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BENTHIC INFAUNAL COMMUNITIES OF BOSTON HARBOR

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INTRODUCTION

The benthic infauna of Boston Harbor and the adjacent Massachusetts Bay are known from a series of studies conducted between 1976 and 1988. The earliest survey was by Gilbert et al. (1976) in which 37 stations were established offshore from Cape Ann to Cape Cod Bay. During the 301(h) waiver application process, infaunal benthos was assessed in Boston Harbor and Massachusetts Bay (Maciolek, 1978; 1980; McGrath et al., 1982; Metcalf & Eddy, 1984). The data from the 1978, 1980, and 1982 programs were mostly concentrated in Boston Harbor and provide the most important resource on the distribution of faunal communities near the Nut Island and Deer Island outfalls as well as at sites throughout the Harbor. The 1982 benthic database was reviewed by Hall (1986), who attempted to correlate the benthic community patterns with the distribution of metals in sediments. The 1978, 1979, and 1982 programs also included a limited number of stations in Massachusetts Bay. The 1984 samples reported on by Metcalf & Eddy (1984) included five soft bottom stations in Massachusetts Bay.

The most extensive database on Massachusetts Bay was developed as part of the Secondary Treatment Facilities Plan (STFP) developed for the Massachusetts Water Resources Authority (MWRA) by Camp Dresser & McKee (Blake et al., 1987; 1988). These studies were the first in which the fauna was sampled on a seasonal basis and provide the first evidence of temporal variation in benthic communities in Massachusetts Bay. To date, however, no seasonal data have been developed for Boston Harbor.

This paper synthesizes the Boston Harbor and Massachusetts Bay data that were collected in 1978, 1979, and 1982 to support the 301(h) waiver application. In addition to a description and interpretation of community patterns that were observed during each of the three years, data on those stations that were sampled in sequential years are compared. In the absence of temporal data, the year-to-year results represent an initial effort to identify patterns that might reflect longer term natural processes.

METHODS AND MATERIALS

Samples collected in 1978 and 1979 were taken with a 0.054-m^2 Ponar grab, whereas those collected in 1982 were taken with a 0.1-m^2 van Veen grab. Three replicates were taken at each station. Station designations and positions are indicated in Table 1 and Figure 1. Following collection, all samples were sieved through screens with mesh diameters of 1.0 and 0.5 mm.

In the laboratory, the fauna were identified to the lowest possible taxon, usually to species, and enumerated. The only major macroinfaunal taxon not identified to species were the Oligochaeta, which were treated as a single taxon.

The data were analyzed on the VAX 11/750 computer at Battelle Ocean Sciences. Counts of organisms for which the identification was uncertain (e.g., juveniles, anterior fragments, indeterminate forms) were only used for density tabulations and were not included in the calculations of similarity or diversity indices. Colonial animals or other forms normally attached to hard surfaces such as hydroids and bryozoa were excluded from all analyses.

Statistical treatment of the infaunal data set included an agglomerative clustering technique to determine similarity between samples. The similarity measure used was the Normalized Expected Species Shared (NESS) (Grassle and Smith, 1976). Stations were analyzed with replicates combined and the number of individuals (m) was set at 50. The clustering strategy used was group average sorting (Boesch, 1977). The Bray-Curtis coefficient (Boesch, 1977) with group average sorting, was also used as a similarity measure. Data were log transformed prior to using the Bray-Curtis coefficient. In addition to the normal analysis of stations, an inverse analysis was performed on the 1982 data with Bray-Curtis in the R-mode. The top 50 species were used for this analysis. A nodal analysis was then performed on the inverse and normal analysis based upon these results (Boesch, 1977). Both constancy, a measure of the frequency of occurrence of a species group at a site group, and fidelity, a measure of the degree of restriction of a species group to a site group, were evaluated.

Benthic community parameters, including Shannon-Wiener diversity (H') and its associated evenness value (J'), were calculated as was the rarefaction method of Sanders (1968) as modified by Hurlbert (1971). The Shannon-Wiener Index was calculated using the base $\log_e$. For the rarefaction analyses, the number of individuals was set at 50, 100, 250, 500, 750, 1000, 2000, 5000, and 7500.

All of the 1982 samples were corrected to a sample size of 0.085 m^2 to account for the removal of the sediment subsamples that were analyzed for grain-size. Sediment subsamples were not removed from the 1978 and 1979 samples, and they were calculated at a sample size of 0.054 m^2. The sediment grain-size data that were generated from the 1982 samples is considered to be invalid because of the use of inappropriate analytical methods, therefore, no effort has been made to use this data in correlations (E. Gallagher, personal communication). Instead, surficial sediment data generated by Fitzgerald (1980) for Boston Harbor have been integrated in the discussion of the infaunal results to assist in the interpretation of community patterns.

RESULTS

Faunal Composition

A total of 237 species of benthic infauna were identified from the 36 Boston Harbor samples taken at 12 stations in 1982. A total of 127 taxa were identified from the single station in Massachusetts Bay, resulting in a total of 282 taxa from all 13 stations. At the 12 Boston Harbor stations, polychaetes were the dominant taxon with 58.0% of the individuals and 35.9% of the species. Molluscs accounted for 21.5% of the individuals and 11.8% of the species, whereas the arthropods included 7.5% of the individuals and 27% of the species.

At the Massachusetts Bay station, PD, the results were quite different. Polychaetes accounted for 75% of the individuals and 52.8% of the species. In contrast, the molluscs and arthropods accounted for only 1.4 and 0.8% of the of the individuals and 7.9 and 26.8% of the species, respectively. The disproportionate density of the polychaetes is largely driven by the dominance of two spionids, Spio limicola (72%) and Polydora quadrilobata (8.1%) in the offshore samples.

The results from the earlier 1978 and 1979 studies were similar to those of 1982 in terms of numbers of species recorded and the relative dominance of major taxa. For example, of the 238 species of benthic invertebrates identified in 1978, 97 species (40.7%) were polychaetes, 47 species (19.7%) were arthropods, and 45 species (18.9%) were molluscs. In 1979, 227 species of benthic invertebrates were identified of which 126 species (55.5%) were polychaetes, 47 species were arthropods (19.8%), and 19 species were molluscs (8.3%).

In each of the three years, the Massachusetts Bay stations differed from the Boston Harbor stations in species composition. In 1978, 12 species occurred only in Massachusetts Bay (3 stations); in 1979, 35 species occurred only in Massachusetts Bay (1 station); and in 1982, 45 species occurred only in Massachusetts Bay (1 station).

Species Diversity and Species Richness

The 1982 Results. Species diversity patterns indicate that a mixture of conditions exist within the Harbor. Results of the Hurlbert rarefaction calculations are depicted (Figure 2; see also Table 2). Four groupings of stations are evident. The first group, represented by Stations B-3, B-12, and B-10, have the highest species diversity. Station B-3 is near the Deer Island outfall, whereas Stations B-10 and B-12 are in the southern part of the Harbor near the Nut Island outfall. The next highest group includes Stations B-2, B-4, B-8, B-9, and B-11. Again these stations represent locations from both the northern and southern regions of the Harbor. Stations B-1 and B-7 comprise the third group, in which species diversity is quite low. Stations B-5 and B-6, in the inner Harbor, have the lowest species diversity. Station PD in Massachusetts Bay is not plotted on Figure 2, but would fall between Stations B-2 and B-7. Station C-2, the most diverse station from the 1987 Massachusetts Bay program, is included in Figure 2 for comparative purposes to emphasize that certain Boston Harbor locations have high species diversity.

The Shannon-Wiener diversity indexes are shown in Table 2. All of the stations that had the highest diversity based on the rarefaction method have H′ values between 4.95 and 3.48. Stations B-1, B-5, B-6, B-7, and PD comprise a group of stations having low diversity.

The 1982 results indicate that species diversity is highest in the outer Harbor, and the Harbor stations with the lowest diversity are in the inner Harbor. Station B-1 in Broad Sound and Station PD in Massachusetts Bay are also quite low. At Station PD, the very high density of two spionid polychaetes resulted in a low species diversity despite 112 species having been identified from the site.

Actual numbers of species recorded at any one station varied considerably throughout the Harbor (Table 2). Stations having the highest numbers of species are B-10 and B-11 with 108 and 105 species respectively. These stations are in the southern part of the Harbor. the three inner Harbor stations, B-5, B-6, and B-7 have the fewest species with 8, 12, and 40 respectively. Stations in the vicinity of Deer Island have 47-70 species, whereas those in the southern part of the Harbor have 65-108. The offshore station, PD, had 112 species.

The 1978 and 1979 Results. Species diversity patterns in Boston Harbor in all three years follow the same patterns that are evident. Stations having the highest species diversity are found offshore, in the outer Harbor, and in the southern part of the Harbor, where the Hurlbert values and Shannon-Wiener H′ index are always higher. Stations having the lowest diversities are found in the inner and northern regions of the Harbor (Table 2).

The actual numbers of species recorded at these stations also follow the same pattern. All stations with 50 or more species were in the outer Harbor (Table 2).

Faunal Density

Density data are for all of the 1978, 1979, and 1982 surveys are provided in Table 2.

In 1978, the lowest densities were recorded from stations T-5 (5,500 indiv. per m^2), T-6 (2,940 indiv. per m^2), and T-9 (2,230 indiv. per m^2), in the vicinity of the Deer Island outfall. Station T-1, located east of Deer Island, also had relatively low densities (8,100 indiv. per m^2). High densities were recorded from nearly all other stations in the Harbor, with the highest recorded from stations T-3 in the outer Harbor (71,900 indiv. per m^2), T-4 on the Deer Island flats (54,480 indiv. per m^2), T-7 off the Logan Airport (42,090 indiv. per m^2), T-12 near Spectacle Island in the middle of the Harbor (54,420 indiv. per m^2), and T-21 in the outer Harbor (41,560 indiv. per m^2). Densities at other stations ranged from about 12,000 to more than 38,000 indiv. per m^2). Surprisingly, all three of the Massachusetts Bay stations had low infaunal densities: DW1 (5,950 indiv. per m^2), DW2 (6,160 indiv. per m^2), and DW3 (1,580 indiv. per^2).

In 1979, the lowest densities were recorded from station DI, off Deer Island (5,970 indiv. per m^2), DE in Broad Sound (16,560 indiv. per m^2), and at the inner Harbor station, B-6 off Logan Airport (5,360 indiv. per m^2). Densities at all other locations in the Harbor were very high, ranging from 34,000+ to 81,000+ indiv. per m^2: B-7 (81,680), B-8 (59,230), B-9 (81,780), DW (35,870), NI (61,620), T-19 (34,160). Station DW1 in Massachusetts Bay had a density of 23,230 indiv. per m^2.

For 1982, species densities were highest at station B-1 (53,013 indiv. per m^2) near the Deer Island Outfall and at stations B-10 (44,200 indiv. per m^2), B-12 (40,587 indiv. per m^2), and B-11 (39,846 indiv. per m^2) near the Nut Island outfall. Other stations near Deer Island ranged from 5,247 to 20,310 individuals per m^2. Inner Harbor stations B-5 and B-6 had the lowest densities with 1,410 and 1,930 individuals per m^2 respectively. The densities recorded from Station PD in Massachusetts Bay were exceptionally high, with a total of 106,358 individuals per m^2 recorded.

Faunal Assemblages and Indicator Species

Cluster analysis was used to identify patterns in station groupings. Regardless of the clustering technique, Bray-Curtis or NESS, the results were very similar. Table 3 lists the top five dominant species at each station in the 1978, 1979, and 1982 surveys. The 1978 results clearly indicate the presence of two major faunal assemblages in the outer and middle regions of the Harbor (Figure 3). Stations T-1, T-4, T-7, T-8, T-11, T-12, T-13, and T-14 comprise a distinct group that encompasses stations extending from Quincy Bay and Nut Island through the middle of the Harbor to the Logan Airport and Deer Island. Within this cluster, Stations T-14, T-8, and T-7 are dominated by two amphipods, *Ampelisca abdita* and *Photis pollex*, and the polychaete *Pholoe minuta*. In contrast, Stations T-4, T-11, and T-12 are characterized by oligochaetes and a cirratulid polychaete, *Chaetozone* sp. A. Stations T-1 and T-13, also part of this group, share elements of all of these faunal components.

