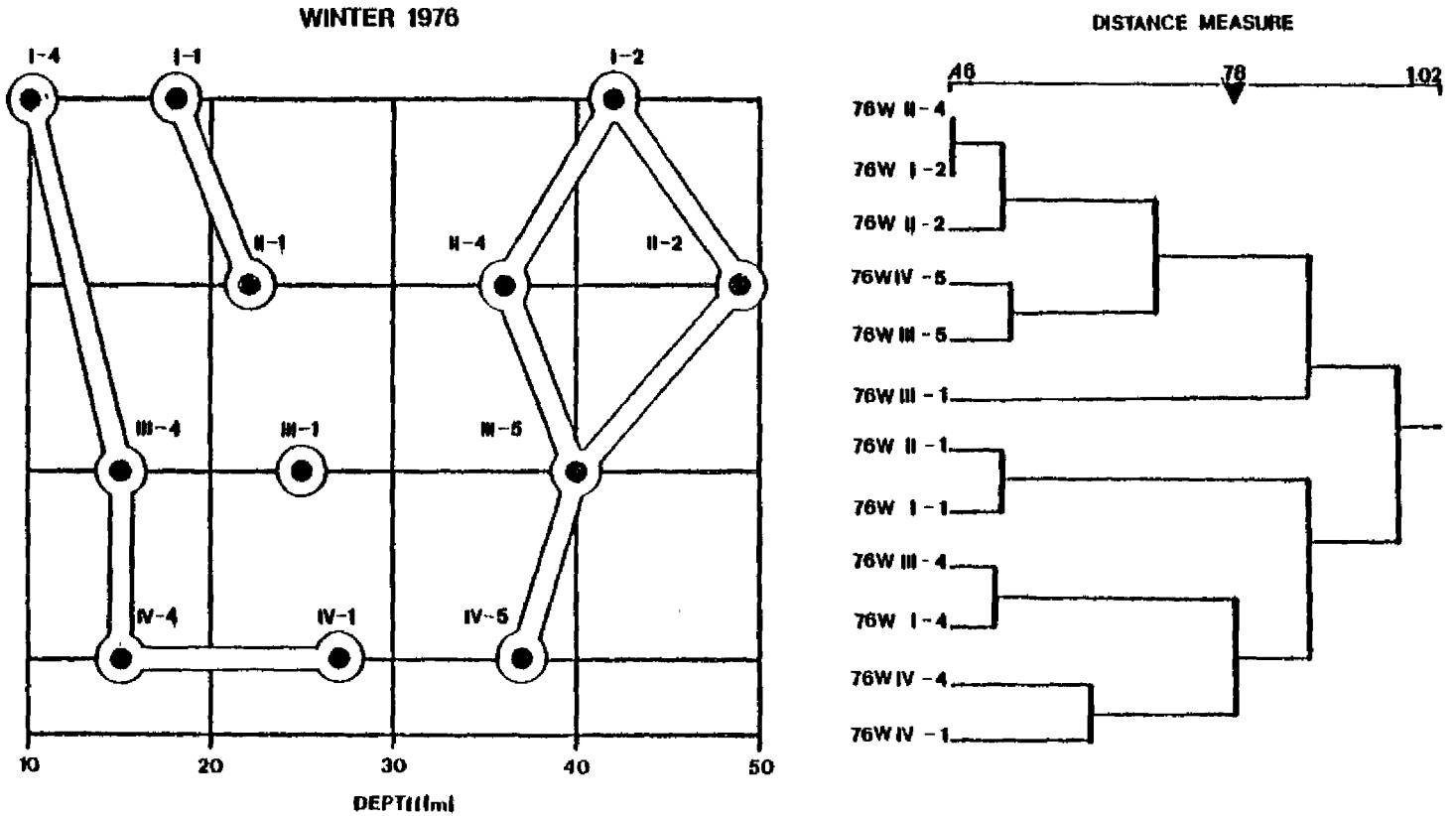

Figure 4-52. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for winter 1976 (0.2% cutoff).

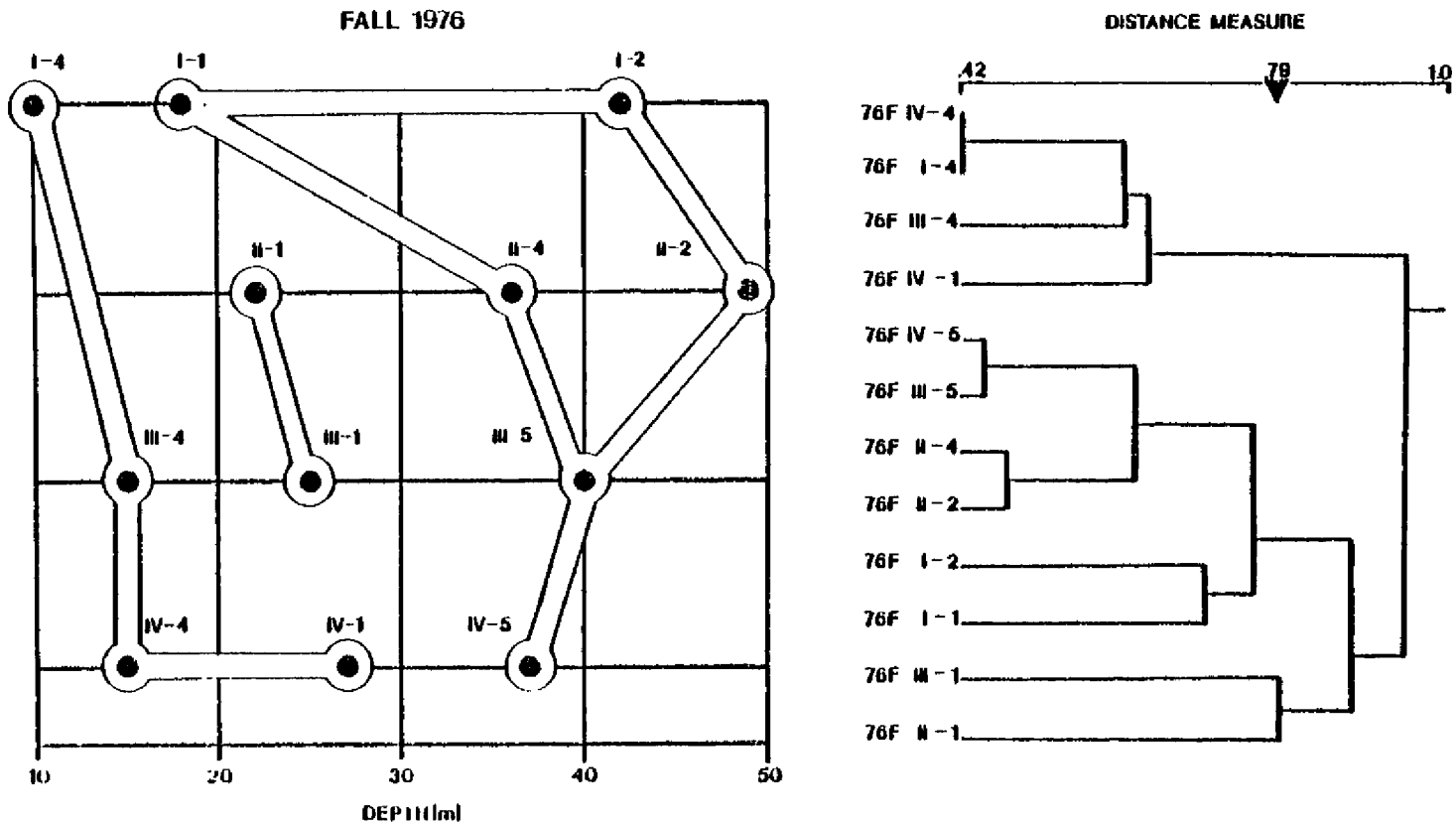

Figure 4-53. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for fall 1976 (0.2% cutoff).

