Padilla Bay
National Estuarine Research Reserve

Technical Report No. 21

BENTHIC ASSEMBLAGES OF THE PADILLA BAY NATIONAL ESTUARINE RESEARCH RESERVE, MOUNT VERNON, WASHINGTON

Gary Ray

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August 1997

Benthic Assemblages of the Padilla Bay National Estuarine Research Reserve, Mount Vernon, Washington

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Abstract

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Despite the importance of benthic invertebrates as forage for a wide range of fish, shellfish and migratory shorebirds, relatively little is known about their distribution or community strucure among habitats in Padilla Bay. In this study sediment texture and infaunal community structure of the most common intertidal and subtidal habitats of Padilla Bay are characterized and compared. Five intertidal habitats including unvegetated flats, Ulva vered sediment, Zostera japonica beds, and low- and high-density Z. marina beds were examined as well as four subtidal habitats including Z. marina beds, unvegetated sands less than 5m deep, unvegetated sands between 5 and 20m deep and sites with depths greater than 20m. Diversity, total numerical abundance, biomass, and species composition varied among habitats corresponding to changes in elevation, vegetation type and sediment type. Diversity increased with decreasing elevation to a maximum in shallow unvegeated subtidal sand habitat, numerical abundances were highest in low- and high-density intertidal Zostera marina beds, and biomass, although variable, was generally highest in vegetated intertidal habitats. Diversity, numerical abundance and biomass were highest in the upper sediment layers although secondary peaks of biomass at greater depths due to the presence of large deep-burrowing bivalves. Two types of species assemblages dominated Padilla Bay habitats, a single widely distributed and a number of habitat specific assemblages. The wide-ranging assemblage was comprised of Barantolla americana, Mediomastus sp, Exogene molesta, Tubificoides foliatus, Transenella tantilla. Mysella tumida, Corophium acheruscium, and Amphioda occidentalis. Common eelgrass taxa included Lacuna variegata, Haminoea vesicula, Idotea resecata, Caprella laeviscula while the Owenia fusiformis, Prionospio cirrifera, P. steenstrupi, Admete gracilior, Acila castraensis, and Eudorella sp. were found only in subtidal or near subtidal habitats.

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Introduction

The Padilla Bay National Estuarine Research Reserve was established in 1980 to protect estuarine habitats, provide opportunities for scientific and management research, and educate the public about the importance of estuarine environments. Located in an embayment of Puget Sound opposite the San Juan Islands, the reserve is bordered to the southwest by Fidalgo Island, to the west and northwest by a series of small islands, and to the north by Samish Bay (Figure 1). The reserve has a tidal range of approximately 7m, a polyhaline salinity regime, and is dominated by sandy sediments (Bulthuis, 1996). Submerged bottoms bordering the reserve drop sharply from depths as shallow as 4m to more than 70m near Hat Island (Figure 1).

The reserve possesses extensive intertidal flats and one of the largest expanses of subtidal and intertidal seagrass in the Pacific Northwest (Bulthuis, 1996). Beds of the seagrass Zostera marina are the dominant intertidal habitat covering 2,300-2,400 hectares (ha) while unvegetated sands comprise an additional 1,000-1,500ha (Table 1). Unvegetated intertidal muds, Zostera japonica beds, and Ulva covered sediments comprise the bulk of the remaining intertidal area. While most of the habitats are relatively stable, the amounts of Z. japonica and unvegetated intertidal sands can vary substantially over time (Table 1). This is a natural occurrence that reflects the periodic expansion and contraction of the seagrass beds (Bulthuis, 1996). In terms of areal extent subtidal habitats are represented by deep (>20m) and shallow (0-5m) sites, with a relatively small amount of intermediate (5-20m) depth bottoms.

In a review of scientific studies conducted in Padilla Bay, Bulthuis (1996) has reported that the bay is highly productive and supplies important food resources and refuge habitat to fish, shellfish, and migratory bird populations. Juvenile fish, including chum salmon (Oncorhynchus keta), surf smelt (Hypomesus pretiosus), and Pacific herring (Clupea harengus) and juvenile Dungeness crab (Cancer magister) feed extensively in the intertidal seagrasses, while waterbirds including brant (Branta bernicla), widgeon (Mareca americana), and pintail (Anas acuta) and mallard (Anas platyrhynchos) ducks utilize them on a seasonal basis. The seagrasses themselves as well as epiphytes and infauna act as food resources for these species.

Although numerous studies have been conducted on Padilla Bay seagrasses, their epiphytes, and fish, shellfish, bird and mammal populations, only a handful have examined benthic assemblages (Table 2). Smith and Webber (1978) conducted the most extensive study of intertidal habitats, sampling a series of transects perpendicular to the shoreline on six occasions between October 1974 and August 1975. The focus of this study was on community differences at different tidal heights rather than other habitat characteristics, however Bulthuis (1996) concluded that the lower strata of samples most likely represent Zostera japonica beds. The upper strata represent unvegetated intertidal habitat. Riggs (1983) sampled intertidal Z. japonica and Z. marina beds but only on one occasion. Smith (1979) sampled a sandy unvegetated subtidal site (3m depth) and two muddy or sandy mud sites (7 and 14m depths) also on one occasion. Barreca (1982) characterized the infaunal communities of three sandy unvegetated subtidal stations at a depth of 9 m south of Hat Island based on collections in February and July of 1981. In addition to the above studies of Padilla Bay proper, there are a number of reports from similar habitats elsewhere in northern Puget Sound. Woodin (1974) has described the infaunal community of Ulva covered sediments and Nyblade (1979) has reported on unvegetated intertidal and subtidal habitats. Simenstad (1983) has summarized information on subtidal channel habitats of the Pacific Northwest, as has Phillips (1984) for Z. marina meadows.

The small number of studies and limited variety of habitats sampled make it difficult to make broad scale habitat comparisons of Padilla Bay infauna. The situation is further complicated by variation in sampling gear, sampling period (time of year), sample size, and sample processing methods (e.g., sieve mesh size) among the existing studies. The intent of the present work has been to characterize the sediments and infaunal communities of Padilla Bay intertidal and subtidal habitats. Characterization was performed by examining sediment bulk properties, intact sediment characteristics (e.g., presence of sediment layering, evidence of bioturbation, etc.), infaunal community structure, and the linkage between infaunal communities and the fisheries resources they support.

Methods

A total of eight habitat types were selected for examination based on the 1989 Padilla Bay habitat map (Bulthuis, 1989). Five intertidal habitats were chosen for study; Unvegetated flats, Ulva covered sediment, Zostera japonica, low-density (<50% cover) Zostera marina, and high-density (75-100% cover) Z. marina. Subtidal habitats selected for study included Zostera marina beds, unvegetated sands less than 5m in depth (Shallow), unvegetated sands between 5 and 20m in depth (Intermediate), and sites greater than 20m in depth (Deep). Fifteen stations were randomly located in each of the habitats and sampled for sediments and infauna. Five stations within each habitat were randomly chosen for collection of multiple samples (5 cores) while a single sample was collected at the remaining ten stations. Multiple cores were taken at least 1 m apart from one another to avoid complications arising from spatially patchy species distributions. In addition, one of the five samples at each of the replicated core stations was vertically sectioned in 2cm intervals to determine vertical distribution of the infauna. Logistical constraints limited the number of samples that could be collected in certain instances (Table 3).

All intertidal habitats and subtidal Zostera marina beds were sampled during July 1994 with either a hand-held or pole-mounted 7.5cm diameter PVC coring tube. Cores were taken to a sediment depth of 10cm. Unvegetated subtidal habitats were sampled in August 1994 using a Van Veen Grab sampler that was subsampled using the 7.5 cm diameter corer. Samples were washed over a 0.5mm mesh screen, fixed in 4% formaldehyde solution, stained with rose bengal, and transported to the laboratory. In the laboratory, samples were examined under 3X magnification and all specimens removed and stored in 70% ethanol. Specimens were identified to the lowest practical taxonomic level, enumerated, and the wet-weights of major taxonomic groups (e.g., Polychaeta, Crustacea) measured. Meiofaunal forms (e.g., nematodes, ostracods, and harpacticoid copepods) were not enumerated since the 0.5mm mesh sieve does not collect them quantitatively. Species and abundance data are presented by habitat in Appendices Tables 1 to 9 and summary data for taxa richness, abundance and biomass in Appendix Table 10. Summary data for vertical distributions are provided in Appendix Table 11.

Samples for grain size analysis of sediments were collected with a 5cm diameter coring tube. Sediment analysis was performed using a combination of wet-sieving and floatation methods (Folk, 1968; Galehouse, 1971). Sediment organic content was measured by loss upon ignition. Sediment data are provided in Appendix Table 13.

Subtidal habitats were also sampled using a Sediment Profile Imaging (SPI) camera. This technique collects 35 mm color images of the sediment-water interface which are analyzed visually or by computer assisted image analyses to derive data on sediment structure and the status of benthic assemblages. Parameters include the depth of camera prism penetration into the substrate as an estimate of sediment compaction, depth of the apparent redox potential discontinuity (RPD), sediment type, and presence of burrows and feeding voids (see Rhoads and Germano, 1986; Revelas, Germano, and Rhoads, 1987).

Nektonic organisms were collected by otter trawl from intermediate and deep subtidal areas for analysis of fish feeding habitats. Dominant species found in the trawls were separated by size class, the stomachs removed, and the stomach contents pooled and preserved. Stomach contents were subsequently rinsed through a nested set of sieves (0.5, 1.0, 2.0, 3.35, and 6.3mm) and the organisms on each sieve separated by taxonomic group, assayed for wet-weight biomass, and all prey items identified to the lowest practical taxonomic level and enumerated.

Infaunal community parameters (taxa richness, numerical abundance, and wet-weight biomass) were subjected to analysis of variance (ANOVA). Prior to ANOVA all data were subjected to Bartlett's Test for homogeneity of variance. As appropriate, the data were transformed: the $\log_{10}(X+1)$ transformation was applied to the abundance data. Nonparametric tests were employed for analysis of the biomass data.

Data from replicated core stations were tested employing a nested one-way ANOVA with Habitat as the main effect and Station as the nested factor. These results were examined for potential differences between habitats, stations, and samples within stations (residual error). Where the sums of squares for residual errors were less than or equal to station variability, it was assumed that sample to sample variability could be ignored and a second one-way ANOVA employing data for the additional ten single core stations was performed. The second procedure was conducted to increase the statistical power of the test. The Tukey-Kramer multiple range test was performed to differentiate between means when ANOVA indicated significant differences ($p<0.05$). Results of the multiple range tests are presented in plots of treatment means (arithmetic mean$\pm$SE). The Kruskal-Wallis test was employed for the biomass one-way ANOVA. Vertical distribution data were subjected to a two-way ANOVA with Habitat and Vertical Section as the main effects. The nonparametric Scheirer-Ray-Hare extension of the Kruskal-Wallis test (Sokal and Rohlf, 1995) was used in lieu of a two-way ANOVA for the biomass data. In this test the data are first ranked and then the two-way ANOVA is performed. Error terms and the resulting H statistic were calculated as described in Sokal and Rohlf (1995) and probabilities obtained from a chi-square Table.

Community species composition was examined by comparing three different multivariate techniques. Comparison of results from different ordination methods has been recommended by Gauch (1982) and Ludwig and Reynolds (1988) to avoid spurious interpretations due to the innate characteristics of any given technique. When similar interpretations are produced by dissimilar methods the results can be considered to be robust. The first method employed was Cluster Analysis. Performed using the Bray-Curtis Dissimilarity Index and a flexible sorting strategy (b=-0.25). Both normal (stations grouped by species composition) and inverse (species grouped by station distribution) clusters were calculated. Since the presence of rare species can confound this type of analysis, only those species comprising 1.0% or more of total abundance were included. Nodal analysis, the simultaneous plotting of both normal and inverse cluster results, was performed for dominance (relative abundance), constancy (a measure of species occurrence), and fidelity (the tendency for a species group to only occur in a particular station group). Detrended Reciprocal Correspondence Analysis and Two-Way Indicator Species Analysis (TWINSPAN) were also performed.

Results

Biological Data

Of the 165 taxa identified there were 78 polychaetous annelids, 4 oligochaetous annelids, 19 bivalve molluscs, 14 gastropod molluscs, 21 amhipods, 7 isopods, 16 other crustacean forms, 3 echinoderms, and 3 miscellaneous taxa (Table 4). Subtidal habitats had the highest number of taxa; Zostera marina and intermediate depth habitats each had 88 taxa and shallow depth habitats had 86 taxa. Unvegetated intertidal habitat (Bare) had the lowest number of taxa (32) followed by Ulva covered sediment (58 taxa) and Zostera japonica (62 taxa). The unvegetated intertidal sites were dominated by small surface feeding forms such as the sabellid polychaete Fabricia sabella, the amhipod Corophium acheruscium, and the spionid polychaete Streblospio benedicti (Table 5). The remaining intertidal habitats and subtidal Zostera marina beds were dominated by epifaunal forms such as the tanaid Leptochelia savigni and the syllid polychaete Exogene molesta. The numerically dominant infaunal species at these sites was the tubificid oligochaete

Tubificoides foliatus. Shallow subtidal habitat was dominated by the tube building oweniid polychaete Owenia fusiformis, the amphipod Photis brevis and the syllid Syllis gracilis. Owenia and a number of bivalve taxa including Transenella tantilla and Acilia castraensis were the most abundant taxa in intermediate and deep subtidal habitats.

Although the nested ANOVA for taxa richness failed to detect a significant difference ($p>0.05$) among habitats (Table 7), the one-way ANOVA utilizing the data from all fifteen stations (i.e., one core per station) did (Table 8). It was assumed that ignoring intra-station variability was acceptable since in the nested design the residual error sums of squares was much less than that for stations. Subsequent multiple range testing (Tukey-Kramer test) indicated that differences in mean taxa richness occurred principally between the highest and lowest values. Shallow subtidal habitats had the highest taxa richness while unvegetated intertidal, Ulva covered sediment and deep subtidal habitats had the lowest values (Figure 2). Both ANOVAs (with and without nesting) yielded statistically significant differences ($p<0.05$) for abundance (Tables 7 and 8). Abundance was highest in the intertidal Zostera marina beds, intermediate in the remaining intertidal habitats, and lowest in the subtidal habitats (Figure 3). Although biomass could not be tested with a nested ANOVA (there is no non-parametric equivalent) the one-way test without nesting (Kruskal-Wallis test) did indicate a significant difference ($p<0.05$) between habitats (Table 8). The high variability of the biomass data makes it difficult to unambiguously distinguish between the habitats, nonetheless, there appears to have been higher biomass at the vegetated intertidal and the intermediate depth subtidal habitats (Figure 4). The relative contribution of the various taxonomic groups to biomass varied widely among the habitats (Figure 5). Polychaetes comprised 50% or more of the biomass at unvegetated intertidal, Ulva covered sediment, and high density intertidal and subtidal Z. marina habitats while molluscs (principally bivalves) dominated biomass in Z. japonica, low density intertidal Z. marina, and intermediate and deep subtidal habitats. Crustaceans provided substantial amounts of biomass in unvegetated intertidal, Ulva covered sediment, low-density intertidal and subtidal Z. marina sites.

Echinoderm biomass was highest in Z. marina habitats and nemertea provided most of the miscellaneous biomass found at unvegetated intertidal habitats.

Analysis of the vertical distribution data also produced distinct patterns in taxa richness, abundance and biomass. Both habitat and vertical section (0-2cm, 2-4cm, etc.) were found to be significantly different ($p<0.05$) for all three community parameters (Table 9). A significant interaction term (i.e., the vertical distribution pattern varied among habitats) was only found for abundance. Taxa richness and abundance were clearly highest in the upper two centimeters of the sediment and declined precipitously with depth (Figures 6 and 7). Biomass produced a bimodal distribution with peaks at 0-2cm and again at 6-10cm (Figure 8). Polychaete biomass dominated the upper 6cm while mollusc biomass (mostly bivalves) as important both at the surface (0-2cm) and below 6cm (Figure 9). Crustacean biomass was concentrated in the upper 6cm and echinoderm biomass was most abundant in the lowest sediment depth interval (8-10cm).

