliophila	1	1+
	Phylum CNIDARIA		
	Class Hydrozoa		
2.	Calycella syringa		
3.	Campanularid sp.	16	16+
4.	Corymorpha pendula	12	66
5.	Eudendrium sp.	1	1
6.	Halecium diminutivum	1	1+
7.	Hybocodon prolifer	3	3
8.	Lovenella gracilis	4	4+
9.	Podocoryne carnea	3	3+
10.	Thuiaria sp.	12	12+
11.	Tubularia sp.	3	3+
	Class Anthozoa		
12.	Ceriantheopsis americanus	11	15
13.	Edwardsia elegans	4	8
14.	Haloclava sp.	1	1
	Phylum MOLLUSCA		
	Class Gastropoda		
15.	Crepidula fornicata	2	3
16.	Crepidula plana	1	1
17.	Facelina bostoniensis	1	1
18.	Mitrella lunata	3	3
19.	Nassarius trivittatus	4	9
	Class Pelecypoda		
20.	Cerastoderma pinnulatum	1	1
21.	Cyclocardia borealis	1	1
22.	Hiatella arctica	1	1
23.	Lyonsia hyalina	2	2
24.	Macoma tenta	6	20
25.	Mulinia lateralis	11	16
26.	Mytilus edulis	8	789
27.	Nucula proxima	18	458
28.	Pitar morrhuana	1	1
29.	Solen viridis	2	2
30.	Tellina agilis	2	2
31.	Tellina sp.	1	1
32.	Yoldia limatula	6	83
33.	Yoldia lucida	1	1
34.	Yoldia sapotilla	3	19

Table 7.3.3-4 (cont.)

	Species	Occurrence/ 30 Samples	No. Individuals
	Phylum ANNELIDA		
	Class Polychaeta		
35.	Ampharete arctica	16	156
36.	Ancistrosyllis groenlandica	1	1
37.	Asabellides oculata	6	17
38.	Asychis elongata	1	1
39.	Autolytus prolifer	1	1
40.	Brada villosa	4	25
41.	Capitella capitata	4	10
42.	Caulleriella fillariensis	5	20
43.	Cirratulid sp.	4	20
44.	Clymenella torquata	7	32
45.	Clymenella zonalis	6	24
46.	Clymenura tenuis	1	1
47.	Diplocirrus hirsutus	1	1
48.	Drilonereis longa	2	2
49.	Eteone heteropoda	1	1
50.	Eteone longa	1	1
51.	Euclymene collaris	10	52
52.	Flabelligera affinis	4	8
53.	Glycera americana	8	8
54.	Harmathoe extenuata	6	55
55.	Harmathoe imbricata	3	7
56.	Hartmania moorei	1	1
57.	Lepidonotus squamatus	7	11
58.	Loimia medusa	3	10
59.	Lumbrineris fragilis	2	2
60.	Lumbrineris impatiens	4	51
61.	Maldanid sp.	1	1
62.	Marphysa bellii	1	1
63.	Mediomastus ambiseta	2	3
64.	Melinna cristata	6	9
65.	Nephtys incisa	27	237
66.	Nereis grayi	1	1
67.	Ninoe nigripes	9	21
68.	Ophioglycera gigantea	1	1
69.	Owenia fusiformis	2	4
70.	Paranaitis speciosa	1	1
71.	Paraonis gracilis	2	2
72.	Pectinaria gouldii	1	2
73.	Pherusa affinis	16	35
74.	Pholoe minuta	5	33
75.	Phyllodoce maculata	3	15
76.	Polycirrus sp.	4	6
77.	Polydora concharum	1	3
78.	Polydora ligni	4	14

Table 7.3.3-4 (cont.)

	Species	Occurrence/ 30 Samples	No. Individuals
79.	Polydora socialis	4	19
80.	Prionospio malmgreni	2	6
81.	Scalibregma inflatum	1	1
82.	Sigambra tentaculata	2	2
83.	Spio filicornis	4	13
84.	Spiophanes bombyx	3	8
85.	Sthenelais boa	1	1
86.	Streblospio benedicti	1	1
87.	Terebella lapidaria	1	1
88.	Tharyx acutus	4	5
	Class Oligochaeta		
89.	Tubificid sp.	1	1
	Phylum ARTHROPODA		
	Class Crustacea		
	Subclass Cirrepedia		
90.	Chthamalus fragilis	1	1
	Sublcass Malacostraca		
	Order Cumacea		
91.	Diastylis quadrispinosa	2	2
92.	Diastylis sculpta	6	12
	Order Isopoda		
93.	Ptilanthura tenuis	2	2
	Order Amphipoda		
94.	Aeginina longicornis	4	7
95.	Ampelisca abdita	5	54
96.	Ampelisca agassizi	4	4
97.	Ampelisca vadorum	11	175
98.	Ampelisca verrilli	1	1
99.	Caprella linearis	1	11
100.	Corophium acherusicum	2	2
101.	Corophium bonelli	1	1
102.	Corophium crassicorne	1	1
103.	Corophium insidiosum	1	1
104.	Dexamine thea	2	4
105.	Dyopedos monacanthus	1	1
106.	Dyopedos porrectus	4	8
107.	Ischyrocerus anquippes	3	7
108.	Jassa falcata	2	2
109.	Lembos websteri	1	1
110.	Leptocheirus pinguis	10	238
111.	Maera danae	3	5
112.	Phoxocephalus holbolli	5	50
113.	Pleusymtes glaber	3	7
114.	Stenopleustes gracilis	3	6
115.	Unciola irrorata	11	92

Table 7.3.3.-4 (cont.)

	Order Mysidacea		
116.	Heteromysis formosa	1	1
	Order Decapoda		
117.	Axius serratus	1	1
118.	Callianassa atlantica	3	6
119.	Cancer irrorata	2	2
120.	Crangon septemspinosa	1	2
121.	Eualus pusiolus	3	3
122.	Majiid sp.	1	2
123.	Pagurus longicarpus	2	5
124.	Pagurus sp.	1	1
125.	Panopeus herbstii	1	1
126.	Pinnixa chaetopterana	2	2
127.	Pinnotheres ostreum	4	7
128.	Upogebia affinis	4	10
	Phylum ECHIURIDA		
129.	Echiurus echiurus	2	2
	Phylum PHORONIDA		
130.	Phoronis architecta	14	77
	Phylum BRYOZOA		
131.	Aeverrillia setigera	1	1+
132.	Bicellariella ciliata	4	4+
133.	Bugula turrita	5	5+
134.	Cryptosula pallasiana	1	1+
135.	Hippoporina sp.	1	1+
136.	Hippothoa hyalina	1	1+
137.	Membranipora tenuis	2	2+
138.	Membranipora sp.	1	1+
139.	Schizoporella unicornis	2	2+
	Phylum ECHINODERMATA		
	Class Asteroidea		
140.	Amphipholis squamata	4	31
141.	Asterias forbesii	3	3
142.	Asterias vulgaris	1	2
	Class Holothuroidea		
143.	Caudina sp.	2	2
144.	HOLOTHUROID sp.	1	1
	Phylum HEMICHORDATA		
145.	Saccoglossus kowalevskii	4	13

PREDOMINANT SPECIES LIST, LONG ISLAND SOUND - SUMMER 1979

TABLE 7.3.3-5

Total No. Phyla: 11
Total No. Species: 148
Total No. Individuals: 3416

Predominant Species List

Species	Phylum	Feeding Type	Occurrence/ 30 Samples	Total No. Individuals	% Total	Cumul. Total
Mytilus edulis	M	DF	8	789	23.1	23.1
Nucula proxima	M	DF	18	458	13.4	36.5
Leptocheirus pinguis	Ar	DF	10	238	7.0	43.5
Nephtys incisa	A	DF	27	237	7.0	50.5
Amphelisca vadorum	Ar	SF	11	175	5.1	55.6
Ampharete arctica	A	SDF	16	156	4.6	60.2
Unciola irrorata	Ar	DF	11	92	2.7	62.9
Yoldia limatula	M	DF	6	83	2.4	65.3
Phoronis architecta	P	SF	14	77	2.2	67.5
Corymorpha pendula	C	SF	12	66	1.9	69.4

A: Annelida
Ar: Arthropoda
C: Cnidaria
M: Mollusca
P: Phoronida
DF: Deposit Feeder
SDF: Surface Deposit Feeder
SF: Suspension Feeder

TABLE 7.3.3-6

DATA SUMMARY (TOTAL DISTRIBUTION): LONG ISLAND SOUND
SUMMER 1979 COLLECTION

	New London Reference (F-8)					New London Dumpsite (C-6)					New Haven Reference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	33	41	31	46	38	19	21	17	31	29	6	4	11	16	17
No. Individuals/Sample	145+	341+	317+	242+	269+	93+	109+	134+	206+	132+	29+	27	260+	118+	114+
No. Phyla/Station			8					8					6		
No. Species/Station			69					61					30		
No. Individuals/Station			1314					674+					548+		

	New Haven Dumpsite					Western Long Island Sound					Green's Ledge				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	14	26	30	35	30	6	3	4	5	5	11	4	8	10	5
No. Individuals/Sample	42+	74+	86+	184+	114+	63+	36	63	41	28	36+	10	32	20+	51
No. Phyla/Station			9					4					7		
No. Species/Station			65					4					19		
No. Individuals/Station			500+					231+					149+		

The Cornfield Shoals Disposal site supported an average of five individuals ($\bar{N}$) and four species ($\bar{S}$) per sample; while an average of eleven individuals and six species were collected per sample at the Cornfield Reference station. These figures represent the lowest populations recovered from any station visited during the DAMOS project and are indicative of the high energy hard bottom substrate that is not readily sampled by the Smith-McIntyre grab.. These data are consistent with data collected at these sites in 1977-78.

The populations collected from the Cable and Anchor Reef (CAR) Disposal site in January 1979 resembled the summer 1978 data in terms of species composition, however, the summer 1978 populations collected at the CAR Reference site were between 2 and 20 times higher per sample than the winter 1979 collections. Although this may reflect seasonal variability, the summer samples were collected with an anchor dredge while the later samples were collected with a Smith-McIntyre. The change in sampling methodology introduces an unmeasurable bias into these results.

Green's Ledge, which was sampled in both the winter and summer of 1979 with the same sampling gear, may display a seasonal variation. The summer samples had a $\bar{N}$ of 30, and an $\bar{S}$ of 8 which was approximately twice the population of the winter series ($\bar{N}$=15, $\bar{S}$=5). After Cornfield Shoals, the Green's Ledge Disposal site supported the smallest populations found during the Damos 1979 cruises. The overall $\bar{N}$ for Long Island Sound, including winter and summer samples was 406; $\bar{S}$ was 21.

Approximately twice as many organisms were collected at the New London Disposal site in the summer as in the winter of

1979 (674 and 390, respectively), however, there was a slight decrease in population size at the New London Reference site in the summer compared to winter samples (1314 versus 1944). The disparity in the number of individuals between the New London Reference and disposal sites resembles that between the Brenton Reef Reference and disposal sites. This disparity can be at least partially explained by the occurrence of a large, mature mussel bed (Mytilus edulis) at the New London Reference site. Mytilus was largely absent from the disposal site center through 1979 although divers noted clusters of juvenile Mytilus on the flanks of the disposal mound, extending onto recent dredged material in some areas (see Section 8). This observation suggests that recovery of the mussel population may occur with the cessation of dumping at this site. The Mytilus population will be monitored in future surveys and results will appear in subsequent reports.