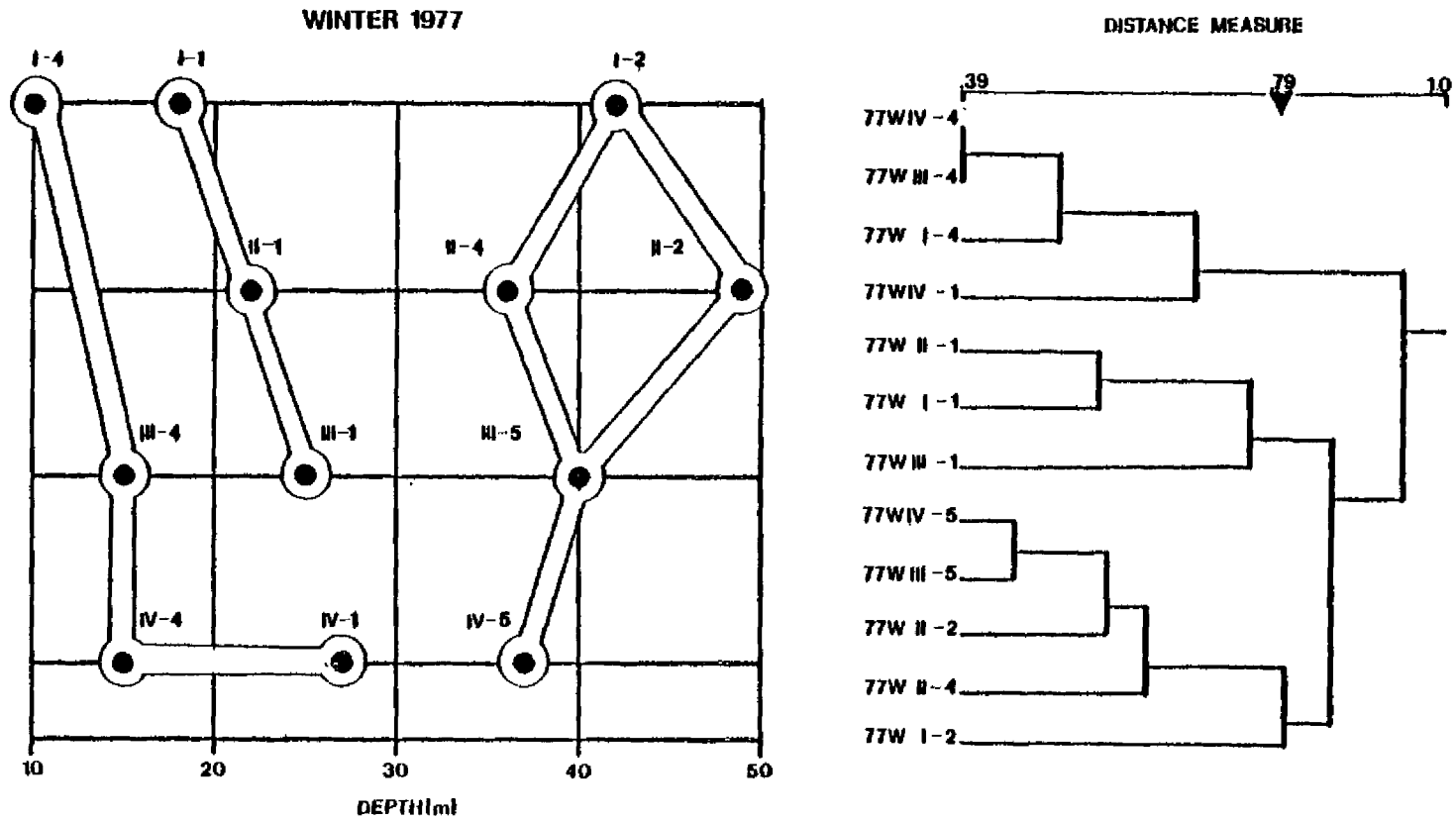

Figure 4-54. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for winter 1977 (0.2% cutoff).

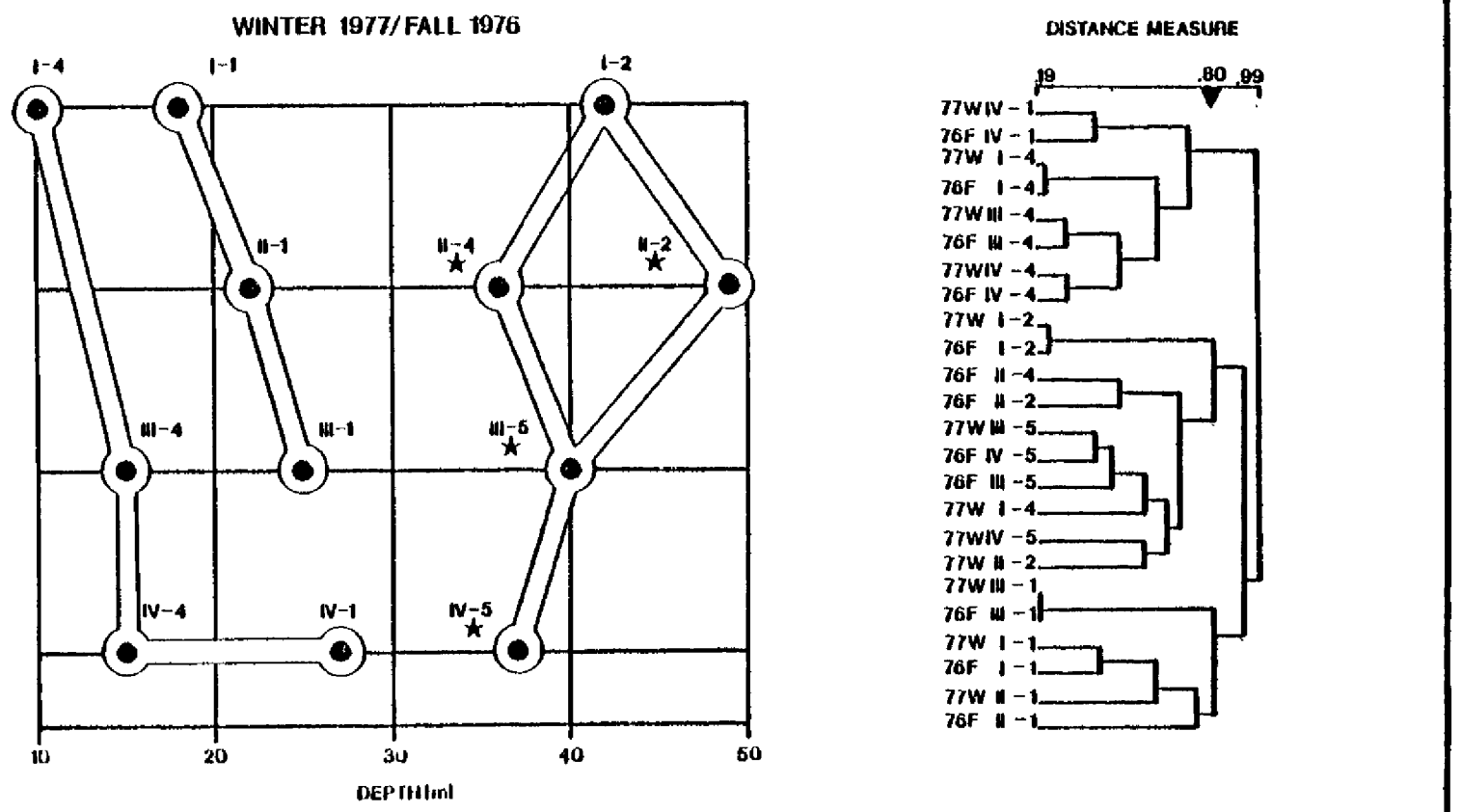

Figure 4-55. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for fall 1976 and winter 1977 together. Stars indicate stations at which fall 1976 and winter 1977 samples did not cluster most closely, i.e. pairwise (see text for explanation) (0.2% cutoff).