The second largest cluster of 1978 stations is an outer Harbor assemblage extending from south of Deer Island to Hingham Bay (Figure 3). All of these stations were dominated by oligochaetes, with strong contributions by the polychaetes Aricidea catherinae and Pholoe minuta. This assemblage is linked to stations T-22 and B-8 outside the southern end of the Harbor by species such as Aricidea catherinae. Stations T-5 and T-9, in the vicinity of the Deer Island outfall, cluster closely together and share high densities of two polychaetes, Capitella spp. and Eteone longa. Stations T-3, T-6, DW3, and DW1/DW2 all cluster separately and are characterized by unique combinations of species. At station T-3, oligochaetes and Eteone longa are dominants, but the amphipod, Marinogammarus finmarchicus, and two polychaetes, Caulleriella sp. and Polygordius sp. A were other top ranked dominants. Station T-6 had several species, including Pectinaria gouldi and Diastylus sculpta, that were rare elsewhere.

The 1979 data cluster into six distinct station groups that can be explained by the species present in the assemblages (Figure 4). Station DE in Broad Sound had a unique assemblage that included Parapionosyllis longocirrata and Exogone hebes, two syllid polychaetes that are characteristic of offshore assemblages. Station DW1 is the one Massachusetts Bay station sampled in this program. Stations DI and B-8 represent two outer Harbor stations that cluster closely based on NESS. Although many species are shared between these stations, the only high-ranked dominant species that is shared is the bivalve, Tellina agilis. Stations B-6 and DW in the inner Harbor form a tight cluster that includes the opportunistic polychaetes, Capitella spp., Polydora cornuta, and Eteone longa. Stations B-7, NI, and B-9 form a cluster of stations that extends from the inner Harbor to Hingham Bay. Station T-9 is linked to this cluster, but separates at a low level of similarity. All have the amphipods, Ampelisca abdita and A. vadorum as the top ranked species. Oligochaetes and other amphipods characterize these stations as well.

Five distinct clusters are apparent in the 1982 data (Figures 5-6). Stations B-5 and B-6 of the inner Harbor joins at the lowest level of similarity. The next lowest clusters to join are Stations PD and Station B-7. Stations B-5 and B-6 are dominated by Capitella spp. and two spionids, Polydora cornuta and P. aggregata. A somewhat more diverse assemblage at the other inner Harbor station B-7 is characterized by oligochaetes and the same two spionids. Station PD is dominated by two other spionids, Spio limicola and Polydora quadrilobata, that together account for 76% of all individuals recorded from the station. The southern and northern regions of the Harbor sare clustered into two distinct groups. Stations B-9, B-10, B-11, and B-12 in the southern region form nearly identical stations groupings, whether NESS or Bray-Curtis are used. These stations have more species than elsewhere in the Harbor, and are the most diverse. Aricidea catherinae and oligochaetes are dominant and characteristic species at these stations. Stations B-1, B-2, B-3, B-4, and B-8 cluster together with Bray-Curtis (Figure 6), while Station B-3 joins at a lower level of similarity when using NESS (Figure 5). Stations B-1 and B-2, located to the east of Deer Island are dominated by Polydora cornuta, P. aggregata, Spio limicola, Tharyx acutus, Tellina agilis, and Edotea nr. agilis. Oligochaetes are dominant at station B-3, whereas the mud snail, Nassarius vibex is the highest ranked species at Station B-4. Tellina agilis and Edotea nr. montosa are also important at this station.

A nodal analysis based on the 1982 data was performed using the Bray-Curtis similarity measure in an attempt to elucidate underlying faunal patterns that could assist in the interpretation of the clustering patterns.

The first step was to cluster the stations as in Figure 6 (normal analysis), but using only the top 50 species. These same 50 species were then clustered using inverse analysis by species). Nine species groups were identified (Table 4). The results of the normal analysis were reduced to five site groups: Site group A included Stations B-9, B-10, B-11, and B-12 from the southern region of the Harbor; Site group B included Station PD from Massachusetts Bay; Site group C included Stations B-1, B-2, B-3, B-4, and B-8 from the northern region of the Harbor; Site Group D included Station B-7 from the inner Harbor; and Site group E included Stations B-5 and B-6 from the inner Harbor. Station PD (Site group B) clustered more closely with the southern Harbor stations (Site Group A), but was considered sufficiently distinct to maintain a separate group identity. The differences between the station groups can be readily seen in Figures 7 and 8. The major differences between the Nut Island station group (A) and the Deer Island group (C) can be seen in the different constancy and fidelity values for species groups 2, 3, 4, 5, and 7. Station group B is distinct from all other groups in the importance of species group 9. The two polychaete and one phoronid species that compose this species group are rare in the Harbor. Station group E, representing the innermost Boston Harbor stations, have only a limited fauna represented by species group 2. This group is characterized by Capitella and Polydora species that are known to be opportunists in stressed environments.

Stations Sampled in Sequential Years.

Only six stations were sampled in more than one year, and only one station (B-8) was sampled in all three years. These stations, and their top 10 ranked species are listed in Table 5. Station B-8, located in the outer Harbor, exhibits large density shifts during the three years (1978: 71,900 per m^2; 1979: 59,230 per m^2; 1982: 11,583 per m^2). No one species or combination of species dominated throughout the three years (Table 5). Only three species were among the top 10 ranked species over the three years of sampling: Tellina agilis, Spiophanes bombyx, and Unciola irrorata. Nucula delphinodonta, which was ranked number 4 in 1978 and number 1 in 1979, was rare in 1982. Similarly, Photis pollex, which was number 2 in 1979 and number 1 in 1982, was entirely absent in 1978.

At the offshore station DW1, total densities were low in 1978 (5,950 per m^2), but increased dramatically in 1979 (23,230 per m^2) with high densities of Mediomastus ambiseta. Four species were shared among the top 10 ranked species in 1978 and 1979, with Polydora socialis the top ranked species in 1978 and Mediomastus ambiseta top ranked in 1979.

The outer Harbor station, T-19 was sampled in 1978 and 1979. Although densities remained consistent between years (1978: 34,220 per m^2; 1979: 34,160 per m^2), only two species shared the top 10 ranked lists in the two years (Oligochaeta, and Pholoe minuta).

The inner Harbor station B-6 was sampled in 1979 and 1982. Densities were low in both years (1979: 5,360 per m^2; 1982: 1,930 per m^2). The three highest ranked species in 1979 (Capitella spp., Polydora cornuta, and Eteone longa) were also ranked 2, 1, and 4 respectively in 1982. Polydora aggregata, which appeared in the number 3 rank in 1982 was very rare in 1979. Another inner Harbor station, B-7, was sampled in 1979 and 1982. The very high densities of 1979 (81,680 per m^2) observed in 1979 were greatly reduced in 1982 (25,897 per m^2). Five species, Ampelisca abdita, Oligochaeta spp., Polydora cornuta, Aricidea catherinae, and Lumbrineris impatiens were present in the top 10 list between the two years. The high densities in 1979 were largely due to the large population of Ampelisca abdita (27,879 per m^2).

The last station to be sampled in sequential years was station B-9, in Hingham Bay that was sampled in 1979 and 1982. The density and faunal patterns were similar to those of station B-7 with very high densities in 1979 (81,780 per m^2) that were dominated by amphipods. Densities in 1982 were 25,987 per m^2. Four species, Ampelisca vadorum, Oligochaeta spp., Orchomenella minuta, and Aricidea catherinae were present in the top 10 list between the two years.

DISCUSSION

Species Assemblage Patterns

The benthic communities of Boston Harbor are zoned into distinct groupings of stations that correspond to (1) a progression from higher saline oceanic conditions in the outer Harbor to estuarine conditions in the inner Harbor and (2) known areas of pollution.

The 1979 and 1982 databases clearly indicate a distinct north/south pattern in the communities (Figure 9), with stations near the northern Deer Island outfall being distinctly different from those near Nut Island in the south. Stations in the inner Harbor are distinct from either of these outer Harbor communities and also have lower species diversities and species richness. The southern region of the Harbor shares more species with Massachusetts Bay than other areas of the Harbor. This suggests that a link between Boston Harbor and Massachusetts Bay is most evident in the infauna in the southern region than in Broad Sound.

A somewhat different pattern emerges when the station groupings from

1978 are mapped (Figure 10). The stations near Deer Island continue to differ from those in the southern part of the Harbor, but the two stations (T-13 and T-14) in closest proximity to Quincy Bay and two stations in the middle of the Harbor (T-11 and T-12) have their closest affinity with the Deer Island assemblages. This pattern suggests that there is a distinct outer Harbor assemblage that includes species with close affinities to faunal communities in Massachusetts Bay. This assemblage changes in the middle of the Harbor to one that contains estuarine species and elements of the so-called pollution indicators or stress tolerant groups. The distinct inner Harbor assemblage that is suggested by the 1979 and 1982 data can be clearly identified in the 1978 database.

Species diversity values for 1978 also indicate a richer infaunal component in the outer rather than the inner Harbor. All stations in the outer Harbor assemblage have more species and higher species diversity values regardless of the technique used than those in the inner Harbor. Species density values, however, follow a different pattern. Stations having low numbers of species and low diversity values may have very high densities owing to high numbers of one or a few species. This is a typical pattern found in stressed environments. In Boston Harbor, very high densities are frequently due to amphipods such as Ampelisca spp., polychaetes such as Capitella spp., Polydora spp., or oligochaetes. Species that have been identified in these taxa are known to be opportunists and capable of establishing large populations. Stations having high infaunal densities are found throughout the station array, but opportunistic species are found only at the inner Harbor stations. Very low total faunal densities are present in the vicinity of the Deer Island outfall.

The inner Harbor assemblages identified in the 1978 data link the benthic communities in the vicinity of Nut Island and Deer Island (Figure 10), which may be suggestive of stress from proximity to sewage outfalls. However, the same dataset raises questions about this association. The actual location of wastewater outfall lines (Figure A) are in closer proximity to other stations (T-5, T-6, T-15, and T-16) which are part of other assemblages. For example, stations T-5 and T-6 are part of separate cluster groups and stations T-15 and T-16 are part of the larger outer Harbor assemblage that includes most of the stations in the southern part of the Harbor. Stations T-5 and T-6 have very low densities and appear to be stressed environments. Capitella spp., a well known indicator of stressed environments, is the dominant organism at T-5. The present sludge discharges south of Deer Island may be the cause of these stressed environments. In the 1979 and 1982 databases, however, low species densities in the same areas were accompanied by greater species richness and higher species diversities in the vicinity of the Deer Island outfalls.

The inner Harbor assemblage identified in the 1978 dataset does show a correspondence to sediment grain size. The distribution of infaunal species has been shown to correlate with sediment texture (Blake et al., 1986; 1987). Tetra Tech (1984) concluded that benthic habitats in the Massachusetts Bay area are often distinguished by differences in grain size. An association with grain size may reflect physical attributes of the sediment, or the tendency for sediment-bound metals or other pollutants to be associated with finer sediments due to their large surface area and high sorptive capacity (Bothner, 1987).

The most complete information on sediment distributions in Boston Harbor was compiled by Fitzgerald (1980) from field data (27 samples) and samples from Mencher et al. (1968, 152 grab samples). Areas of high mud (silt + clay) content (Figure 11) correspond reasonably well to the inner Harbor assemblage, suggesting an association.

If there is an association between infauna and sediment grain size, then the factors controlling the distribution of grain size may be significant. Fitzgerald (1980) concluded that muds (silt + clay) within the Harbor are concentrated in areas where dredging has not taken place and where tidal velocities are at a minimum.

Although mud concentrations are not located where tidal constrictions result in highest velocities (NOAA, undated) such as off the north or south ends of Peddocks Island, or north of Long Island, high mud concentrations do not appear related to tidal velocities. Mud concentrations also do not correlate with water depth (NOAA, 1986). Because the factors controlling modern sedimentation do not, within this limited dataset, correlate with bottom mud concentrations, the control may be with the underlying geology. The high mud concentrations in bottom sediments do correlate with areas of maximum total sediment overburden (Fitzgerald, 1980). This overburden consists of acoustically undifferentiated Blue Clay (post-glacial) and modern marine muds. The location of these areas of mud concentration may be associated with the pre-existing Blue Clay surface.

Year-to-Year Patterns

In absence of temporal data, a comparison of some stations that were sampled sequentially in two or three in 1978, 1979, and 1982 have been made.