The data from the Central Long Island Sound Disposal area (focusing on Stamford-New Haven sites) are presented in a separate section in order to more thoroughly discuss preliminary results of the "capping" procedure.

7.3.4 Stamford-New Haven

The Central Long Island Sound disposal area was intensively studied between January and August 1979 in order to determine whether the disposal and 'capping' procedures had any detectable influence on population densities. The Stamford-New Haven South (STNH-South) site received "contaminated" Stamford dredged material until April 22, 1979, and was subsequently capped with clean New Haven silt. The Stamford-New Haven North

(STNH-North) site received Stamford spoil between April and June 1979 and was capped with clean New Haven sand between June 15 and 21.

A summary of the data obtained during the sampling period is presented in Tables 7.3.4-1 through 6. The master species lists for both winter and summer sampling periods are presented in Tables 7.3.4-1 and 4; the predominant species lists in Tables 7.3.4-2 and 5; and Table 7.3.4-3 and 6 summarize the distribution of phyla, species and individuals for each station. The numeric density data are provided in Appendix 7.6. Additional samples have been analyzed for taxanomic identification and will be discussed in future reports in conjunction with the data presented here.

A visual comparison of three population statistics (N, S, H') within and between stations in the CLIS disposal area, and at the Central Long Island Sound Reference site is presented in Figures 7.3.4-1, 2, 3 and 4. The stations designated for study were the North and South disposal points and two locations 1000 m east and west of the south site.

No post-disposal data are available from the STNH-North site at this time, however, a pre-disposal survey was conducted at the North site in March 1979. This station was found to be comparable to the January and May collections at the South sites in terms of population size. In terms of species' composition and predominant species, it resembled the East and West perimeter stations at the South site with deposit-feeding mollusks comprising 22% of the total distribution.

A comparison between the preliminary survey (January 1979) and the post-cap survey (August 1979) at the center of the STNH South pile indicated that population densities had not returned to pre-disposal levels. However, the two stations located 1000 m east and west of the disposal point were also sampled in January, May and August 1979. A slight increase in numbers of individuals and species was found during the May survey over January (pre-disposal) levels at the eastern site. No significant differences were found between May and January population densities at the western site.

The August (post-cap) survey indicated substantial population increases at both sites. Approximately 4 and 6 times the number of individuals were collected at the east and west stations, respectively, over January collections. There was a similarity in predominant species at both sites between sampling periods, including the polychaetes Nephtys incisa and Melinna cristata, and the burrowing anemone Ceriantheopsis americanus. By the August survey, however, three species of deposit-feeding mollusks (Mulinia lateralis, Yoldia limatula, Nucula proxima) were found to be dominating the assemblages. Combined, they comprised 55% and 74% of the total populations at the East and West sites, respectively. Whether this bloom in the mollusk population proves to be a seasonal event or continuous trend will be determined by future surveys at these sites.

Increases in three population statistics (N, S, H') were also found during the same period at the Central Long Island Sound Reference station between the May and January surveys (Fig 7.3.4-4). This suggests that increases in population size and

diversity at the CLIS disposal area sites may be partially explained as natural seasonal fluctuations. Based on this preliminary examination of the data there are no indications of detrimental effects on the benthic populations beyond those immediate impacts created at the disposal point by burial.

Table 7.3.4-1 Master Species list and species occurrance in samples taken in Stamford-New Haven, Winter 1978-79.

	Species	Occurrence/ 30 Samples	No. Individuals
	Phylum PORIFERA		
1.	Hymeniacidon heliophila	1	1+
	Phylum CNIDARIA		
	Class Hydrozoa		
2.	Clytia sp.	1	1+
3.	Corymorpha pendula	5	5
4.	Corymorpha sp.	1	1
5.	Thuiaria sp.	2	2+
6.	Tubularia sp.	1	1
7.	HYDROZOAN sp.	3	3+
	Class Anthozoa		
8.	Ceriantheopsis americanus	24	86
9.	Edwardsia elegans	7	10
10.	Haloclava producta	4	5
	Phylum NEMATODA		
11.	NEMATODE sp.	1	2
	Phylum PLATYHELMINTHES		
12.	PLATYHELMINTH sp.	2	3
	Phylum RHYNCHOCOEL		
13.	Cerebratulus sp.	3	4
14.	Micrura sp.	4	6
15.	Tubulanus sp.	2	2
16.	RHYNCHOCOEL sp.	2	2
	Phylum MOLLUSCA		
	Class Gastropoda		
17.	Nassarius trivittatus	4	1
18.	Polinices duplicatus	1	1
	Class Pelecypoda		
19.	Ensis directus	1	2
20.	Macoma tenta	7	37
21.	Macoma sp.	1	1
22.	Mulinia lateralis	7	14
23.	Mya (arenaria)	1	1
24.	Nucula proxima	7	26
25.	Pandora sp.	1	1
26.	Pitar morrhuana	2	2
27.	Yoldia limatula	3	3
28.	Yoldia lucida	1	2
29.	Yoldia sapotilla	1	1
	Phylum ANNELIDA		
	Class Polychaeta		
30.	Aglaophamus circinata	1	1
31.	Ampharete arctica	9	95
32.	ARCHIANNELID sp.	5	44
33.	Asabellides oculata	4	5

Table 7.3.4-1 cont.

	Species	Occurrence/ 30 Samples	No. Individuals
34.	Asychis elongata	5	5
35.	Caulleriella fillariensis	2	2
36.	CIRRATULID sp.	1	1
37.	Clymenella torquata	1	1
38.	Clymenella zonalis	1	2
39.	Diplocirrus hirsutus	2	11
40.	Eteone heteropoda	2	3
41.	Eteone (longa)	1	1
42.	Euclymene collaris	12	50
43.	EUCLYMENINAE sp.	1	1
44.	Glycera americana	7	8
45.	Lepidonotus (sublevis)	1	2
46.	Loimia medusa	3	4
47.	Lumbrineris fragilis	1	1
48.	Maldane sarsi	1	1
49.	Melinna cristata	19	115
50.	Myriochele heeri	1	1
51.	Nephtys incisa	30	377
52.	Ninoë nigripes	9	11
53.	Owenia fusiformis	3	10
54.	Paranaitis speciosa	3	3
55.	Paraonis gracilis	4	4
56.	Pectinaria gouldii	8	11
57.	Pherusa affinis	17	41
58.	Pholoë minuta	1	2
59.	Phyllodoce arenae	4	14
60.	Polycirrus sp.	1	2
61.	Polydora ligni	5	244
62.	Potamilla reniformis	1	1
63.	Sigambra tentaculata	5	6
64.	Spiophanes bombyx	1	1
65.	Syllis cornuta	4	4
66.	TEREBELLID sp.	1	1
	Phylum SIPUNCULIDA		
67.	Phascolion strombi	1	1
	Phylum ARTHROPODA		
	Class Crustacea		
	Subclass Malcostraca		
	O. Amphipoda		
68.	Ampelisca abdita	3	3
69.	Ampelisca vadorum	1	1
70.	Gammarus annulatus	1	16
71.	Gammarus lawrencianus	1	3
72.	Leptocheirus pinguis	5	11
73.	Pontogeneia inermis	1	2
74.	Unicola irrorata	5	53
	O. Mysidacea		
75.	Mysidopsis bigelowi	2	7
76.	Neomysis americana	3	4

Table 7.3.4-1 cont.

	Species	Occurrence/ 30 Samples	No. Individuals
	O. Decapoda		
77.	Hexapanopeus angustifrons	1	1
78.	Pinnixa chaetopterana	3	3
79.	Pagurus longicarpus	1	1
80.	Upogebia affinis	5	10
	Phylum BRYOZOA		
81.	Bugula turrita	1	1+
82.	Hippoporina sp.	1	1+
83.	Membranipora tenuis	2	2+
84.	Parasmittina sp.	1	1+
	Phylum PHORONIDA		
85.	Phoronis architecta	16	31
	Phylum HEMICHORDATA		
86.	Saccoglossus kowalevskii	10	23

Predominant Species List. Stamford-New Haven - Winter 1978-79

Figure 7.3.4-2

Total No. Phyla : 12
Total No. Species : 86
Total No. Individuals: 1492+

Species	Phylum	Feeding Type	Occurrence/ 25 Samples	Total No. Individuals	% Total	Cumul. %
Nephtys incisa	A	DF	30	377	25.3	25.3
Polydora ligni	A	SDF	5	244	16.4	41.7
Melinna cristata	A	SDF	19	115	7.7	49.4
Ampharete arctica	A	SDF	9	95	6.4	55.8
Ceriantheopsis americanus	CN	SF	24	86	5.8	61.6
Unicola irrorata	AR	DF	5	53	3.6	65.2
Euclymene collaris	A	DF	12	50	3.4	68.6

Predominant Species List. Corrected for Polydora ligni

Total No. Individuals: 1248+

Nephtys incisa	A	DF	30	377	30.2	
Melinna cristata	A	SDF	19	115	9.2	39.4
Ampharete arctica	A	SDF	9	95	7.6	47.0
Ceriantheopsis americanus	CN	SF	24	86	6.9	53.9
Unicola irrorata	AR	DF	5	53	4.2	58.1
Euclymene collaris	A	DF	12	50	4.0	62.1

A : Annelida
CN : Cnidaria
AR : Arthropoda
DF : Deposit Feeder
SDF : Surface Deposit Feeder

TABLE 7.3.4-3 DATA SUMMARY (Total Distribution); Stamford-New Haven. Winter 1978-79

	New Haven Reference (N W Control) January 1979					New Haven Dumpsite January 1979					STNH N Disposal Point March 1979				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
#Species/Sample	5	6	7	7	4	19	21	28	28	24	10	8	9	8	5
#Individuals/Sample	15	25	20	24	21	104	148+	120+	193+	108+	44	17	41	30	16
#Phyla/Station			5					10					6		
#Species/Station			17					52					20		
#Individuals/Station			105					673+					148		

	STNH S-1 Disposal Point January 1979					STNH S-6 1000m E January 1979					STNH S-7 1000m W January 1979				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
#Species/Sample	17	11	7	6	9	10	7	7	11	10	12	13	14	10	9
#Individuals/Sample	47+	41+	44	39+	53	36	18	25	51	42+	42+	36	41	23	28+
#Phyla/Station			7					6					9		
#Species/Station			26					24					32		
#Individuals/Station			224+					172+					170+		

Table 7.3.4-4 Master Species list and species occurrence in samples taken in Stamford-New Haven, Summer 1979.

	Species	Occurrence/ 25 Samples	No. Individuals
	Phylum CNIDARIA		
	Class Hydrozoa		
1.	Campanularid sp.	7	7+
2.	Corymorpha pendula	9	27
3.	Garveia groenlandica	3	3+
4.	Halecium sp.	1	1+
5.	Perigonimus sp.	1	1+
6.	Thuiaria sp.	3	3+
	Class Anthozoa		
7.	ANTHOZOAN sp.	1	1
8.	Ceriantheopsis americanus	20	91
9.	Edwardsia elegans	7	8
10.	Haloclava producta	1	1
11.	Haloclava sp.	1	1
	Phylum RHYNCHOCOELA		
12.	Amphiporus sp.	1	1
13.	Cerebratulus sp.	7	9
14.	Micrura sp.	1	1
15.	Tubulanus sp.	1	1
	Phylum MOLLUSCA		
	Class Gastropoda		
16.	Acteocina canaliculata	2	2
17.	Coryphella sp.	1	1
18.	Cylichna oryza	1	1
19.	Nassarius trivittatus	1	1
20.	Polinices duplicatus	1	1
21.	Retusa obtusa	2	2
22.	Turbonilla sp.	1	1
	Class pelecypoda		
23.	Lyonsia hyalina	1	1
24.	Macoma tenta	2	2
25.	Mulinia lateralis	14	652
26.	Nucula proxima	11	34
27.	Nucula tenuis	1	1
28.	Periploma papyratium	4	8
29.	Solen viridis	2	2
30.	Yoldia limatula	12	188
31.	Yoldia lucida	3	5
32.	Yoldia sapotilla	4	6
	Phylum ANNELIDA		
	Class Polychaeta		
33.	Amphitrite cirrata	1	1

Table 7.3.4-4 (cont.)