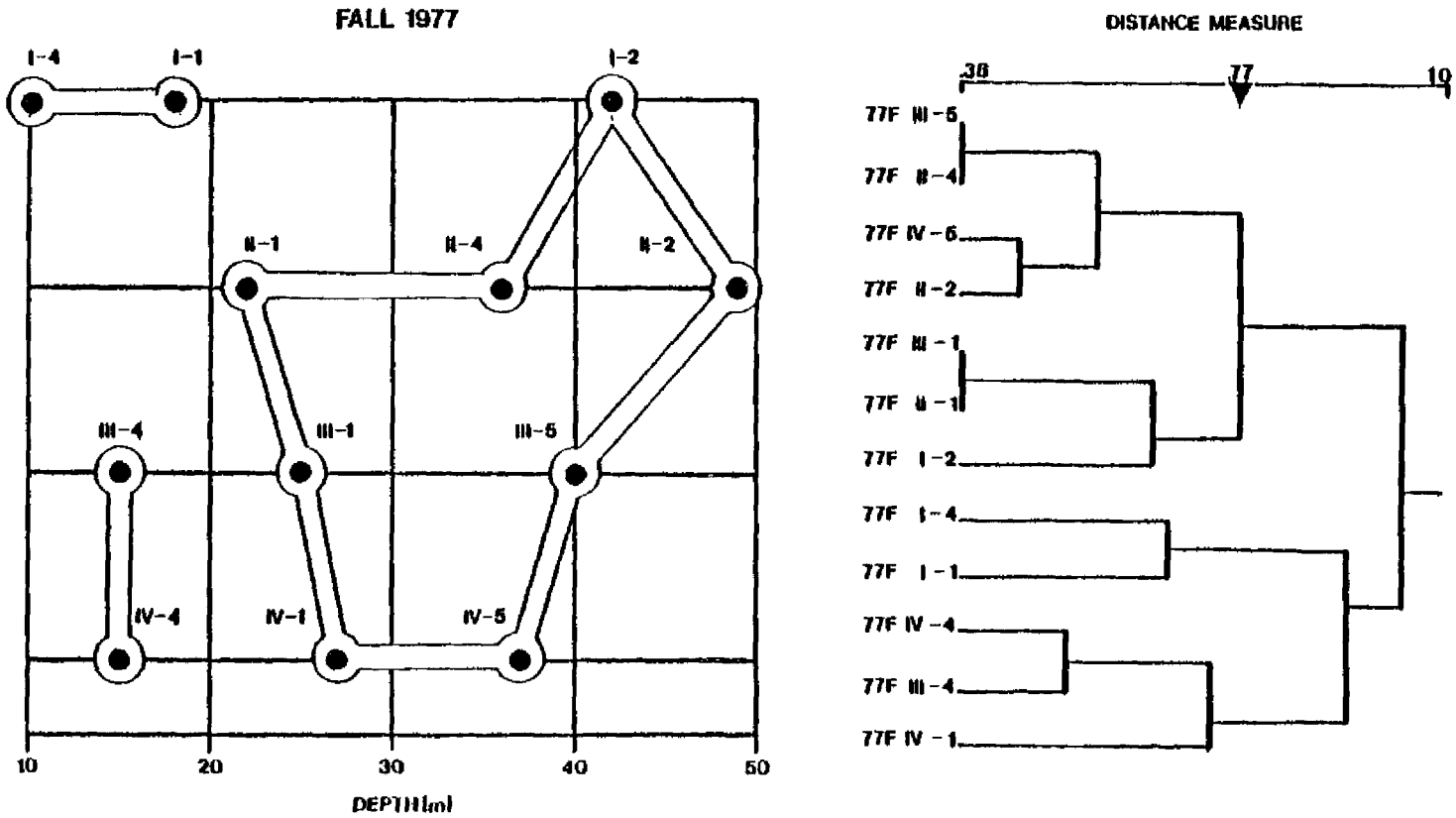

Figure 4-56. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for fall 1977 (0.2% cutoff).

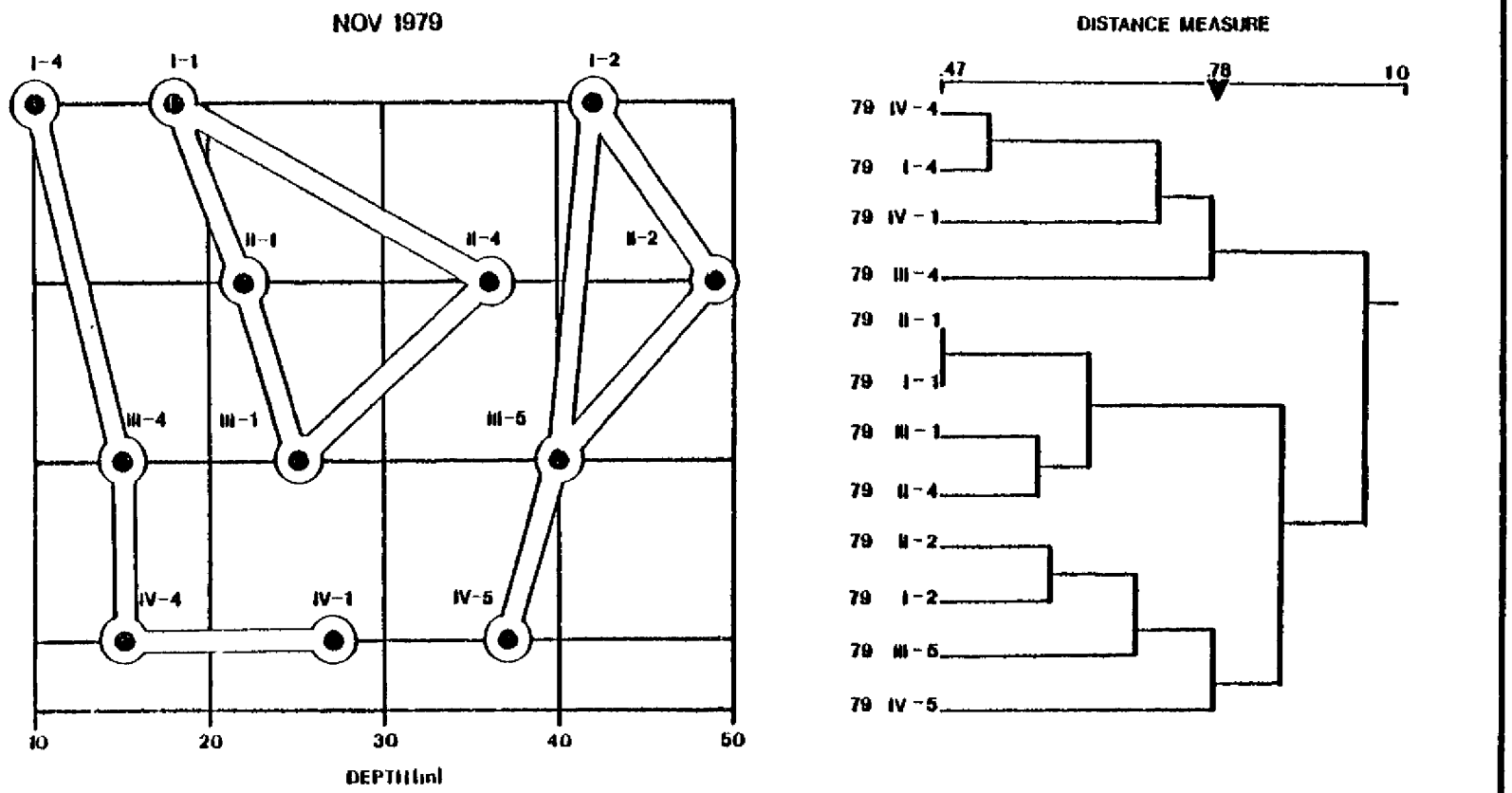

Figure 4-57. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for 1979 (0.2% cutoff).

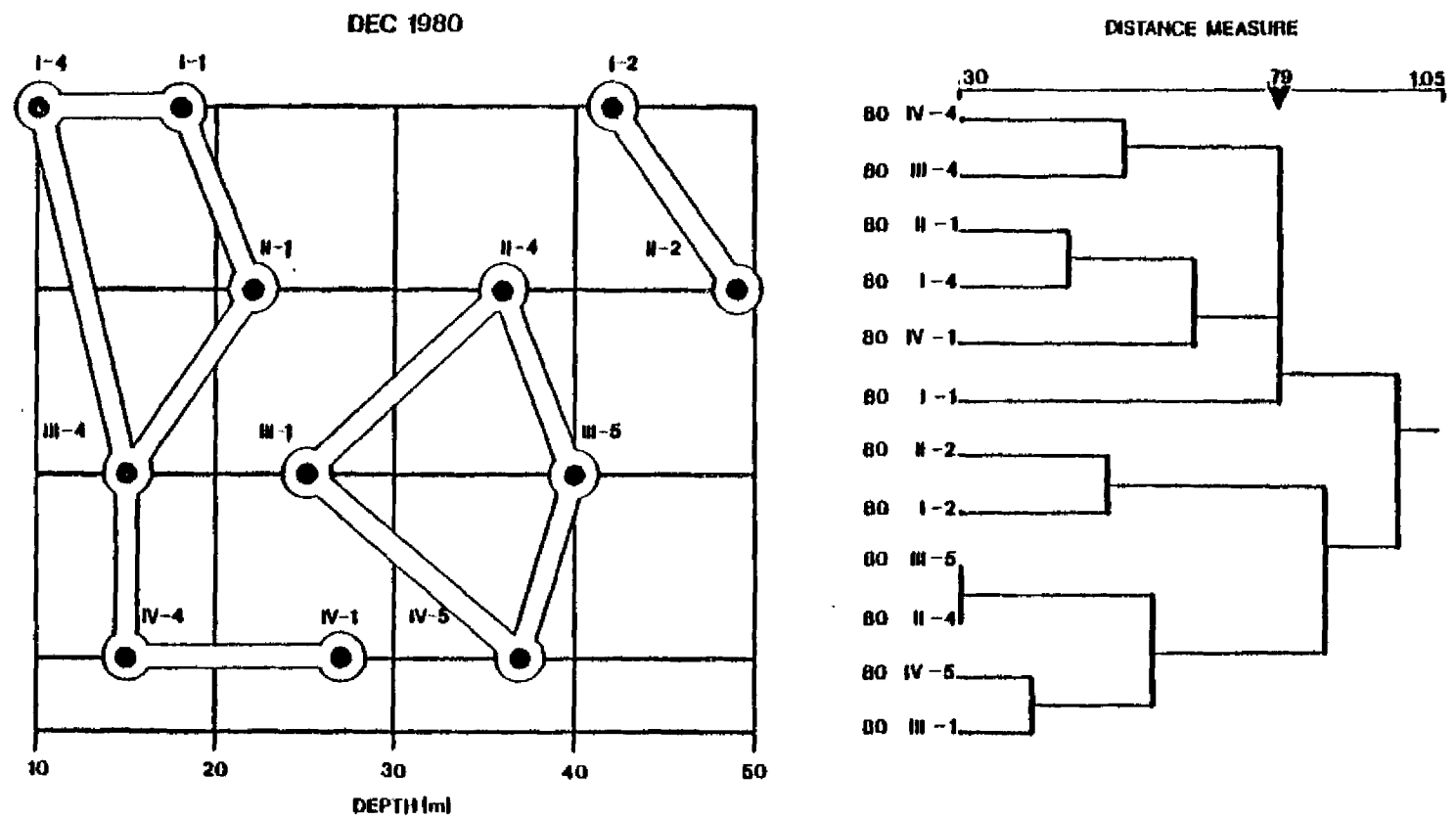

Figure 4-58. Schematic map of station groupings derived from cluster analysis of abundance of numerically dominant taxa, for 1980 (0.2% cutoff).