These stations rarely exhibited the same densities in different years and the dominant species were never in the same rank order. In some cases, a few high ranked species persisted from year to year. These results clearly indicate the need for a well designed, temporal sampling program for Boston Harbor. The natural processes governing the maintenance of benthic communities in Boston Harbor will need to be understood in order to interpret changes that may occur during the pollution abatement that will occur in the 1990's.

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FIGURE LEGENDS

Figure 1. Map of Boston Harbor and Massachusetts Bay Showing Historical Benthic Infaunal Sampling Sites.

Figure 2. Hurlbert Rarefaction Curves For 12 Boston Harbor Stations Sampled in 1982 and One Massachusetts Bay Station Sampled in 1987.

Figure 3. Dendrogram of Two Summed Replicates Collected at 23 Stations in Boston Harbor and Three Stations in Massachusetts Bay Sampled in 1978. Clustering is With Bray-Curtis and Group Average Sorting.

Figure 4. Dendrogram of Two Summed Replicates Collected at Nine Boston Harbor and One Massachusetts Bay Station Sampled in 1979. Clustering is with NESS and Group Average Sorting.

Figure 5. Dendrogram of Three Summed Replicates Collected at 12 Boston Harbor and One Massachusetts Bay Station Sampled in 1982. Clustering is With NESS and Group Average Sorting.

Figure 6. Dendrogram of Three Summed Replicates Collected at 12 Boston Harbor and One Massachusetts Bay Station Sampled in 1982. Clustering is With Bray-Curtis and Group Average Sorting.

Figure 7. Nodal Analysis of Constancy for Species Groups and Site Groups Sampled in Boston Harbor and Massachusetts Bay in 1982. Clustering is with Bray-Curtis and Group Average Sorting.

Figure 8. Nodal Analysis of Fidelity for Species Groups and Site Groups Sampled in Boston Harbor and Massachusetts Bay in 1982. Clustering is with Bray-Curtis and Group Average Sorting.

Figure 9. Map of Boston Harbor and Massachusetts Bay Showing Distribution of

TABLE 1. STATION DESIGNATIONS AND POSITIONS OF BOSTON HARBOR AND MASSACHUSETTS BAY STATIONS SAMPLED IN 1978, 1979, AND 1982.

Station Number	Original Number	Latitude (N)	Longitude (W)
		1978	
T-1	T8S	42°20'58.6"	70°56'49.0"
T-2	T8M	42°20'31.9"	70°56'11.1"
T-3	T8N	42°20'03.9"	70°55'20.0"
T-4	T4N	42°20'58.4"	70°57'47.6"
T-5	T4CB	42°20'42.7"	70°57'41.0"
T-6	T4M	42°20'21.0"	70°57'41.0"
T-7	T5N	42°21'23.5"	70°58'40.0"
T-8	T5M	42°20'54.0"	70°58'31.9"
T-9	T5S	42°20'37.0"	70°58'28.0"
T-10	T7N	42°19'53.7"	70°58'34.3"
T-11	T7M	42°19'39.6"	70°58'54.3"
T-12	T7S	42°19'04.0"	70°58'48.0"
T-13	T10	42°16'52.6"	70°57'44.6"
T-14	T1M	42°17'02.3"	70°57'31.9"
T-15	T1I	42°17'05.8"	70°57'26.9"
T-16	T2S	42°17'54.5"	70°56.20.7"
T-17	T2M	42°18'09.5"	70°56'38.8"
T-18	T2N	42°18'25.8"	70°57'02.0"
T-19	T3S	42°18'12.4"	70°56'09.0"
T-20	T3M	42°18'21.4"	70°56'24.5"
T-21	T3N	42°18'30.9"	70°56'53.5"
T-22	CD	42°19'19.4"	70°53'20.6"
B-8	CS	42°19'36.0"	70°53'55.0"
DW1	DWI	42°23'03.0"	70°50'27.2"
DW2	DWII	42°20'50.9"	70°49'39.0"
DW3	DWIII	42°21'59.5"	70°52'01.3"
		1979	
DI	DI	42°20'33.7"	70°56'40.9"
DE	DE	42°21'02.4"	70°55'22.0"
DW	DW	42°20'21.9"	70°59'00.7"
NI	NI	42°17'49.2"	70°56'42.3"
B-6	CI	42°20'35.5"	71°00'30.0"
B-7	CD	42°19'14.2"	71°00'47.0"
B-8	CS	42°19'36.0"	70°53'55.0"
B-9	CH	42°16'58.0"	70°54'45.0"
T-19	T3	42°18'12.4"	70°56'09.0"
DW1	DP(Deepwater)	42°23'03.0"	70°50'27.2"
		1982	
B-1	DOB	40°20.93'	70°56.84'
B-2	DIA	42°20.74'	70°56.67'
B-3	DIC	42°20.37'	70°51.44'
B-4	DIB	42°20.39'	70°57.54'
B-5	DOA	42°20.66'	70°58.50'
B-6	CI	42°20.66'	71°00.58'
B-7	CD	42°19.35'	71°00.81'
B-8	CS	42°19.64'	70°53.99'
B-9	CH	47°17.06'	70°54.86'
B-10	NO	42°18.23'	70°56.11'
B-11	NIB	42°17.67'	70°57.12'
B-12	NIC	42°17.65'	70°57.34'
PD	PD	42°23.44'	70°49.59'

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TABLE 2. BENTHIC COMMUNITY PARAMETERS FOR STATIONS IN BOSTON HARBOR AND MASSACHUSETTS BAY COLLECTED IN 1978, 1979, AND 1982.

Station	Depth (m)	Density $/m^2$	Total Species	Spp/50 indiv.	Spp/100 indiv.	Spp/250 indiv.	Spp/500 indiv.	Spp/1000 indiv.	H'	J'
					1978					
T-1	2.3-5	8,100	30	15.0	18.8	25.1	*	*	3.71	0.756
T-2	15-21	15,670	51	17.1	23.9	34.8	43.6	*	4.05	0.714
T-3	2.3-5	7,190	20	9.0	12.6	19.7	*	*	2.33	0.756
T-4	3-4	54,480	39	11.9	14.9	20.1	25.2	32.0	3.32	0.629
T-5	?	5,550	13	5.6	6.9	9.5	12.4	*	2.09	0.565
T-6	15-21	2,940	13	10.1	12.1	*	*	*	2.78	0.753
T-7	3-4	42,090	28	7.8	10.1	14.8	19.2	23.7	2.55	0.531
T-8	3-4	47,550	36	9.0	12.2	17.6	22.3	27.1	2.67	0.516
T-9	?	2,230	8	5.3	6.9	*	*	*	1.57	0.523
T-10	15-21	11,810	36	13.9	19.0	27.1	35.0	*	3.33	0.644
T-11	2.3-5	20,350	30	10.5	14.1	20.0	24.6	28.4	2.79	0.570
T-12	2.3-5	54,420	27	7.9	10.9	15.8	19.9	23.8	1.72	0.361
T-13	2.3-7	33,090	25	6.9	9.3	12.9	16.1	19.3	1.60	0.344
T-14	2.3-7	38,220	40	10.3	14.5	21.2	26.5	31.7	2.24	0.422
T-15	2.3-7	34,850	68	20.5	27.6	37.6	45.8	54.9	4.46	0.733
T-16	5-13	17,010	33	15.2	19.6	25.9	30.3	32.7	3.69	0.731
T-17	2.3-7	21,310	71	24.7	35.2	49.2	58.7	67.5	4.98	0.811
T-18	5-13	36,580	59	18.4	25.9	36.4	44.1	51.4	4.04	0.687
T-19	7.3	34,220	50	17.9	24.9	35.6	44.0	*	4.08	0.722
T-20	5-13	17,830	69	22.3	31,7	45,5	56.6	67.7	4.67	0.762
T-21	5-15	41,560	50	18.4	25.7	35.9	42.9	48.1	4.19	0.741
T-22	12	27,140	77	18.3	26.9	40.0	50.5	62.5	3.93	0.627
B-8	7.3	21,380	58	16.2	22.0	31.2	39.0	47.9	3.94	0.673
DW1	32	5,950	36	15.7	21.5	29.8	*	*	3.57	0.692
DW2	32	6,160	39	18.1	24.3	33.7	*	*	4.18	0.791
DW3	22	1,580	25	20.1	*	*	*	*	4.19	0.903

					1979					
B-6	10.6	5,360	21	9.1	12.1	16.9	*	*	2.65	0.603
B-7	7.3	81,680	47	10.4	14.5	22.1	28.4	34.4	2.86	0.514
B-8	7.3	59,230	65	16.8	24.1	35.8	45.4	54.5	3.58	0.594
B-9	7.3	81,780	45	16.3	22.0	30.5	36.3	40.1	3.77	0.686
DE	7.3	16,560	37	10.4	13.9	20.3	26.7	33.5	2.81	0.540
DI	7.9	5,870	39	16.3	23.6	36.1	*	*	3.62	0.686
DW	7.6	35,870	19	4.9	6.4	9.1	11.5	14.2	1.47	0.345
NI	8.5	61,620	43	15.4	20.6	27.0	31.8	36.7	3.47	0.640
T-19	7.3	34,160	84	22.1	31.2	45.4	57.3	69.3	4.74	0.743
DW1	32	23,230	81	16.1	23.4	36.5	48.8	62.9	3.89	0.614
					1982					
B-1	6.9	53,013	63	10.4	14.3	20.5	26.1	32.5	2.64	0.441
B-2	11.0	20,310	63	16.7	21.9	29.7	36.6	44.4	4.01	0.671
B-3	20.1	8,460	70	23.8	32.9	45.6	55.5	65.3	4.94	0.805
B-4	20.1	5,247	47	14.3	19.8	28.7	36.5	44.9	3.48	0.627
B-5	12.2	1,410	8	2.5	3.7	6.5	*	*	2.95	0.985
B-6	12.2	1,930	12	5.3	6.6	9.3	*	*	1.80	0.805
B-7	7.3	19,357	40	11.1	15.5	22.5	28.4	33.8	2.48	0.467
B-8	8.8	11,583	67	17.3	22.9	32.3	40.5	49.8	4.19	0.691
B-9	8.5	25,897	65	14.4	20.1	29.5	37.4	45.1	3.75	0.623
B-10	12.5	44,200	108	18.0	25.8	39.0	50.9	64.3	4.03	0.597
B-11	11.0	39,846	87	15.9	21.5	30.6	38.9	48.8	3.79	0.589
B-12	12.5	40,587	105	17.4	26.1	40.8	52.9	65.5	3.71	0.553
PD	34.4	100,140	112	7.9	11.7	19.7	28.5	39.6	1.83	0.268

TABLE 3. DOMINANT TAXA FROM STATIONS SAMPLED FROM BOSTON HARBOR AND MASSACHUSETTS BAY IN 1978, 1979, and 1982.