All three parameters also displayed distinct patterns of vertical distribution among habitats. Taxa richness and abundance were always highest in the upper 2cm of the sediment column but differed among habitats in the rate at which they declined with increasing sediment depth (Figures 10-16). Taxa richness declined by nearly half between vertical sections up to 8cm in all habitats except intertidal Z. marina habitats where the decline was less rapid (Figures 12a and 13a). Abundance declined by a factor of 5- to 10-fold between the first two vertical sections (0-2cm and 2-4cm) in all habitats except shallow subtidal (Figure 15b). Vertical distribution of biomass differed considerably among habitats although the variability of the data masked any statistical relationships. Biomass in Ulva covered sediments was limited to the upper 4cm of sediment (Figure 10c) and was dominated by polychaetes and miscellaneous taxa. In Z. japonica habitat, biomass was principally in the uppermost 2cm and consisted almost entirely of molluscs (Figure 11c). Low-density intertidal and subtidal Z. marina beds had most of their biomass in the upper 2cm, but substantial amounts were also present in deeper intervals (Figures 12c and 14c). Polychaetes dominated the biomass in both habitats and at all sediment levels. The bimodal pattern that was found in the overall biomass distribution (Figure 8) was limited to high-density intertidal Z. marina and shallow and intermediate depth subtidal habitats (Figures 13c, 15c, and 16c). In the high-density intertidal seagrass and shallow subtidal habitats most of the biomass was present in the 6- 8cm layer and was comprised primarily of molluscs (Figures 13c and 15c). Polychaetes dominated the 0-2cm layer, the second highest concentration of biomass. At intermediate subtidal depths, the uppermost sediment layer had the highest biomass and was dominated by molluscs. The lowest sediment layer (8-10 cm) had the next highest biomass and consisted of nearly equal weights of polychaetes, molluscs, and echinoderms (Figure 16c).

Multivariate analyses (Clustering, DRA and TWINSPAN) indicated that species composition varied among habitats, sediment types, and depths. Clustering of stations based on species composition (Normal cluster analysis) produced seven station groups (Table 10) (Note: the full normal cluster dendrogram is furnished in Appendix Figure 1); Group A- unvegetated intertidal sediments, Ulva, and Zostera japonica stations with gravelly sands and muds, Group B- muddy unvegetated intertidal sediments and Zostera japonica stations, Group C- subtidal Zostera marina beds on gravelly muddy sands, Group D- sandy low and high intertidal Zostera marina and Ulva sites, Group E- deep subtidal stations with gravelly mud, Group F- mainly shallow and intermediate depth sandy subtidal stations and Group G- Intermediate and deep subtidal mud sites (Table 12). Clustering of subtidal stations with depths less than 10m in Groups F and G suggests that the habitat classification based on depth should be modified. There appear to be only two depth-related habitats, shallow and deep, with 10 meters being an approximate demarcation line between them. Additional sampling is required to confirm this result.

Inverse clustering (species groups defined by station distributions) produced five species groups (Table 11). Species Group 1 contained the polychaetes Barantolla americana, Malacoceros glutaeus, Axiothella rubrocinta, and Exogene molesta, the oligochaete Tubificoides foliatus, the amphipods Eobrolgus spinosus and Corophium acheruscium, the tanaids Leptochelia savigni and Pancolus californiensis, and the cumacean Leptocuma sp. Species Group II was comprised of the polychaetes Dipolydora quadrilobata and Brania brevipharyngea, the amphipods Amphithoe valida and Ericthonius hunteri, and the cumacean Leucon sp. Species Group III had only two species, the polychaetes Streblospio benedicti and Fabricia sabella. Species Group IV contained the polychaetes Mediomastus sp. (probably capensis) and Owenia fusiformis, the oligochaete Grania paucispina, the amphipod Photis brevipes, the bivalve molluscs Transenella tantilla and Mysella tumida, and the ophiuriod echinoderm Amphioda occindentalis. Species Group V consisted of two species, the bivalve Acila castraensis and the cumacean Eudorella sp.

Nodal analysis of the cluster results and examination of the sediment data (Tables 12 and 14) point out several associations between station and species groupings (Figure 17). Stations with equal amounts of mud and sand (Station Group A) were closely associated with Species Group II (high dominance, constancy and fidelity). Likewise, there was a very strong relationship between Species Group V and the muddy intermediate and deep subtidal stations of Station Group G. Muddy intertidal habitats (Station Group B) had high constancy and fidelity and fairly high dominance by Species Group III, whereas Species Group I dominated sandy intertidal sites (Station Group D. Sandy shallow and intermediate depth subtidal stations (Station Group F) were characterized by Species Group IV, subtidal Zostera marina (Station Group C) by both Species Groups I and IV, and deep sites with gravelly muds (Station Group E) by Species Groups II and V.

Results from Detrended Reciprocal Correspondence Analysis (DRA) were very similar to those of clustering; stations associated with the normal clusters were generally found plotted together with the only clear exception that of Group F which split into two groups along axis 1 (Table 13, Figure 18). One grouping contained Shallow Stations 108, 130, 149, and 151 and the other Shallow Stations 129 and 152, Intermediate Station 148, and Deep Stations 140, 142, and 145. DRA did not recapitulate separation of Intermediate sites into those less than or greater than 10 m deep. DRA species plots were similar to inverse cluster results with members of the species cluster groups plotting near one another (Figure 19). For instance, Group V taxa were found in the upper left-hand side of the plot with Group IV taxa occurring just below them. Photis brevipes was the only Group IV taxon found well away from the other group members. Species Groups I and II were slightly intermixed with Pancolus californiensis and Corophium acheruscium (Group I) occurring in the midst of Group II. The two Group III taxa, Streblospio benedicti and Fabricia sabella, were also separated with F. sabella occurring near the bottom of the plot.

Results from TWINSPAN analysis also broadly resembled the cluster and DRA results although slightly more station and species groupings were created (Figure 20). TWINSPAN produced 8 station groupings. The first station grouping contained mostly Cluster Group A stations, the second was dominated by Group D stations, and the third by Group C and D stations. The fourth had equal numbers of Group C and F stations. Group E stations were predominant in the sixth TWINSPAN station group, while the fifth and seventh contained only Cluster Group F stations. The last TWINSPAN station group was comprised completely of Group G stations. As in normal clustering a distinction was made between Intermediate stations with depths less than or greater than 10m. The seventh TWINSPAN station group was made up entirely of stations less than 10m deep (Intermediate Stations 109, 113, 124, and 138). The first TWINSPAN species grouping had only one taxon, Leucon sp. The second was composed of Species Cluster Groups I, II, and III taxa and the third and fourth were dominated by Group I taxa. The fifth and sixth species groupings were made up of Species Group IV taxa and the final grouping was identical to Species Group V.

In addition to changes in the composition of dominant taxa, a number of less abundant taxa were characteristic of certain habitats (Table 4). For instance, the polychaete Arenicola pacifica, the gastropod Batillaria zonalis (=attramentaria) and enteropneusts were found principally in intertidal habitats. The polychaete Prionospio steenstrupi was collected in subtidal habitats and the polychaete Spirobis spirillum was found only in Z. marina beds. The isopod Colanthura sp. was found in shallow and intermediate depth subtidal samples while the polychaete Euclymene sp. and the bivalve Nuculana hamata were collected only in intermediate and deep subtidal habitats.

Sediment Grain Size and Sediment Profile Imagery

Sediment grain size varied considerably among and within habitats (Table 14 and Appendix Table 13). Unvegetated intertidal substrates ranged from gravelly sand (Station 42) to sand (Station 213) and muddy sand (Station 209). Ulva covered intertidal sediments were more uniform with three being sandy (>75% sand), three being muddy sand, and the remaining site being sandy mud. Similar results were found among Z. japonica habitats with three sand, one muddy sand and one sandy mud station present. All but one of the low density intertidal Z. marina sites were sandy (the remaining one was sandy mud) as were all but two of the high-density intertidal Z. marina stations (the remaining sites were muddy sand). Two of the six subtidal Z. marina stations where sediments were collected had sandy sediments (Stations 59 and 203), two were muddy sand (Stations 31 and 48) and two were sandy muds (Stations 65 and 201). In shallow subtidal habitats 11 stations had sandy sediments and the remaining four had muddy sands (Stations 108, 110, 129, and 153). Intermediate depth subtidal stations were predominantly muddy with only three stations being classified as sandy (Stations 124, 137, and 148). Deep subtidal sediments were quite variable with five sand sites (Stations 140, 142, 144, 145, and 500), five muddy sands (Stations 131, 138, 143, 146, and 501), one sandy mud (Station 132), three muds (Stations 123, 126, and 141) and one gravelly sand (Station 139). There are no clear relationships between depth and sediment type among intermediate or deep subtidal habitats with sand and mud stations being found at all depths. For instance, depths for Intermediate Stations 125 and 137 are 11m and 12m respectively, yet one has a sand substrate and the other mud. Likewise, depths for Deep Stations 123 and 142 are 25 m and 23 m respectively, yet the first is muddy and the second sandy.

Sediment profile photographs were obtained from nearly all the unvegetated subtidal stations (Table 15). Visual analysis of the photographs supported the grain size results confirming the presence of one of three sediment types at all stations: mud, mixed mud and sand, and sand. Shallow sites were either muddy sand or sand and at least one (Station 153) had Zostera marina present (See Appendix Photographs). Penetration depths ranged from 10 to 20cm and apparent redox potential depths (RPD) from 3 to 6cm (Table 15). Maldanid polychaete tubes, feeding voids, burrows and other evidence of bioturbation were found in all muddy sand sediments. Sandy sediments from shallow subtidal stations also contained indications of infaunal activity and Zostera marina shoots (Stations 150, 151, 152, and 153). An Ulva mat was present in at Station 149 apparently having washed in from the intertidal flats. Intermediate depth sediments were mud and mixed sediments (sand and mud). Mud stations had penetration depths from 15 to 29cm and RPDs between 2.4 and 4.3cm. Large fecal casts were observed at a number of stations as was evidence of deep burrows and feeding voids. Mixed sediments generally had lower penetration depths (4.9 to 14 cm) and RPDs (1.8 to 2.4cm). RPDs were patchily distributed at several stations (e.g., Stations 109 and 111). Fecal casts and feeding voids were present at most of the sites. Deep stations had either mud or sand substrates. Deep muddy stations were similar to shallow muddy sites with deep penetration depths and RPDs and numerous indications of bioturbation. Deep sand stations, however, had low penetration depths, a large amount of debris (decaying grass blades, shell hash, etc.) and several large burrows.

Fish Feeding Habits

English sole (Pleuronectes vetulus) are common throughout Puget Sound (Monaco et al., 1990) and were the most abundant fish species collected in both intermediate and deepwater trawls (Table 16). They have been reported to prefer sandy substrates in depths of less than 16m for recruitment. Larger juveniles (140 to150mm) migrate into deeper waters in late summer and fall (Lassuy, 1989). The same pattern is seen in the Padilla Bay collections with younger juveniles (<140mm) and adults (> 150mm) found at intermediate depth sites, but only older juveniles and adults present at the deep stations. Blackbelly eelpout (Lycodes pacificus) in the 100-150mm range were collected in large numbers from the deep stations. The eelpout is common in muddy bottoms at depths greater than 10m (Eschmeyer, Herald, and Hammann, 1983).

Feeding habitats of English sole varied with size class and trawl site. The smallest sole (< 100mm) from the intermediate depth stations fed predominantly on molluscs and polychaetes (Figure 21a). Molluscan taxa collected in their stomach contents consisted principally of Macoma nasuta, Mysella tumida, and Transenella tantilla; polychaete prey were dominated by Owenia fusiformis and an unidentifiable ampharetid (Table 17). Crustaceans, a much smaller proportion of the diet, were comprised of the amphipods Corophium sp. and Photis brevipes cumaceans, ostracods, and crabs. English sole between 100 and 150mm from intermediate depths fed on crustaceans and polychaetes (Figure 21b) including cumaceans, ostracods, the amphipods Photis brevipes, Eyakia robustus, and Cheirmedeia macrodactyla, and the polychaetes Owenia fusiformis and Nepthys cornuta (Table 18). Sole in the 150 - 200mm range fed on polychaetes including Owenia fusiformis and Sternapsis scutata. (Figure 21c and Table 19). Size class I sole trawled from deep stations had mostly large molluscs (Acila castraensis and Yoldia myalis) in their gut contents (Figure 22a and Table 20) while deep station 150-200mm sole fed on these same large molluscs as well as the ophuiroid echinoderm Amphioda occidentalis (Figure 22b and Table 21). Blackbelly eelpout fed mostly on Yoldia myalis, ostracods, cumaceans, and the amphipod Eyakia robustus (Figure 23 and Table 22).

Discussion

Benthic invertebrate assemblages are critical to the functioning of estuarine and coastal ecosystems. Deposit-feeding forms (e.g., oligochaetes and polychaetes) rework surficial and buried sediments thus altering sediment chemical gradients and releasing trapped nutrients (Huttel, 1990; Pelegri and Blackburn, 1994). Two species of deposit-feeding polychaetes found in Padilla Bay, Axiothella rubrocincta and Pectinaria californiensis, are known to be able to process 5 and 8.6 grams of sediment per day respectively (Kudenov, 1982; Nichols, 1974). The entire top 2cm of sediment of sandy subtidal sites can be turned over in approximately 12 days, while it can take from 6 months to 2.5 years to rework the top 10cm (Meyers, 1977). Deposit-feeding also transforms microalgae at the sediment surface and microbes associated with buried detritus into animal tissue which in turn serves as forage for higher trophic levels. Filter feeders such as bivalve molluscs perform a similar function by turning phytoplankton into animal biomass and may even control phytoplankton populations under certain conditions (Nichols, 1985). Many fish, shellfish and migratory shorebirds rely on benthic invertebrates as a food resource. For instance, juvenile and adult English sole (Pleuronectes vetulus) feed on a variety of benthic invertebrates (Hogue and Carey, 1982), juvenile and adult dungeness crabs (Cancer magister) both rely heavily on clams as food (Gotshall, 1977; Stevens, Armstrong, and Cusimano, 1982), and the diet of migrating green-winged teal (Anas crecca) consists principally of amphipods (Baldwin and Lovvorn (1994).

The structure of benthic assemblages is determined by the interaction of a number of habitat features. In intertidal habitats, sediment texture, intertidal height, salinity regime, and wave action are considered to be the most important structuring factors (Raffaelli and Hawkins, 1996). Sediment texture is generally recognized as the most important factor structuring both intertidal (Sanders, 1958; Holland and Dean, 1977; Larsen and Doggett, 1990 and 1991) and subtidal (Lie and Kelley, 1970, Lie and Kisker, 1970; Weston, 1988) communities with characteristic assemblages associated with different sediment types. Changes in assemblage structure also occur at different intertidal elevations (Aitken and Gilbert, 1986; Aitken, Risk, and Howard, 1988) or subtidal depths (Lie and Kelley, 1970, Lie and Kisker, 1970). For instance, burrowing deposit-feeders generally dominate high intertidal sites and filter- and surface-feeders are dominant at lower intertidal elevations (Aitken and Gilbert, 1986; Koh and Shin, 1988; Hertwick, 1994). In estuaries, characteristic assemblages are associated with different salinity regimes (Sanders, Mangelsdorf, and Hampson, 1965; Jones et al., 1990). While wave action is of less importance in areas such as Padilla Bay which are protected from the direct effects of ocean swells, it can have a strong influence on exposed intertidal and subtidal sites (Oliver et al., 1979; McLachlan, 1983; Morin et al., 1985). Areas of strong current may result in depleted benthic abundances in tidally scoured channels (Jones et al., 1990; Chester, Ferguson, and Thayer, 1983). Vegetative structure can also affect benthic assemblage structure. Everett (1991) found that heavy concentrations of the macrolgae Ulva reduced abundance of the bivalve Macoma nasuta on California intertidal flats. Drake and Arias (1996) have reported mixed effects of Ulva on Spanish intertidal flats. Dense macroalgal cover negatively affected abundance of the polychaetes Nereis diversicolor and Streblospio shrubsoli and the gastropod Hydrobia ventrosa while the amphipod Microdeuptopus gryllotalpa and the gastropod Hydrobia ulvae were positively affected. Accumulations of decomposing macroalgae generally produce anoxic conditions and defaunate the underlying sediments (Norkko and Bonsdorff, 1996). Seagrass benthic communities tend to be more abundant than those in unvegetated sediments and have particularly high densities of epifauna (Virnstein et al., 1983; Lewis and Stoner, 1983). Increased epifaunal densities appear to be correlated with plant biomass (Stoner, 1980), however, interspecific differences in plant structure also appear to be important (Gee and Warwick, 1994).

Benthic assemblages also vary both spatially and temporally (Livingston, 1987). Spatial distributions can vary horizontally on scales ranging from mm (Jumars, Thistle, and Jones, 1977) to km (Morrisey et al., 1992). Vertically, most infauna are found in the upper 2-5 cm of the sediment column (Johnson, 1967; Hines and Comtois, 1985; Quijon and Jaramillo, 1996). Temporal fluctuations occur on a variety of scales ranging from hours (Bell and Devlin, 1983) and weeks (Diaz, 1984) to months (Dauer, 1980) and years (Nichols and Thompson, 1985; Holland, Shaughnessy and Hiegel, 1987; Service and Feller, 1992).

Long-term or broad scale changes in the hydrological or chemical dynamics of estuarine systems can have profound impacts on benthic community structure. Flint (1985) has reported episodic bursts of benthic secondary production in Corpus Christi Bay, Texas associated with peaks in freshwater input while Livingston et al. (1997) have documented changes in the trophic structure of the Apalachicola Bay estuary, Florida linked to periods of drought.