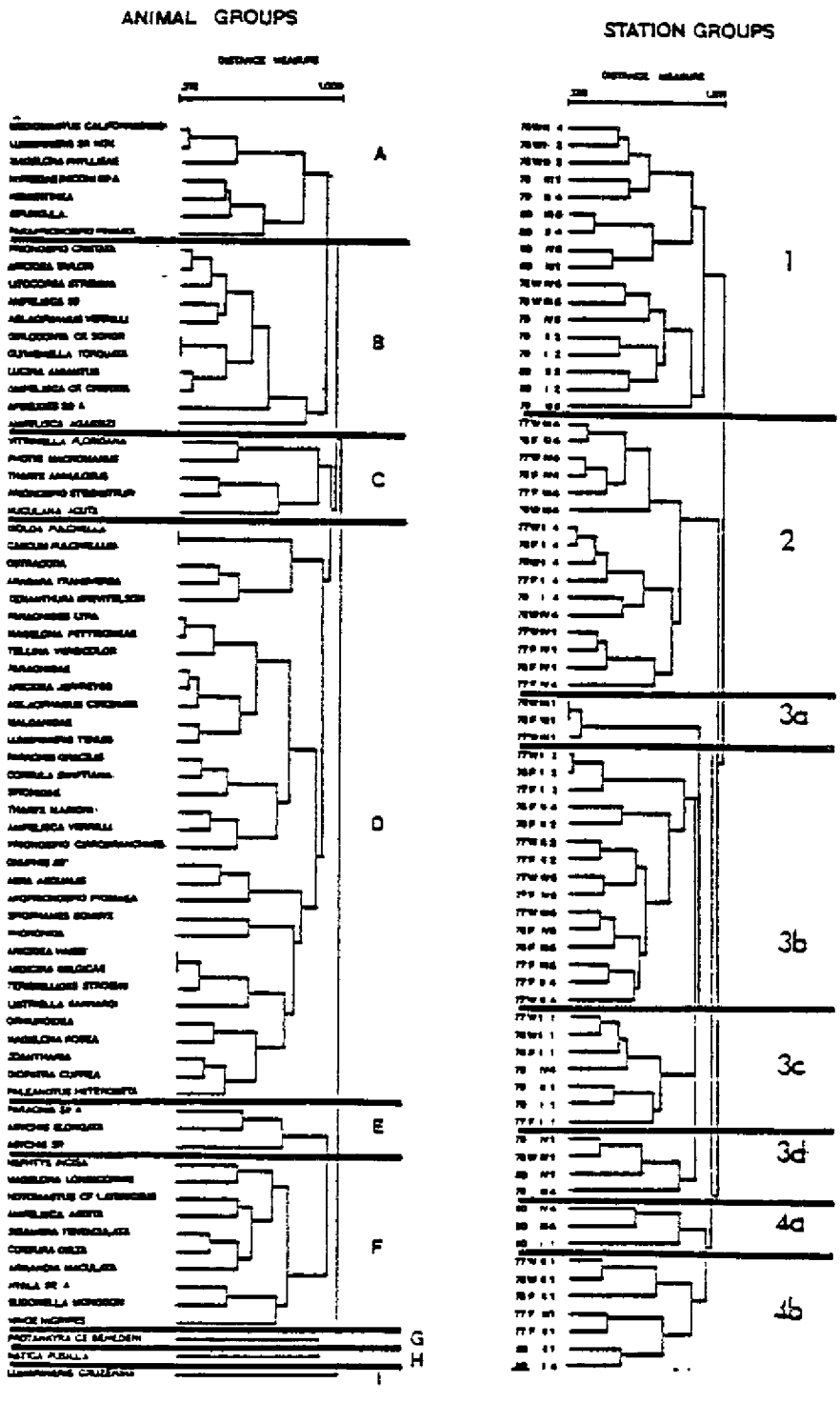

Figure 4-59. Animal Groups (left) and Station Groups (right) derived from cluster analyses (see text for explanation) (0.2% cutoff).

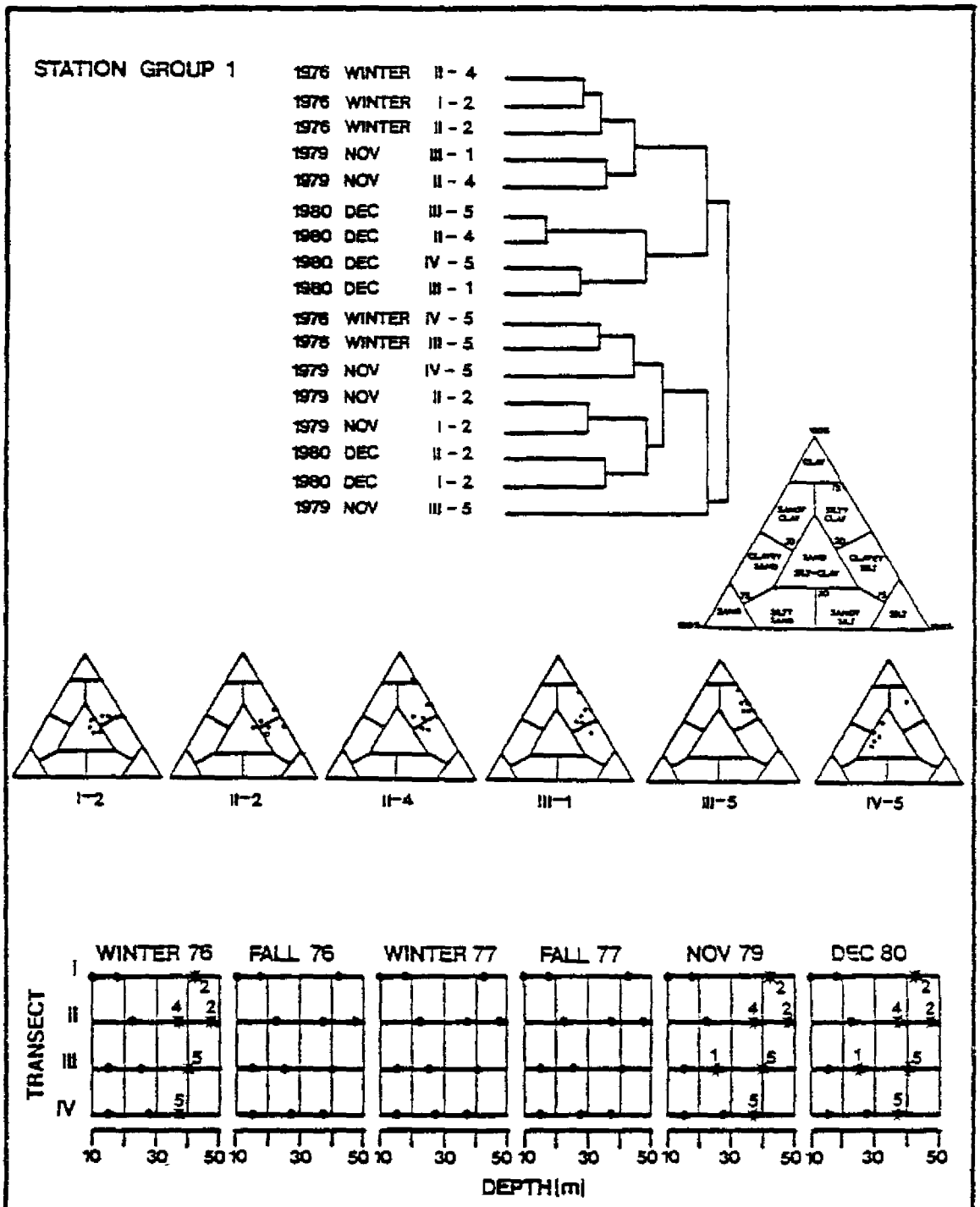

Figure 4-60. Station Group 1 (from Figure 4-59); station numbers and sampling periods are shown in cluster diagram (top) and on schematic location grids (asterisks, bottom); sediment profiles for each station (center) include six sampling periods (dots) for comparison (see text for explanation).