	Species	Occurrence/ 25 Samples	No. Individuals
34.	Asabellides oculata	3	4
35.	Clymenella torquata	1	1
36.	Clymenella zonalis	3	6
37.	Euclymene collaris	2	4
38.	Euclymeninae sp.	1	1
39.	Flabelligera affinis	1	1
40.	Glycera americana	1	1
41.	Loimia medusa	1	1
42.	Melinna cristata	19	124
43.	Nephtys incisa	25	314
44.	Ninoe nigripes	3	3
45.	Pherusa affinis	13	33
46.	Polydora ligni	1	1
47.	Sigambra tentaculata	6	7
	Phylum ARTHROPODA		
	Order Isopoda		
48.	Edotea montosa	1	1
	Order Amphipoda		
49.	Ampelisca abdita	1	1
50.	Ampelisca agassizi	1	1
51.	Unciola irrorata	1	1
	Order Mysidacea		
52.	Neomysis americana		
	Order Decapoda		
53.	Axius serratus	3	4
54.	Cancer borealis	1	1
55.	Cancer Irroratus	3	5
56.	Crangon septemspinosa	6	7
57.	Libinia emarginata	2	2
58.	Ovalipes ocellatus	2	2
59.	Pagurus longicarpus	3	3
60.	Pinnixa chaetopterana	2	2
61.	Pinnixa sayana	2	2
62.	Upogebia affinis	1	1
	Phylum SIPUNCULIDA		
63.	Golfingia minuta	1	1
	Phylum PHORONIDA		
64.	Phoronis architecta	13	39
	Phylum BRYOZOA		
65.	Bugula turrita	1	1+
66.	Microporella ciliata	1	1+

Table 7.3.4-4 (cont.)

	Species	Occurrence/ 25 Samples	No. Individuals
67.	Triticella sp.	1	1+
	Phylum ECHINODERMATA Class Holothuroidea		
68.	Caudina sp.	1	1
	Phylum HEMICHORDATA		
69.	Saccoglossus kowalevskii	14	44

PREDOMINANT SPECIES LIST. STAMFORD - NEW HAVEN - SUMMER 1979

TABLE 7.3.4-5

Total No. Phyla : 10
Total No. Species : 69
Total No. Individuals: 1688+

Species	Phylum	Feeding Type	Occurrence/ 25 Samples	Total No. Individuals	% Total	Cumul. %
Mulinia lateralis	M	DF	14	652	38.6	-
Nephtys incisa	A	DF	25	314	18.6	57.2
Yoldia limatula	M	DF	12	188	11.1	68.3
Melinna cristata	A	SDF	19	124	7.3	75.6

A : Annelida
M : Mollusca
DF : Deposit Feeder
SDF : Surface Deposit Feeder

TABLE 7.3.4-6

DATA SUMMARY (TOTAL DISTRIBUTION): STAMFORD-NEW HAVEN
SUMMER 1979 COLLECTION

	STNH S-6 1000 M East May 1979					STNH S-7 1000 M West May 1979				
	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	9	7	9	17	10	12	15	10	10	10
No. Individuals/Sample	36	32+	35+	65+	36+	43	39	37+	30	25+
No. Phyla/Station			7					7		
No. Species/Station			24					31		
No. Individuals/Station			204+					174+		

	STNH S-6 1000 M East August 1979					STNH S-7 1000 M West August 1979				
	1	2	3	4	5	1	2	3	4	5
No. Species/Sample	14	9	11	19	10	21	13	14	13	12
No. Individuals/Sample	165	37	58	107+	124	225+	132	145	138+	145+
No. Phyla Station			8					8		
No. Species/Station			30					33		
No. Individuals/Station			491+					785+		

	STNH Disposal Point August 1979				
	1	2	3	4	5
No. Species/Sample	7	5	7	3	3
No. Individuals/Sample	9	7	9	5	4
No. Phyla/Station			5		
No. Species/Station			15		
No. Individuals/Station			34		