Species (Percent)	Species (Percent)	Species (Percent)
Station T-1 (T8N)	Station T-2 (T8M)	Station T-3 (T8S)
1. Nephtyidae spp. juv (35.8)	Oligochaeta (38.2)	Oligochaeta (59.1)
2. Edotea nr montosa (13.1)	Mytilus edulis (11.9)	Eteone longa (14.3)
3. Polydora cornuta (11.1)	Eteone longa (7.8)	Marinogammarus finmarchicus (13.2)
4. Phyllodoce mucosa (8.5)	Hiatella striata (7.2)	Caulleriella sp. (4.7)
5. Polydora aggregata (5.1)	Pholoe minuta (5.3)	Polygordius sp. A (2.0)
Station T-4 (T4N)	Station T-5 (T4CB)	Station T-6 (T4M)
1. Oligochaeta spp. (39.9)	Capitella spp. complex (42.2)	Oligochaeta spp. (43.2)
2. Chaetozone sp. A (31.4)	Mytilus edulis (26.4)	Diastylis sculpta (18.4)
3. Pholoe minuta (6.0)	Eteone longa (16.2)	Eteone longa (8.5)
4. Eteone longa (4.2)	Procerea cornuta (11.6)	Pectinaria gouldi (4.8)
5. Streblospio benedicti (3.0)	Pholoe minuta (1.1)	Edotea nr. montosa (4.8)
Station T-7 (T5N)	Station T-8 (T5M)	Station T-9 (T5S)
1. Ampelisca abdita (37.7)	Photis pollex (32.2)	Eteone longa (45.3)
2. Pholoe minuta (15.3)	Pholoe minuta (23.2)	Capitella spp (39.0)
3. Photis pollex (14.7)	Ampelisca abdita (18.4)	Oligochaeta (5.4)
4. Phyllodoce mucosa (14.5)	Eteone longa (6.1)	Phyllodoce maculata (2.2)
5. Eteone longa (5.7)	Phyllodoce mucosa (3.3)	Chaetozone sp. A (1.8)
Station T-10 (T7N)	Station T-11 (T7M)	Station T-12 (T7S)
1. Oligochaeta spp. (49.7)	Chaetozone sp. A (48.1)	Chaetozone sp. A (57.6)
2. Mytilus edulis (17.2)	Eteone longa (11.4)	Oligochaeta spp. (28.2)
3. Pholoe minuta (6.1)	Pholoe minuta (9.9)	Pholoe minuta (3.3)
4. Eteone longa (5.2)	Oligochaeta spp. (5.8)	Eteone longa (2.6)
5. Chaetozone sp. A (2.8)	Nephtyidae spp. juv. (5.5)	Nephtyidae spp. juv. (1.6)
Station T-13 (TIO)	Station T-14 (TIM)	Station T-15 (TI1)
1. Ampelisca abdita (71.4)	Ampelisca abdita (63.4)	Oligochaeta (25.2)
2. Eteone longa (11.0)	Eteone longa (6.5)	Ampelisca abdita (15.6)
3. Cirratulus grandis (4.1)	Photis pollex (4.6)	Phoxocephalus holbolli (7.7)
4. Photis pollex (2.7)	Pholoe minuta (4.6)	Polydora aggregata (4.2)
5. Oligochaeta (2.2)	Orchomenella minuta (3.4)	Phyllodoce maculata (4.0)
Station T-16 (T2S)	Station T-17 (T2M)	Station T-18 (T2N)
1. Oligochaeta (21.5)	Oligochaeta (22.2)	Oligochaeta (32.8)
2. Ampelisca abdita (21.8)	Pholoe minuta (8.5)	Aricidea catherinae (17.9)
3. Nephtyidae spp. juv. (9.6)	Aricidea minuta (6.8)	Ampelisca abdita (8.3)
4. Spio filicornis (7.7)	Ostracoda (3.9)	Ostracoda (4.5)
5. Polydora quadrilobata (6.7)	Harmothoe imbricata (3.8)	Pholoe minuta (4.5)

Station T-19 (T3S)

1. Oligochaeta spp. (69.4)
2. Chaetozone sp. A (7.6)
3. Eteone longa (4.9)
4. Pholoe minuta (2.4)
5. Aricidea catherinae (2.2)

Station T-20 (T3M)

Oligochaeta spp. (29.4)
Aricidea catherinae (11.2)
Pholoe minuta (9.4)
Hiatella striata (3.6)
Ostracoda (3.4)

Station T-21 (T3N)

Oligochaeta (55.1)
Aricidea catherinae (6.6)
Pholoe minuta (5.6)
Nucula delphinodonta (5.6)
Ampelisca abdita (5.0)

Station T-22 (CD)

1. Aricidea catherinae (26.7)
2. Oligochaeta (18.7)
3. Hiatella striata (10.9)
4. Chaetozone sp. A (6.1)
5. Chaetozone setosa (5.8)

Station B-8 (CS)

Spiophanes bombyx (19.6)
Polygordius sp. A (13.4)
Caprella linearis (10.9)
Nucula delphinodonta (9.4)
Aricidea catherinae (6.5)

Station DW1

Polydora socialis (22.9)
Spio filicornis (19.3)
Chaetozone sp. A (7.6)
Prionospio steenstrupi (4.7)
Nephtyidae spp. juv. (4.5)

Station DW2

1. Nephtyidae spp. juv. (21.4)
2. Ninoe nigripes (11.2)
3. Phyllodoce mucosa (7.0)
4. Haploscoloplos sp. (7.0)
5. Capitella spp. (7.0)

Station DW3

Oligochaeta spp. (27.2)
Hiatella striata (10.1)
Nephtyidae spp. juv. (7.0)
Cirratulid sp. C (5.1)
Strongylocentrotus droebachiensis (5.1)

1979

Station B-6 (CI)

1. Capitella spp. (31.0)
2. Polydora cornuta (22.2)
3. Eteone longa (19.2)
4. Chaetozone sp. Y (6.7)
5. Oligochaeta spp. (6.2)

Station B-7 (CD)

Ampelisca abdita (34.1)
Oligochaeta (15.1)
Photis pollex (14.0)
Polydora cornuta (13.5)
Pholoe minuta (6.2)

Station B-8 (CS)

Nucula delphinodonta (45.6)
Photis pollex (7.5)
Tellina agilis (5.7)
Aricidea catherinae (3.9)
Unciola irrorata (3.9)

Station B-9 (CH)

1. Ampelisca vadorum (25.6)
2. Oligochaeta spp. (23.9)
3. Orchomenella minuta (6.2)
4. Ampelisca abdita (5.2)
5. Tellina agilis (4.2)

Station DE

Parapionosyllis longocirrata (35.4)
Pseudunciola obliquua (25.3)
Tanais cavolini (8.4)
Oligochaeta spp. (6.0)
Exogone hebes (4.6)

Station DI

Nephtyidae spp. juv. (35.9)
Tellina agilis (16.4)
Oligochaeta spp. (10.2)
Nassarius vibex (8.5)
Spiophanes bombyx (6.3)

Station DW (Boston Harbor)

1. Polydora cornuta (66.6)
2. Eteone longa (21.5)
3. Capitella spp. (6.3)
4. Phyllodoce mucosa (1.3)
5. Spio cf. armata (0.9)

Station NI

Ampelisca abdita (33.8)
Corophium spp. (7.8)
Orchomenella minuta (7.7)
Leptocheirus pinguis (6.5)
Oligochaeta (6.3)

Station T-19 (T-3)

Oligochaeta spp. (20.7)
Cirratulus grandis (11.7)
Harmothoe imbricata (9.1)
Pholoe minuta (6.5)
Hiatella striata (4.7)

Station DW1 (DP, Massachusetts Bay)

1. Mediomastus ambiseta (24.6)
2. Polydora socialis (11.5)
3. Prionospio steenstrupi (12.0)
4. Spio cf. armata (10.0)
5. Asabellides oculata (5.4)

1982

Station B-1

1. Polydora aggregata (50)
2. Polydora cornuta (14.6)
3. Tharyx acutus (9.8)
4. Tellina agilis (5.3)
5. Spio limicola (2.5)

Station B-2

Etodea nr. montosa (18.3)
Tellina agilis (14)
Polydora cornuta (8.4)
Nephtys spp. juv (7.8)
Nassarius vibex (6.4)

Station B-3

Oligochaeta spp. (31.2)
Eteone longa (7.1)
Spio cf. armata (5.8)
Polydora cornuta (5.8)
Phoxocephalus holbolli (4.4)

Station B-4

1. Nassarius vibex (26.5)
2. Tellina agilis (19.6)
3. Edotea nr. montosa (10.2)
4. Diastylis polita (5.5)
5. Nephtys spp. juv. (5.2)

Station B-5

Capitella spp. complex (96.4)
Eteone longa (1.1)
Tharyx acutus (0.8)

Station B-6

Polydora cornuta (41.4)
Capitella spp. complex (38.7)
Polydora aggregata (8.3)
Eteone longa (4.9)
Nephtys spp. juv. (2.8)

Station B-7

1. Oligochaeta spp. (41.6)
2. Polydora cornuta (31.5)
3. Lumbrineris impatiens (5.2)
4. Nephtys spp. juv. (5.0)
5. Polydora aggregata (3.0)

Station B-8

Photis pollex (15.2)
Tellina agilis (11.0)
Spiophanes bombyx (9.9)
Edotea nr. montosa (8.0)
Spio limicola (6.2)

Station B-9

Oligochaeta spp. (24.2)
Ampelisca vadorum (13.9)
Aricidea catherinae (12.7)
Leptocheirus pinguis (11.8)
Polydora quadrilobata (7.3)

Station B-10

1. Aricidea catherinae (27.1)
2. Oligochaeta spp. (20.8)
3. Spio cf. armata (6.7)
4. Tharyx acutus (6.3)
5. Phoxocephalus holbolli (5.3)

Station B-11

Aricidea catherinae (27.2)
Ampelisca vadorum (15.9)
Phoxocephalus holbolli (7.2)
Oligochaeta spp. (5.9)
Orchomenella minuta (5.7)

Station B-12

Aricidea catherinae (35)
Oligochaeta spp. (19.5)
Phoxocephalus holbolli (6.3)
Spio cf. armata (5.9)
Ampelisca vadorum (4.1)

TABLE 4. SPECIES GROUPS IDENTIFIED BY INVERSE CLUSTER ANALYSIS OF 12 STATIONS IN BOSTON HARBOR AND ONE IN MASSACHUSETTS BAY SAMPLED IN 1982.

Group 1

- *Aricidea catherinae*
- *Edotea* nr. *montosa*
- *Orchomella minuta*
- *Phoxocephalus holobolli*
- *Polydora socialis*
- *Polydora quadrilobata*
- *Nassarius vibex*
- *Spio armata*
- *Spio limicola*
- *Tellina agilis*
- *Tharyx acutus*
- *Unciola* sp. C
- *Unciola irrorata*

Group 2

- *Capitella* spp.
- *Eteone longa*
- *Polydora aggregata*
- *Polydora cornuta*

Group 3

- *Exogone hebes*
- *Diastylus sculpa*
- *Photis pollex*
- *Polygordius* sp. A
- *Photis pollex*

Group 4

- *Ampelisca vadorum*
- *Harmothoe imbricata*
- *H. extenuataa*
- *Leptocheirus pinguis*
- *Mediomastus ambiseta*
- *Modiolus modiolus*
- Nemertean sp. F
- *Pholoe minuta*
- *Prionospio steenstrupi*

Group 5

- *Aeginina longicornis*
- *Asabellides oculata*
- *Chaetozone setosa*
- *Hiatella striata*
- *Lyonsia hyalina*
- Nemertean sp. F
- *Procerea fasciatus*
- *Spio filicornis*
- *Tharyx baptistae*

Group 6

- *Jassa falcata*
- *Proboloides holmesi*
- *Procerea cornuta*

Group 7

- *Diastylis polita*

Group 8

- *Ampelisca abdita*
- *Cirratulus grandis*
- *Lumbrineris impatiens*

Group 9

- *Euclymene* sp. A
- *Phoronis architecta*
- *Tharyx marioni*

TABLE 5. DOMINANT TAXA FROM BOSTON HARBOR AND MASSACHUSETTS BAY STATIONS SAMPLED IN SEQUENTIAL YAERS.