The structure of Padilla Bay benthic assemblages are similar in most regards to those found in other Puget Sound benthic habitats (Tables 23 and 24). Diversity measures (total taxa, taxa/sample, H') indicate a pattern of increasing diversity with decreasing intertidal elevation. This pattern continues into subtidal areas, with total taxa and H' reaching maxima at depths of 5-20m and taxa/sample being highest in shallow (< 5m) areas. All three diversity measures are lower for deep (>20m) areas. Riggs (1983) has previously reported very low diversity in intertidal Zostera japonica and Z. marina habitats. Nyblade (1979) found diversity levels similar to the present study at all but a deep subtidal site where he recorded very high diversity values (H' = 4.26). The pattern of increasing abundance (no./m^2) with decreasing intertidal elevation and declining densities with increasing subtidal depth (Figure 3) is apparent in the data of Nyblade (1979). He recorded highest abundance in high intertidal sites and lowest in shallow and intermediate depths. Data from Smith and Webber (1978) is somewhat more variable: high intertidal sites had 800-2800 animals/m^2 while Z. japonica beds lower in the intertidal zone had only 400 animals/m^2. Likewise, shallow subtidal sites sampled by Smith (1979) had nearly twice as many animals as those at intermediate depths. Actual abundances vary considerably between studies (range from 400-97,000/m^2) but this is consistent with interannual variability and inter-study differences in sampling procedure. Padilla Bay biomass ranged from 12 to 370 g/m^2 with maxima occurring in Z. japonica, high-density intertidal Z. marina, and intermediate subtidal depth habitats (Table 23). Previous studies have reported biomass values ranging from 74 to 3655 g/m^2 (Table 24) with no clear pattern of maxima or minima. As with abundance, a portion of this variability reflects differences between studies, however, temporal fluctuations in populations of relatively large taxa are most likely responsible.

It is obvious from examination of species distributions (Tables 4 and 5) that two groups of species are associated with Padilla Bay habitats: those with wide inter-habitat distributions and those with relatively restricted distributions. Species found in virtually all habitats include the polychaetes Barantolla americana, Mediomastus sp. (probably capensis), Exogene molesta, the oligochaete Tubificoides foliatus, the bivalves Transenella tantilla and Mysella tumida, the amphipod Corophium acheruscium, and the ophuiroid echinoderm Amphioda occidentalis. The polychaetes Dipolydora quadrilobata and Axiothella rubrocincta, the amphipod Eobrolgus spinsosus, the cumaceans Leptocuma sp. and Leucon sp., and the tanaids Leptochelia savigni and Pancolus californiensis are absent from deep subtidal samples. The polychaete Malacoceros glutaeus, the amphipod Ericthonius hunteri, and the holothurian echinoderm Leptosynapta clarki are restricted to intertidal and shallow subtidal habitats. The polychaetes Owenia fusiformis, Prionospio cirrifiera and P. steenstrupi, the gastropod Admete gracilior, the bivalve Acila castraensis, and the cumacean Eudorella sp. are found only in subtidal or near subtidal habitats. These distributions are essentially identical to those reported in previous studies. Domination of high intertidal sites by oligochaetes, Corophium, and spionid polychaetes has been described by Nyblade (1979), Woodin (1974), and Smith and Webber (1978). Other common high intertidal taxa included cirratulid polychaetes and cumaceans. The most abundant taxa of Ulva covered sediments included the tanaid L. savigni and the syllid polychaete Exogene molesta. Woodin (1974) reported the same taxa as dominants from Ulva covered intertidal sediments and at Mitchell Bay, Washington, although the syllid is identified as E. lourei. This species is the most commonly reported syllid in Puget Sound benthic studies (Table 24), however, specimens collected during the present study all appeared to be the closely related species E. molesta (Kozloff, 1987). In order to avoid confusion in the subsequent discussion it will be assumed that one species, Exogene sp., is present as the dominant taxon. Leptochelia sp., Corophium, and the bivalve Transenella tantilla were the most abundant taxa found in Z. japonica beds in the present study and by Riggs (1983) and Smith and Webber (1978). Riggs (1983) reported the polychaetes Notomastus tenuis, Exogene sp., Capitella, and Owenia fusiformis and oligochaetes as the most abundant taxa in Padilla Bay intertidal Z. marina beds. In 1994, Leptochelia, Exogene, oligochaetes, and Corophium were dominants, but the other species were still present in substantial numbers. Although no comparable studies were found for subtidal Z. marina habitats, Phillips (1984) and Kozloff (1983) provide species lists and comments on the most frequently encountered species. Common eelgrass fauna include the snails Lacuna variegata and Haminoea vesicula, the isopod Idotea resecata, the caprellid amphipod Caprella laeviscula, and the polychaetes Mediomastus sp. and Malacoceros glutaeus. All of these taxa were well represented in the Padilla Bay Z. marina beds as well as Leptochelia, Corophium acheruscium, Exogene sp., and the amphipod Eobrolgus spinosus. Previous studies of unvegetated subtidal sites in the area of Padilla Bay also reported the dominance of the polychaetes Exogene, Owenia, Axiothella rubrocincta and the bivalves T. tantilla and Mysella tumida at shallow and intermediate depths, and the polychaete Prionospio steenstrupi and the bivalve Lucina tenuiscuplta at depths greater than 20 m (Nyblade, 1979; Barreca, 1982).

The vertical distribution of Padilla Bay infauna matched the results of previous studies (Johnson, 1967; Hines and Comtois, 1985; Quijon and Jaramillo, 1996). Taxa, abundance, and biomass tend to be concentrated in the upper few centimeters of both sand and mud sediments. Biomass may form secondary peaks at depths greater than 5 cm, particularly in sand due to the presence of large, deep burrowers such as the polychaete Notomastus (Johnson, 1967) or bivalve molluscs like Macoma balthica (Hines and Comtois, 1985). The variability in vertical distribution of biomass among Padilla Bay habitats is due primarily to differences in the distribution of M. nasuta and T. tantilla (Appendix Table 12).

The fish feeding habitat data are also similar to previous reports. The dominant species from Padilla Bay trawls, English sole, is found primarily in shallow water as juveniles but in late summer and fall the older juveniles and adults migrate into deeper waters (Lassuy, 1989). The same pattern is seen in the Padilla Bay collections with juveniles and adults found at intermediate depth sites, but only older juveniles and adults present at the deep stations. The young feed extensively on meiofaunal-sized organisms (e.g., harpacticoid copepods and small polychaetes) while juveniles and adults are opportunistic benthic feeders (Hogue and Carey, 1982). Comparison of stomach contents of Padilla Bay specimens with the biomass and species composition among habitats suggests that English sole from the deep sites fed at deep and intermediate depths while those found in intermediate depths fed in shallow and intermediate depths. For instance, taxa dominating the stomach contents of specimens from intermediate depths (Macoma nasuta, Mysella tumida, Owenia fusiformis, Photis brevipes, Eyakia robustus, and Cheirmedeia macrodactyla) are typical of shallow and intermediate depths and intertidal and subtidal Zostera marina beds. Sternapsis scutata, Yoldia myalis, and Acila castraensis, which dominated stomach contents from all the deep station collections, are found principally in intermediate and deep subtidal habitats. These results are consistent with the known size distribution and feeding habitats of English sole. Blackbelly eelpout, collected entirely from deep waters, also fed mostly on taxa characteristic of deep-water habitats (e.g., the bivalve Yoldia myalis and the amphipod Eyakia robustus).

Although this study is the most thorough examination of Padilla Bay benthic assemblages to date, it still represents a limited database of information. Due to logistical constraints some habitats were under-sampled (unvegetated intertidal sand and mud) or went unsampled (sloughs, salt marsh, and Ruppia beds) and sampling of vertical distributions was incomplete in unvegetated intertidal and deep subtidal habitats. Also, the extreme northern and southern ends of the reserve were inadequately sampled and additional sampling is required to determine if there should be two (Shallow and Deep) or three (Shallow, Intermediate, and Deep) depth classifications of unvegetated subtidal habitats. Further distinction of subtidal Z. marina and unvegetated habitats based on sediment type may also be advisable. Finally, the present study represents a single time period or "snapshot in time" of benthic assemblage distribution and structure. Species populations fluctuate over time and habitat distributions may not be consistent from one time period to another. Sampling over both short-term (weekly to monthly) and long-term (seasonal and annual) time periods is required to understand the dynamics of the infaunal populations and verify the distribution patterns of the benthic assemblages.

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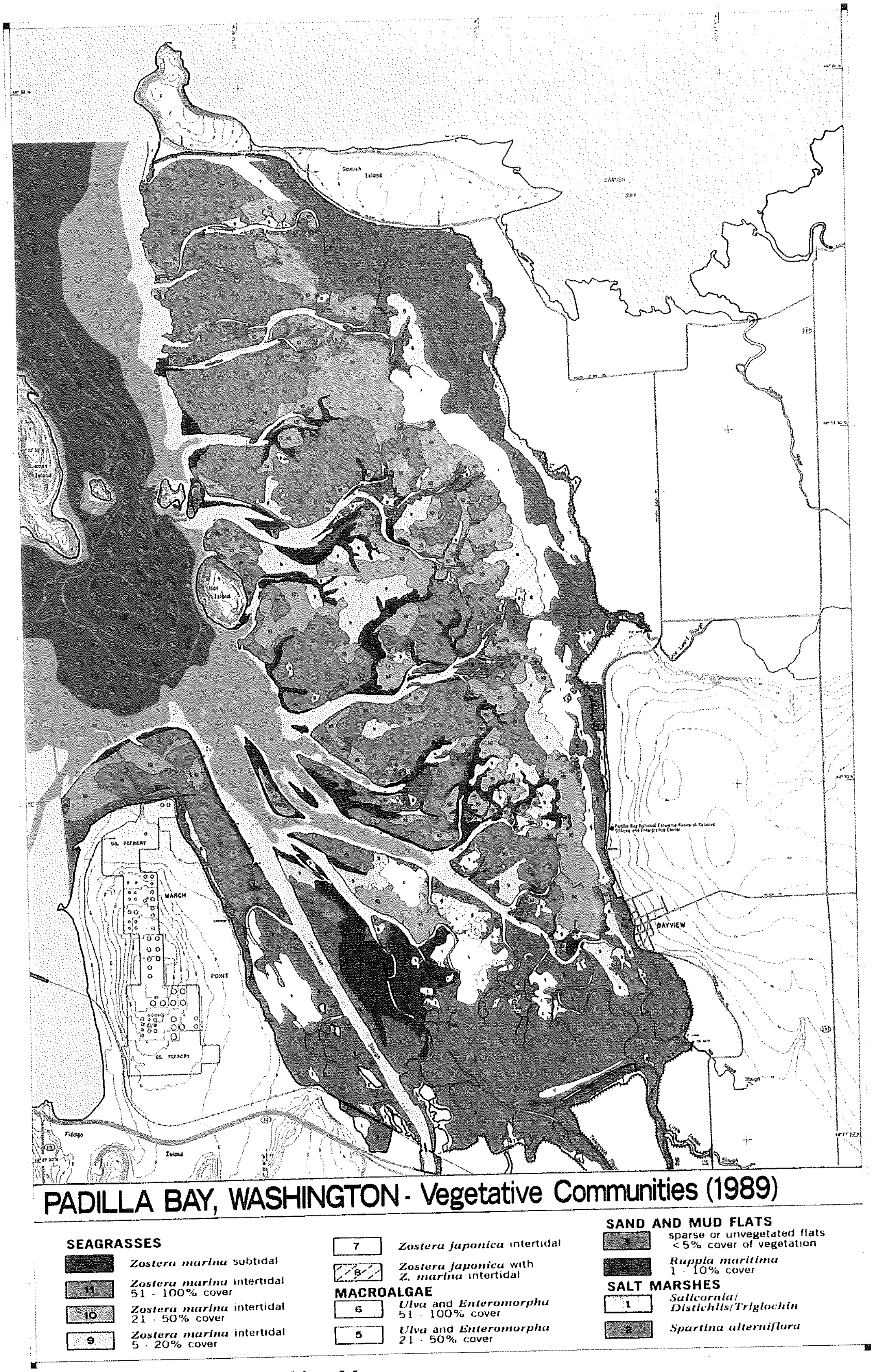


Figure 1. Padilla Bay Habitat Map.

Figure 2. Habitat Distribution of Taxa Richness

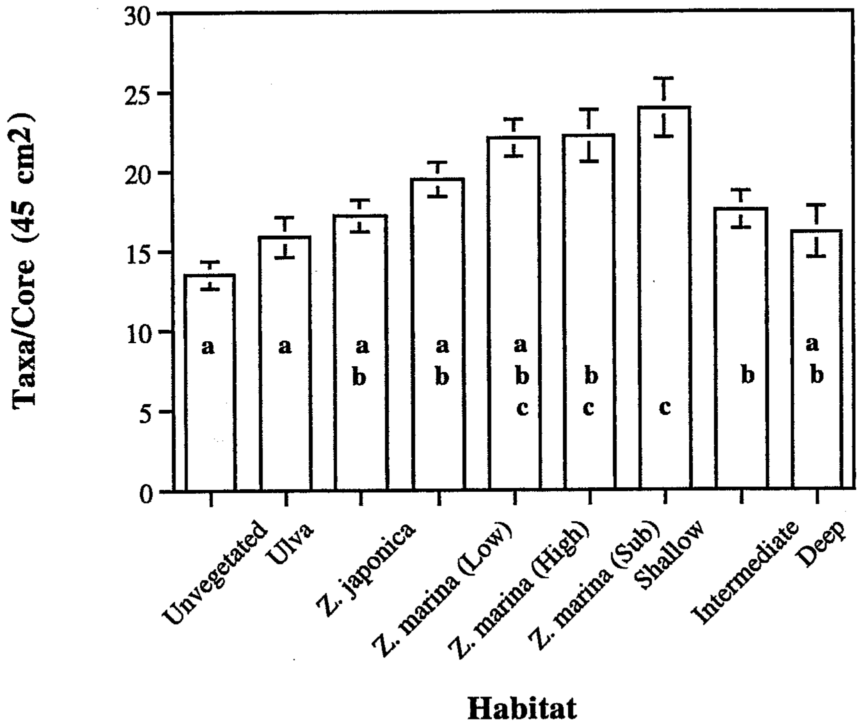
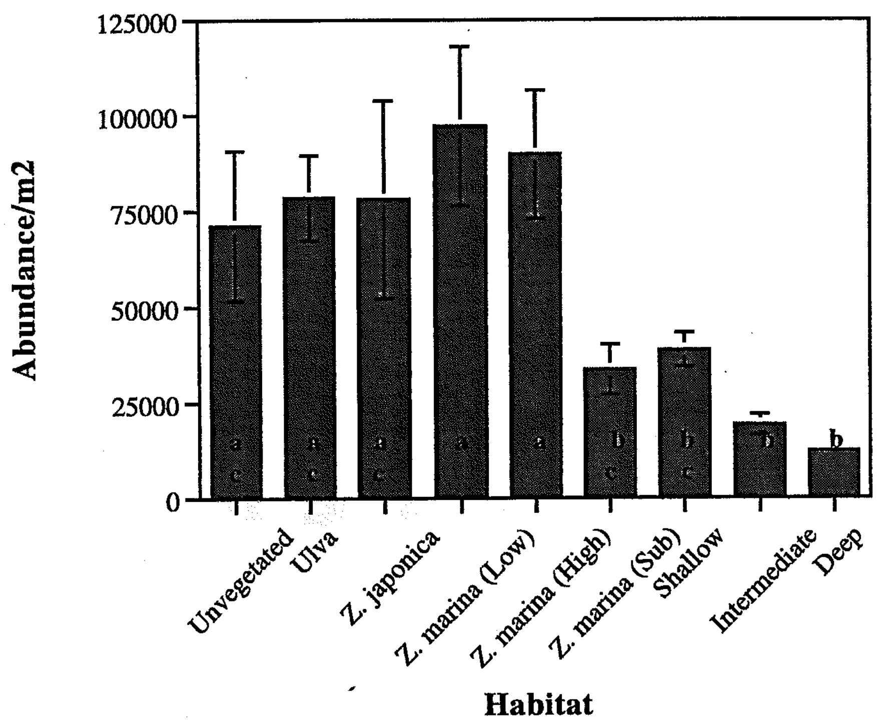