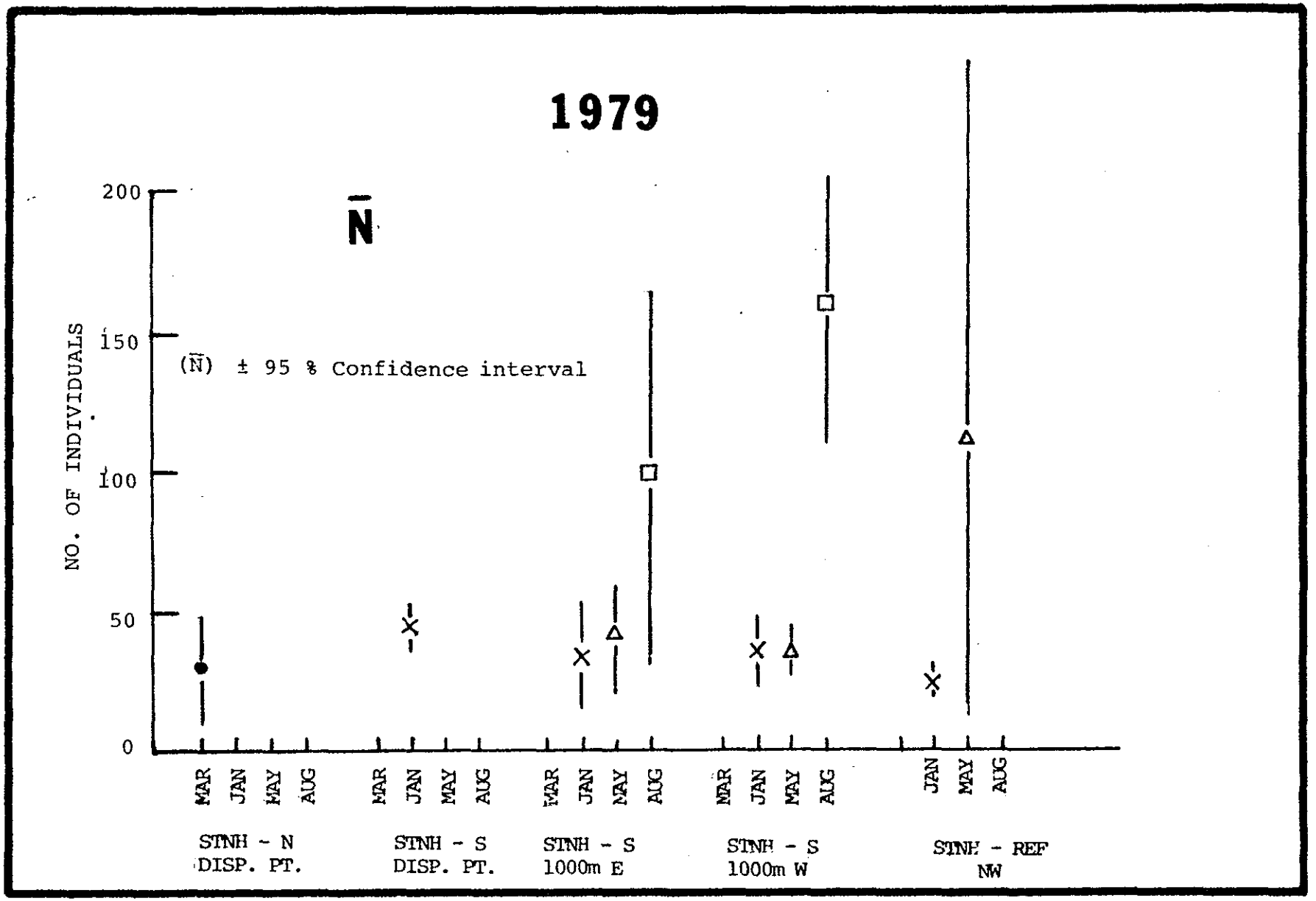

FIGURE 7.3.4-1. MEAN NO. OF INDIVIDUALS

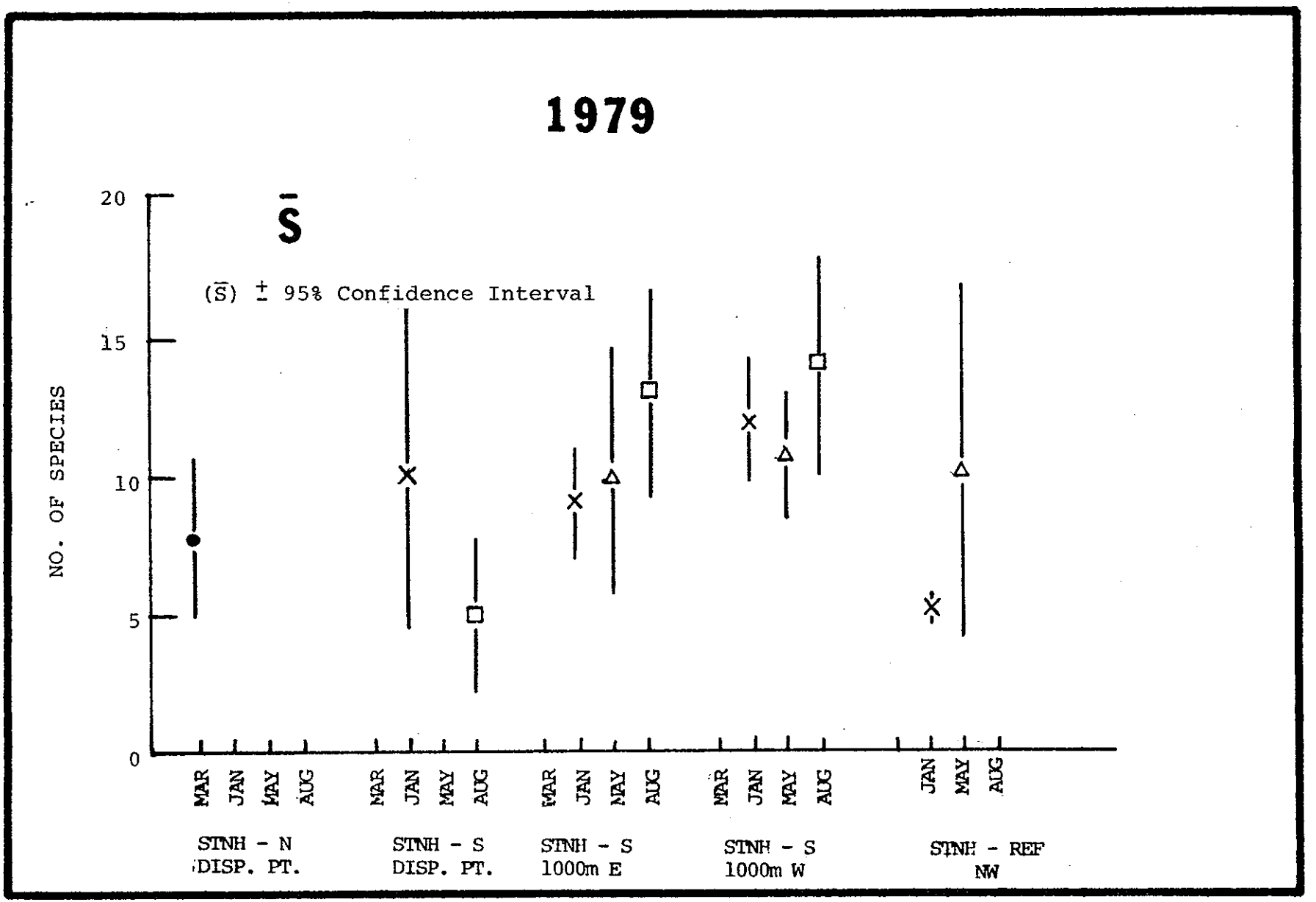

FIGURE 7.3.4-2 MEAN NO. of SPECIES

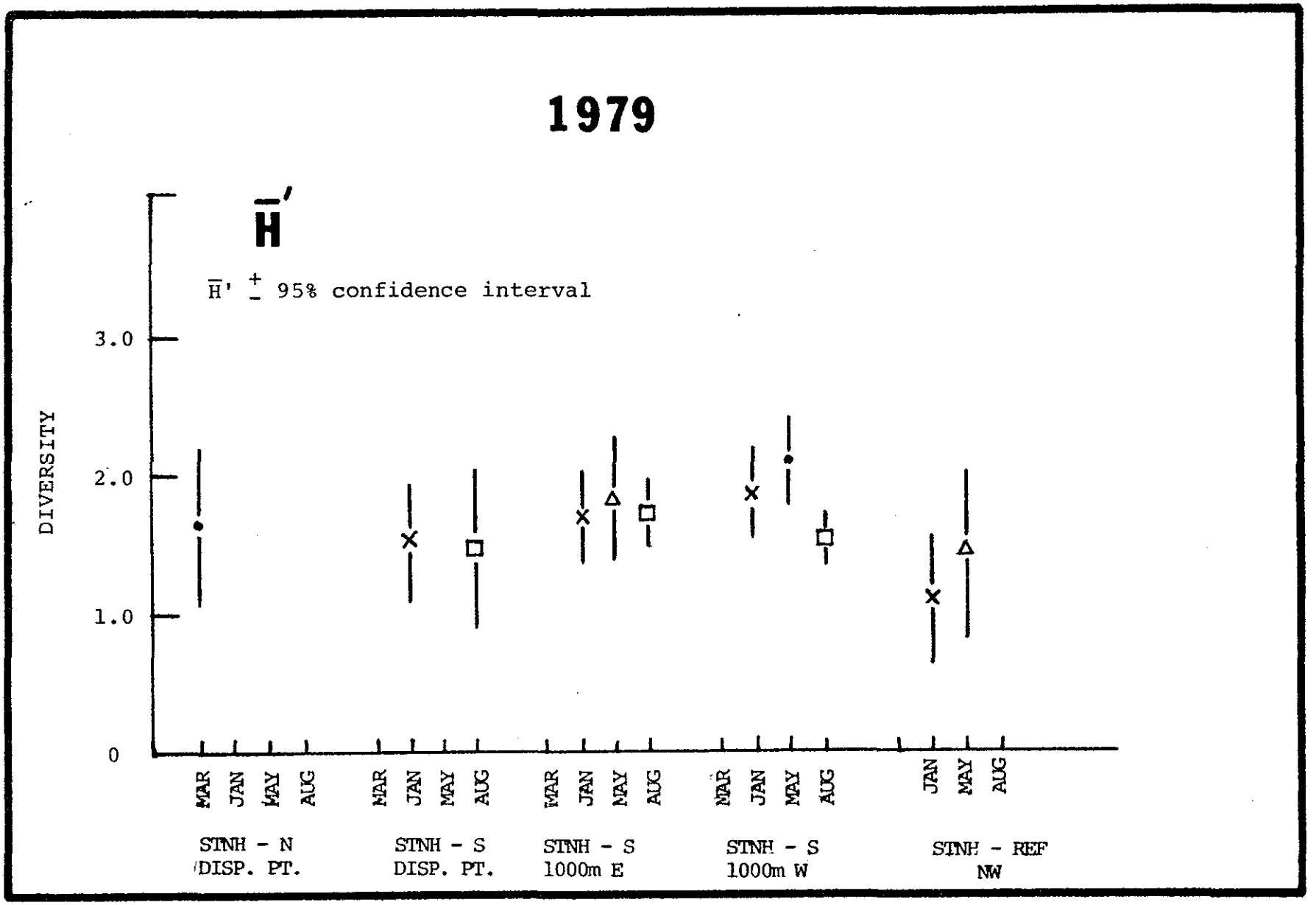

FIGURE 4.3.4-3 MEAN DIVERSITY

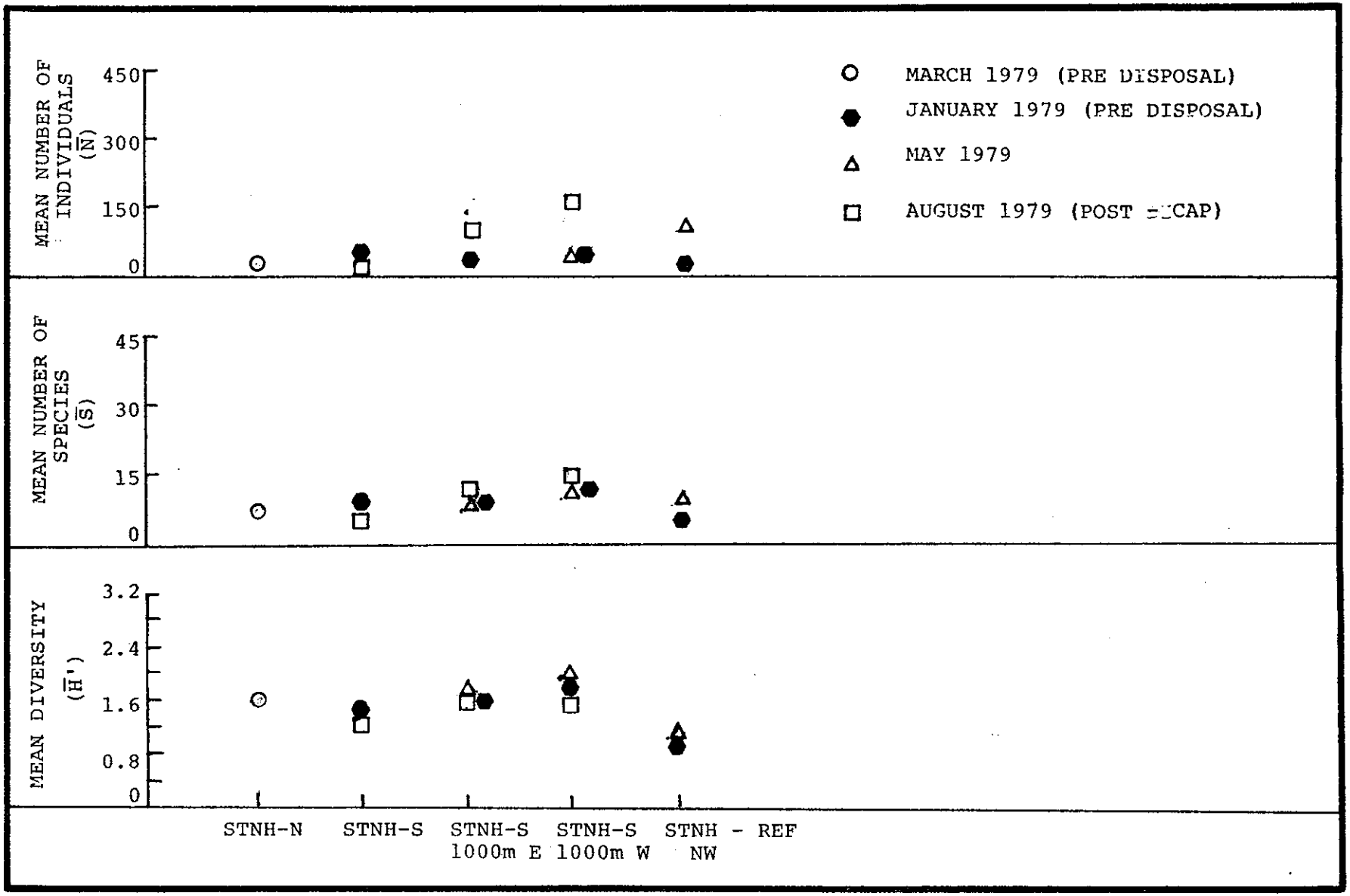

FIGURE 7.3.4-4. Comparison of population statistics at STNH-North, South and reference stations by sampling date.

APPENDIX 7.1

ROCKLAND, ME DUMP SITE

Date: 16 November 1978

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Nucula proxima	19	35	69	-	-	123	41.0	25.5	15.9	0 - 104.4	1	54.4	54.4
2.	Ampharete arctica	4	5	9	-	-	18	6.0	2.6	1.1	0 - 12.6	2	8.0	62.4
3.	Nephtys incisa	2	4	6	-	-	12	4.0	2.0	1.0	0 - 9.0	3	5.3	67.7
4.	Yoldia sapotilla	2	1	8	-	-	11	3.7	3.8	3.9	0 - 13.1	4	4.9	72.6
5.	Sternaspis scutata	3	3	2	-	-	8	2.7	0.6	0.1	1.2 - 4.1	5	3.5	76.1
6.	Trichobranchus glacialis	0	4	4	-	-	8	2.7	2.3	2.0	0 - 8.4	5	3.5	79.6
7.	Thyasira insignis	1	3	2	-	-	6	2.0	1.0	0.5	0 - 4.5	6	2.7	82.3
8.	Ninoe nigripes	0	3	2	-	-	5	1.7	1.5	1.3	0 - 5.5	7	2.2	84.5

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.95	1.98	1.61	-	-	1.85	0.21
Equitability (J'):	0.76	0.72	0.59			0.69	0.09

APPENDIX 7.1 (Cont.)

Date: 19 Nobember 1978

PORTLAND, ME DUMP SITE

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Astarte undata	7	6	20	-	-	33	11.0	7.8	5.5	0 - 30.4	1	19.9	19.9
2.	Rhodine loveni	0	6	4	-	-	10	3.3	3.1	2.9	0 - 10.9	2	6.0	25.9
3.	Streblosoma spiralis	1	8	0	-	-	9	3.0	4.4	6.5	0 - 13.8	3	5.4	31.3
4.	Thyasira sp.	0	0	9	-	-	9	3.0	5.2	9.0	0 - 15.9	3	5.4	36.7
5.	Cyclocardia borealis	3	3	2	-	-	8	2.7	0.6	0.1	1.2 - 4.1	4	4.8	41.5
6.	Lumbrineris fragilis	0	1	7	-	-	8	2.7	3.8	5.3	0 - 12.1	4	4.8	46.3
7.	Ampharete arctica	0	3	4	-	-	7	2.3	2.1	1.9	0 - 7.5	5	4.2	50.5
8.	Goniada maculata	0	1	6	-	-	7	2.3	3.2	4.5	0 - 10.3	5	4.2	54.7
9.	Nephtys incisa	0	2	4	-	-	6	2.0	2.0	2.0	0 - 7.0	6	3.6	58.3
10.	Nicomache lumbricalis	1	3	1	-	-	5	1.7	1.2	0.8	0 - 4.5	7	3.0	61.3
11.	Ninoë nigripes	0	3	2	-	-	5	1.7	1.5	1.3	0 - 5.5	7	3.0	64.3
12.	Pista cristata	0	1	2	-	-	3	1.0	1.0	1.0	0 - 3.5	8	1.8	66.1
13.	Scalibregma inflatum	0	1	2	-	-	3	1.0	1.0	1.0	0 - 3.5	8	1.8	67.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.18	3.09	2.97	-	-	2.75	0.49
Equitability (J'):	0.91	0.89	0.84	-	-	0.88	0.04

APPENDIX 7.1 (Cont.)