	1978 Species (Percent)	1979 Species (Percent)	1982 Species (Percent)
Station B-8 (Station CS in 1978, 1979, and 1982 reports)			
1.	Spiophanes bombyx (21.3)	Nucula delphiondonta (45.6)	Photis pollex (15.2)
2.	Polygordius sp. A (14.5)	Photis pollex (7.5)	Tellina agilis (11.0)
3.	Caprella linearis (11.8)	Tellina agilis (5.7)	Spiophanes bombyx (9.9)
4.	Nucula delphinodonta (10.1)	Aricidea catherinae (3.9)	Edotea nr. montosa (8.0)
5.	Aricidea catherinae (7.0)	Unciola irrorata (3.9)	Spio limicola (6.2)
6.	Chaetozone sp. A (6.4)	Polydora socialis (3.7)	Polydora socialis (5.9)
7.	Tellina agilis (4.3)	Echinorachnius parma (2.7)	Unciola sp. C (5.0)
8.	Unciola irrorata (2.8)	Rhepoxynius epistomus (2.6)	Unciola irrorata (4.5)
9.	Spio filicornis (2.2)	Spiophanes bombyx (2.5)	Orchomenella minuta (4.4)
10.	Capitella spp. complex (2.1)	Phoxocephalus holbolli (1.6)	Phoxocephalus holbolli (4.3)
Total Density	Total Density (71,900 per m²)	Total Density (59,230 per m²)	Total Density (11,583 per m²)
Station DW1			
1.	Polydora socialis (24.7)	Mediomastus ambiseta (25.8)	
2.	Spio filicornis (23.1)	Polydora socialis (15.3)	
3.	Prionospio steenstrupi (5.5)	Prionospio steenstrupi (12.5)	
4.	Polydora quadrilobata (5.2)	Spio cf. armata (10.6)	
5.	Oligochaeta spp. (5.2)	Asabellides oculata (5.7)	NOT SAMPLED IN 1982
6.	Mediomastus ambiseta (4.8)	Capitella spp. complex (3.6)	
7.	Capitella spp. complex (3.4)	Spio filicornis (2.1)	
8.	Polydora caulleryi (2.7)	Exogone verugera (2.1)	
9.	Polydora aggregata (2.4)	Microphthalmus aberrans (1.7)	
10.	Ninoe nigripes (2.2)	Oligochaeta spp. (1.6)	
Total Density	Total Density (5,950 per m²)	Total Density (23,230 per m²)	
Station T-19 (T3S in 1978 report; T-3 in 1979 report)			
1.	Oligochaeta spp. (73.0)	Oligochaeta spp. (21.8)	
2.	Chaetozone sp. A (5.5)	Cirratulus grandis (12.3)	
3.	Eteone longa (5.2)	Harmothoe imbricata (9.6)	
4.	Pholoe minuta (2.5)	Pholoe minuta (6.8)	
5.	Aricidea catherinae (2.3)	Hiatella striata (5.0)	NOT SAMPLED IN 1982
6.	Ampelisca abdita (1.3)	Capitella spp. (3.8)	
7.	Spio filicornis (1.1)	Phoxocephalus holbolli (3.6)	
8.	Microphthalmus aberrans (0.9)	Proboloides holmesi (3.1)	
9.	Tellina agilis (0.8)	Pleusymtes glabor (2.8)	
10.	Mediomastus ambiseta (0.7)	Chaetozone sp. Y (2.7)	
Total Density	Total Density (34,220 per m²)	Total Density (34,160 per m²)	
Station B-6 (CI in 1979 and 1982 reports)			
1.		Capitella spp. complex (31.6)	Polydora cornuta (41.4)
2.		Polydora cornuta (22.7)	Capitella spp. complex (38.7)
3.		Eteone longa (19.6)	Polydora aggregata (8.3)
4.		Chaetozone sp. Y (6.8)	Eteone longa (4.9)
5.	NOT SAMPLED IN 1978	Oligochaeta spp. (6.3)	Nephtys spp. juv. (2.8)
6.		Crangon septemspinosa (3.4)	
7.		Spio cf. armata (1.5)	
8.		Nassarius vibex (1.5)	
9.		Mytilus edulis (0.8)	
10.		Streblospio benedicti (0.8)	
Total Density		Total Density (5,360 per m²)	Total Density (1,930 per m²)

Station B-7 (CD in 1979 and 1982 reports)

1.	*Ampelisca abdita* (34.9)	Oligochaeta spp. (41.6)
2.	Oligochaeta spp. (15.4)	*Polydora cornuta* (31.5)
3.	*Photis pollex* (14.3)	*Lumbrineris impatiens* (5.2)
4.	*Polydora cornuta* (13.8)	*Nephtys* spp. juv. (5.0)
5. NOT SAMPLED IN 1978	*Pholoe minuta* (6.3)	*Polydora aggregata* (3.0)
6.	*Chaetozone* sp. Y (4.4)	*Aricidea catherinae* (1.8)
7.	*Nassarius vibex* (1.1)	*Ampelisca abdita* (1.4)
8.	*Aricidea catherinae* (1.0)	*Spio limicola* (1.3)
9.	*Lumbrineris impatiens* (0.8)	*Eteone longa* (1.2)
10.	*Leptocheirus pinguis* (0.75)	*Ampelisca* spp. (1.2)
Total Density	Total Density (81,680 per m^2)	Total Density (19,357 per m^2)

Station B-9 (CH in 1979 and 1982 reports)

1.	*Ampelisca vadorum* (25.6)	Oligochaeta spp. (24.2)
2.	Oligochaeta spp. (23.9)	*Ampelisca vadorum* (13.9)
3.	*Orchomenella minuta* (6.2)	*Aricidea catherinae* (12.7)
4.	*Ampelisca abdita* (5.2)	*Leptocheirus pinguis* (11.8)
5. NOT SAMPLED IN 1978	*Tellina agilis* (4.2)	*Polydora quadrilobata* (7.3)
6.	*Nucula delphinodonta* (4.0)	*Orchomenella minuta* (4.5)
7.	*Aricidea catherinae* (2.6)	*Cirratulus grandis* (3.4)
8.	*Photis pollex* (2.4)	*Polydora cornuta* (2.8)
9.	*Prionospio steenstrupi* (2.1)	*Nephtys* spp. juv. (2.7)
10.	*Phoxocephalus holbolli* (2.1)	*Lumbrineris impatiens* (2.4)
Total Density	Total Density (81,780 per m^2)	Total Density (25,897 per m^2)

Fig. 1

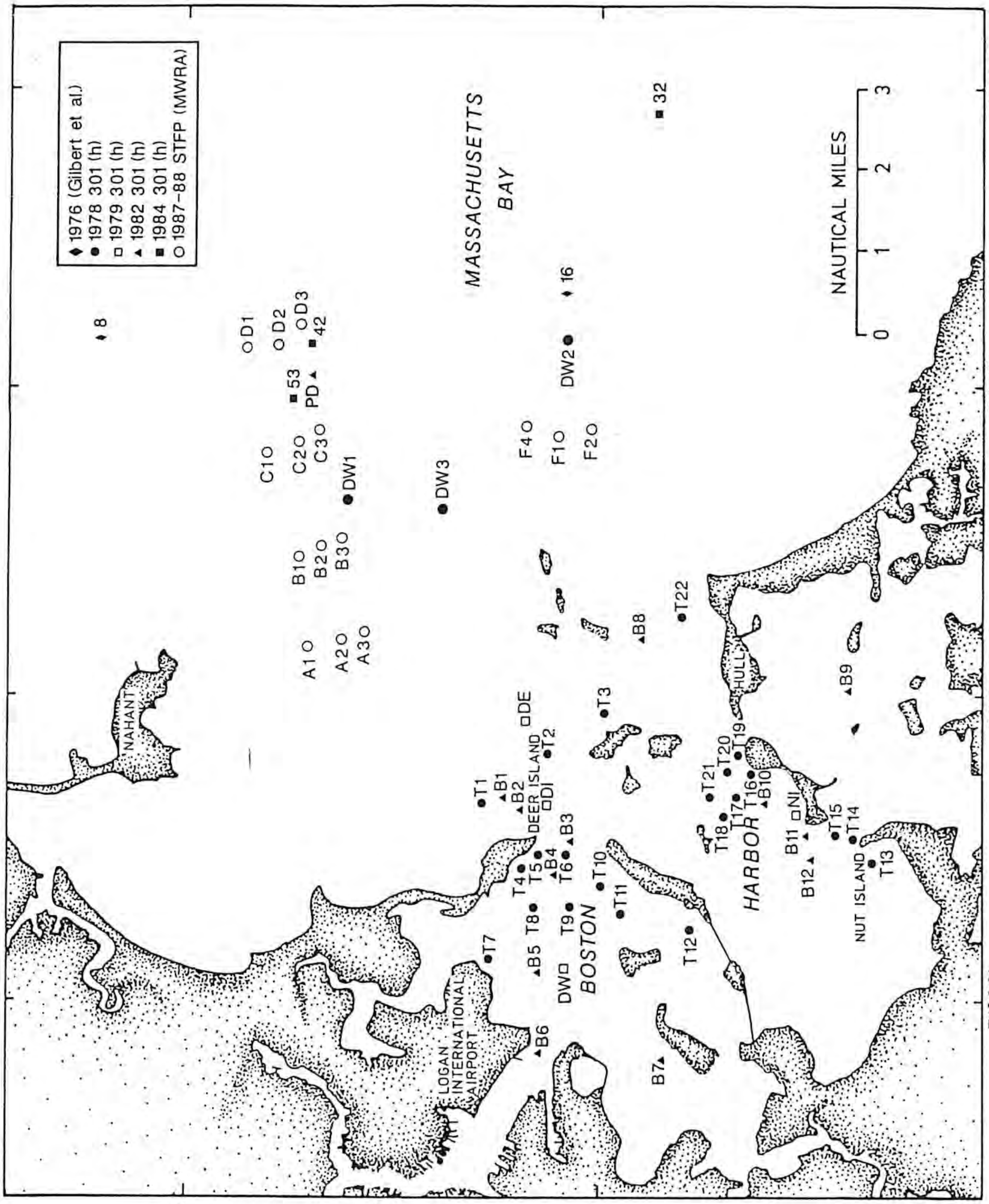

1976 (Gilbert et al.)
1978 301 (h)
1979 301 (h)
1982 301 (h)
1984 301 (h)
1987-88 STFP (MWRA)
MASSACHUSETTS BAY
NAUTICAL MILES
0 1 2 3
NAHANT
DEER ISLAND
BOSTON HARBOR
HULL
NUT ISLAND
LOGAN INTERNATIONAL AIRPORT
42°25'
42°20'
71°00'
70°55'
70°50'
70°45'

Fig. 2

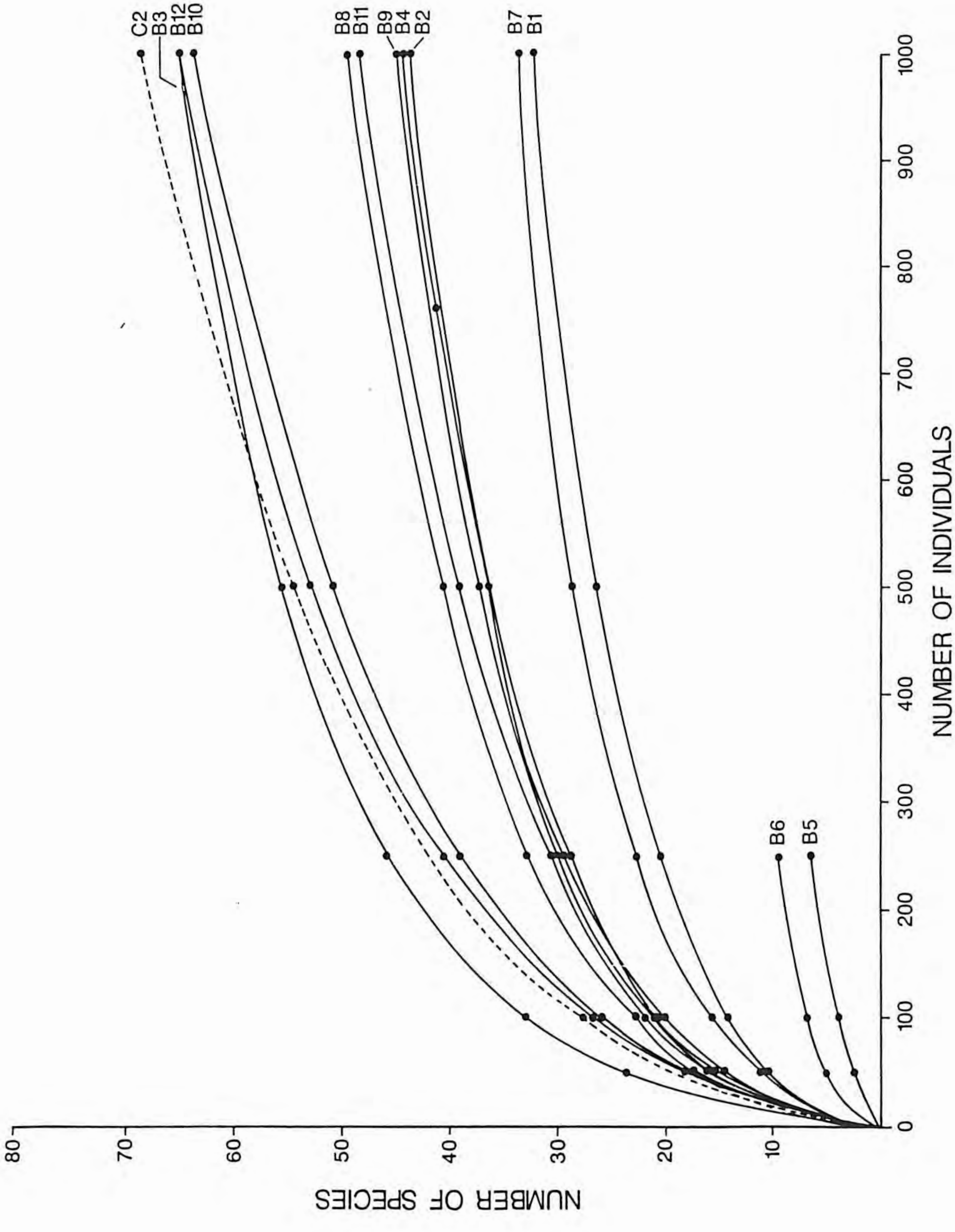

NUMBER OF SPECIES
NUMBER OF INDIVIDUALS
0
10
20
30
40
50
60
70
80
100
200
300
400
500
600
700
800
900
1000
C2
B3
B12
B10
B8
B11
B9
B4
B2
B7
B1
B6
B5