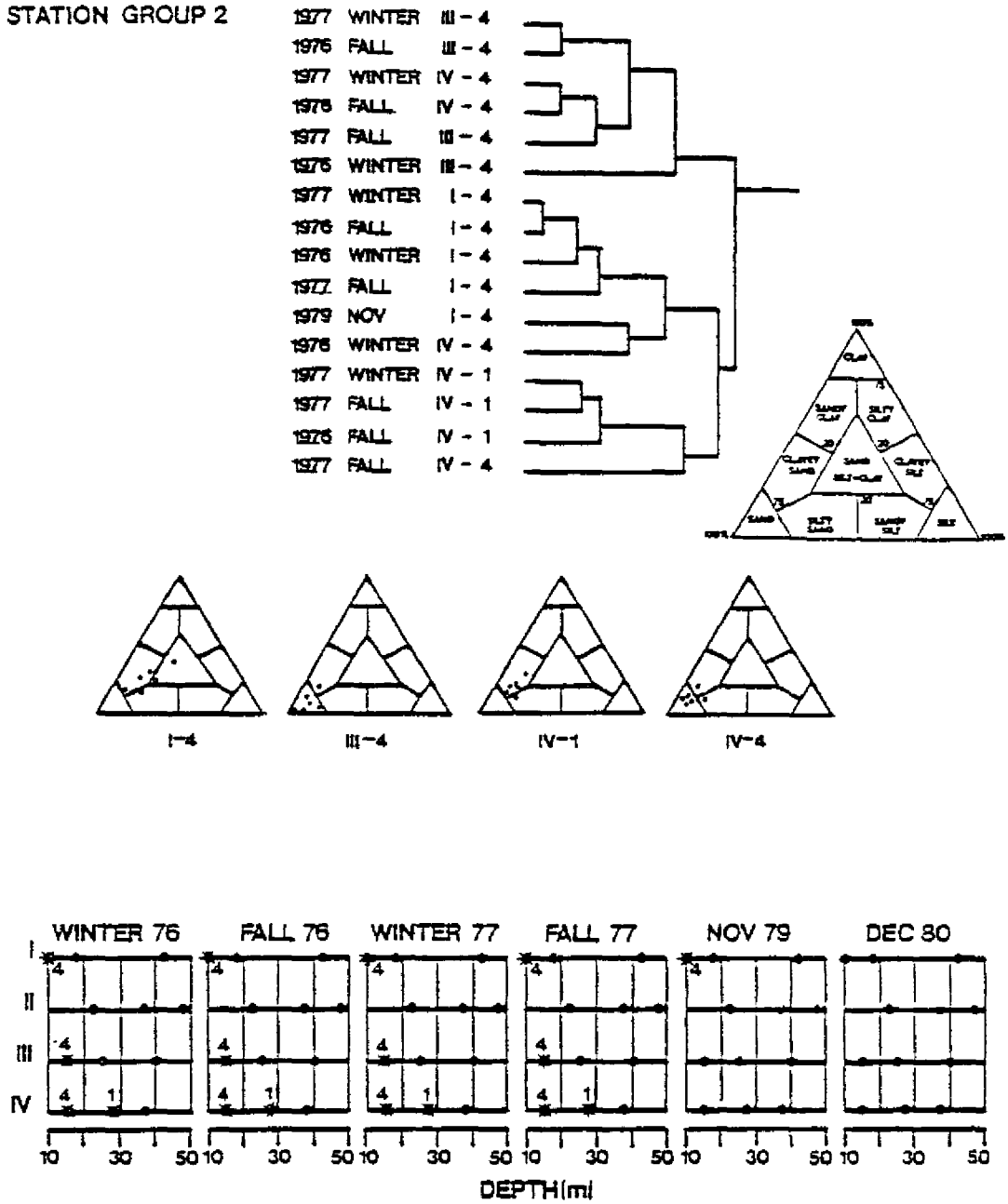

Figure 4-61. Station Group 2 (from Figure 4-59); station numbers and sampling periods are shown in cluster diagram (top) and on schematic location grids (asterisks, bottom); sediment profiles for each station (center) include six sampling periods (dots) for comparison (see text for explanation).

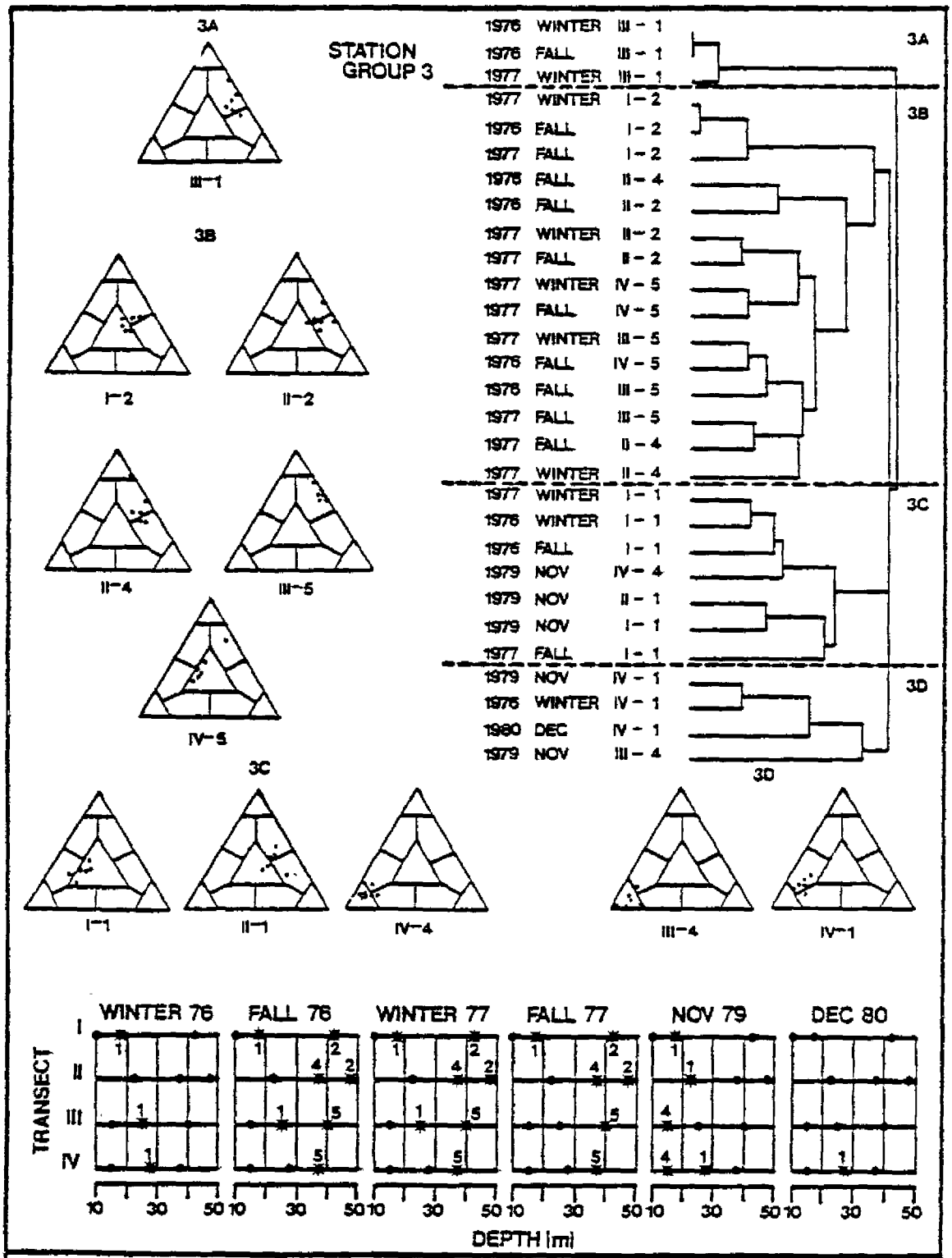

Figure 4-62. Station Group 3 (from Figure 4-59); station numbers and sampling periods are shown in cluster diagram (top) and on schematic location grids (asterisks, bottom); sediment profiles for each station (center) include six sampling periods (dots) for comparison (see text for explanation).