ISLE OF SHOALS, NH DUMP SITE

Date: 8 December 1978

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Sternaspis scutata	35	27	21	-	-	83	27.7	7.0	1.8	10.2 - 45.1	1	23.2	23.2
2. Praxillella gracilis	13	8	24	-	-	45	15.0	8.2	4.5	0 - 35.3	2	12.6	35.8
3. Amphareta arctica	11	12	3	-	-	26	8.7	4.9	2.8	0 - 20.9	3	7.3	43.1
4. Melinna cristata	5	7	11	-	-	23	7.7	3.1	1.2	0.1 - 15.3	4	6.4	49.5
5. Spio filicornis	1	3	18	-	-	22	7.3	9.3	11.8	0 - 30.4	5	6.1	55.6
6. Ninoe nigripes	8	8	4	-	-	20	6.7	2.3	0.8	0.9 - 12.4	6	5.6	61.2
7. Edwardsia elegans	2	5	4	-	-	11	3.7	1.5	0.6	0 - 7.5	7	3.1	64.3
8. Myriochele heeri	0	2	9	-	-	11	3.7	4.7	6.0	0 - 15.4	7	3.1	67.4
9. Nephtys incisa	3	4	4	-	-	11	3.7	0.6	0.1	2.2 - 5.1	7	3.1	70.5
10. Ctenodiscus crispatus	5	3	2	-	-	10	3.3	1.5	0.7	0 - 7.1	8	2.8	73.3
11. Euclymene sp.	0	3	6	-	-	9	3.0	3.0	3.0	0 - 10.5	9	2.5	75.8
12. Lumbrineris fragilis	1	6	1	-	-	8	2.7	2.9	3.1	0 - 9.8	10	2.2	78.0

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	4.24	2.75	2.92	-	-	3.30	0.82
Equitability (J'):	1.33	0.83	0.83	-	-	1.00	0.29

APPENDIX 7.1 (Cont.)

BOSTON FOUL GROUND DUMP SITE

Date: 6 December 1978

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Ninoe nigripes	12	11	9	-	-	42	10.7	1.5	0.2	6.9 - 14.5	1	20.0	20.0
2.	Ampharete arctica	12	5	8	-	-	25	8.3	3.5	1.5	0 - 17.1	2	11.9	31.9
3.	Lumbrineris fragilis	4	9	12	-	-	25	8.3	4.0	1.9	0 - 18.4	2	11.9	43.8
4.	Cirratulid sp.	17	0	0	-	-	17	5.7	9.8	16.8	0 - 30.1	3	8.1	51.9
5.	Thyasira insignis	4	10	0	-	-	14	4.7	5.0	5.3	0 - 17.2	4	6.7	58.6
6.	Yoldia sapotilla	8	4	1	-	-	13	4.3	3.5	2.8	0 - 13.1	5	6.2	64.8
7.	Micrura sp.	7	3	2	-	-	12	4.0	2.6	1.7	0 - 10.6	6	5.7	70.5
8.	Scoloplos acutus	8	1	1	-	-	10	3.3	4.0	4.8	0 - 13.4	7	4.8	75.3
9.	Goniada maculata	0	2	6	-	-	8	2.7	3.1	3.6	0 - 10.3	8	3.8	79.1
10.	Tharyx acutus	0	3	5	-	-	8	2.7	2.5	2.3	0 - 8.9	8	3.8	82.9
11.	Spio filicornis	3	1	2	-	-	6	2.0	1.0	0.5	0 - 4.5	9	2.9	85.8
12.	Melinna cristata	1	0	4	-	-	5	1.7	2.1	2.6	0 - 6.8	10	2.4	88.2
13.	Laonice cirrata	0	3	1	-	-	4	1.3	1.5	1.7	0 - 5.1	11	1.9	90.1

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.54	2.44	2.58	-	-	2.52	0.07
Equitability (J'):	0.82	0.86	0.86	-	-	0.85	0.02

APPENDIX 7.1 (Cont.)

BOSTON LIGHTSHIP DUMP SITE

Date: 6 December 1978

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Sternaspis scutata	22	19	44	-	-	85	28.3	13.7	6.6	0 - 62.2	1	29.6	29.6
2.	Ninoe nigripes	7	8	8	-	-	23	7.7	0.6	0.1	6.2 - 9.1	2	8.0	37.6
3.	Lumbrineris fragilis	6	8	7	-	-	21	7.0	1.0	0.1	4.5 - 9.5	3	7.3	44.9
4.	Nephtys incisa	3	7	6	-	-	16	5.3	2.1	0.8	0.2 - 10.5	4	5.6	50.5
5.	Praxillella gracilis	2	12	2	-	-	16	5.3	5.8	6.3	0 - 19.7	4	5.6	56.1
6.	Scoloplos acutus	2	5	9	-	-	16	5.3	3.5	2.3	0 - 14.1	4	5.6	61.7
7.	Ampharete arctica	8	3	1	-	-	12	4.0	3.6	3.2	0 - 13.0	5	4.2	65.9
8.	Maldane sarsi	2	0	8	-	-	10	3.3	4.2	5.3	0 - 13.7	6	3.5	69.4
9.	Micrura sp.	2	2	5	-	-	9	3.0	1.7	1.0	0 - 7.3	7	3.1	72.5
10.	Goniada maculata	4	2	2	-	-	8	2.7	1.2	0.5	0 - 5.5	8	2.8	75.3
11.	Asychis elongata	0	6	0	-	-	6	2.0	3.5	6.1	0 - 10.6	9	2.1	77.4
12.	Terebellides stroemi	2	1	3	-	-	6	2.0	1.0	0.5	0 - 4.5	9	2.1	79.5

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.67	2.58	2.49	-	-	2.58	0.09
Equitability (J'):	0.82	0.82	0.77	-	-	0.80	0.03

APPENDIX 7.2

Date: 13 June 1979

ROCKLAND DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nucula proxima	14	34	55	29	7	139	27.8	18.7	12.6	4.6 - 51.0	1	25.7	25.7
2. Ampharete arctica	14	24	54	30	15	137	27.4	16.3	9.7	7.2 - 47.6	2	25.4	51.1
3. Yoldia sapotilla	15	7	9	11	5	47	9.4	3.8	1.5	4.6 - 14.2	3	8.7	59.8
4. Sternaspis scutata	5	5	11	10	4	35	7.0	3.2	1.5	3.0 - 11.0	4	6.5	66.3
5. Nephtys incisa	5	4	9	6	2	26	5.2	2.6	1.3	2.0 - 8.4	5	4.8	71.1
6. Thyasira insignis	5	5	9	3	4	26	5.2	2.3	1.0	2.4 - 8.0	5	4.8	75.9
7. Capitella capitata	3	0	7	3	1	14	2.8	2.7	2.6	0 - 6.1	6	2.6	78.5
8. Ninoe nigripes	1	1	2	3	5	12	2.4	1.7	1.2	0.3 - 4.5	7	2.2	80.7
9. Nucula tenuis	1	0	5	5	0	11	2.2	2.6	3.1	0 - 5.4	8	2.0	82.7
10. Trichobranchus glacialis	3	0	4	4	0	11	2.2	2.0	1.8	0 - 4.7	8	2.0	84.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.24	2.34	2.32	2.19	2.34	2.29	0.07
Equitability (J'):	0.83	0.75	0.70	0.79	0.87	0.79	0.07

APPENDIX 7.2 (Cont.)

Date: 10 June 1979

PORTLAND DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Haploops tubicola	32	54	44	29	8	167	33.4	17.3	9.0	11.9 - 54.9	1	18.1	18.1
2. Ampharete arctica	19	36	15	40	21	131	26.2	11.1	4.7	12.4 - 40.0	2	14.2	32.3
3. Astarte undata	10	12	4	20	14	60	12.0	5.8	2.8	4.8 - 19.2	3	6.5	38.8
4. Thyasira insignis	10	13	3	4	8	38	7.6	4.2	2.3	2.8 - 12.8	4	4.1	42.9
5. Sternaspis scutata	3	13	0	6	15	37	7.4	6.4	5.5	0 - 15.4	5	4.0	46.9
6. Cyclocardia borealis	7	6	5	8	3	29	5.8	1.9	0.6	3.4 - 8.2	6	3.1	50.0
7. Calathura branchiata	2	8	14	1	0	25	5.0	5.9	7.0	0 - 12.3	7	2.7	52.7
8. Goniada maculata	3	8	4	2	6	23	4.6	2.4	1.3	1.6 - 7.6	8	2.5	55.2

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	3.28	3.04	3.30	3.22	3.34	3.24	0.12
Equitability (J'):	0.83	0.78	0.82	0.80	0.86	0.82	0.03

APPENDIX 7.2 (Cont.)

ISLE OF SHOALS, NH DUMP SITE

Date: 8 June 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Spio filcornis	150	159	173	402	115	999	199.8	115.0	66.2	57.0-342.6	1	57.8	57.8
2.	Ampharete arctica	92	36	4	50	30	212	42.4	32.4	24.8	2.2 - 82.6	2	12.3	70.1
3.	Sternaspis scutata	18	36	6	29	33	122	24.4	12.3	6.2	9.1 - 39.7	3	7.1	77.2
4.	Maldane sarsi	25	5	2	2	19	53	10.6	10.7	10.8	0 - 23.9	4	3.1	80.3
5.	Haploops tubicola	19	7	1	11	7	45	9.0	6.6	4.8	0.8 - 17.1	5	2.6	82.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.98	2.05	1.35	1.41	2.09	1.78	0.36
Equitability (J'):	0.56	0.55	0.42	0.39	0.62	0.51	0.10

APPENDIX 7.2 (Cont.)

Date: 6 June 1979 BOSTON FOUL GROUND DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Spio filicornis	31	57	55	58	147	348	69.6	44.7	28.7	14.1 - 125.1	1	54.8	54.8
2. Heteromastus filiformis	9	8	10	18	2	47	9.4	5.7	3.5	2.3 - 16.5	2	7.4	62.2
3. Chaetozone setosa	1	2	5	5	7	20	4.0	2.4	1.4	1.0 - 7.0	3	3.1	65.3
4. Trochochaeta multisetosa	0	3	1	2	11	17	3.4	4.4	5.7	0 - 8.9	4	2.7	68.0
5. Ninoe nigripes	7	1	3	1	4	16	3.2	2.5	2.0	0.1 - 6.3	5	2.5	70.5
6. Micrura sp.	6	3	3	2	1	15	3.0	1.9	1.2	0.7 - 5.3	6	2.4	72.9
9. Prionospio malmgreni	2	3	2	3	3	13	2.6	0.5	0.1	1.9 - 3.3	7	2.0	74.9
8. Scoloplos acutus	1	0	6	2	3	12	2.4	2.3	2.2	0 - 5.3	8	1.9	76.8

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.32	1.96	2.18	2.36	1.37	2.04	0.41
Equitability (J'):	0.75	0.63	0.65	0.70	0.42	0.63	0.13

APPENDIX 7.2 (Cont.)