Fig. 3

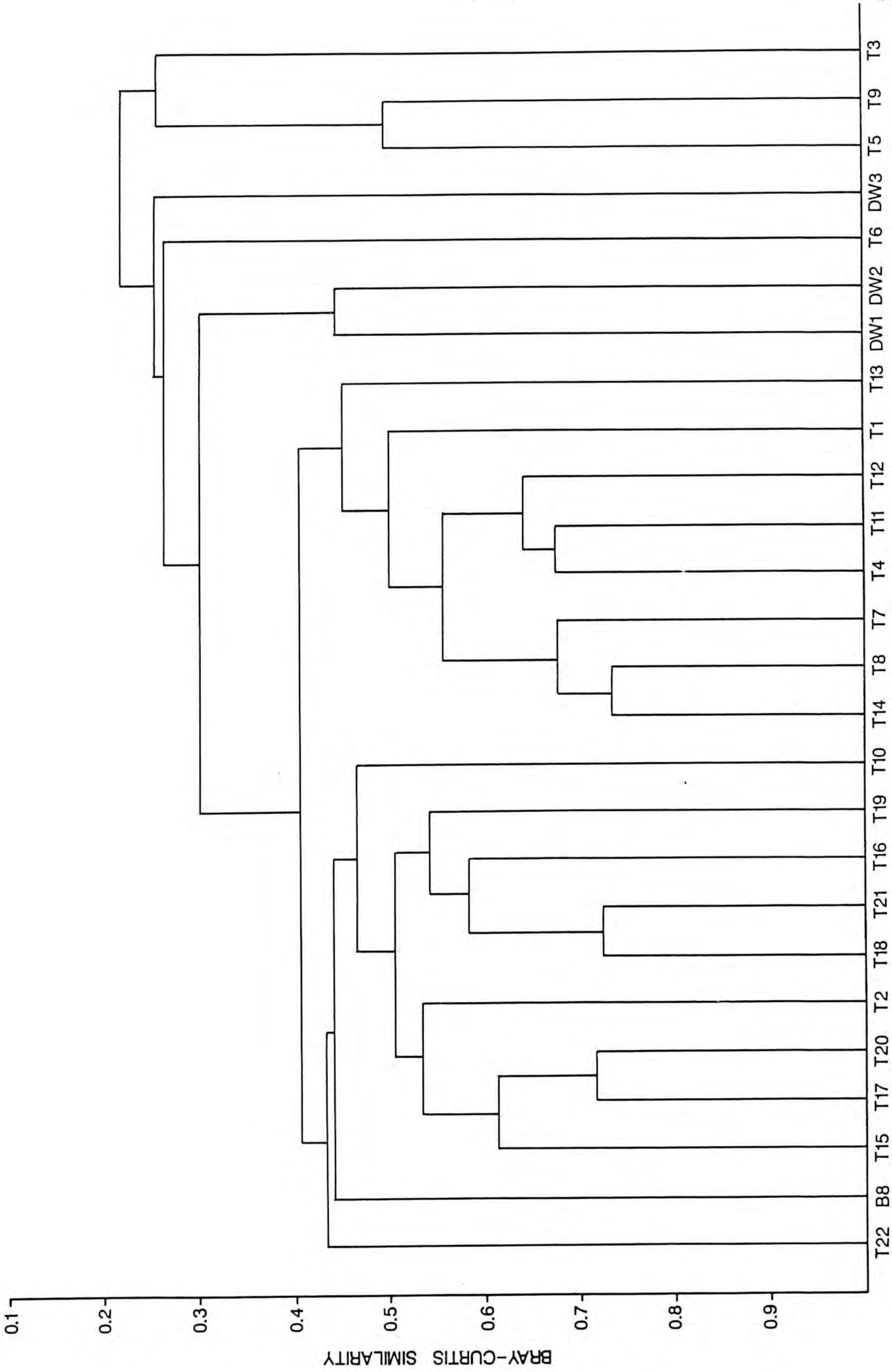

T3
T9
T5
DW3
T6
DW2
DW1
T13
T1
T12
T11
T4
T7
T8
T14
T10
T19
T16
T21
T18
T2
T20
T17
T15
B8
T22
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
BRAY-CURTIS SIMILARITY

Fig. 4

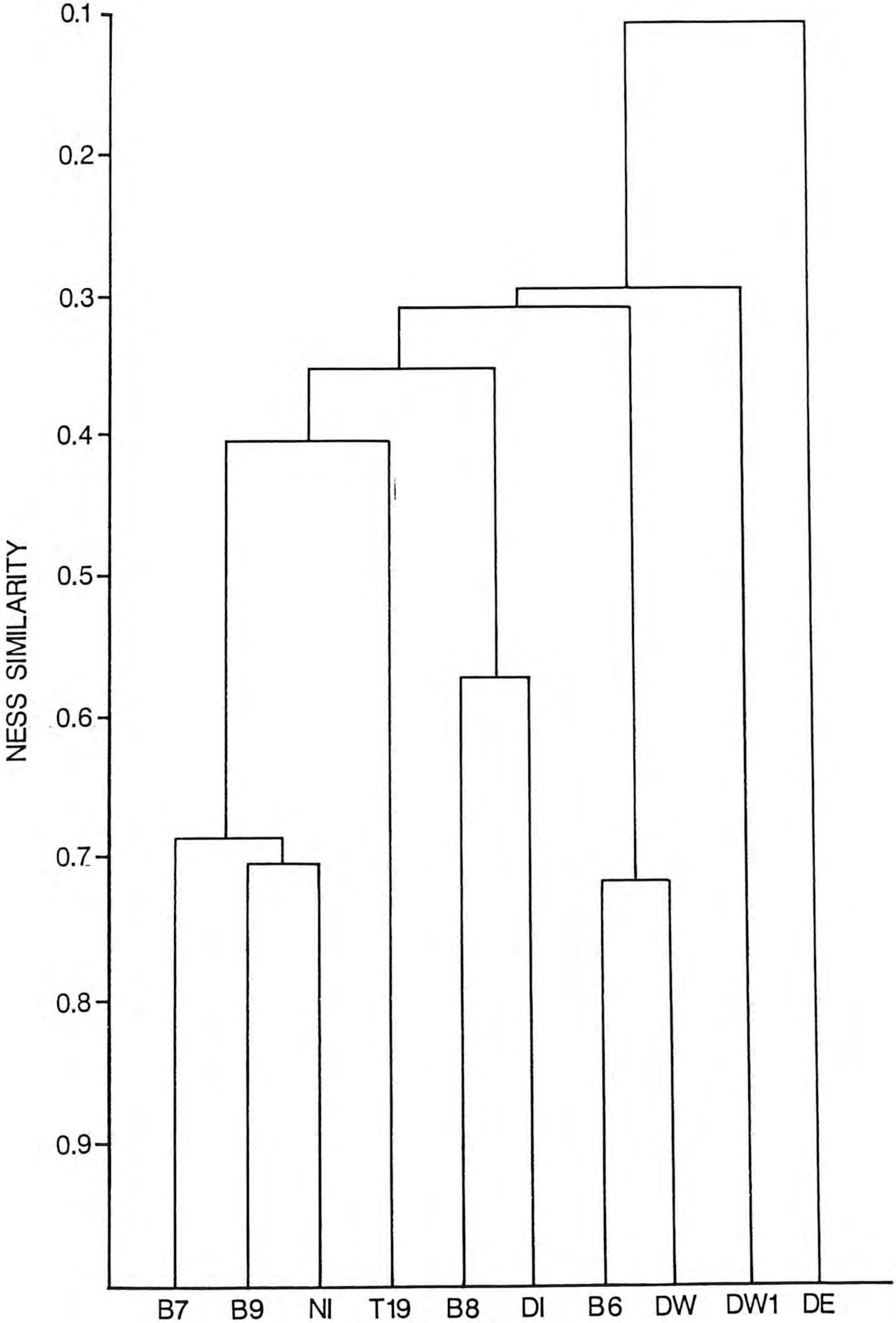

NESS SIMILARITY
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
B7
B9
NI
T19
B8
DI
B6
DW
DW1
DE