Figure 3. Habitat Distribution of Abundance/m2



***Bars with the same letter are not significantly different (p>0.05) in the Tukey-Kramer Multiple Range Test**

Figure 4. Habitat Distribution of Biomass/m2

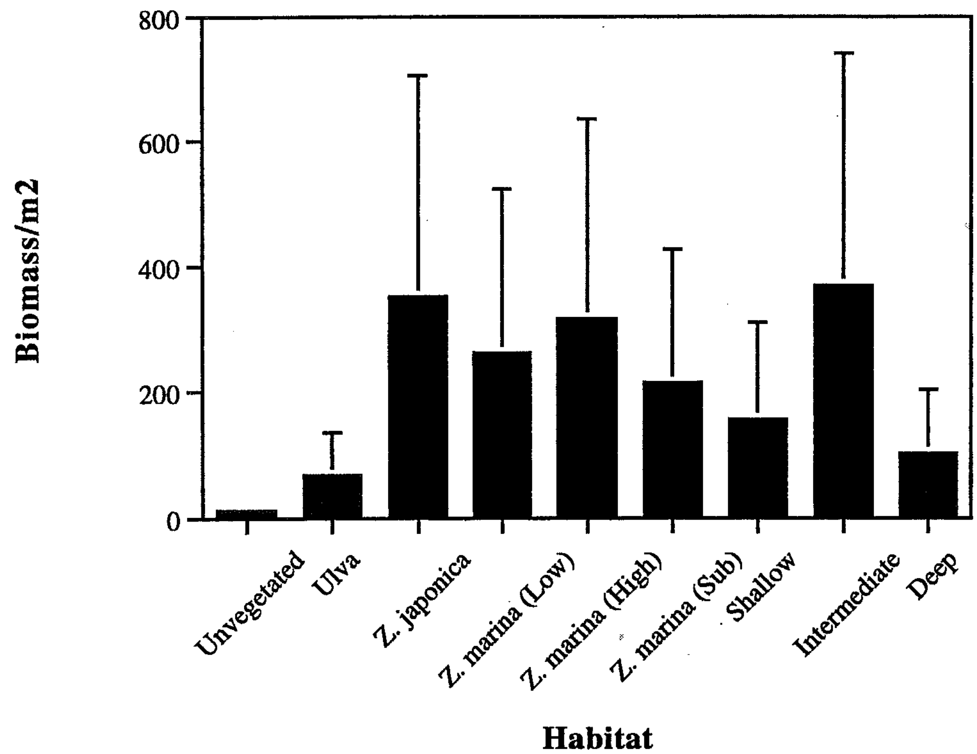


Figure 5. Taxonomic Distribution of Biomass

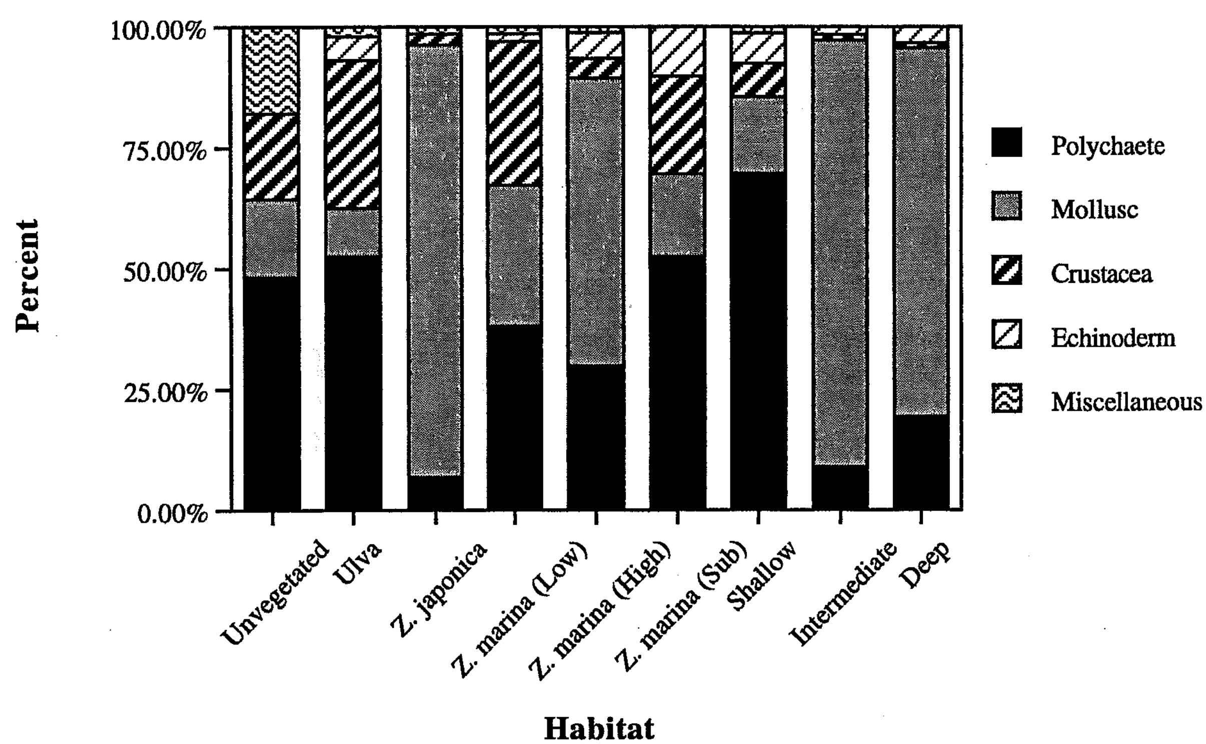


Figure 6. Vertical Distribution of Infaunal Taxa

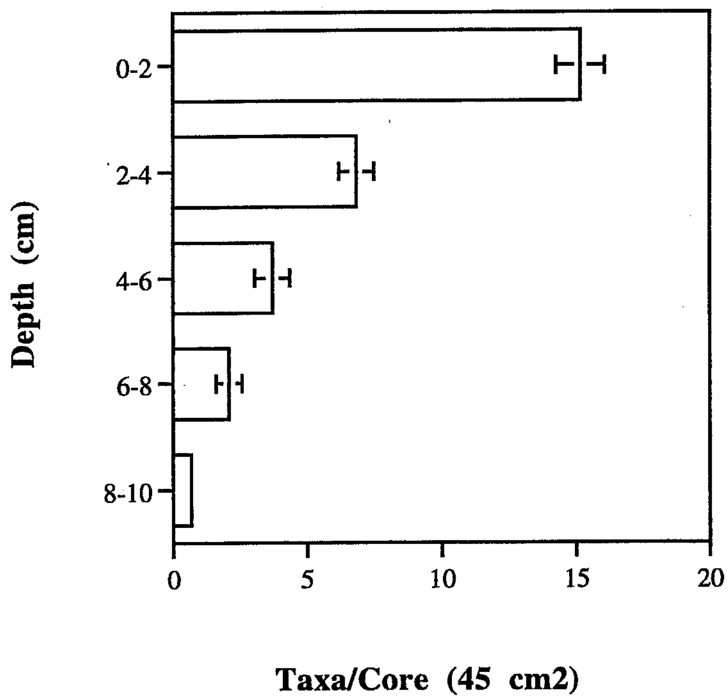


Figure 7. Vertical Distribution of Animals/m2

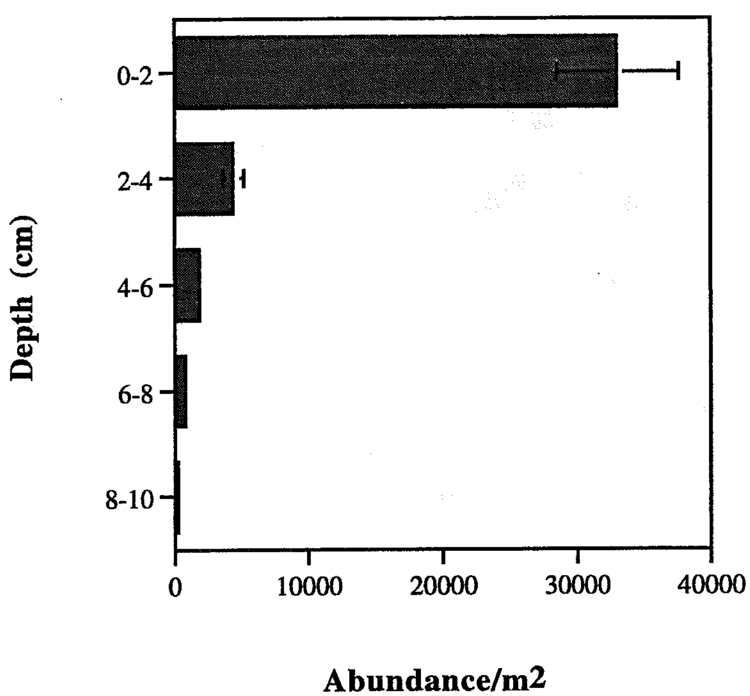


Figure 8. Vertical Distribution of Biomass

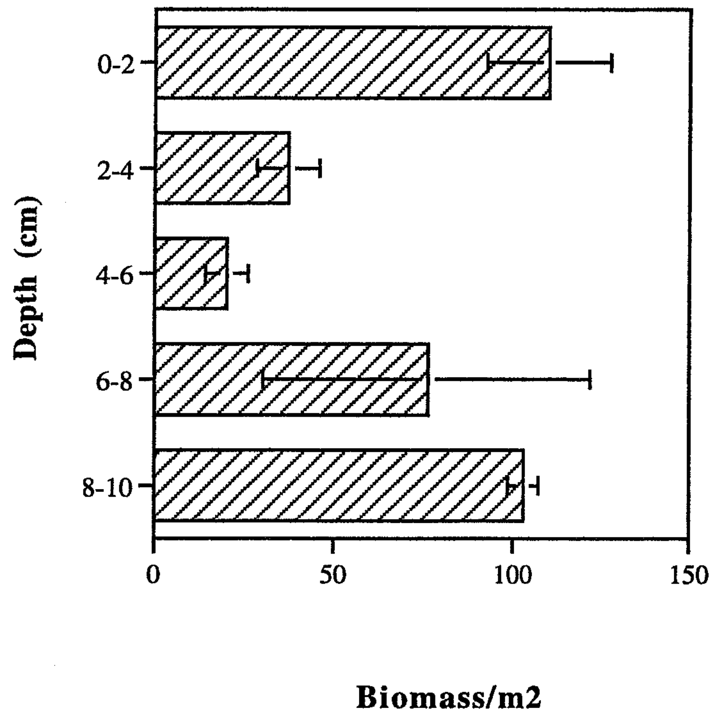


Figure 9. Vertical Distribution of Biomass by Taxonomic Group

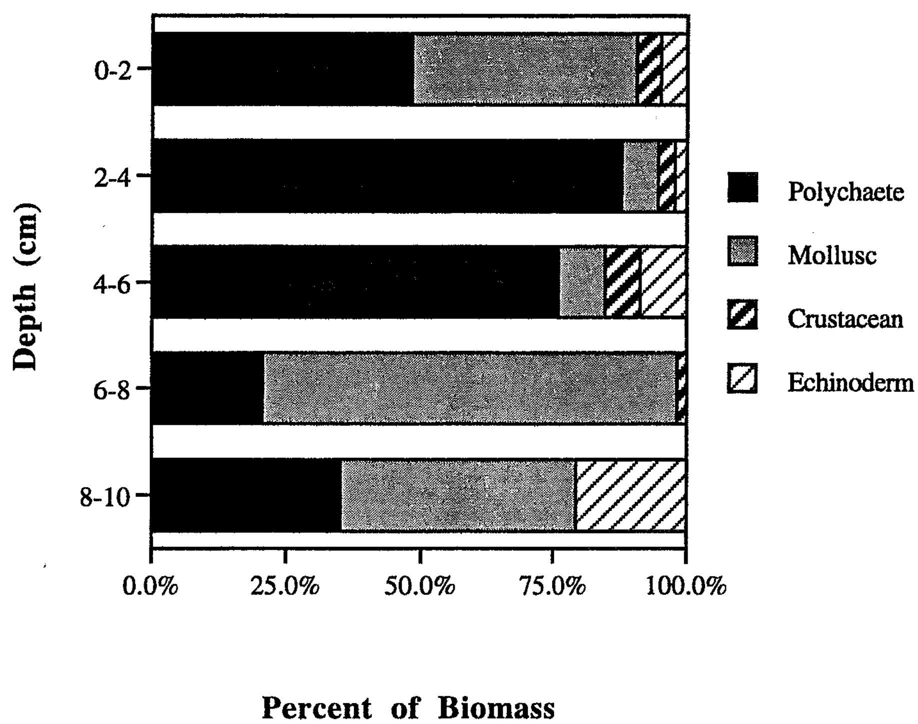


Figure 10a-c. Vertical Distribution of Taxa, Abundance and Biomass Ulva Habitat

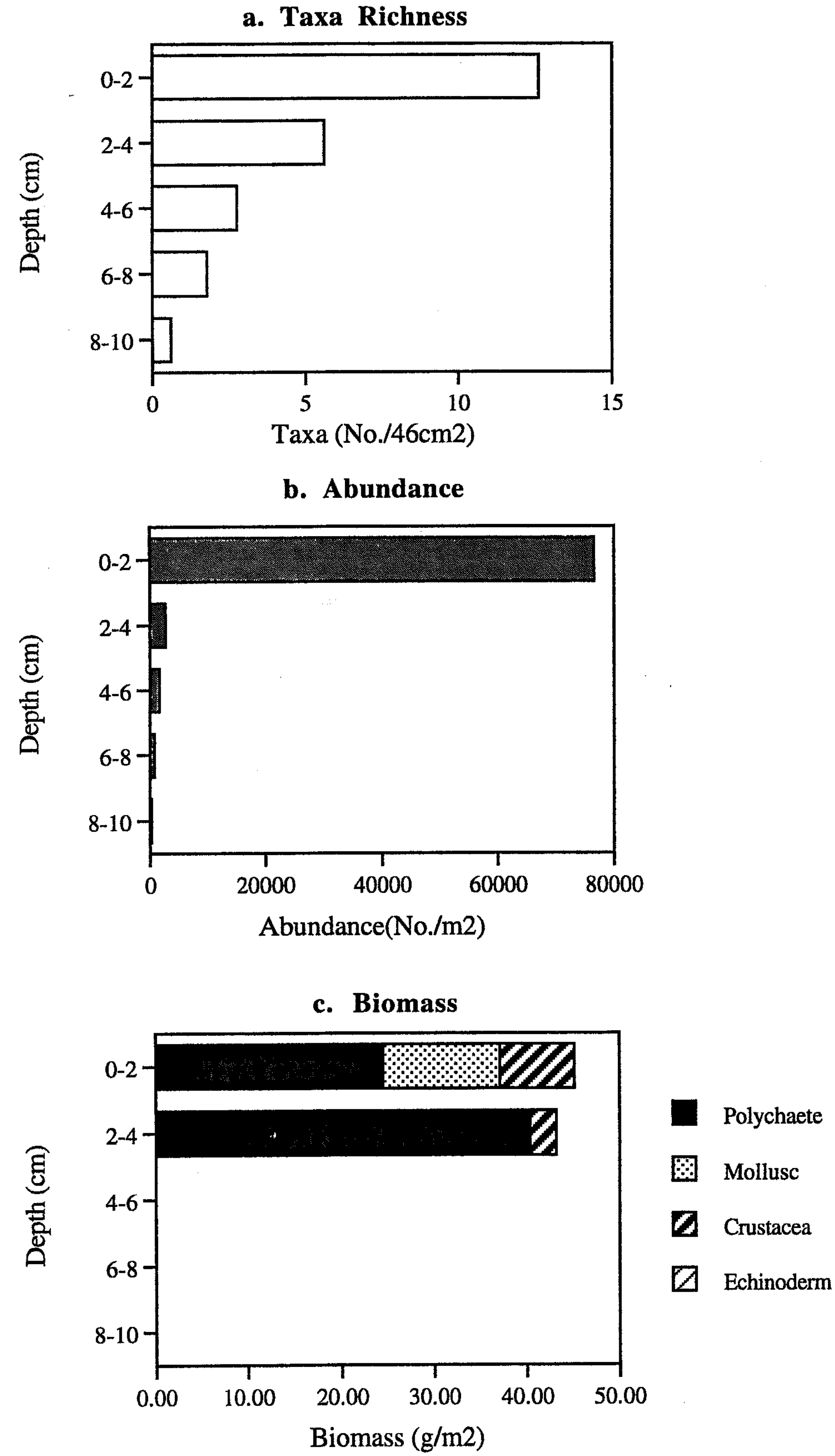


Figure 11a-c. Vertical Distribution of Taxa, Abundance, and Biomass Zostera japonica Habitat