BOSTON LIGHTSHIP DUMP SITE

Date: 6 June 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Spio filicornis	234	347	437	234	147	1399	279.8	113.0	45.6	139.5-420.1	1	66.0	66.0
2.	Sternaspis scutata	49	36	57	27	36	205	41.0	11.9	3.5	26.2-55.8	2	9.7	75.7
3.	Maldane sarsi	53	20	25	22	31	151	30.2	13.4	5.9	13.6-46.8	3	7.1	82.8
4.	Scoloplos acutus	13	13	9	9	6	50	10.0	3.0	0.9	6.3-13.7	4	2.4	85.2

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.83	1.28	1.30	1.66	1.74	1.56	0.26
Equitability (J'):	0.50	0.37	0.37	0.46	0.51	0.44	0.07

APPENDIX 7.3

BRENTON REEF DUMP SITE

Date: 30 May 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Cirolana polita	5	0	76	0	19	100	20.0	32.3	52.2	0 - 60.0	1	31.3	31.3
2.	Scalibregma inflatum	13	19	0	11	5	48	9.6	7.3	5.6	0.5 - 18.7	2	15.0	46.3
3.	Pseudunciola obliqua	6	0	22	0	0	28	5.6	9.5	16.1	0 - 17.4	3	8.8	55.1
4.	Lumbrineris fragilis	4	8	0	8	1	21	4.2	3.8	3.4	0 - 8.9	4	6.6	61.7
5.	Protohaustorius wigleyi	1	0	17	0	0	18	3.6	7.5	15.6	0 - 12.9	5	5.6	67.3
6.	Clymenura tenuis	0	13	0	0	0	13	2.6	5.8	12.9	0 - 9.8	6	4.1	71.4
7.	Caulleriella fillariensis	0	9	0	1	0	10	2.0	3.9	7.6	0 - 6.9	7	3.1	74.5
8.	Aglaophanus circinnata	3	1	1	1	1	8	1.6	0.9	0.5	0.5 - 2.7	8	2.5	77.0
9.	Unicola inermis	0	2	0	2	4	8	1.6	1.7	1.8	0 - 3.7	8	2.5	79.5
10.	Uniciola irrorata	0	4	0	1	1	6	1.2	1.6	2.1	0 - 3.2	9	1.9	81.4

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.19	2.31	1.45	2.22	1.87	2.01	0.35
Equitability (J'):	0.83	0.80	0.53	-.80	0.75	0.74	0.12

APPENDIX 7.3 (cont.)

BRENTON REEF REFERENCE

Date: 30 May 1979

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Ampelisca agassize	602	993	1280	1325	1224	5424	1084.8	298.6	159.0	714.1 - 1455.5	1	79.9	79.9
2. Unciola irrorata	27	25	47	27	64	190	38.0	17.1	7.7	16.8 - 59.2	2	2.8	82.7
3. Leptocheirus pinguis	14	54	19	46	51	184	36.8	18.8	9.6	13.4 - 60.2	3	2.7	85.4
4. Ninoe nigripes	26	20	28	29	20	123	24.6	4.3	0.8	19.2 - 30.0	4	1.8	87.2

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.52	1.18	0.97	0.97	1.10	1.14	0.23
Equitability (J'):	0.41	0.31	0.25	0.25	0.28	0.30	0.07

APPENDIX 7.4 (cont.)

Date: 26 January 1979

NEW HAVEN REFERENCE (NW CONTROL)

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	11	15	11	16	18	71	14.2	3.1	0.7	10.3 - 18.1	1	67.6	67.6
2. Mysidosis bigelowi	0	5	2	0	0	7	1.4	2.2	3.5	0 - 4.1	2	6.7	74.3
3. Euclymene collaris	0	1	2	1	0	4	0.8	0.8	0.8	0 - 1.8	3	3.8	78.1
4. Ampharete arctica	0	0	0	3	0	3	0.6	1.3	2.8	0 - 2.3	4	2.9	81.0
5. Ceriantharian sp.	1	1	0	0	1	3	0.6	0.5	0.4	0 - 1.3	4	2.9	83.9
6. Melinna cristata	1	0	2	0	0	3	0.6	0.9	1.4	0 - 1.7	4	2.9	86.8
7. Glycera americana	0	0	1	0	1	2	0.4	0.5	0.6	0 - 1.1	5	1.9	88.7
8. Phoronis architecta	0	0	0	1	1	2	0.4	0.5	0.6	0 - 1.1	5	1.9	90.6

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	0.95	1.22	1.47	1.19	0.57	1.08	0.34
Equitability (J'):	0.59	0.68	0.76	0.61	0.35	0.60	0.15

APPENDIX 7.4 (cont.)

Date: 19 January 1979

NEW HAVEN DUMP SITE

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Polydora ligni	41	44	45	94	20	244	48.8	27.3	15.3	15.0 - 82.6	1	36.3	36.3
2.	Ampharete arctica	11	32	15	22	7	87	17.4	9.9	5.6	5.2 - 29.6	2	12.9	49.2
3.	Unciola irrorata	2	28	8	12	3	53	10.6	10.5	10.4	0 - 23.7	3	7.9	57.1
4.	Archiannelid sp.	25	8	3	7	1	44	8.8	9.5	10.2	0 - 20.6	4	6.5	63.6
5.	Euclymene collaris	2	6	18	4	11	41	8.2	6.4	5.0	0.2 - 16.2	5	6.1	69.7
6.	Macoma tenta	2	0	0	9	17	28	5.6	7.4	9.8	0 - 14.7	6	4.2	73.9
7.	Phoronis architecta	3	1	1	5	6	16	3.2	2.3	1.7	0.4 - 6.0	7	2.4	76.3
8.	Nephtys incisa	1	1	1	3	9	15	3.0	3.5	4.1	0 - 7.3	8	2.2	78.5
9.	Pherusa affinis	1	6	1	5	1	14	2.8	2.5	2.2	0 - 5.9	9	2.1	80.6
10.	Phyllodoce arenae	2	5	2	5	0	14	2.8	2.2	1.7	0.1 - 5.5	9	2.1	82.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.00	2.10	2.27	2.10	2.56	2.21	0.22
Equitability (J'):	0.68	0.69	0.68	0.63	0.81	0.70	0.07

APPENDIX 7.5 (cont.)

NEW HAVEN DUMP SITE

Date: 21 May 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Ampharete arctica	2	23	12	52	31	120	24.0	19.1	15.2	0.3 - 47.7	1	24.0	24.0
2.	Unciola irrorata	0	5	6	34	10	55	11.0	13.3	16.1	0 - 27.6	2	11.0	35.0
3.	Nephtys incisa	8	4	11	4	10	37	7.4	3.3	1.5	3.3 - 11.5	3	7.4	42.4
4.	Corymorpha pendula	9	3	7	9	5	33	6.6	2.6	1.0	3.4 - 9.8	4	6.6	49.0
5.	Brada villosa	0	3	1	15	6	25	5.0	6.0	7.2	0 - 12.5	5	5.0	54.0
6.	Pherusa affinis	1	2	3	2	8	16	3.2	2.8	2.5	0 - 6.6	6	3.2	57.2
7.	Polydora socialis	0	0	0	12	4	16	3.2	5.2	8.5	0 -9.7	6	3.2	60.4
8.	Macoma tenta	10	0	4	1	0	15	3.0	4.2	5.9	0 - 8.3	7	3.0	63.4
9.	Phoronis architecta	1	2	3	0	8	14	2.8	3.1	3.4	0 - 6.7	8	2.8	66.2
10.	Leptocheirus pinguis	0	1	1	8	3	13	2.6	3.2	3.9	0 - 6.6	9	2.6	68.8
11.	Polydora ligni	0	4	1	8	0	13	2.6	3.4	4.4	0 - 6.9	9	2.6	71.4
12.	Saccoglossus kowalevskii	0	1	7	1	4	13	2.6	2.9	3.2	0 - 6.2	9	2.6	74.0
13.	Asabellides oculata	0	3	0	7	2	12	2.4	2.9	3.5	0 - 6.0	10	2.4	76.4
14.	Euclymene collaris	0	4	3	4	0	11	2.2	2.0	1.8	0 - 4.7	11	2.2	78.6

APPENDIX 7.5 (cont.)

Date: 21 May 1979

NEW HAVEN DUMP SITE (*cont.*)

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
15.	Loimia medusa	0	0	5	4	1	10	2.0	2.3	2.6	0 - 4.9	12	2.0	80.6
16.	Upogebia affinis	4	0	2	2	2	10	2.0	1.4	1.0	0.2 - 3.8	12	2.0	82.6

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.16	2.71	2.99	2.59	2.76	2.64	0.31
Equitability (J'):	0.82	0.83	0.88	0.73	0.81	0.81	0.05

APPENDIX 7.5 (cont.)

Date: 21 May 1979

NEW HAVEN REFERENCE (NW CONTROL)

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Nucula proxima	1	9	188	56	29	283	56.6	76.5	103.4	0 - 151.5	1	51.6	51.6
2.	Nephtys incisa	16	15	23	19	27	100	20.0	5.0	1.3	13.8 - 26.2	2	18.2	69.8
3.	Yoldia limatula	0	0	36	17	26	79	15.8	15.9	16.0	0 - 35.6	3	14.4	84.2
4.	Yoldia sapotilla	9	2	0	8	0	19	3.8	4.4	5.1	0 - 9.2	4	3.5	87.7
5.	Caprella linearis	0	0	0	0	11	11	2.2	4.9	10.9	0 - 8.3	5	2.0	89.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.16	1.01	0.97	1.76	2.02	1.38	0.48
Equitability (J'):	0.65	0.73	0.41	0.63	0.71	0.63	0.13

APPENDIX 7.6

STAMFORD-NEW HAVEN SOUTH - 1 (Dump Pt.)

Date: 26 January 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Nephtys incisa	20	16	23	15	25	100	20.0	4.1	0.8	15.0 - 25.0	1	44.6	44.6
2.	Melinna cristata	8	9	10	17	16	60	12.0	4.2	1.5	6.8 - 17.2	2	26.8	71.4
3.	Ceriantheopsis americanus	4	4	6	3	3	20	4.0	1.2	0.4	2.5 - 5.5	3	8.9	80.3
4.	Saccoglossus kowalevskii	1	4	0	0	3	8	1.6	1.8	2.0	0 - 3.9	4	3.6	83.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.91	1.66	1.35	1.11	1.46	1.50	0.30
Equitability (J'):	0.66	0.69	0.69	0.62	0.67	0.67	0.03

APPENDIX 7.6 (cont.)

Date: 9 August 1979

STAMFORD-NEWHAVEN SOUTH (Dump Pt.)

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Nephtys incisa	2	2	1	3	2	10	2.0	0.7	0.2	1.1 - 2.9	1	29.4	29.4
2.	Axius serratus	0	1	2	0	1	4	0.8	0.8	0.8	0 - 1.8	2	11.8	41.2
3.	Cerebratulus sp.	1	2	0	0	0	3	0.6	0.9	1.4	0 - 1.7	3	8.8	50.0
4.	Crangon septemspinosa	0	0	1	1	1	3	0.6	0.5	0.4	0 - 1.3	3	8.8	58.8
5.	Cancer irroratus	0	0	2	0	0	2	0.4	0.9	2.0	0 - 1.5	4	5.9	64.7
6.	Melinna cristata	2	0	0	0	0	2	0.4	0.9	2.0	0 - 1.5	4	5.9	70.6
7.	Pagurus longicarpus	0	1	0	1	0	2	0.4	0.5	0.6	0 - 1.1	4	5.9	76.5
8.	Ceriantheopsis americanus	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.0	79.4
9.	Clymenella zonalis	0	1	0	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	82.3
10.	Libinia emarginata	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	85.2
11.	Pherusa affinis	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	88.1
12.	Polydora ligni	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	91.0
13.	Solen viridis	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	93.9
14.	Uniciola irrorata	1	0	0	0	1	1	0.2	0.4	0.8	0 - 0.8	5	2.9	96.8
15.	Upogebia affinis	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	5	2.9	99.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.89	1.55	1.89	0.95	1.04	1.46	0.45
Equitability (J'):	0.97	0.96	0.97	0.87	0.95	0.94	0.04

APPENDIX 7.6 (cont.)