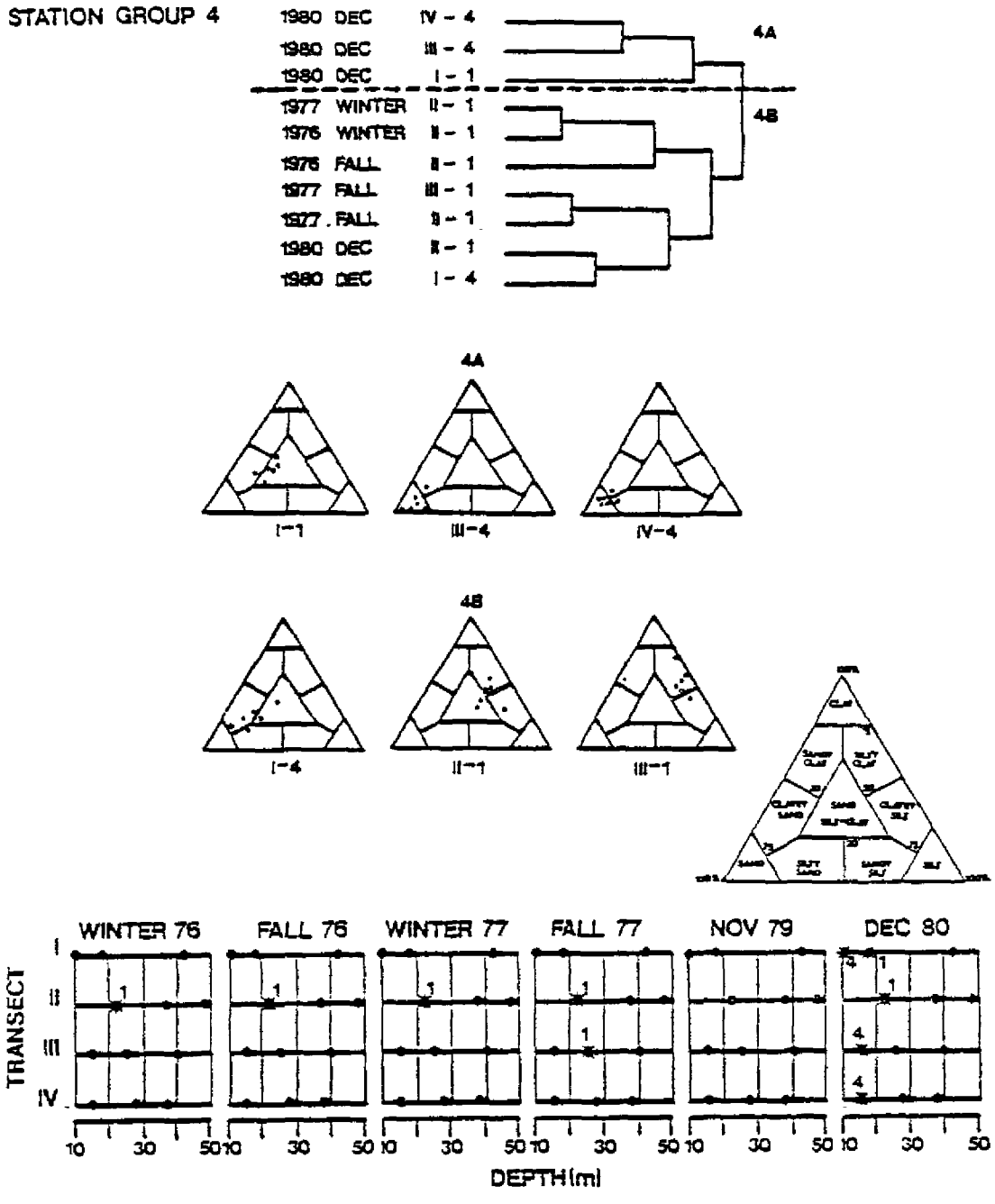

Figure 4-63. Station Group 4 (from Figure 4-59); station numbers and sampling periods are shown in cluster diagram (top) and on schematic location grids (asterisks, bottom); sediment profiles for each station (center) include six sampling periods (dots) for comparison (see text for explanation).

most similar to one another in winter 1976, and in 1979 and 1980; none of the fall 1976, winter 1977, or fall 1977 samples were within Station Group 1. This association may be also be seen clearly in Figure 4-52, as the winter 1976 offshore cluster of six stations included five from Station Group 1. In Figure 4-57, all four of the 1979 offshore cluster of stations and two of the intermediate cluster of stations were included in Group 1. In Figure 4-58, all six of the stations falling within the 1980 offshore and intermediate clusters of stations were included within Station Group 1.

Station Group 1 included 51 dominant taxa, made up primarily of organisms in Animal Groups A and F. Numerically important forms included the polychaetes Paraprionospio pinnata, Nephtys incisa, and Magelona longicornis; the amphipod Ampelisca agassizi; and unidentified species of nemerteans and ostracods. Compared to the other three major station groupings, Station Group 1 had relatively few of the numerically dominant taxa per station/period (mean = 16, standard deviation = 8.0, range = 7-30). Diversity (H') and evenness (V') for 51 numerically dominant taxa were 3.10 and 0.77, respectively, for Station Group 1. When no cutoff limits were used, H' and V' were 3.83 and 0.72, respectively, based upon data from 153 taxa.

Station Group 2 included a set of stations (I-4, III-4, IV-4, and IV-1) ranging in depth from 10 m to 27 m (average depth 17 m), primarily having coarse sandy and clayey-sand sediment (Figure 4-61). Three of these are shallow nearshore stations (depth range 10-15 m), while the fourth is somewhat deeper (27 m). As a group, they are the same stations discussed above as being sandy and containing virtually all of the taxa which were absent at the remaining eight stations (Figure 4-49). The stations were biologically most similar to one another during 1976 and 1977. They may also be seen in Figure 4-52 as all four of the winter 1976 nearshore cluster of stations; in Figure 4-53 as three of the four fall 1976 nearshore cluster of stations; in Figure 4-54 as all four of the winter 1977 nearshore cluster of stations; and in Figure 4-56 again as all four of the fall 1977 nearshore cluster of stations. In 1979, only the shallowest of the stations in Group 2 (Station I-4, depth 10 m) remained within the Group as a single element, now part of the four-station nearshore cluster (Figure 4-57).

Station Group 2 included 71 of the 72 numerically dominant taxa, and was characterized by the presence of most of the taxa in nearly every station/period (mean = 43, standard deviation = 19, range = 29-64). The only consistently abundant taxon was the polychaete Magelona phyllisae, though miscellaneous unidentified sipunculids were represented in large numbers in a single sample from station I-4 in fall 1977. Diversity (H') and evenness (V') for 71 numerically dominant taxa were 3.29 and 0.77, respectively, for Station Group 2. When no cutoff limits were used, H' and V' were 3.91 and 0.63, respectively, based upon 463 taxa.

Station Group 3 was a heterogeneous assemblage of mostly offshore and intermediate stations having silty-clay sediment, biologically similar to one another during 1976 and 1977, and a set of inshore stations having more sandy sediment and resembling the other deeper stations primarily in 1979 (Figure 4-62). Station Group 3 was further subdivided into four subgroups (3a, 3b, 3c, and 3d) due to the mixture of sediment types present, and the

apparently anomalous grouping of deep water stations with nearshore stations.

Station Group 3a included only Station III-1 (depth 25 m), which has fine silty-clay sediment, and which was dominated from winter 1976 through winter 1977 by the amphipod Ampelisca agassizi. During this period the taxonomic composition of the station remained quite constant in terms of numbers of numerically dominant taxa per station/period (mean = 31, standard deviation = 3.1, range = 28-34). Organisms from Animal Groups A and F were well represented in Station Group 3a, also. Station III-1 may be seen in Figure 4-49 to have had few of the species typical of the nearshore, sandy group, and to share affinities on gross scale with the five deepest stations and with II-1 and I-1, its shallower neighbors, and to have little in common with the next deeper station (IV-1, which resembled the three shallowest stations most closely).

Cluster analyses by individual time periods showed that Station III-1 often had close affinities to two other stations, I-1 (depth 18 m) and II-1 (depth 22 m). In winter 1976 (Figure 4-52) Station III-1 stood alone (although at a higher level of similarity <distance measure 0.86> it grouped with the offshore set of stations, while Stations I-1 and II-1 grouped with the nearshore set of stations, unlike their more typical pattern). In fall 1976 (Figure 4-53), Station III-1 clustered with Station II-1, while in winter 1977 (Figure 4-54) Station III-1 grouped again with Station II-1 and with Station I-1. When the samples from fall 1976 were clustered with those from winter 1977 (Figure 4-55), Station III-1 fall samples grouped most closely with those from Station III-1 winter samples, and were associated again with Stations II-1 and I-1. Diversity (H') and evenness (V') values for 40 numerically dominant taxa were 1.58 and 0.40 for Station Group 3a, respectively. When no cutoff limits were used, H' and V' were 1.82 and 0.37, respectively, based upon 81 taxa.