Fig. 5

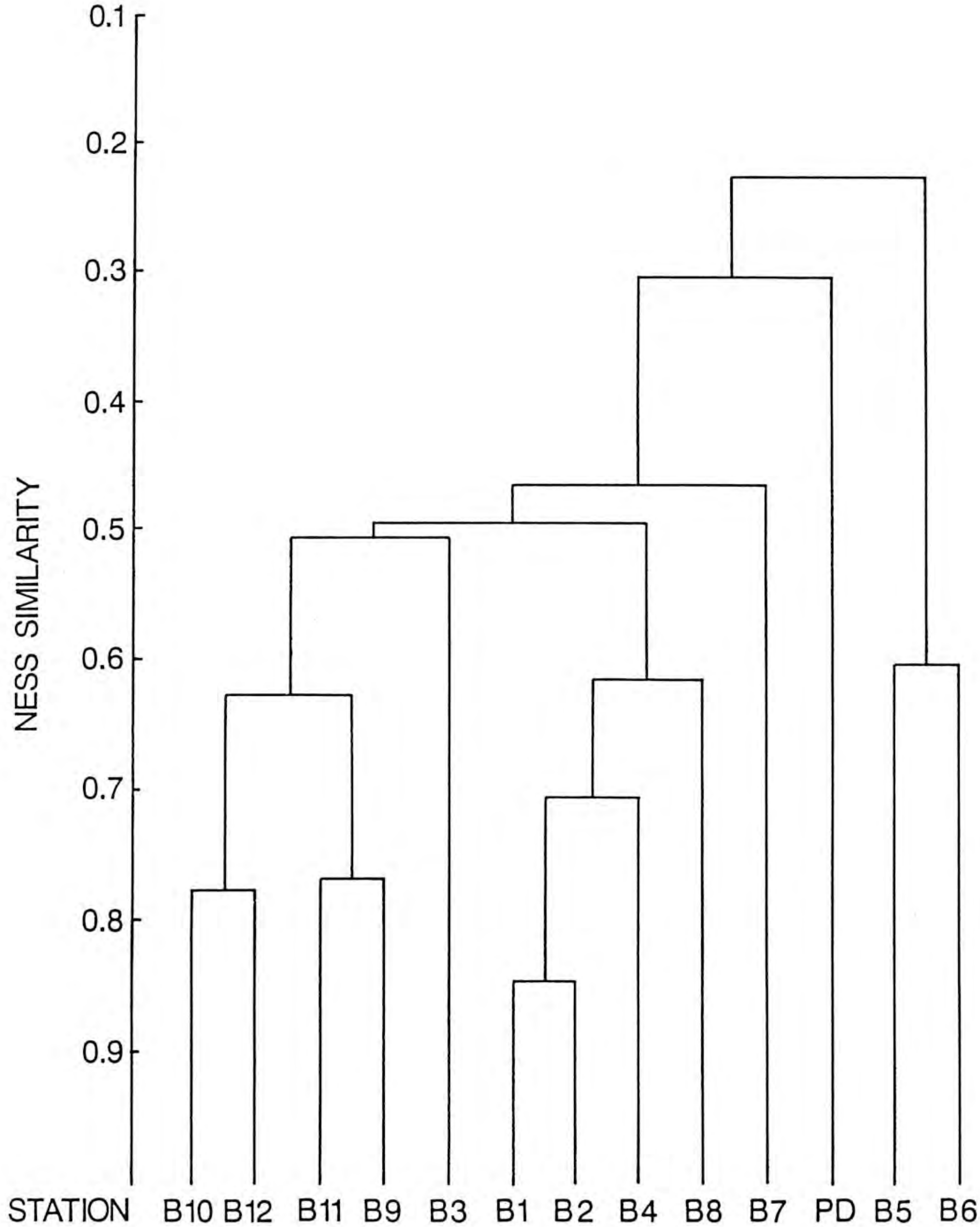
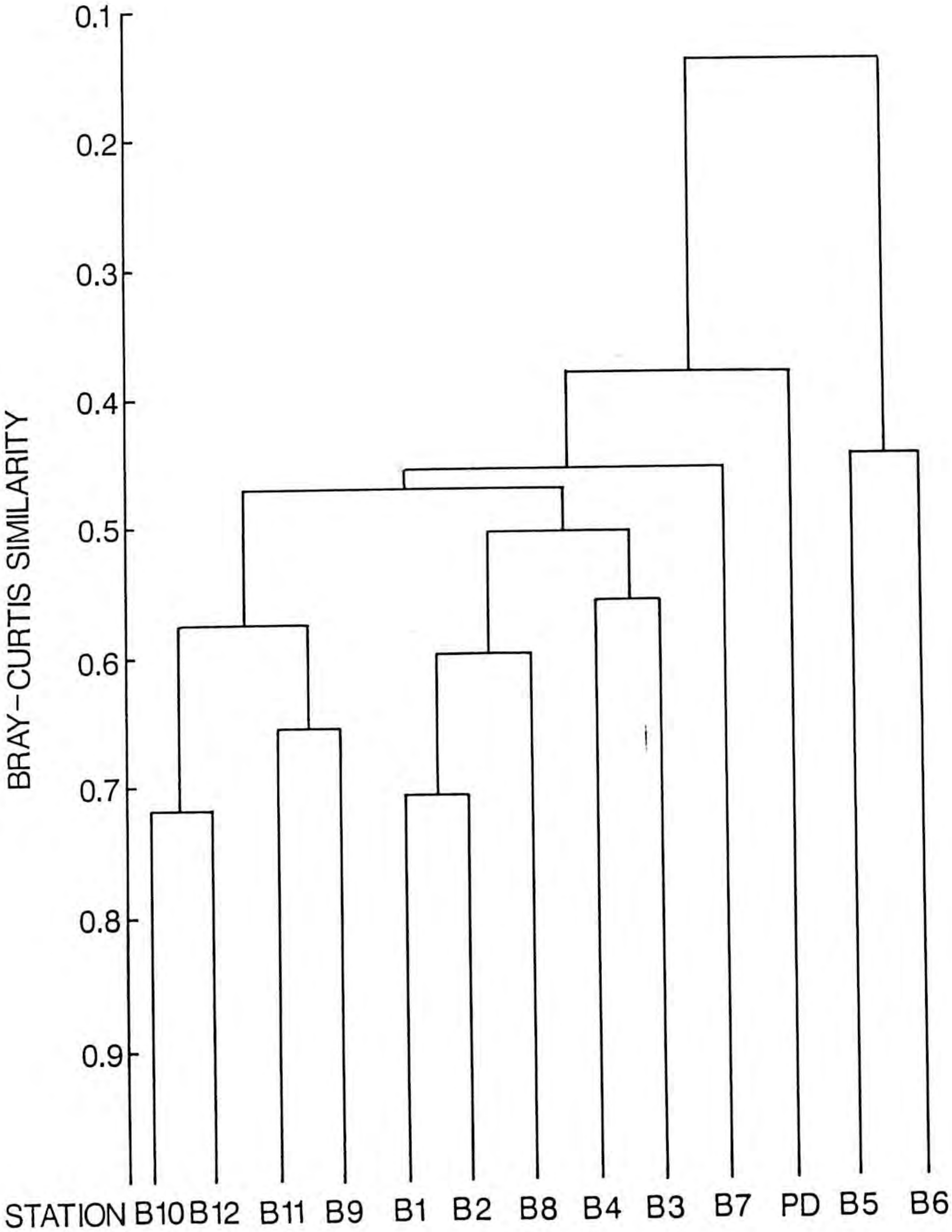
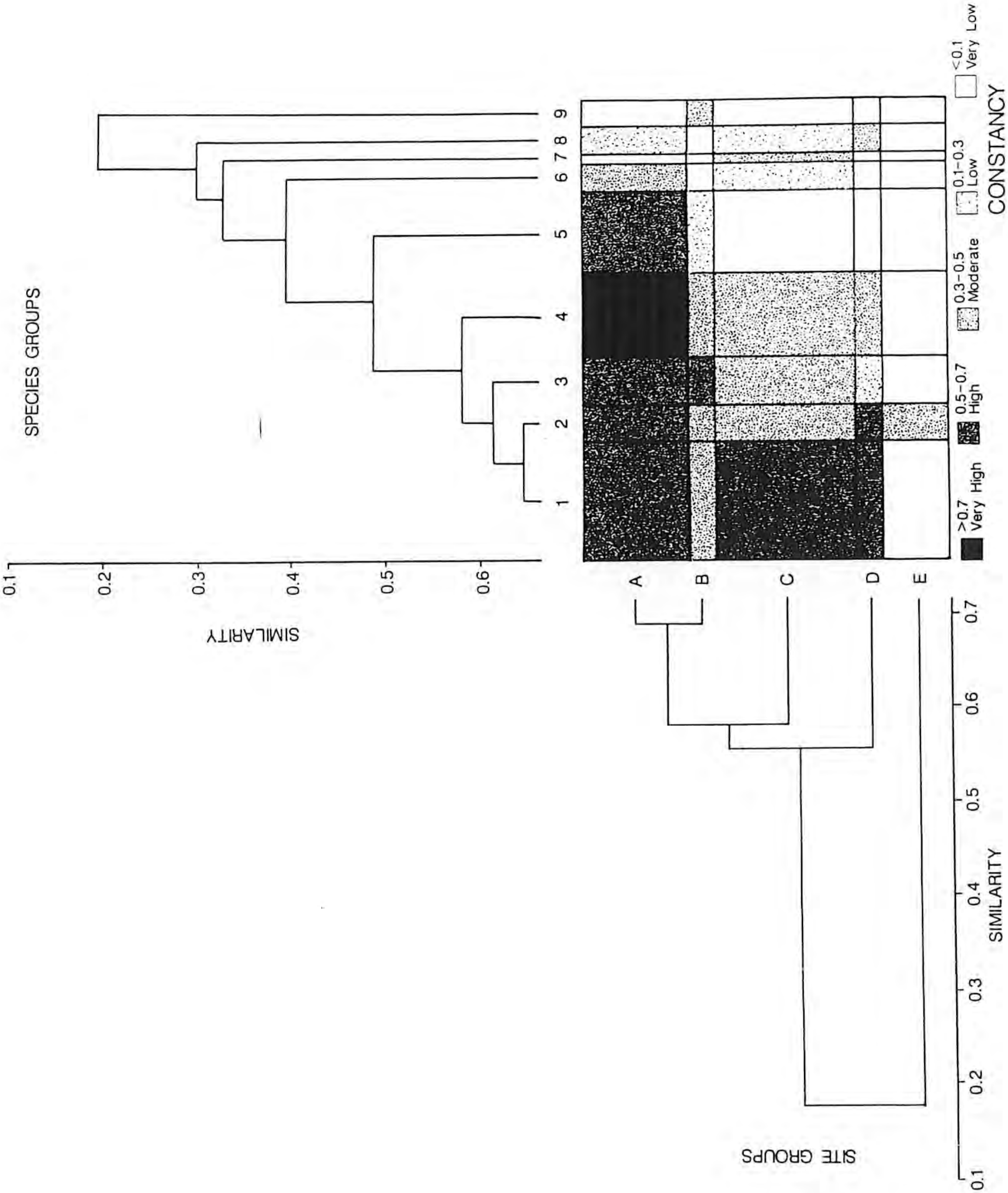

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
NESS SIMILARITY
STATION
B10
B12
B11
B9
B3
B1
B2
B4
B8
B7
PD
B5
B6

Fig. 6



0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
BRAY-CURTIS SIMILARITY
STATION B10 B12 B11 B9 B1 B2 B8 B4 B3 B7 PD B5 B6

Fig. 7



SPECIES GROUPS
SIMILARITY
0.1
0.2
0.3
0.4
0.5
0.6
1
2
3
4
5
6
7
8
9
A
B
C
D
E
SITE GROUPS
SIMILARITY
0.1
0.2
0.3
0.4
0.5
0.6
0.7
>0.7 Very High
0.5–0.7 High
0.3–0.5 Moderate
0.1–0.3 Low
<0.1 Very Low
CONSTANCY

Fig. 8

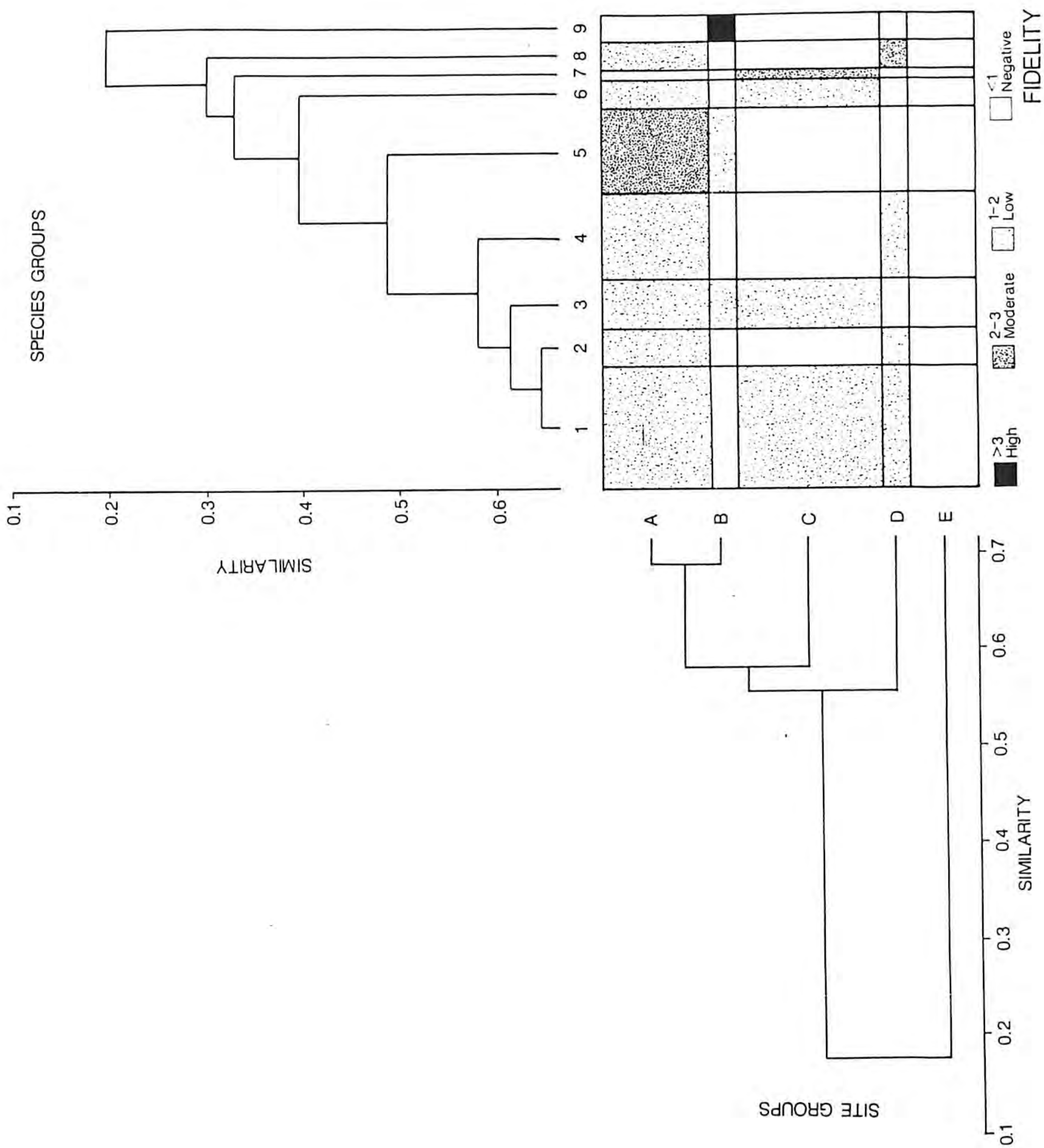

SPECIES GROUPS
SIMILARITY
0.1
0.2
0.3
0.4
0.5
0.6
1
2
3
4
5
6
7
8
9
A
B
C
D
E
SITE GROUPS
SIMILARITY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
>3 High
2–3 Moderate
1–2 Low
<1 Negative
FIDELITY