STAMFORD-NEW HAVEN SOUTH 6 (1000M East)

Date: 26 January 1979

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	14	6	15	12	18	65	13.0	4.5	1.6	7.4 - 18.6	1	37.8	37.8
2. Melinna cristata	3	3	4	7	11	28	5.6	3.4	2.1	1.3 - 9.9	2	16.3	54.1
3. Gammarus annulatus	0	0	0	16	0	16	3.2	7.2	16.2	0 - 12.1	3	9.3	63.4
4. Ceriantheopsis americanus	4	0	1	4	5	14	2.8	2.2	1.7	0.1 - 515	4	8.1	71.5
5. Saccoglossus kowalevskii	5	4	0	0	0	9	1.8	2.5	3.5	0 - 4.9	5	5.2	76.7
6. Phoronis architecta	2	0	1	3	1	7	1.4	1.1	0.9	0 - 2.8	6	4.1	80.8
7. Pherusa affinis	3	0	1	0	2	6	1.2	1.3	1.4	0 - 2.8	7	3.5	84.3

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.92	1.73	1.37	1.95	1.56	1.70	0.25
Equitability (J'):	0.83	0.89	0.66	0.81	0.68	0.77	0.10

APPENDIX 7.6 (cont.)

STAMFORD-NEW HAVEN SOUTH (1000M East)

Date: 21 May 1979

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	19	15	11	16	11	72	14.4	3.4	0.8	10.1 - 18.7	1	35.3	35.3
2. Ceriantheopsis americanus	8	6	8	3	6	31	6.2	2.0	0.6	3.7 - 8.7	2	15.2	50.5
3. Phoronis architecta	0	4	2	12	6	24	4.8	4.6	4.4	0 - 10.5	3	11.8	62.3
4. Melinna cristata	3	3	4	9	3	22	4.4	2.6	1.5	1.2 - 7.6	4	10.8	73.1
5. Corymorpha pendula	1	2	5	7	5	20	4.0	2.4	1.4	1.0 - 7.0	5	9.8	82.9
6. Mulinia lateralis	1	0	0	4	0	5	1.0	1.7	2.9	0 - 3.2	6	2.5	85.4

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.48	1.54	1.86	2.32	1.94	1.83	0.34
Equitability (J'):	0.67	0.79	0.85	0.82	0.84	0.79	0.07

APPENDIX 7.6 (cont.)

STAMFORD-NEW HAVEN SOUTH 6 (1000M East)

Date: 9 August 1979

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Mulinia lateralis	65	16	10	54	69	214	42.8	27.8	18.1	8.2 - 77.4	1	43.6	43.6
2. Nephtys incisa	28	10	20	21	22	101	20.2	6.5	2.1	12.1 - 28.3	2	20.6	64.2
3. Yoldia limatula	21	2	5	8	11	47	9.4	7.3	5.7	0.3 - 18.5	3	9.6	73.8
4. Melinna cristata	28	0	6	3	9	46	9.2	11.0	13.2	0 - 22.9	4	9.4	83.2
5. Ceriantheopsis americanus	5	4	8	5	5	27	5.4	1.5	0.4	3.5 - 7.3	5	5.5	88.7
6. Nucula proxima	6	0	0	2	2	10	2.0	2.4	2.9	0 - 5.0	6	2.0	90.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.79	1.60	1.94	1.78	1.45	1.71	0.19
Equitability (J'):	0.68	0.73	0.81	0.60	0.63	0.69	0.08

APPENDIX 7.6 (cont.)

Date: 26 January 1979

STAMFORD-NEW HAVEN SOUTH 7 (1000M West)

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	17	21	13	11	10	72	14.4	4.6	1.5	8.7 - 20.1	1	42.4	42.4
2. Ceriantheopsis americanus	3	3	7	4	7	24	4.8	2.0	0.8	2.3 -7.3	2	14.1	56.5
3. Melinna cristata	5	1	5	1	5	17	3.4	2.2	1.4	0.7 - 6.1	3	10.0	66.5
4. Pherusa affinis	4	1	3	0	0	8	1.6	1.8	2.0	0 - 3.9	4	4.7	71.2
5. Ninoe nigripes	2	1	0	1	1	5	1.0	0.7	0.5	0.1 - 1.9	5	2.9	74.1
6. Euclymene collaris	0	1	2	0	1	4	0.8	0.8	0.8	0 - 1.8	6	2.4	76.5
7. Phoronis architecta	0	1	2	1	0	4	0.8	0.8	0.8	0 - 1.8	6	2.4	78.9
8. Saccoglossus kowaleuskii	0	1	2	1	0	4	0.8	0.8	0.8	0 - 1.8	6	2.4	81.3

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.91	1.68	2.19	1.75	1.62	1.83	0.23
Equitability (J'):	0.77	0.65	0.83	0.76	0.74	0.75	0.07

APPENDIX 7.6 (cont.)

Date: 22 May 1979

STAMFORD - NEW HAVEN SOUTH 7 (1000M West)

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Nephtys incisa	14	10	12	9	10	55	11.0	2.0	0.4	8.5 - 13.5	1	31.6	31.6
2.	Saccoglossus kowaleuskii	8	3	5	9	5	30	6.0	2.4	1.0	3.0 - 9.0	2	17.2	48.8
3.	Ceriantheopsis americanus	6	3	4	4	0	17	3.4	2.2	1.4	0.7 - 6.1	3	9.8	58.6
4.	Mulinia lateralis	0	6	6	0	0	12	2.4	3.3	4.5	0 - 6.5	4	6.9	65.5
5.	Melinna cristata	2	3	4	0	1	10	2.0	1.6	1.3	0 - 4.0	5	5.7	71.2
6.	Corymorpha pendula	1	2	0	1	3	7	1.4	1.1	0.9	0 - 2.8	6	4.0	75.2
7.	Pherusa affinis	4	2	0	1	0	7	1.4	1.7	2.1	0 - 3.5	6	4.0	79.2
8.	Nucula proxima	0	2	1	2	0	5	1.0	1.0	1.0	0 - 2.2	7	2.9	82.1
9.	Phoronis architecta	2	1	1	0	0	4	0.8	0.8	0.8	0 - 1.8	8	2.3	84.4
10.	Yoldia sapotilla	2	2	0	0	0	4	0.8	1.1	1.5	0 - 2.2	8	2.3	86.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.04	2.40	1.96	1.85	1.84	2.02	0.23
Equitability (J'):	0.82	0.89	0.85	0.80	0.80	0.83	0.04

APPENDIX 7.6 (cont.)

Date: 9 August 1979 STAMFORD-NEW HAVEN SOUTH 7 (1000M West)

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Mulinia lateralis	116	75	78	84	68	421	84.2	18.7	4.2	61.0 - 107.4	1	53.6	53.6
2. Yoldia limatula	40	17	19	19	44	139	27.8	13.1	6.2	11.6 - 44.0	2	17.7	71.3
3. Nephtys incisa	19	10	21	12	14	76	15.2	4.7	1.6	9.4 - 21.0	3	9.7	81.0
4. Melinna cristata	20	8	5	5	6	44	8.8	6.4	4.7	0.9 - 16.7	4	5.6	86.6
5. Nucula proxima	4	1	4	6	4	19	3.8	1.8	0.9	1.6 - 6.0	5	2.4	89.0
6. Pherusa affinis	4	4	7	4	0	19	3.8	2.5	1.6	0.7 - 6.9	5	2.4	91.4

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.69	1.60	1.58	1.42	1.46	1.55	0.11
Equitability (J'):	0.55	0.62	0.60	0.56	0.59	0.58	0.03

APPENDIX 7.6 (cont.)

Date: 21 March 1979

STAMFORD-NEW HAVEN NORTH, DUMP POINT

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	11	7	18	7	11	54	10.8	4.5	1.9	5.2 - 16.4	1	36.5	36.5
2. Nucula proxima	3	2	11	7	1	24	4.8	4.1	3.5	0 - 9.9	2	16.2	52.7
3. Ceriantheopsis americanus	6	2	3	5	2	18	3.6	1.8	0.9	1.3 - 5.9	3	12.2	64.9
4. Mulinia lateralis	0	2	1	6	0	9	1.8	2.5	3.5	0 - 4.9	4	6.1	71.0
5. Pherusa affinis	7	0	1	0	1	9	1.8	2.9	4.7	0 - 5.5	4	6.1	77.1
6. Macoma tenta	3	0	4	0	0	7	1.4	1.9	2.6	0 - 3.8	5	4.7	81.8
7. Melinna cristata	6	1	0	0	0	7	1.4	2.6	4.8	0 - 4.6	5	4.7	86.5
8. Edwardsia elegans	3	0	1	0	0	4	0.8	1.3	2.1	0 - 2.4	6	2.7	89.2
9. Nassarius trivittatus	3	0	1	0	0	4	0.8	1.3	2.1	0 - 2.4	6	2.7	91.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.09	1.79	1.59	1.82	1.04	1.66	0.39
Equitability (J'):	0.91	0.86	0.72	0.88	0.65	0.80	0.11

APPENDIX 7.4 (cont.)

Date: 23 January 1979

PROPOSED WLIS DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	14	7	11	15	8	55	11.0	3.5	1.1	6.6 - 15.4	1	75.3	75.3
2. Mulinia lateralis	0	0	1	1	1	3	0.6	0.5	0.4	0 - 1.3	2	4.1	79.4
3. Mytilus edulis	0	0	1	1	0	2	0.4	0.5	0.6	0 - 1.1	3	2.7	82.1
4. Nassarius trivittatus	0	0	0	1	1	2	0.4	0.5	0.6	0 - 1.1	3	2.7	84.8

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	0.25	0.68	1.08	0.81	0.64	0.69	0.30
Equitability (J'):	0.35	0.62	0.47	0.50	0.58	0.51	0.11

APPENDIX 7.4 (cont.)

Date: 23 January 1979

CAR DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nephtys incisa	12	11	14	14	12	63	12.6	1.3	0.1	10.9 - 14.3	1	35.6	35.6
2. Phoronis architecta	3	6	4	8	3	24	4.8	2.2	1.0	2.1 - 7.5	2	13.6	49.2
3. Streblospio benedicti	2	3	2	5	2	14	2.8	1.3	0.6	1.2 - 4.4	3	7.9	57.1
4. Pitar morrhuana	1	5	4	3	0	13	2.6	2.1	1.7	0 - 5.2	4	7.3	64.4
5. Mediomastus ambiseta	1	6	0	1	0	8	1.6	2.5	3.9	0 - 4.7	5	4.5	68.9
6. Pectinaria gouldii	3	2	1	0	1	7	1.4	1.1	0.9	0 - 2.8	6	4.0	72.9
7. Leptocheirus pinguis	0	5	1	0	0	6	1.2	2.2	4.0	0 - 3.9	7	3.4	76.3
8. Lumbrineris fragilus	1	1	0	1	2	5	1.0	0.7	0.5	0.1 - 1.9	8	2.8	79.1
9. Notophlana sp.	0	0	0	5	0	5	1.0	2.2	4.8	0 - 3.8	8	2.8	81.9
10. Diplocirrus hirsutus	0	4	0	0	0	4	0.8	1.8	4.1	0 - 3.0	9	2.3	84.2
11. Polydora ligni	0	0	1	1	1	3	0.6	0.5	0.4	0 - 1.3	10	1.7	85.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.98	2.30	1.75	2.09	1.88	2.00	0.21
Equitability (J'):	0.80	0.85	0.76	0.82	0.78	0.80	0.03

APPENDIX 7.4 (Cont.)