Group 3b consisted of the five deepest stations (II-4, IV-5, III-5, I-2, and II-2) ranging in depth from 36 m to 49 m (average 41 m), typically having silty-clay sediments. All five of these stations belonged to Station Group 3b throughout the same three sampling periods (fall 1976, winter 1977, and fall 1977). This constancy is also reflected in the individual cluster diagrams by sampling period. In fall 1976 (Figure 4-53), five out of the six offshore stations were from Station Group 3b; the sixth was Station I-1 (depth 18 m), which usually was clustered with the offshore stations rather than with the adjacent nearshore stations due, apparently, to its lack of the suite of species present primarily at the three shallowest station and at Station IV-1 (Figure 4-49). In winter 1977 (Figure 4-54), all five of the offshore cluster of stations were from Station Group 3b. In fall 1977 (Figure 4-56), five out of the seven stations in the offshore cluster were from Station Group 3b.

When the samples from fall 1976 were clustered with the samples from winter 1977 (Figure 4-55), all five of the stations in the offshore cluster were from Station Group 3b. Four of the five stations from Station Group 3b did not show their closest affinities in this cluster analysis between the two consecutive sampling seasons for each station. These four stations (II-2, II-4, III-5, and IV-5) were the only ones out of twelve which did not most closely pair fall and winter samples within stations, indicating

that despite similarities between the Station Group 3b stations, temporal differences were substantial within stations. However, on an overall basis, the fall 1976 and winter 1977 samples from these stations were sufficiently similar to obscure the differences when all station/periods were clustered together.

Numerically dominant species within Station Group 3b included the polychaete Asychis sp., which was abundant from fall 1976 through fall 1977 at Station I-2 (depth 42 m); miscellaneous unidentified spionid polychaetes (common thoughout Station Group 3b but especially abundant in the winter 1977 samples from Station II-2 (depth 49 m); and large numbers of the polychaete Paraprionospio pinnata and miscellaneous unidentified nemerteans in fall 1977. Representatives of Animal Groups A, D, E, and F were also common. Most taxa found in Station Group 3b were those typical of the deeper stations, i.e. those not limited to either deep or shallow stations, but more or less common at all stations; the taxa previously described as typically restricted to shallow and/or sandy environments (e.g. Stations I-4, III-4, IV-4, and IV-1) were rare at Station Group 3b stations. Within Station Group 3b the numbers of numerically dominant taxa were relatively constant (mean = 31, standard deviation = 5.5, range = 17-39). Diversity (H') and evenness values (V') were 3.12 and 0.77, respectively, based upon 57 numerically dominant taxa. When no cutoff limits were used, H' and V' were 3.62 and 0.66, respectively, based upon 205 taxa.

Station Group 3c consisted of three stations of intermediate depth (I-1, IV-1, and II-1, average depth 18 m, range 15-22 m) whose sediment varied from sand to roughly even mixtures of sand, silt, and clay. From winter 1976 through winter 1977 the only component of this group was Station I-1 (depth 18 m). In 1979 Station I-1 was associated with the next deeper Station (II-1, depth 22 m) and the next shallower station (IV-4, depth 15 m).

A clear pattern of shifts in association by Station I-1 back and forth from deeper to shallower groups of stations may be seen in the cluster analyses by sampling period. From winter 1976 through winter 1977, Station I-1 was grouped either with Station II-1 (depth 22 m) or with Station II-1 and Station III-1 (depth 25 m), or with the offshore group of stations in fall 1976 (Figures 4-52, 4-53, and 4-54). At that time it was clearly not a component of the nearshore group of stations (I-4, IV-4, and IV-1) to which its nearest neighbor (Station I-4) belonged. This is also evident from inspection of Figure 4-49. However, in fall 1977 (Figure 4-56), Station I-1 was grouped with its shallow neighbor, Station I-4 (depth 10 m). In 1979, Station I-1 was again clustered with deeper stations, II-1, III-1, and II-4 (depth 36 m) (Figure 4-57). In 1980 (not a period in which Station I-1 was a member of Station Group 3c), Station I-1 was once again associated with the nearshore group of stations (Figure 4-58).

The polychaete Magelona phyllisae dominated the samples from Station Group 3c, although in fall 1977 the polychaete Paraprionospio pinnata and miscellaneous unidentified sipunculids were numerically more important at Station I-1. The most consistent members of Station Group 3c were organisms from Animal Groups A and F. The number of dominant taxa included in the samples from Station Group 3c averaged 28 (standard deviation = 8.0, range 17-40). Diversity (H') and evenness (V') for Station Group 3c were 2.77 and 0.66, respectively, based upon 59 numerically dominant taxa. When

no cutoff limits were used, H' and V' were 3.32 and 0.59, respectively, based upon 191 taxa.

Station Group 3d included only two stations, Station IV-1 (depth 27 m) having fairly coarse clayey-sand sediment, and present in Station Group 3 in winter 1976 and again in 1979 and 1980; and Station III-4 (depth 15 m), which had sandy sediment and was present in Station Group 3 only in 1979. In the cluster analysis by sampling period, Station IV-1 was part of the nearshore group of stations for all three periods (Figures 4-52, 4-57, and 4-58). In the 1979 cluster analysis, Station III-4 was also part of the same nearshore grouping.

None of the numerically dominant taxa present in Station Group 3d was sufficiently abundant to exceed 20% of the total number of individuals in any one station/period. Members of Animal Group A were well represented in Station Group 3d, along with a smattering of other taxa from other groups. Both stations fell within the set of four nearshore and/or sandy stations characterized by the presence of a large number of species absent from the remaining eight stations (Figure 4-49). Number of dominant taxa present averaged 32 (standard deviation = 6.0, range = 27-40). Diversity (H') and evenness (V') for Station Group 3d were 2.26 and 0.81, respectively, based upon 53 numerically dominant taxa. When no cutoff limits were used, H' and V' were 4.14 and 0.75, based upon 195 taxa.

Station Group 4 included six shallow and mid-depth stations (average depth 18 m, range 10-25 m) with shared biological community characteristics during 1976, 1977, and 1980. Station Group 4 is most easily treated as two subgroups, 4a and 4b, each somewhat different in sediment texture and taxonomic composition (Figure 4-62).

Station Group 4a consisted of three shallow stations (IV-4, III-4, and I-1, average depth 16 m, range 15-18 m) which appeared in Station Group 4a only in 1980. In the 1980 cluster analysis (Figure 4-58), the stations of Station Group 4a all were grouped within the nearshore cluster of six stations. Station Group 4a stations had coarse sandy sediment (IV-4 and III-4, both 15-m deep) and somewhat finer silty-clayey sand (I-1, depth 18 m). Dominant taxa in Station Group 4a included the gastropod Natica pusilla (Animal Group H), the polychaete Magelona phyllisae, and the holothuroid Protankyra cf. benedeni (Animal Group G, not seen at any other station at any time). Figures 4-48 and 4-49 further illustrate the situation; in 1980, Stations III-4 and IV-4 lost a large number of typically shallow-water taxa compared to previous periods, thereby closely resembling the pattern at Station I-1, at which of the same taxa had appeared infrequently if at all. Average number of dominant taxa at each station averaged 24 (standard deviation 1.2, range 23-25). Diversity (H') and evenness (V') for Station Group 4a were 2.12 and 0.58, respectively, based upon 38 numerically dominant taxa. When no cutoff limits were used, H' and V' were 2.82 and 0.57, respectively, based upon 101 taxa.

Station Group 4b included two stations of intermediate depth (II-1, depth 22 m, and III-1, depth 25 m) and one shallow station (I-4, depth 10 m). Station II-1 had fairly fine silty-clay sediment, and was represented consistently in Station Group 4b during all four 1976 and 1977 sampling periods and in 1980. Station III-1 also had fine silty-clay sediment, and was a component of Station Group 4b only once (fall 1977). The shallower

station (I-4) joined the others in Station Group 4b only in 1980. In 1980, Station I-4 lost many shallow-water associated taxa, thus coming to resemble the deeper stations more closely, since most of the taxa found at deeper stations were also common in shallow water (Figures 4-48 and 4-49). A somewhat similar pattern may be seen in the individual cluster analyses by sampling period. In winter 1976, fall 1976, and winter 1977, Station II-1 was most closely associated with either two stations of intermediate depth (III-1 and I-1, depths 18 and 25 m respectively) or with the offshore cluster of stations (Figures 4-52, 4-53, and 4-54). When fall 1976 and winter 1977 samples were clustered together (Figure 4-55), Station Group 4b stations were associated with Station I-1. Both Station Group 4b stations present in fall 1977 were clustered with the offshore group (Figure 4-56). In 1980, Station II-1 was grouped with the nearshore, shallow group of stations (unlike previous associations) of which Station I-4 was also a member (Figure 4-58).