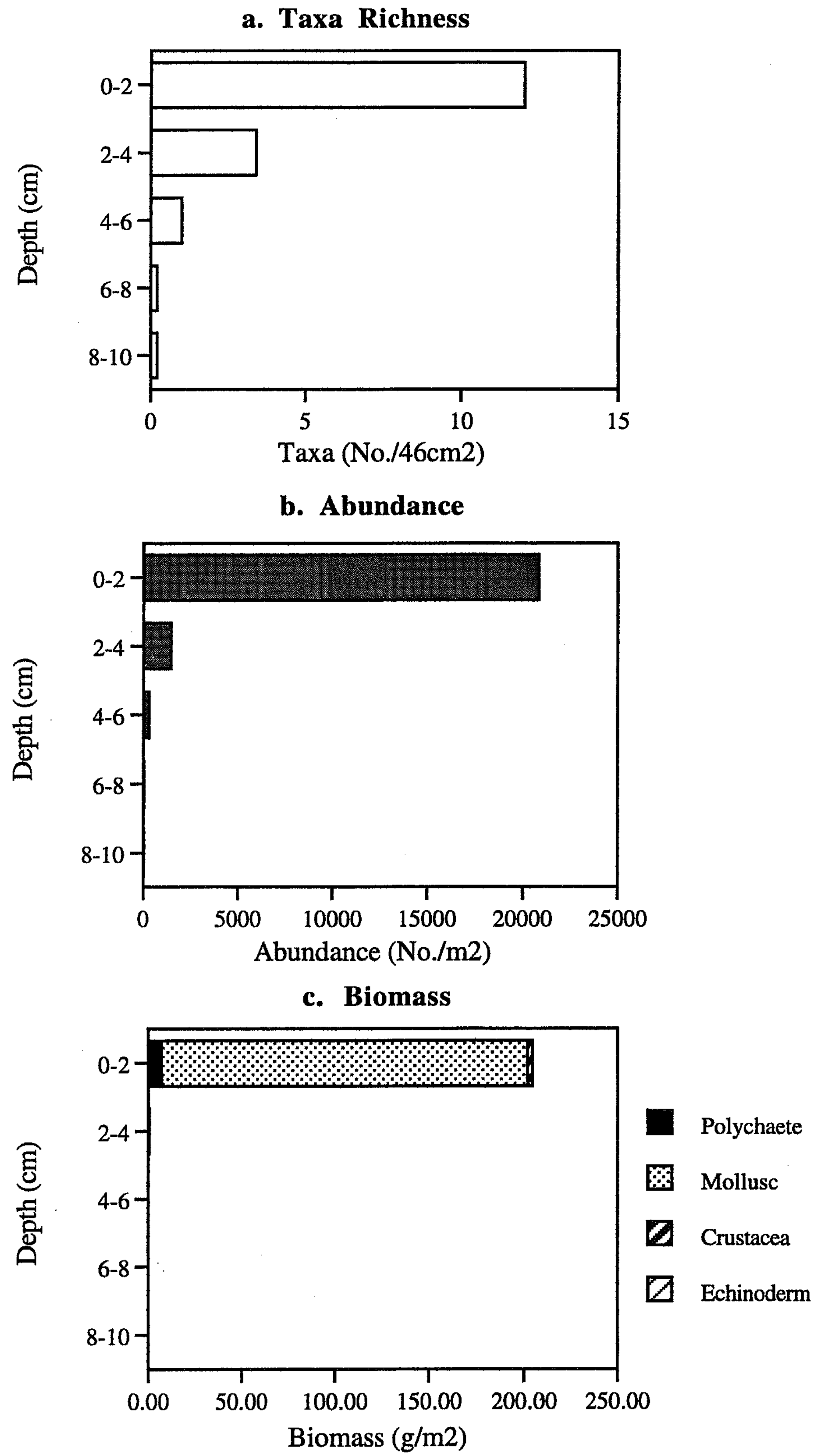


Figure 12a-c. Vertical Distribution of Taxa, Abundance, and Biomass Low Density Intertidal Zostera marina Habitat

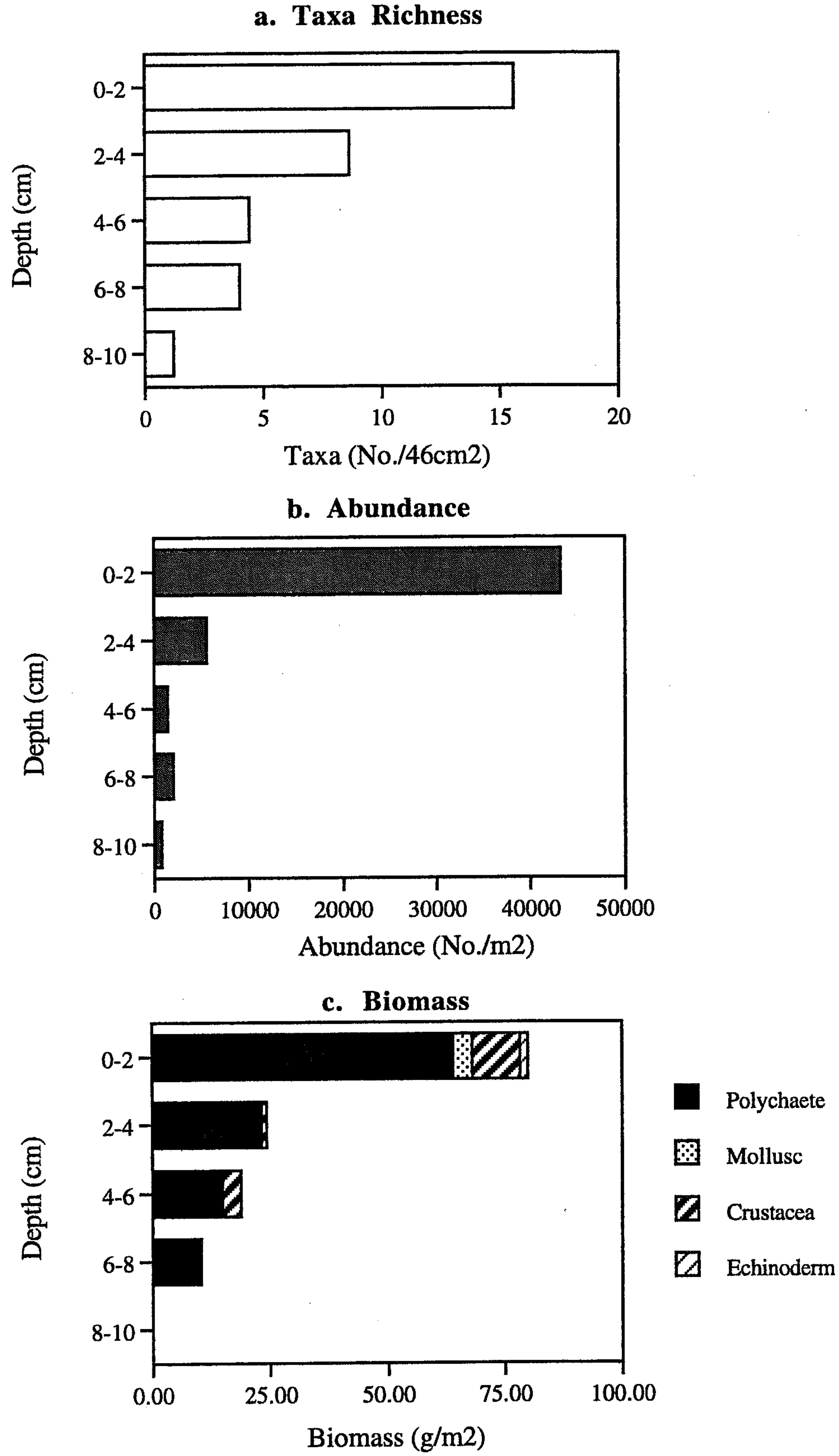


Figure 13a-c.Vertical Distribution of Taxa, Abundance and Biomass High Density Intertidal Zostera marina Habitat

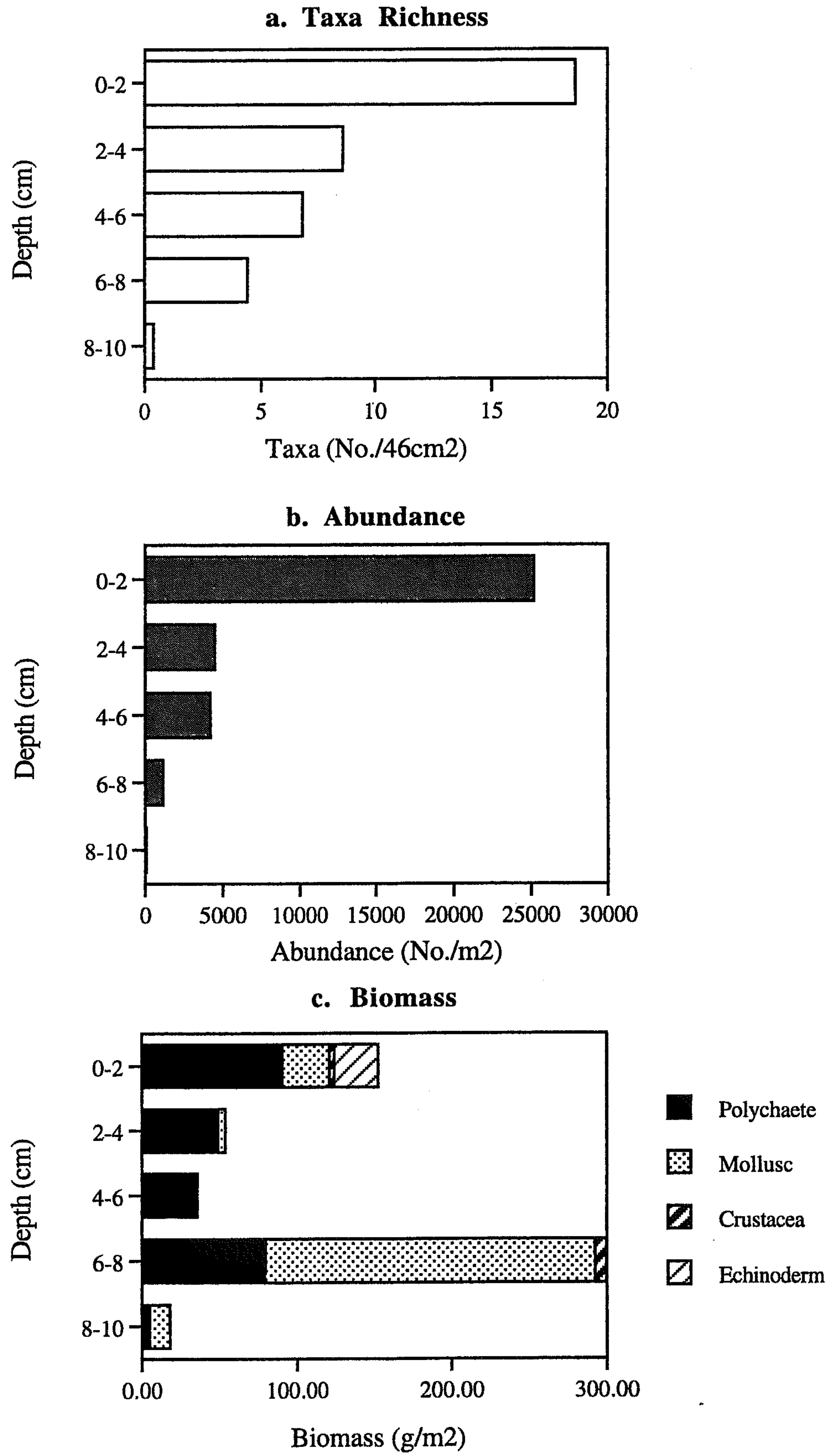


Figure 14a-c. Vertical Distribution of Taxa, Abundance, and Biomass Subtidal Zostera marina Habitat

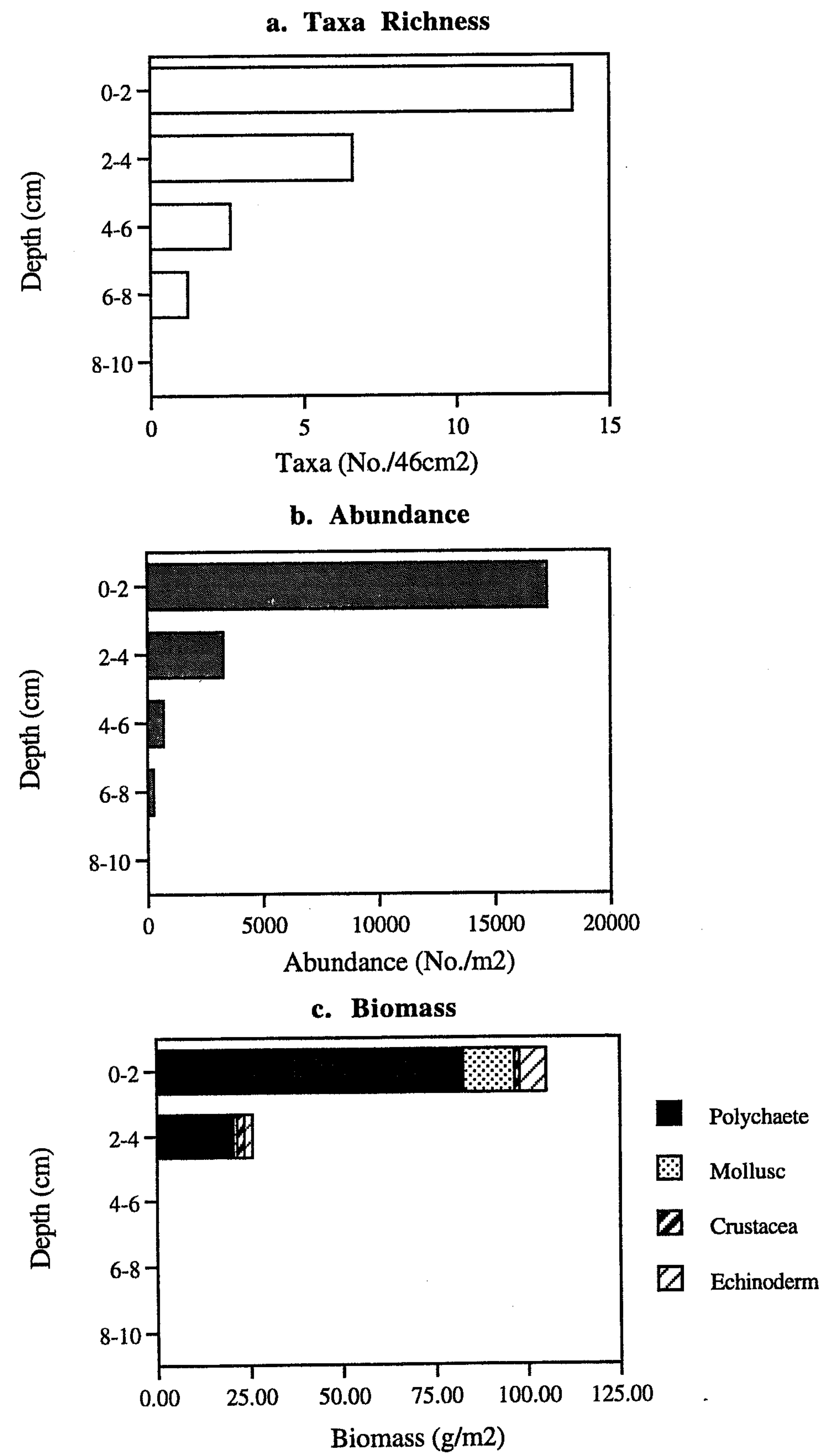


Figure 15a-c. Vertical Distribution of Taxa, Abundance and Biomass Shallow (<5 m) Subtidal Habitat