Date: 23 January 1979

CAR - WLIS Reference

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Phoronis architecta	13	2	0	13	3	31	6.2	6.3	6.4	0 - 14.0	1	22.6	22.6
2.	Nephtys incisa	5	6	4	7	7	29	5.8	1.3	0.3	4.2 - 7.4	2	21.2	43.8
3.	Sabellaria vulgaris	18	0	0	0	0	18	3.6	8.0	17.8	0 - 13.6	3	13.1	56.9
4.	Ampharete arctica	3	2	1	2	1	9	1.8	0.8	0.4	0.8 - 2.8	4	6.6	63.5
5.	Mediomastus ambiseta	2	0	0	4	0	6	1.2	1.8	2.7	0 - 3.4	5	4.4	67.9
6.	Nassarius trivittatus	0	1	5	0	0	6	1.2	2.2	4.0	0 - 3.9	5	4.4	72.3
7.	Lumbrineris fragilis	3	1	0	1	0	5	1.0	1.2	1.4	0 - 2.5	6	3.6	75.9
8.	Polydora ligni	5	0	0	0	0	5	1.0	2.2	4.8	0 - 3.8	6	3.6	79.5
9.	Asabellides oculata	2	2	0	0	0	4	0.8	1.1	1.5	0 - 2.2	7	2.9	82.4
10.	Ceriantharian sp.	0	2	0	0	1	3	0.6	0.9	1.4	0 - 1.7	8	2.2	84.6
11.	Pherusa affinis	1	2	0	0	0	3	0.6	0.9	1.4	0 - 1.7	8	2.2	86.8
12	Unciola irrorata	2	0	0	0	1	3	0.6	0.9	1.4	0 - 1.7	8	2.2	89.0

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.11	2.03	1.15	1.41	1.58	1.65	0.41
Equitability (J'):	0.78	0.82	0.71	0.79	0.81	0.78	0.04

APPENDIX 7.4 (Cont.)

NEW LONDON DUMP SITE (C-6)

Date: 28 January 1979

	Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1.	Ampelisca vadorum	20	10	5	21	51	107	21.4	17.9	15.0	0 - 43.6	1	27.4	27.4
2.	Dacrydium vitreum	24	0	30	0	30	84	16.8	15.5	14.3	0 - 36.1	2	21.5	48.9
3.	Leptocheirus pinquis	13	4	7	19	24	67	13.4	8.3	5.1	3.1 - 23.7	3	17.2	66.1
4.	Nephtys incisa	4	7	6	5	7	29	5.8	1.3	0.3	4.2 - 7.4	4	7.4	73.5
5.	Potamilla reniformis	0	0	12	0	0	12	2.4	5.4	12.2	0 - 9.1	5	3.1	76.6

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.90	1.73	1.71	1.92	1.53	1.76	0.16
Equitability (J'):	0.59	0.83	0.56	0.77	0.51	0.65	0.14

APPENDIX 7.4 (Cont.)

Date: 28 January 1979

NEW LONDON REFERENCE (F-8)

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Caulleriella fillariensis	109	4	173	3	40	694	65.8	73.8	82.8	0 - 157.4	1	35.7	35.7
2. Mytilus edulis	141	126	155	121	51	594	118.8	40.2	13.6	68.9 - 168.7	2	30.6	66.3
3. Euclymene collaris	12	29	27	23	21	103	20.6	8.1	3.2	10.5 - 30.7	3	5.3	71.6
4. Phoxocephalus holbolli	16	14	44	12	15	101	20.2	13.4	8.9	3.6 - 36.8	4	5.2	76.8
5. Lurnbrineris tenuis	16	10	16	13	28	83	16.6	6.8	2.8	8.1 - 25.1	5	4.3	81.1

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.00	1.77	2.08	2.07	1.46	1.88	0.26
Equitability (J'):	0.54	0.53	0.58	0.58	0.41	0.53	0.07

APPENDIX 7.4 (Cont.)

Date: 27 January 1979

CORNFIELD SHOALS DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Scolelepis squamata	0	2	3	0	5	9	1.8	1.8	1.8	0 - 4.0	1	33.3	33.3
2. Ophelia bicornis	0	1	0	0	1	2	0.4	0.5	0.6	0 - 4.1	2	7.4	40.7
3. Trichophoxus epistomus	0	0	0	2	0	2	0.4	0.9	2.0	0 - 1.5	2	7.4	48.1
4. Ampelisca abdita	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	51.8
5. Aricidea neosuicica	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	55.5
6. Asabellides oculata	0	0	1	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	59.2
7. Capitella capitata	0	0	0	1	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	62.9
8. Edwardsia elegans	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	66.6
9. Euclymene collaris	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	70.3
10. Gammarus lawrencianus	0	0	0	0	1	1	0.2	0.4	0.8	0 - 0.8	3	3.7	74.0
11. Leptocheirus pinguis	1	0	0	0	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	77.7
12. Protohaustorius deichmannae	0	0	0	1	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	81.4
13. Protohaustorius wigleyi	0	0	0	1	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	85.1
14. Scalibregma inflatum	0	0	0	1	0	1	0.2	0.4	0.8	0 - 0.8	3	3.7	88.8

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.56	0.64	1.24	1.56	0.87	1.17	0.41
Equitability (J'):	0.97	0.92	0.90	0.97	0.79	0.91	0.07

APPENDIX 7.4

Date: 27 January 1979

CORNFIELD SHOALS REFERENCE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Scolelepis squamata	5	0	1	6	4	16	3.2	2.6	2.1	0 - 6.4	1	28.1	28.1
2. Acanthohaustorius millsi	0	1	6	4	1	12	2.4	2.5	2.6	0 - 5.5	2	21.1	49.2
3. Ophelia bicornis	4	1	0	1	0	6	1.2	1.6	2.1	0 - 3.2	3	10.5	59.7
4. Gammarus lawrencianus	0	0	0	3	1	4	0.8	1.3	2.1	0 - 2.4	4	7.0	66.7
5. Archiannelid sp.	1	0	0	0	2	3	0.6	0.9	1.4	0 - 1.7	5	5.3	72.0
6. Parahaustorius holmesii	0	1	1	0	0	2	0.4	0.5	0.6	0 - 1.1	6	3.5	75.5

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.15	1.20	1.42	1.38	1.49	1.33	0.15
Equitability (J'):	0.71	0.67	0.79	0.77	0.72	0.73	0.05

APPENDIX 7.5

NEW LONDON REFERENCE (F-8)

Date: 23 May 1979

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Mytilus edulis	79	198	208	128	147	760	152.0	52.9	18.4	86.4 - 217.6	1	57.8	57.8
2. Harmathoe extenuta	8	15	12	8	11	54	10.8	2.9	0.8	7.1 - 14.5	2	4.1	61.9
3. Lumbrineris impatiens	0	16	9	16	10	51	10.2	6.6	4.3	2.0 - 18.4	3	3.9	65.8
4. Phoxocephalus holbolli	3	13	17	6	11	50	10.0	5.6	3.1	3.1 - 16.9	4	3.8	69.6
5. Euclymene collaris	5	11	5	1	17	39	7.8	6.3	5.1	0 - 15.6	5	3.0	72.6
6. Amphipholis squamata	0	2	4	21	4	31	6.2	8.4	11.4	0 - 16.7	6	2.4	75.0
7. Pholoe minuta	0	15	5	3	8	31	6.2	5.7	5.2	0 - 13.3	6	2.4	77.4
8. Clymenella torquata	5	9	9	0	3	26	5.2	3.9	2.9	0.4 - 10.0	7	2.0	79.4

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.14	2.00	1.65	2.04	2.14	1.99	0.20
Equitability (J'):	0.61	0.54	0.48	0.57	0.58	0.56	0.05

APPENDIX 7.5 (cont.)

Date: 23 May 1979

NEW LONDON DUMP SITE (C-6)

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Leptocheirus pinguis	26	36	68	63	31	1224	44.8	19.3	8.3	20.8 - 68.8	1	33.2	33.2
2. Ampelisca vadorum	14	27	26	50	52	169	33.8	16.5	8.9	13.3 - 54.3	2	25.1	58.3
3. Ampleisca abdita	22	12	18	0	1	53	10.6	9.9	9.2	0 - 22.9	3	7.9	66.2
4. Unciola irrorata	11	7	2	13	9	42	8.4	4.2	2.1	3.2 - 13.6	4	6.2	72.4
5. Mytilus edulis	0	2	0	26	1	29	5.8	11.3	22.0	0 - 19.9	5	4.3	76.7

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.20	2.14	1.64	2.27	2.16	2.08	0.25
Equitability (J'):	0.75	0.70	0.58	0.66	0.64	0.67	0.06

APPENDIX 7.5 (cont.)

Date: 18 May 1979

ACTUAL WLIS DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Nucula proxima	39	28	45	25	19	156	31.2	10.6	3.6	18.1 - 44.4	1	67.5	67.5
2. Nephtys incisa	9	6	8	8	1	32	6.4	3.2	1.6	2.4 - 10.4	2	13.9	81.4
3. Corymorpha pendula	12	0	6	6	6	30	6.0	4.2	2.9	0.7 - 11.3	3	13.0	94.4
4. Phoronis architecta	1	2	4	0	1	8	1.6	1.5	1.4	0 - 3.5	4	3.5	97.9

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	1.09	0.66	0.90	1.08	0.95	0.94	0.18
Equitability (J'):	0.61	0.60	0.65	0.67	0.59	0.62	0.03

APPENDIX 7.5 (cont.)

Date: 18 May 1979

GREEN'S LEDGE DUMP SITE

Predominant Species	Number of Individuals: Sample No. 1	2	3	4	5	Total	Mean	Std. Dev.	Coeff. of Dispersion	95% Conf. Limits of Mean	Species Abundance Rank	Percent of Total Individuals	Cumulative Percent of Individuals
1. Phoronis architecta	8	2	6	5	33	54	10.8	12.6	14.7	0 - 26.4	1	36.2	36.2
2. Nephtys incisa	9	6	18	6	14	53	10.6	5.3	2.7	4.1 - 17.1	2	35.6	71.8
3. Pherusa affinis	6	0	2	1	0	9	1.8	2.5	3.5	0 - 4.9	3	6.0	77.8
4. Ceriantharian sp.	3	0	1	1	0	5	1.0	1.2	1.4	0 - 2.5	4	3.4	81.2
5. Mulinia lateralis	4	0	1	0	0	5	1.0	1.7	2.9	0 - 3.2	4	3.4	84.6
6. Yoldia limatula	1	0	0	0	2	3	0.6	0.9	1.4	0 - 1.7	4	2.0	86.6

	Sample 1	2	3	4	5	Mean	Std. Dev.
Species Diversity (H'):	2.03	1.09	1.42	1.99	0.92	1.49	0.51
Equitability (J'):	0.85	0.79	0.68	0.86	0.57	0.75	0.12