Dominant taxa in Station Group 4b were the polychaetes Paraprionospio pinnata, Magelona phyllisae, and Mediomastus californiensis, the gastropod Natica pusilla, and the amphipod Ampelisca agassizi. Taxa from Animal Groups A and F were consistently represented in Station Group 4b. An average of 24 of the 72 numerically dominant taxa were present within each station/period (standard deviation = 5.6, range 15-35). Diversity (H') and evenness (V') for Station Group 4b were 2.36 and 0.59, respectively, based on 38 numerically dominant taxa. When no cutoff limits were used, H' and V' were 2.67 and 0.53, respectively, based upon 124 taxa.

The relative importance of the various Animal Groups (A-I) delineated by the cluster analyses did not remain constant with time, although some general patterns were evident (Figures 4-64, 4-65, and 4-66). They will be treated below in approximate order of overall abundance. Numerically dominant taxa only (0.2% cutoff) are included. The percentages in Figure 4-65 sum vertically to 100%, and thus represent the relative abundance of each group within individual sampling periods.

Animal Group A included only seven taxa but was represented by more individuals (29,262) than any other group in every sampling period, from 49% to 62% of all individuals collected. All seven taxa were present in all sampling periods. The number of individuals per taxon in Animal Group A was higher than in any other group in every sampling period but 1980, when high densities of Natica pusilla (Animal Group H) at three stations and Protankyra cf. benedeni (Animal Group G) at one station raised the number of individuals per taxon above the value for Animal Group A. Animal Group A had its highest abundance per taxon in fall 1976 (1,186), followed by a slight decline in winter 1977 (1,033) and a greater drop in fall 1977 (877). The winter 1976 value (635) was about half that in fall 1976, and 1979 (266) and 1980 (183) values were about a fifth of those in fall 1976. Animal Group A included three deposit feeding polychaetes (Paraprionospio pinnata, Mediomastus californiensis, and Magelona phyllisae), two carnivorous or omnivorous polychaetes (Lumbrineris sp. nov. and Nereis micromma), and two taxa not differentiated beyond the phylum level (the carnivorous nemerteans and the deposit feeding sipunculids).

Animal Group D included 33 taxa, comprised of a variety of feeding types; all were present in fall 1976, while 32 were present in winter 1976,

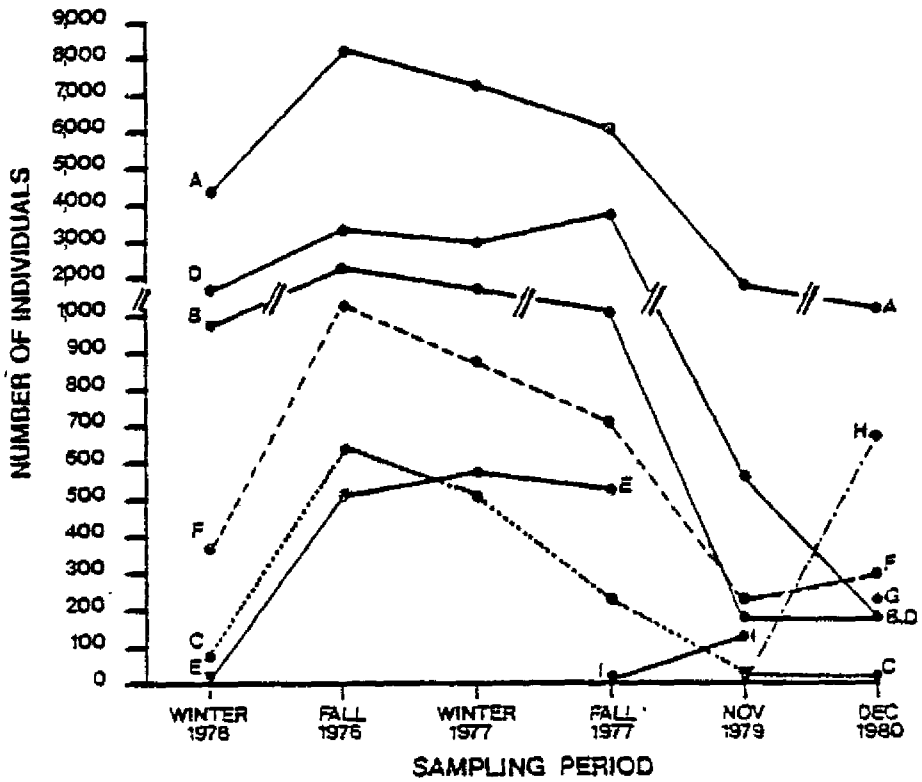

Figure 4-64. Numbers of individual Animal Cluster Groups A through I (from figure 4-59), by sampling period.

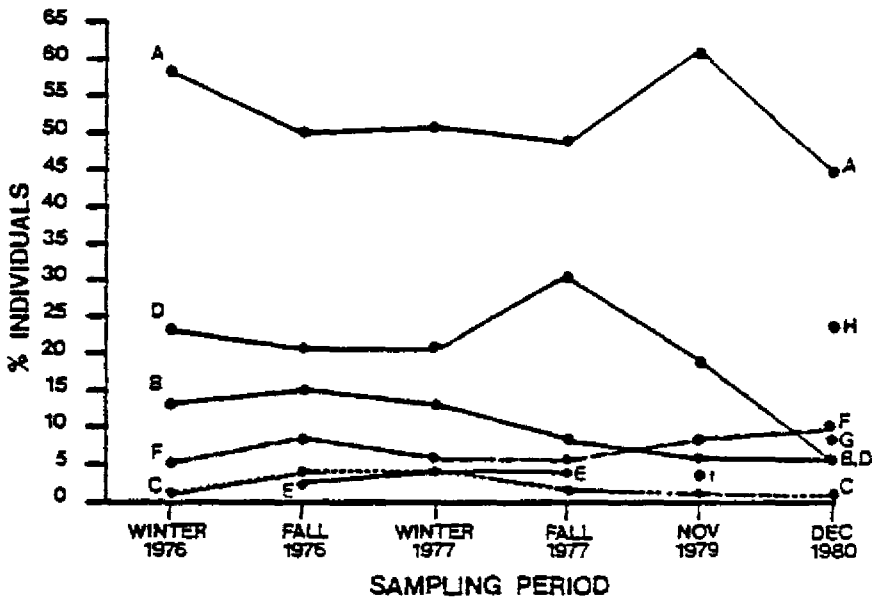

Figure 4-65. Relative proportions of numbers of individuals of Animal Cluster Groups A through I (from Figure 4-59), as % of total within each sampling period.

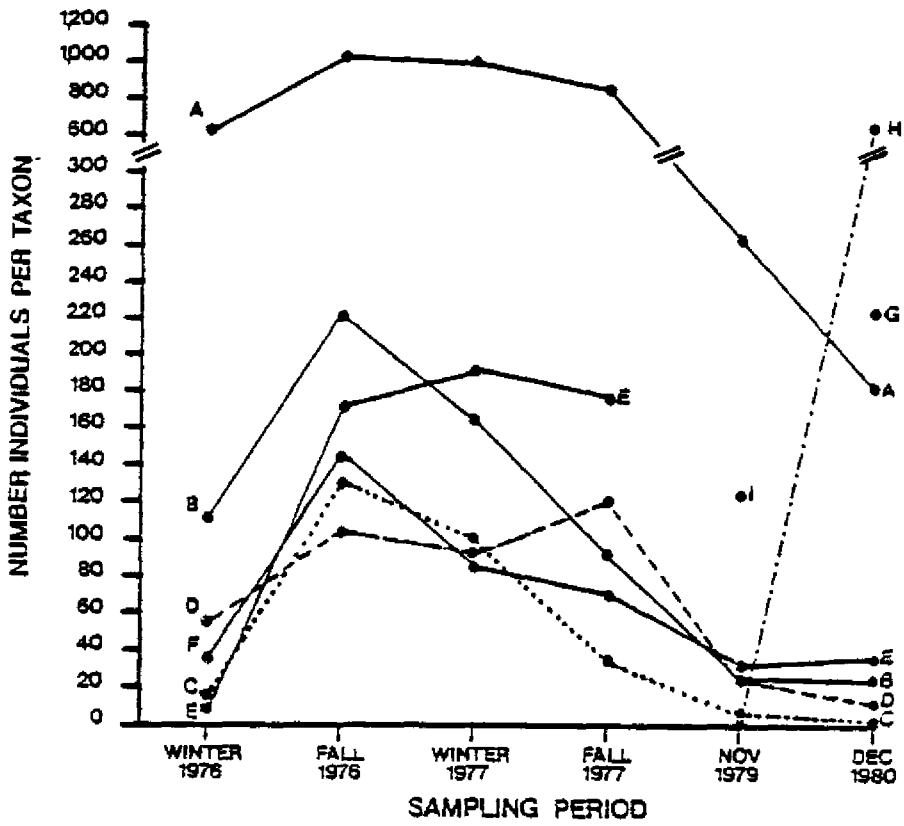

Figure 4-66. Numbers of individuals per taxon within Animal Cluster Groups A through I (from Figure 4-59), by sampling period.