Fig. 9

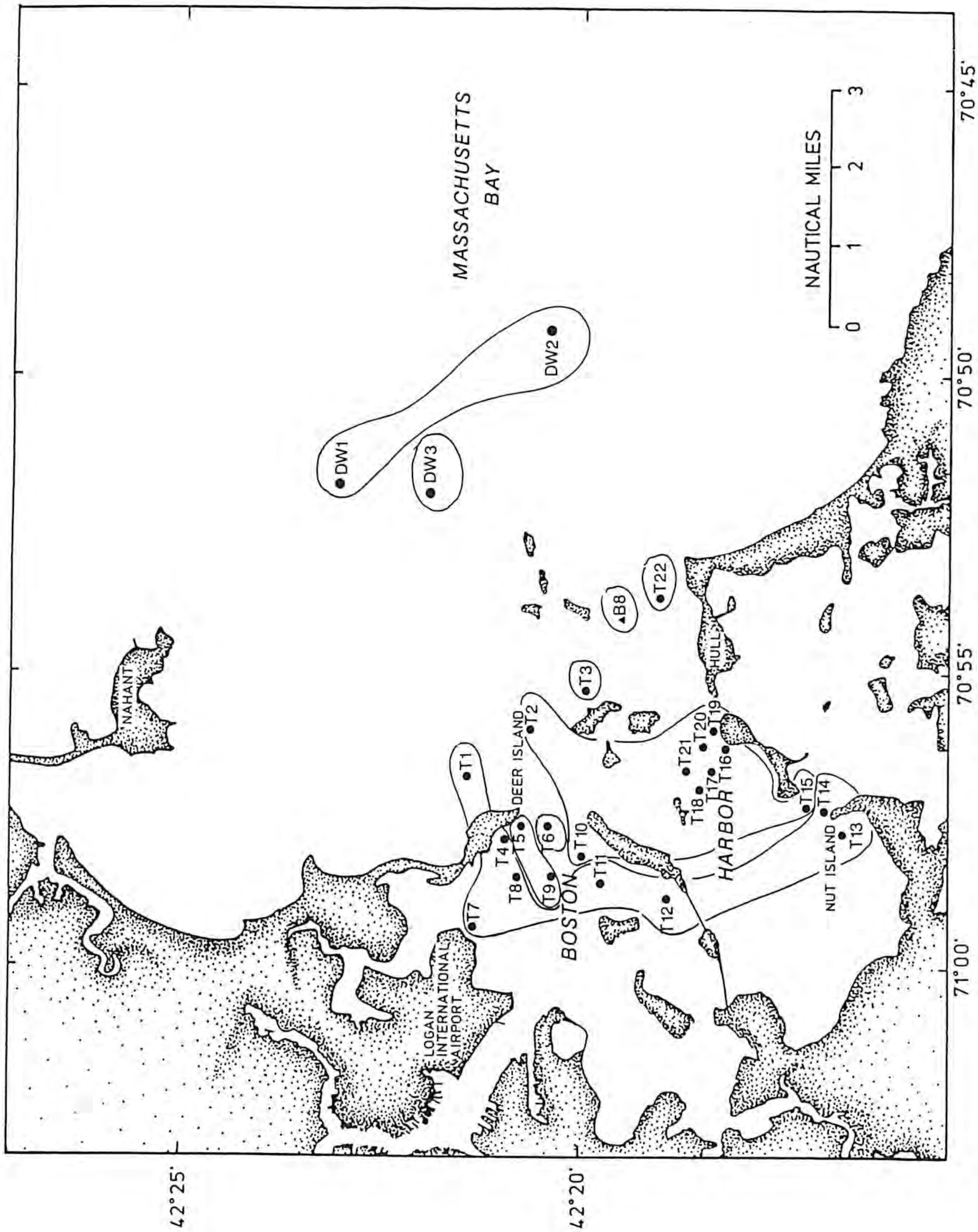
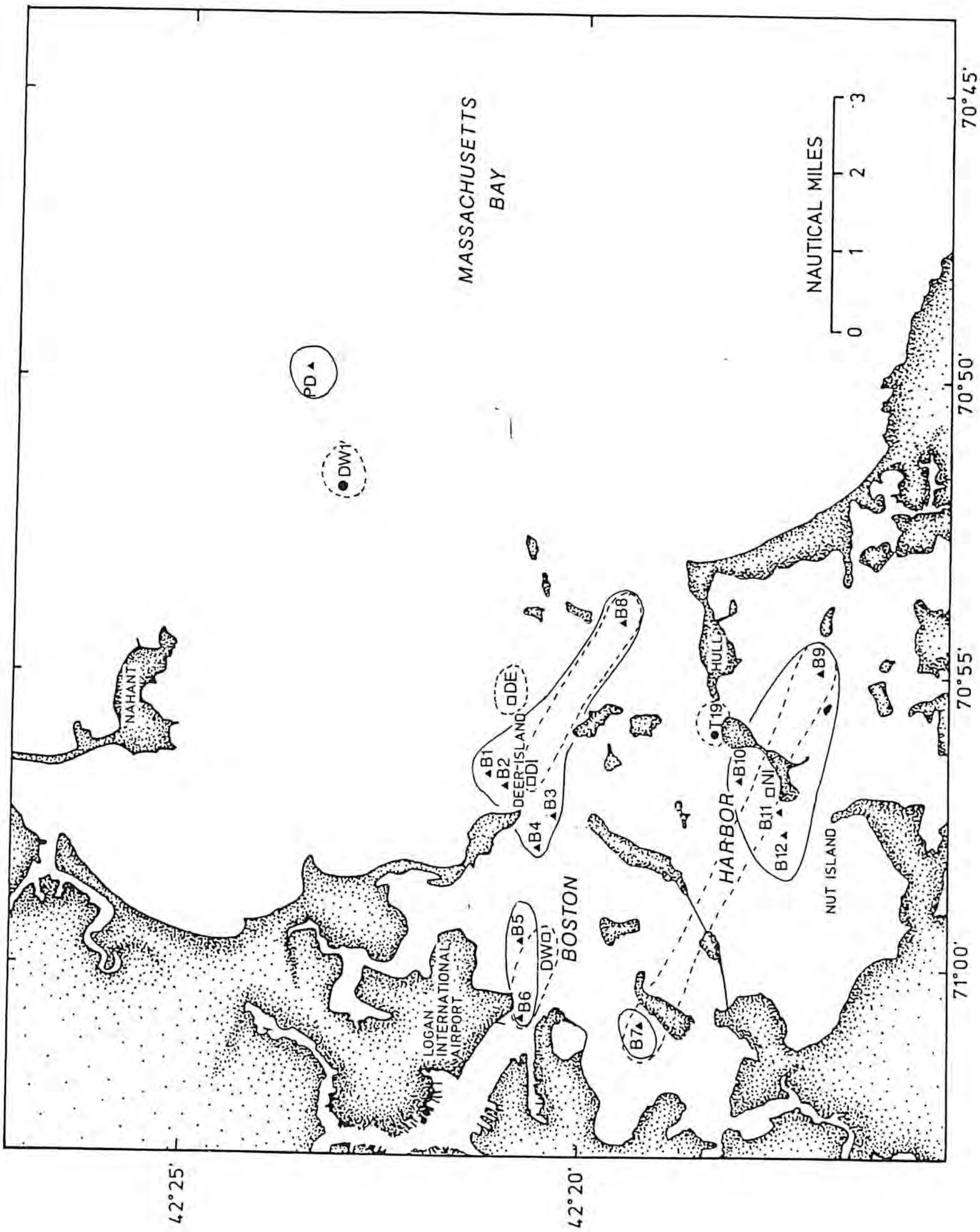
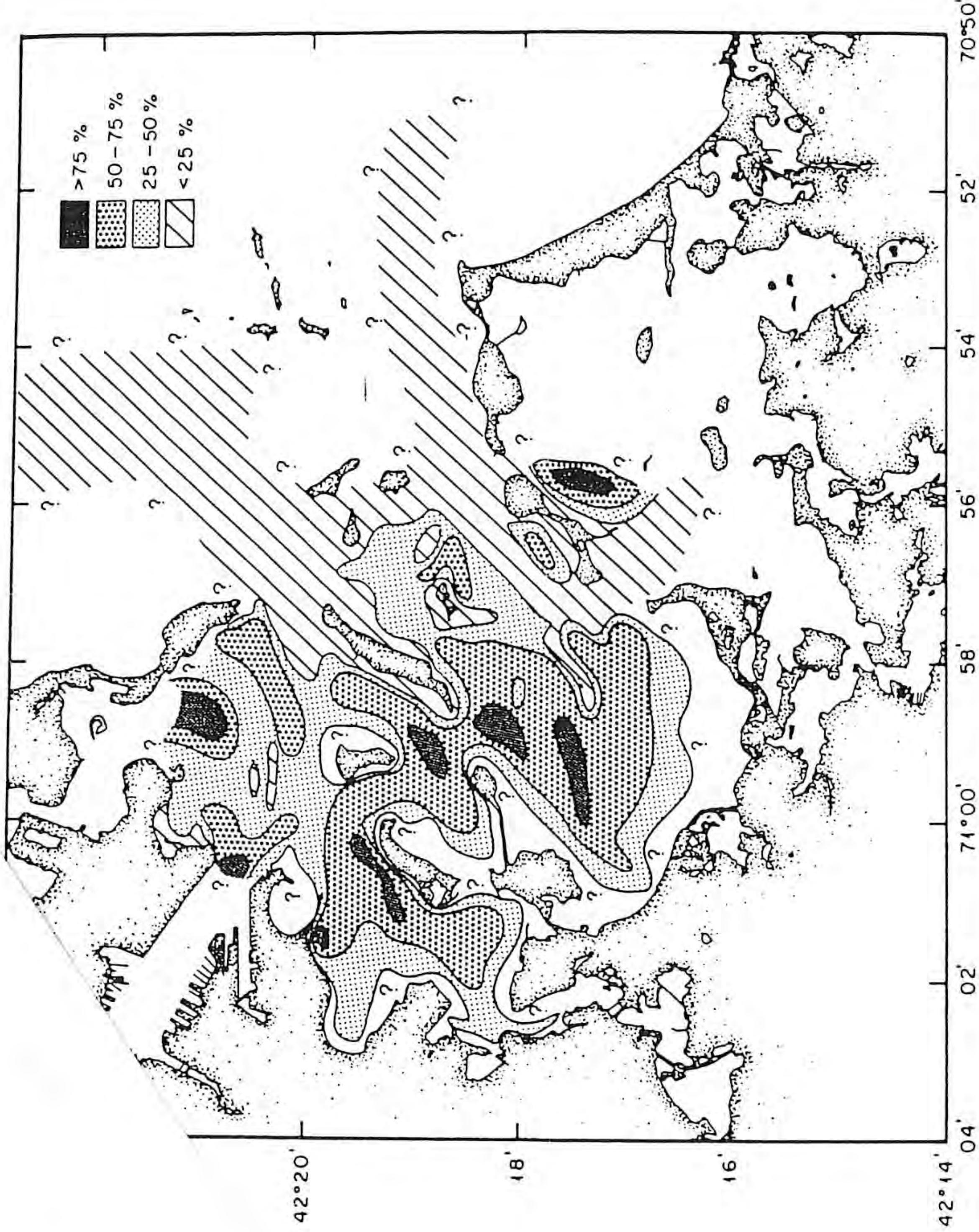

MASSACHUSETTS BAY
NAUTICAL MILES
0 1 2 3
NAHANT
LOGAN INTERNATIONAL AIRPORT
DEER ISLAND
BOSTON HARBOR
HULL
NUT ISLAND
DW1
DW2
DW3
B8
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
T19
T20
T21
T22
42°25'
42°20'
71°00'
70°55'
70°50'
70°45'

Fig. 10



MASSACHUSETTS
BAY
NAUTICAL MILES
0
1
2
3
NAHANT
DEER ISLAND
DI
DE
PD
DW1
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12
NI
T19
HULL
HARBOR
BOSTON
DWD
NUT ISLAND
LOGAN
INTERNATIONAL
AIRPORT
42°25'
42°20'
71°00'
70°55'
70°50'
70°45'

Fig. 11



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