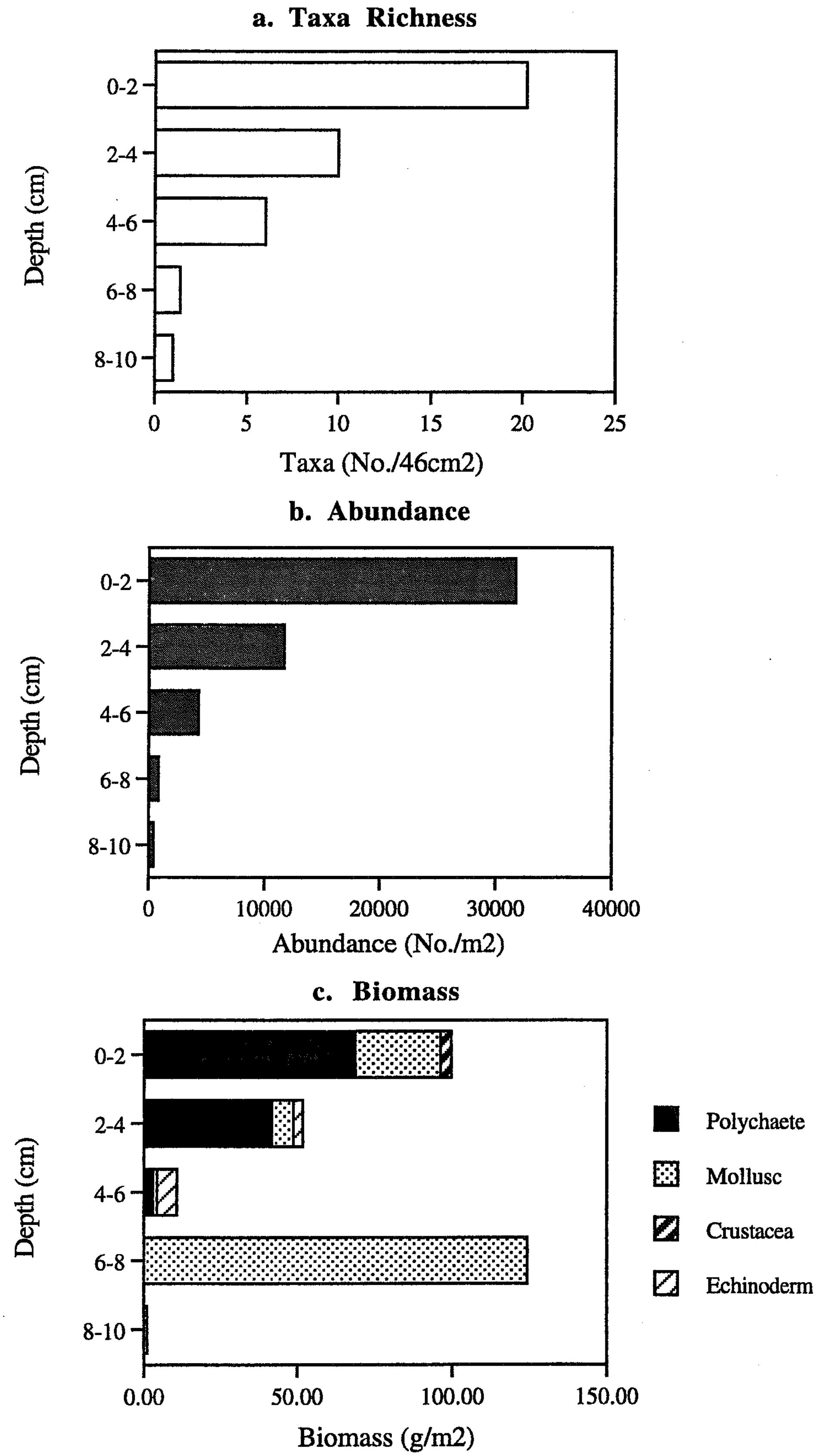


Figure 16a-c. Vertical Distribution of Taxa, Abundance, and Biomass Intermediate Depth (5-20m) Subtidal Habitat

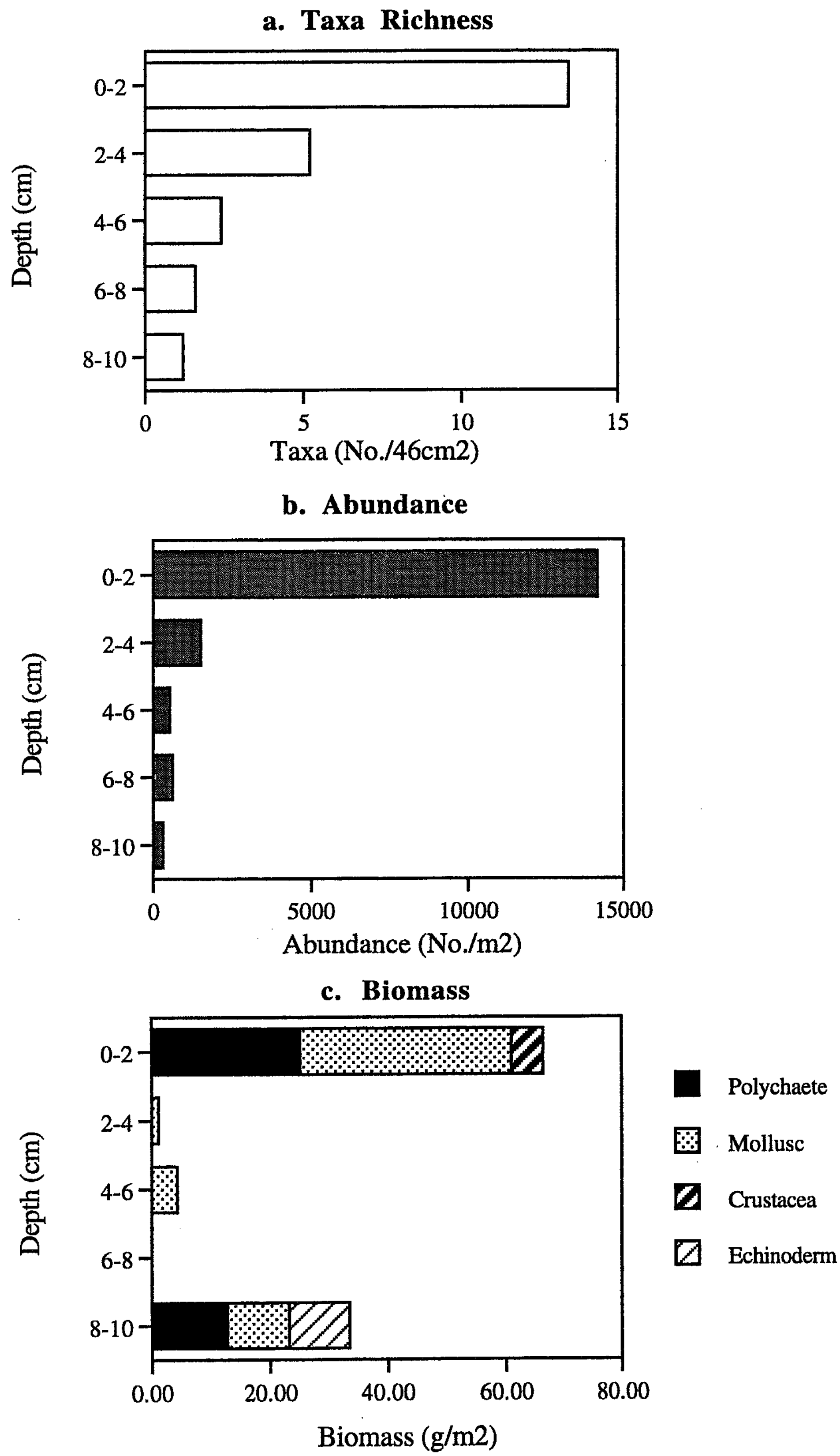


Figure 17. Nodal Analysis

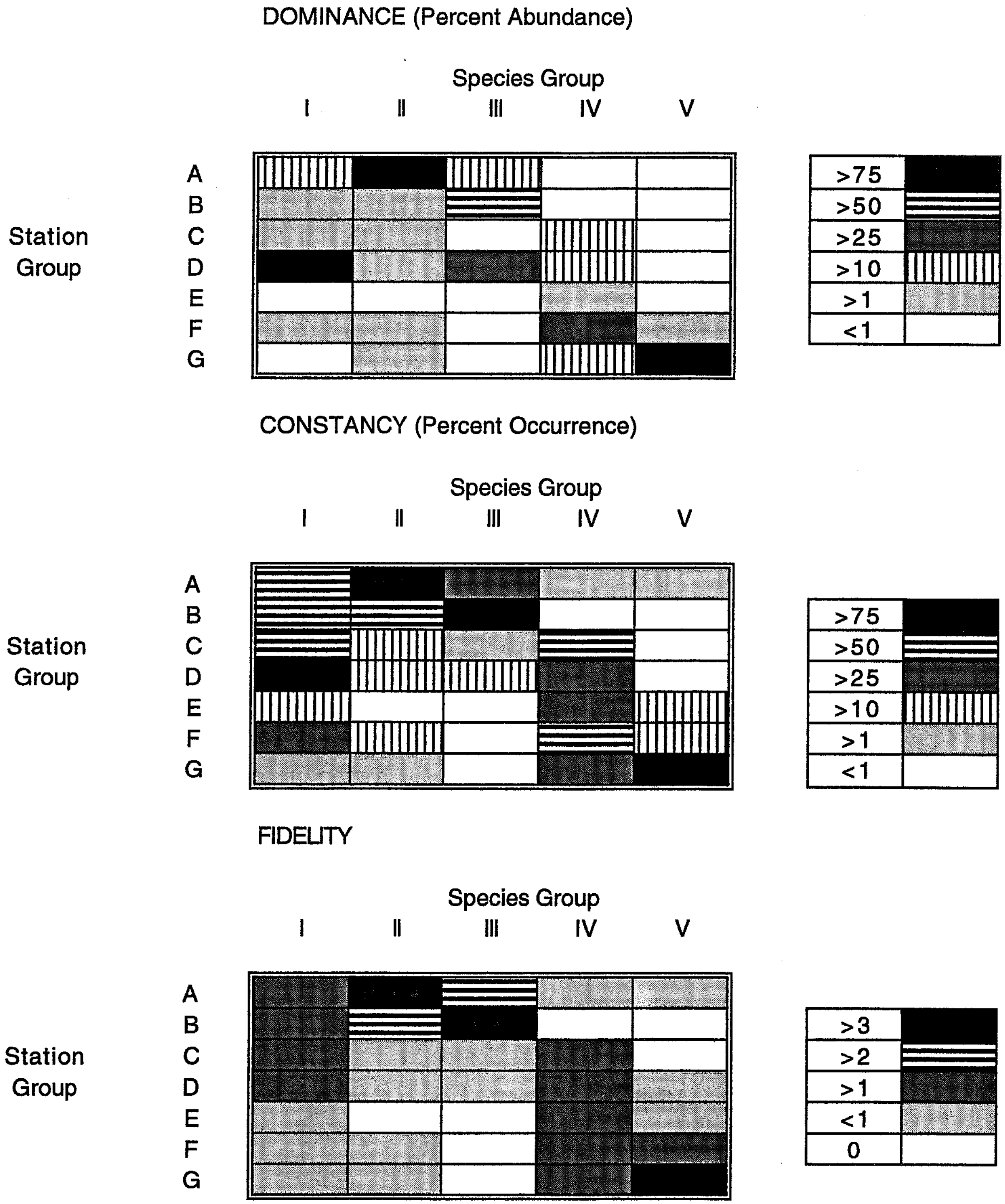
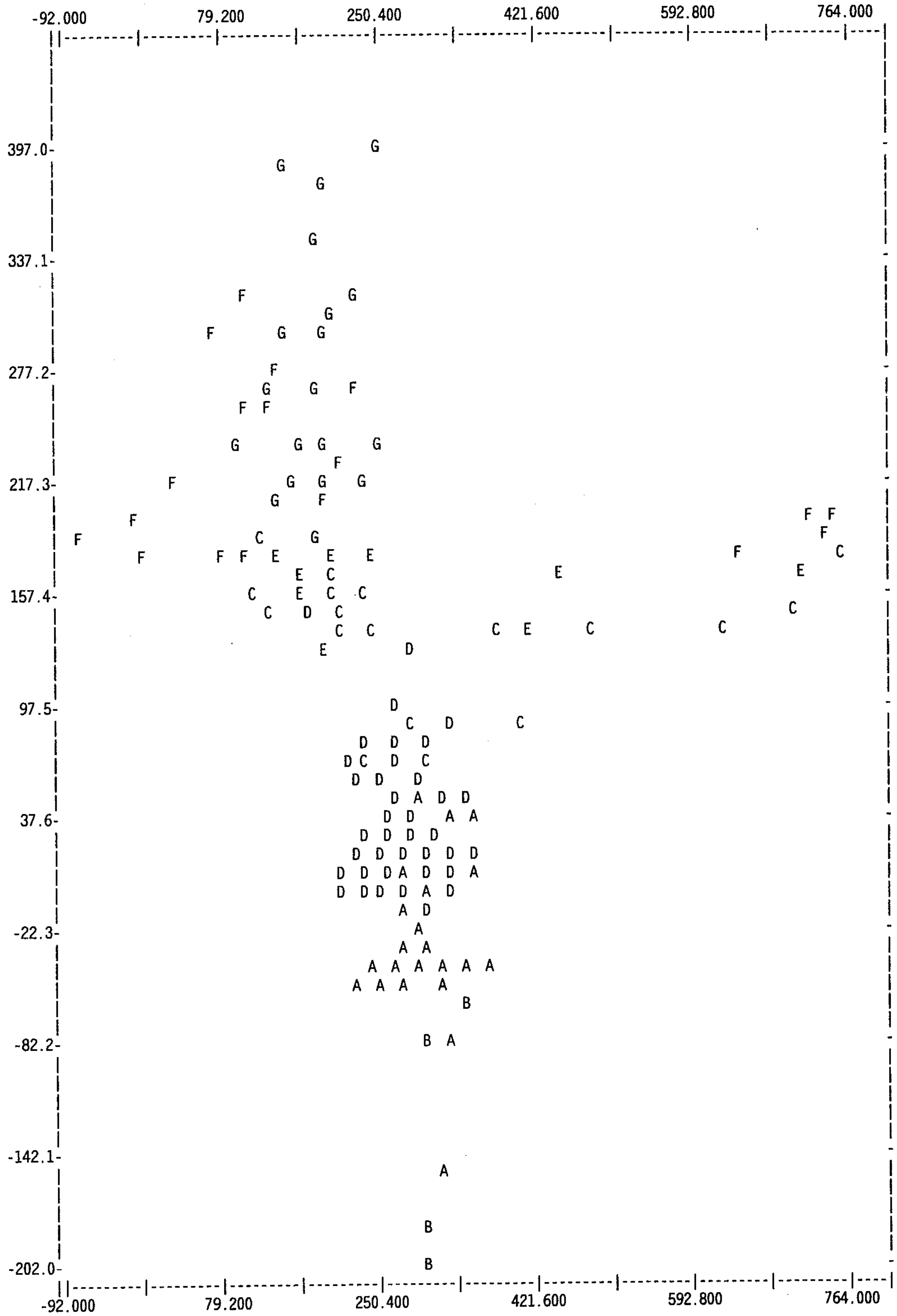
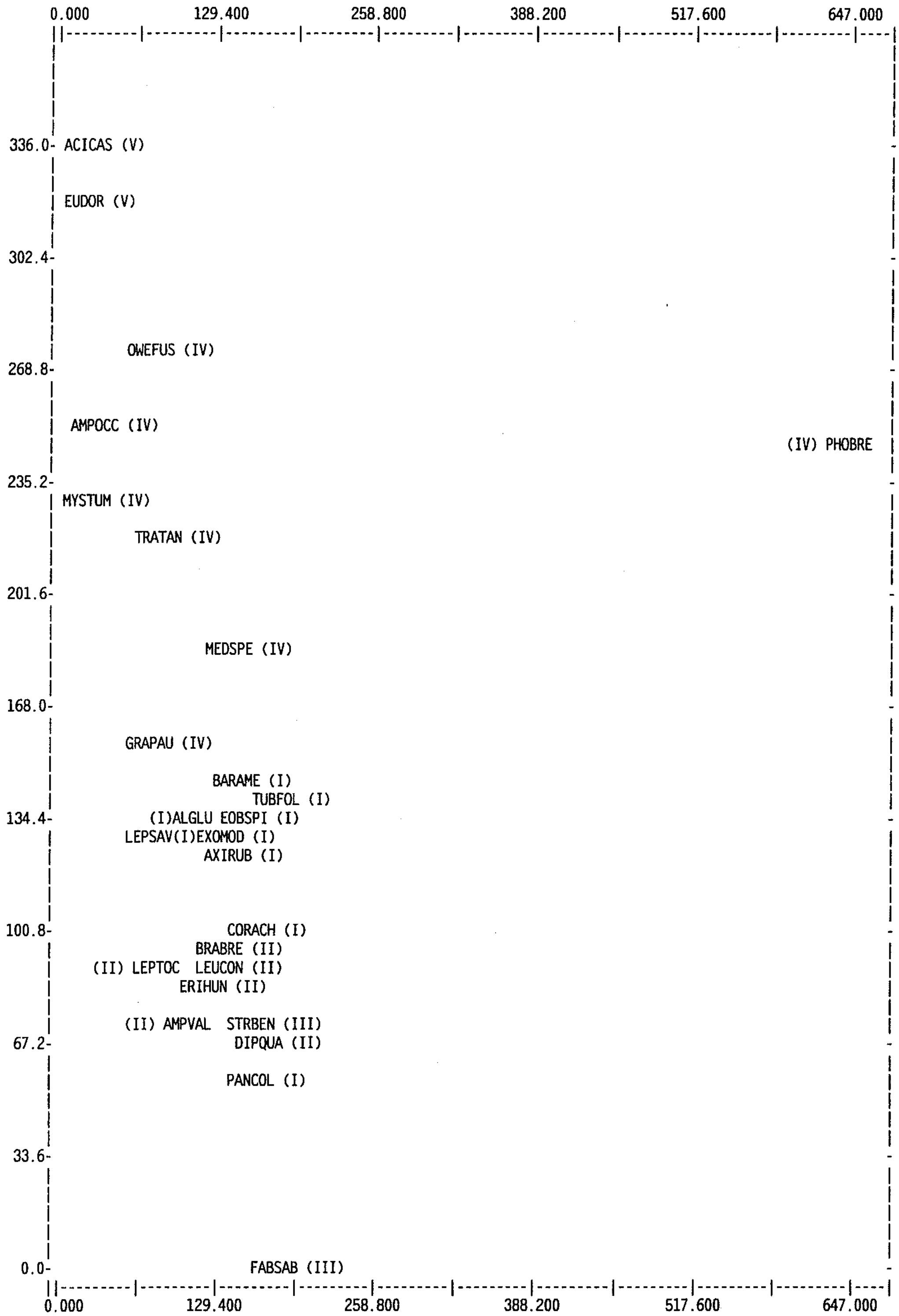


Figure 18. Detrended Reciprocal Correspondence Analysis for Stations



PLOT OF AXIS 1 (VERTICAL AXIS) AGAINST AXIS 2 (HORIZONTAL AXIS)

Figure 19. Detrended Reciprocal Correspondence Analysis for Species



PLOT OF AXIS 1 (VERTICAL AXIS) AGAINST AXIS 2 (HORIZONTAL AXIS)

Figure 20. Padilla Bay TWINSPAN Analysis

```
                     Cluster Station Group
                     BBBAAAAAAAAAAAAAAAAA AAAAACCDDDDDDDDDDDDDDDDDDDDDDDDA DDCDDDDDDDDDCDCDDCCCCECCCC CCFFFCCEFCFEFFF FFFFF EEEEEGEEG FFFF GGGGGGGGGGGGGGGG
                     Habitat
                     BBBJBJJJJBUUJJLJJJJJ UJJLBUULLLLHHJLLLLLLHHHHUUUUUUUU ULZULLHHHHHZZZHHZSZZZZHZZZ ZZSDSHZDSSSSSSS SSSID SSDDDDDDD IIII DIIIIIDDIIIIIIIDD

   II    LEUCON  213155554314545234-1 1524------1--------1------11---2 2-------1----1-212-------- --------1-31212 -1--- --------- --12 -3122-----------  000

   II    DIPQUA  ---2-4342-1133-13555 3-41---2--1-1--11----21--------1 -----------------2------1 --------------- ----- --------- ---- ----------------  001
   III   FABSAB  55524541------------ -------------------------------- -------------------------- --------------- ----- --------- ---- ----------------  001
   II    AMPVAL  ----44154-1-11-32-12 2512----------1----------------- 2-2------------------2-- --------------- ----- --------- ---- ----------------  001
C  II    ERIHUN  1-223-5455--452-332- 441--11----------------------32 ---1---1---42---2--------- ------4-------- ----- --------- ---- ----------------  001
l  III   STRBEN  554-345--43542---32- ----2-2---------1--------55-515- ---2-------1------2------- --------------- ----- --------- ---- ----------------  001
u  I     LEPTOC  -12-53232-33555435-5 54523-1----1152-2321235243454455 4--------112----1--------- ----2-----1---- ----- --------- ---- ----------------  001
s  I     AXIRUB  ---------------124-1 2232----4--33545334334443--2-21- 2----422223212--2--------- 2-------1--1--1 --1-- --------- ---- ----------------  001
t  I     BRABRE  -----3235---221315-4 -2145-----133-----132-22-------- ------13-2-32--3--22------ ----------2---- ----- --------- ---- ----------------  001
e  I     CORACH  53555-55555555555545 555532-31--2153244532553534-1525 232212333-1-1-25-2----121- ----3---3212245 11--- -1-1----- --1- --------11112----  001
r  I     PANCOL  1555----22---1211113 3422-3-4541324-234432241------3- 2222--1----2---2--2------- ----2---------- 1---- --------- ---- ----------------  001

   I     MALGLU  --------------21--- 33233-1-4222-33352-5443555545452 21-444333444132---22--21-- 222--1--------- ----- --------- ---- ----------------  010
S  IV    GRAPAU  -------------------- ---------3-2--3---22------------ 55---2-5--25223554-22----- -1------------- ----- --------- ---- ----------------  010
p  I     EOBSPI  -------2--5344543323 24512--311-31545232134445451541 4444-445334432244-3-2-3355 2-1-2----2----- --2-- -1------- ---- ----------------  010
e  I     LEPSAV  31--32---243525224-- 55155545555555555555555555555555 55555555555555524-1-5242 43--141-5345-1- ----- --------- 2--- ----------------  010
c
i  I     BARAME  113---424223-4232323 21352-2522233233353---111-----3- -4-1332212331324433342-1221 442-125-32-412- 121-1 1-------- ---1 ---------------1  011
e  I     EXOMOD  5-1-1----3-1-332-4-2 5555-1355555555555555555554555552 5555555555544455532242-12 23--411----2-1- ----- 1111-1--- 2--- -1--------------  011
s  I     TUBFOL  5135433--24542522514 -445-1345335555555555554544553451 553555455455254454555355532 43--44524435343 223-2 32322--2- ---- ---------------1  011

G  IV    MEDSPE  -------------------- ----3-1----21---123321--21411--3 ---1---12-23--4-44221-21-- 121-1--12-22212 ---11 1-2312113 -1-- 1---------2------  10
r  IV    MYSTUM  ----1--------------- ---2----------1---211112212-2-1- 3253-2242-32123-5533321-22 4555532-42555-2 445-3 221122--1 33-2 21--------------  10
o  IV    PHOBRE  -----1-------------- -------------------------------- ------------------32--2--3 -22-----5545255 -4--- --12----- 12-- -----1-1---------  10
u
p  IV    OWEFUS  -------------------- -----------------------1-112122 ----2--2-----23231----3-2- 452-535-5255555 5555- 2-22-1--2 5452 333223224212----1  110
   IV    TRATAN  ----1-----222------- ----121-11-2-532125-2553533-524- 42-424-21-22232-4111------ 2-2-4---133322- 24212 222222334 55-2 5534445553444445 4  110
   IV    AMPOCC  -------------------- -------------12-1222----------- 112--122-2321--343211----2 -2--11--113413- --433 --------- 2244 223234311413-2-1-  110

   V     ACICAS  -------------------- -------------------------------- ---------------1---------- --------------- --2-- --1-13-11 ---- 24145344554424345  111
   V     EUDORE  ---------------1---- -------------------------------- -------------------------- --------1--2--- -1--- --------- 2412 -423332-544434-1-  111

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                 0000 0000000000000000 00000000000000000000000000000000 11111111111111111111111111 111111111111111 00000 000000000 1111 1111111111111111
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```

Habitat

B = bare	U = *Ulva*	J = *Z. japonica*	L = Low Density Intertidal *Z. marina*
Z = Subtidal *Z. marina*	S = Shallow Subtidal	I = Intermediate Subtidal	H = High Density Intertidal *Z. marina*
D = Deep Subtidal			

Figure 21a-c. English Sole Feeding Habits (Intermediate Depths)

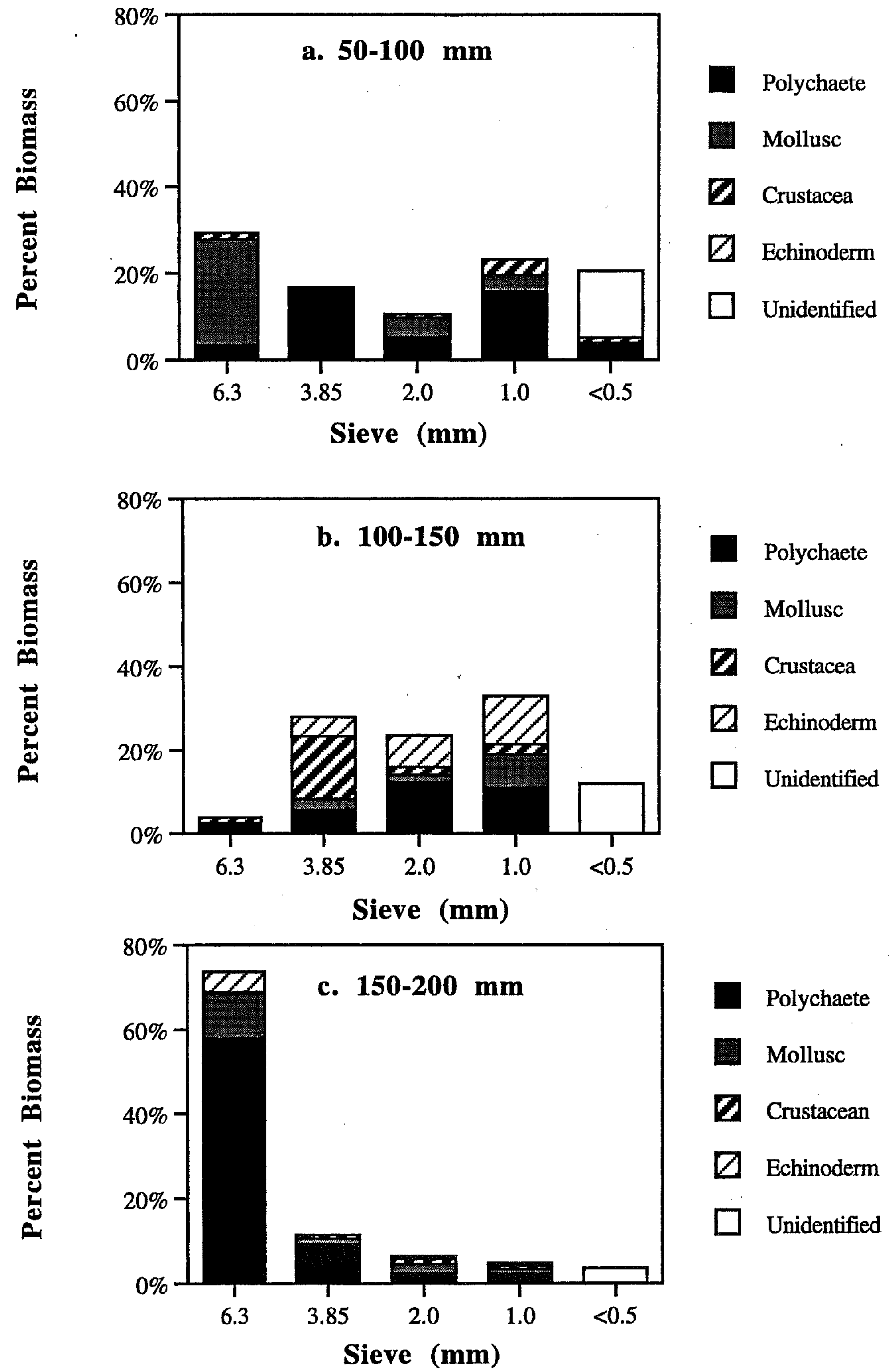

Figure 22a-b. English Sole Feeding Habits (Deep Sites)

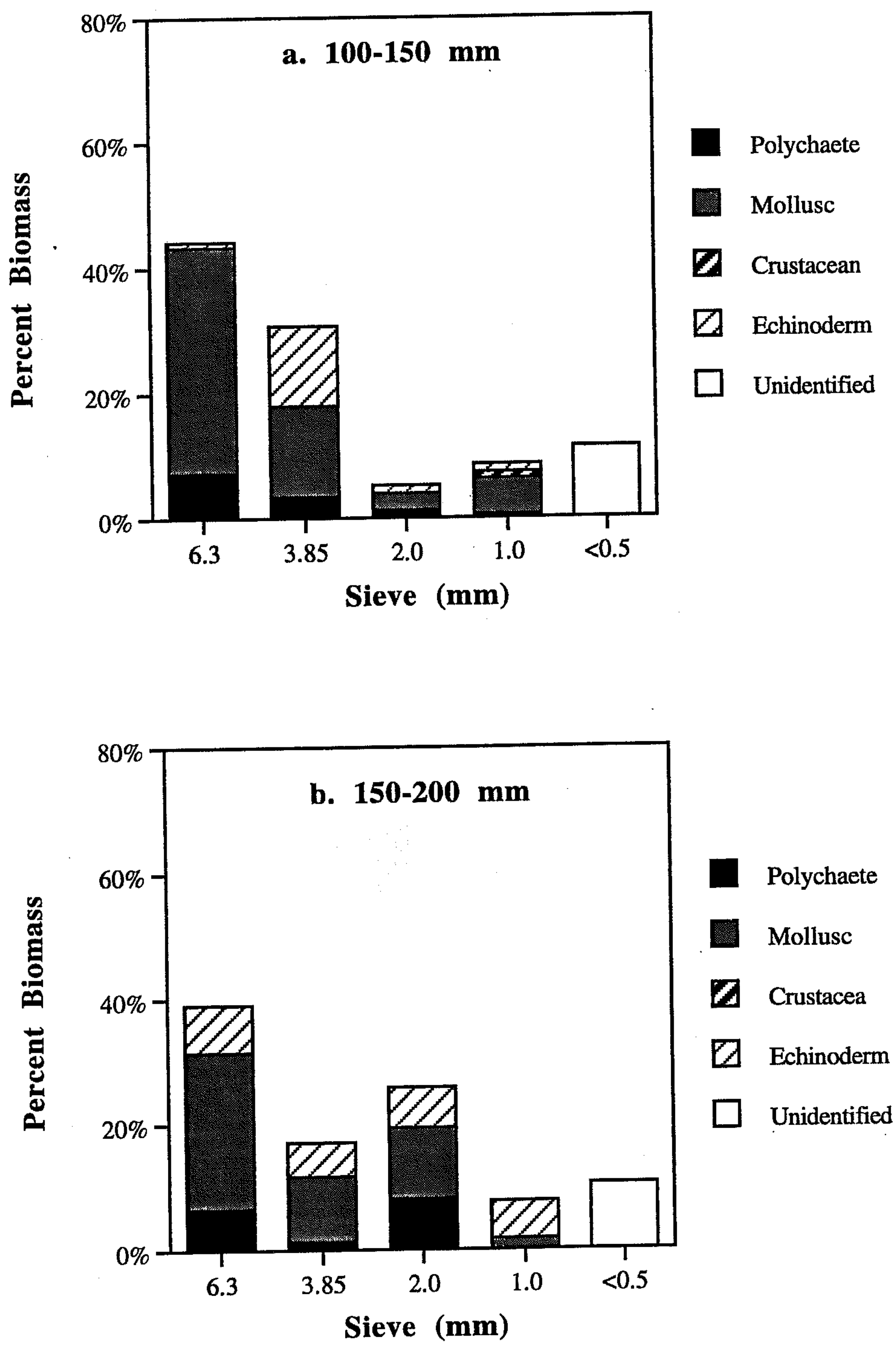

Figure 23. Blackbelly Eelpout Feeding Habits (Deep Sites)

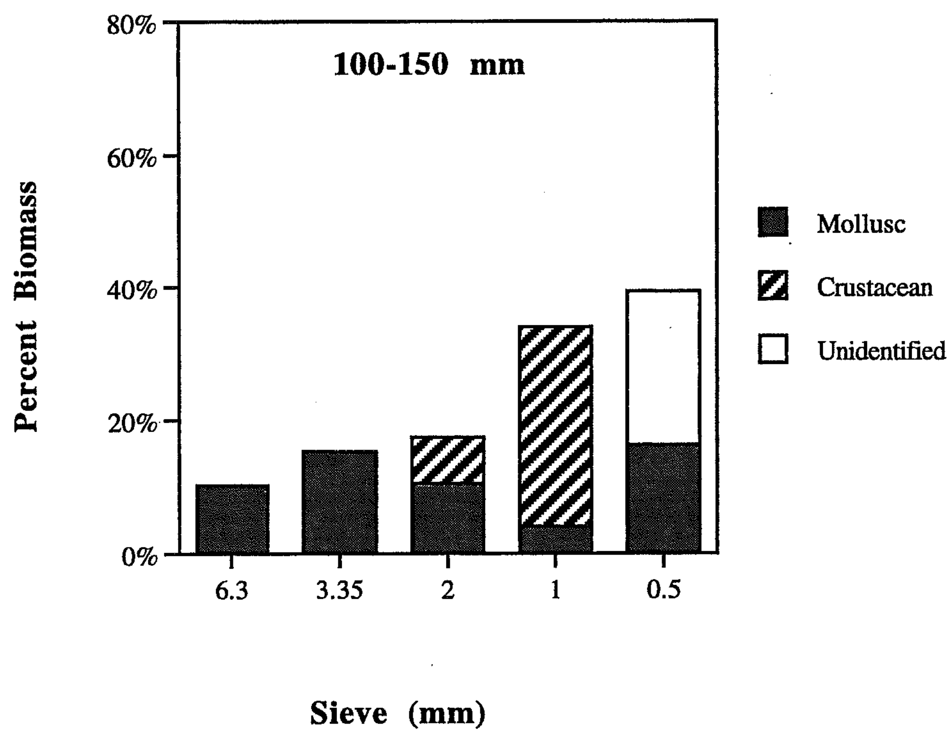

Table 1. Padilla Bay Habitats (Area in Hectares)

Habitat		Area (Ha) (1989)	Area (Ha) (1993)
Unvegetated Intertidal			
Mud		350	350
Sand		1,515	1,140
Cobble-Gravel		< 1	< 1
Rock		< 1	< 1
Vegetated Intertidal			
Zostera marina		2,462	2,312
Zostera japonica		317	850
Ulva		220	220
Marsh		68	68
Spartina alterniflora		2	2
Vegetated Subtidal			
Zostera marina		239	239
Unvegetated Subtidal			
Shallow	2 - 4 m (MLW)	739	739
Intermediate	5-20 m (MLW)	405	405
Deep	20-75 m (MLW)	877	877

Table 2. Studies of Padilla Bay Infauna

Habitat	Reference
Intertidal	
Unvegetated Sand	Smith and Webber (1978)
Zostera japonica	Smith and Webber (1978)
	Riggs (1983)
Zostera marina	Riggs (1983)
Subtidal	
Unvegetated Sand	Smith (1979) - 3, 7 and 14 m
	Barreca (1982) - 9 m

Table 3. Padilla Bay Study Station Locations (Latitude - Longitude)

Station	North		West		Habitat	Station Type
4	48°	33.90	122°	33.01	Zostera marina High Density Intertidal	Multiple
6		33.45		33.91	Zostera marina High Density Intertidal	Mulitple
11		33.04		31.90	Zostera marina High Density Intertidal	Single
12		33.96		33.15	Zostera marina High Density Intertidal	Single
14		32.80		32.24	Zostera marina High Density Intertidal	Single
15		32.79		32.60	Zostera marina High Density Intertidal	Single
16		32.61		31.87	Zostera marina Subtidal	Single
17		32.56		32.89	Zostera marina Subtidal	Single
18		32.48		31.48	Zostera marina High Density Intertidal	Multiple
22		32.26		31.91	Zostera marina High Density Intertidal	Single
27		31.96		31.32	Zostera marina High Density Intertidal	Single
28		31.77		31.72	Zostera marina Subtidal	Single
30		31.85		30.80	Zostera japonica	Single
31		31.66		31.93	Zostera marina Subtidal	Multiple
33		31.58		31.37	Zostera marina Low Density Intertidal	Multiple
34		31.71		31.37	Zostera marina Low Density Intertidal	Single
36		31.48		30.92	Zostera marina Low Density Intertidal	Single
37		31.48		30.85	Zostera marina Low Density Intertidal	Single
42		30.74		29.42	Unvegetated Intertidal (Gravel)	Single
43		30.92		30.92	Zostera marina Subtidal	Single
44		30.58		29.37	Zostera japonica	Single
45		30.66		29.24	Zostera japonica	Multiple
46		31.96		30.95	Zostera marina High Density Intertidal	Multiple
47		30.48		29.35	Zostera japonica	Single
48		30.73		30.85	Zostera marina Subtidal	Multiple
49		30.74		30.56	Zostera marina High Density Intertidal	Single
50		30.37		29.19	Zostera japonica	Single
51		30.33		29.33	Zostera japonica	Multiple
52		30.37		29.36	Zostera japonica	Single
53		30.51		29.70	Zostera marina Low Density Intertidal	Multiple
54		30.33		29.72	Zostera marina Low Density Intertidal	Single
55		30.30		29.12	Zostera japonica	Multiple
56		30.00		29.49	Zostera marina Low Density Intertidal	Single

Table 3 (Cont.)

Station	North		West		Habitat	Station Type
57	48°	30.02	122°	30.02	Zostera marina High Density Intertidal	Mulitple
58		30.05		31.74	Zostera marina Subtidal	Single
59		29.82		30.19	Zostera marina Subtidal	Multiple
60		29.93		29.71	Zostera marina Subtidal	Single
61		29.90		29.61	Zostera marina Low Density Intertidal	Multiple
62		29.69		30.16	Zostera marina Subtidal	Single
63		29.66		28.98	Zostera japonica	Single
64		29.97		31.57	Zostera marina Low Density Intertidal	Multiple
65		29.43		31.59	Zostera marina Subtidal	Multiple
67		29.65		31.30	Ulva	Muliple
68		29.37		28.86	Zostera japonica	Multiple
69		29.50		28.86	Zostera japonica	Single
70		29.24		29.99	Zostera marina Low Density Intertidal	Single
71		29.04		30.27	Ulva	Multiple
72		29.10		29.03	Unvegetated Intertidal	Single
73		29.08		28.93	Zostera marina Low Density Intertidal	Single
74		28.89		30.15	Ulva	Single
75		28.57		30.18	Ulva	Single
82		28.82		31.61	Ulva	Single
85		28.73		31.55	Ulva	Single
91		28.50		30.30	Ulva	Single
92		28.42		30.02	Ulva	Multiple
93		28.69		29.27	Ulva/Ruppia	Single
98		28.66		29.22	Ulva	Single
106		34.43		33.68	Shallow Subtidal (< 5 m)	Single
107		34.23		33.72	Shallow Subtidal (< 5 m)	Single
108		34.08		33.75	Shallow Subtidal (< 5 m)	Single
109		34.30		33.90	Intermediate Subtidal (5 - 20 m)	Single
110		33.77		33.60	Shallow Subtidal (< 5 m)	Multiple
111		33.85		33.87	Intermediate Subtidal (5 - 20 m)	Single
112		34.05		34.37	Intermediate Subtidal (5 - 20 m)	Single
113		33.83		33.73	Intermediate Subtidal (5 - 20 m)	Multiple
114		33.42		33.83	Intermediate Subtidal (5 - 20 m)	Single

Table 3 (Cont.)

Station	North		West		Habitat	Station Type
115	48°	33.43	122°	34.02	Intermediate Subtidal (5 - 20 m)	Single
116		33.55		34.28	Intermediate Subtidal (5 - 20 m)	Single
117		33.43		34.37	Deep Subtidal (> 20 m)	Single
119		33.18		33.83	Intermediate Subtidal (5 - 20 m)	Multiple
120		33.10		33.77	Intermediate Subtidal (5 - 20 m)	Single
121		33.10		33.88	Deep Subtidal (> 20 m)	Single
122		33.02		33.87	Deep Subtidal (> 20 m)	Single
123		33.12		34.22	Deep Subtidal (> 20 m)	Single
124		32.90		33.48	Intermediate Subtidal (5 - 20 m)	Multiple
125		32.93		33.58	Intermediate Subtidal (5 - 20 m)	Single
126		33.70		33.68	Deep Subtidal (> 20 m)	Single
127		32.52		33.45	Shallow Subtidal (< 5 m)	Single
129		33.43		33.50	Shallow Subtidal (< 5 m)	Single
130		32.65		33.43	Shallow Subtidal (< 5 m)	Single
131		32.48		34.23	Deep Subtidal (> 20 m)	Single
132		32.50		34.22	Deep Subtidal (> 20 m)	Single
133		33.78		33.65	Shallow Subtidal (< 5 m)	Multiple
134		32.02		32.75	Shallow Subtidal (< 5 m)	Single
136		31.97		33.08	Shallow Subtidal (< 5 m)	Multiple
137		31.83		33.13	Intermediate Subtidal (5 - 20 m)	Multiple
138		30.98		33.08	Deep Subtidal (> 20 m)	Single
139		31.35		33.33	Deep Subtidal (> 20 m)	Single
140		31.18		33.43	Deep Subtidal (> 20 m)	Single
141		31.22		33.48	Deep Subtidal (> 20 m)	Single
142		31.17		34.55	Deep Subtidal (> 20 m)	Single
143		31.07		34.30	Deep Subtidal (> 20 m)	Single
144		30.77		33.97	Deep Subtidal (> 20 m)	Single
145		30.98		30.58	Deep Subtidal (> 20 m)	Single
146		30.73		33.58	Deep Subtidal (> 20 m)	Single
147		30.98		32.85	Intermediate Subtidal (5 - 20 m)	Single
148		30.77		32.62	Intermediate Subtidal (5 - 20 m)	Multiple
149		30.13		32.05	Shallow Subtidal (< 5 m)	Single
150		30.43		32.17	Shallow Subtidal (< 5 m)	Single

Table 3 (Cont.)

Station	North		West		Habitat	Station Type
151	48°	30.45	48°	32.05	Shallow Subtidal (< 5 m)	Multiple
152		29.73		32.57	Shallow Subtidal (< 5 m)	Single
153		29.68		32.27	Shallow Subtidal (< 5 m)	Multiple
200		32.55		31.67	Zostera marina Low Density Intertidal	Single
201		30.78		30.67	Zostera marina Subtidal	Single
202		30.78		30.50	Ulva	Single
203		30.03		32.05	Zostera marina Subtidal	Multiple
204		29.20		31.13	Zostera marina High Density Intertidal	Multiple
205		29.38		31.52	Ulva	Single
206		29.90		29.65	Zostera marina High Density Intertidal	Single
207		29.65		29.42	Zostera marina Low Density Intertidal	Multiple
208		29.59		29.63	Zostera marina High Density Intertidal	Single
209		30.26		28.96	Unvegetated Intertidal	Single
210		29.13		28.84	Zostera japonica	Multiple
211		29.34		28.91	Zostera marina Low Density Intertidal	Single
212		29.25		28.95	Zostera japonica	Single
213		31.24		29.06	Unvegetated Intertidal	Single
214		31.20		29.50	Zostera japonica	Single
215		31.18		29.44	Unvegetated Intertidal	Single
216		29.83		29.13	Zostera japonica	Single
217		29.12		31.26	Zostera marina Low Density Intertidal	Single
218		29.05		31.19	Ulva	Single
219		28.96		31.16	Ulva	Single
220		28.93		31.12	Unvegetated Intertidal	Single
221		28.72		31.14	Ulva	Multiple
222		28.86		31.16	Ulva	Multiple
223		29.00		31.23	Ulva	Single
224		31.85		30.80	Ulva	Multiple
225		30.91		32.37	Zostera marina Subtidal	Single
226		30.33		32.61	Zostera marina Subtidal	Single
500		31.57		33.40	Deep Subtidal (> 20 m)	Single
501		31.68		33.77	Deep Subtidal (> 20 m)	Single

Table 4. Padilla Bay Infaunal Species List

	Bare		Ulva		Zj		ZmLow		ZmHigh	
	No./m2	%	No./m2	%	No./m2	%	No./m2	%	No./m2	%
Barantolla americana	527	0.72	678	0.89	1477	2.25	1890	2.31	1520	2.25
Capitella sp.	---------	---------	710	0.94	678	1.03	---------	---------	---------	---------
Heteromastus filibranchus	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Heteromastus filiformis	---------	---------	---------	---------	---------	---------	678	0.83	---------	---------
Mediomastus sp.	188	0.26	622	0.82	---------	---------	565	0.69	894	1.33
Notomastus tenuis	---------	---------	---------	---------	339	0.52	226	0.28	819	1.21
Cossura soyeri	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Arenicola pacifica	75	0.1	---------	---------	452	0.69	---------	---------	---------	---------
Nainereis uncinata	---------	---------	---------	---------	---------	---------	452	0.55	---------	---------
Scoloplos armiger	---------	---------	367	0.48	226	0.34	504	0.61	326	0.48
Armandia brevis	---------	---------	316	0.42	---------	---------	226	0.28	377	0.56
Aricidea neosuecica	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Paraonis gracilis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Pherusa plumulosus	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Sphaerodoropsis sphaerulifer	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Laonice cirrata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Malacoceros glutaeus	226	0.31	4633	6.11	753	1.15	2343	2.86	1631	2.42
Paraprionospio pinnata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Polydora ligni	452	0.62	---------	---------	603	0.92	433	0.53	---------	---------
Polydora quadrilobata	---------	---------	1089	1.44	3461	5.26	424	0.52	362	0.54
Polydora socialis	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Polydora (Boccarida) pugetensis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Prionospio cirrifera	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Prionospio steenstrupi	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Pseudopolydora kempi	1620	2.2	---------	---------	---------	---------	---------	---------	---------	---------
Spiophanes bombyx	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Spio cirrifera	---------	---------	452	0.6	---------	---------	452	0.55	---------	---------
Streblospio benedicti	11714	15.94	10547	13.9	1211	1.84	678	0.83	---------	---------
Magelona longicornis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Axiothella rubrocinta	---------	---------	504	0.66	1695	2.58	2109	2.57	1490	2.21
Euclymene sp.	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Maldane sarsi	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Nichomache persona	---------	---------	---------	---------	452	0.69	678	0.83	---------	---------
Owenia fusiformis	---------	---------	777	1.02	---------	---------	452	0.55	777	1.15
Chone mollis	---------	---------	---------	---------	904	1.38	377	0.46	283	0.42
Fabricia sabella	17816	24.24	---------	---------	3119	4.74	226	0.28	---------	---------
Chaetozone actuta	1055	1.44	---------	---------	904	1.38	283	0.34	622	0.92
Cirratulus cirratus	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Tharyx parvus	753	1.03	226	0.3	1195	1.82	490	0.6	603	0.89
Pectinaria californiensis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Ampharete goesi brazhnikova	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Asabellides lineata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Eupolymnia heterobranchia	---------	---------	452	0.6	---------	---------	522	0.64	904	1.34
Pista cristata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Polycirrus sp.	---------	---------	---------	---------	537	0.82	---------	---------	---------	---------
Terebellides stroemi	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Table 4 (Cont.)

	Bare		Ulva		Zj		ZmLow		ZmHigh	
	No./m2	**%**	**No./m2**	**%**	**No./m2**	**%**	**No./m2**	**%**	**No./m2**	**%**
Sternapsis scutata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Spirorbis spirillum	---------	---------	---------	---------	---------	---------	622	0.76	452	0.67
Chaetopteridae	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Brania brevipharyngea	942	1.28	---------	---------	2308	3.51	781	0.95	946	1.4
Exogene molesta	1733	2.36	18539	24.44	7113	10.82	25267	30.81	18512	27.45
Syllis gracilis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Pilargis berkelyae	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Eteone longa	38	0.05	339	0.45	610	0.93	226	0.28	226	0.34
Eulalia (Eumida) tubiformis	---------	---------	---------	---------	226	0.34	---------	---------	226	0.34
Notophyllum tectum	---------	---------	---------	---------	---------	---------	226	0.28	---------	---------
Phylloduce maculata	---------	---------	678	0.89	226	0.34	283	0.34	249	0.37
Phylloduce multiseriata	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Platynereis bicanaliculata	---------	---------	1017	1.34	283	0.43	817	1	857	1.27
Nepthys caeca	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Nepthys caecoides	---------	---------	226	0.3	226	0.34	226	0.28	226	0.34
Nepthys cornuta franciscana	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Glycera americana	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Glycera capitata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Glycera tesselata	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Glycinde armiger	38	0.05	316	0.42	226	0.34	254	0.31	329	0.49
Lumbrineris californiensis	---------	---------	---------	---------	452	0.69	226	0.28	396	0.59
Onuphis elegans	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Ophiodromus pugettensis	---------	---------	339	0.45	---------	---------	452	0.55	578	0.86
Protodorvillea gracilis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Schistomeringos pseudorubrovitt	---------	---------	678	0.89	---------	---------	678	0.83	1305	1.93
Harmothoe imbricata	---------	---------	520	0.69	301	0.46	428	0.52	484	0.72
Harmothoe lunulata	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Unidentified Polynoidea	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Pholoe minuta	---------	---------	226	0.3	---------	---------	---------	---------	264	0.39
Aphroditidae	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Unidentified Polychaete Sp. 1	---------	---------	3616	4.77	2034	3.09	---------	---------	226	0.34
Unidentified Polychaete Sp. 2	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Tubificoides foliatus	7232	9.84	5477	7.22	2967	4.51	8762	10.69	7329	10.87
Tubificidae sp. 2	38	0.05	---------	---------	---------	---------	---------	---------	---------	---------
Amphichaeta sp.	---------	---------	---------	---------	377	0.57	---------	---------	---------	---------
Grania paucispina	---------	---------	5650	7.45	---------	---------	1632	1.99	3345	4.96
Acila castraensis	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Clinocardium nuttallii	38	0.05	---------	---------	---------	---------	---------	---------	---------	---------
Corbula sp.	---------	---------	---------	---------	---------	---------	226	0.28	---------	---------
Crytptogemma ?	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Lucina tenuisculpta	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Lyonsia californica	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Macoma nasuta	---------	---------	427	0.56	226	0.34	258	0.31	301	0.45
Macoma sp.	---------	---------	---------	---------	---------	---------	226	0.28	---------	---------
Mysella tumida	38	0.05	703	0.93	---------	---------	473	0.58	1912	2.84
Nuculana hamata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Table 4 (Cont.)

	Bare		Ulva		Zj		ZmLow		ZmHigh	
	No./m2	%	No./m2	%	No./m2	%	No./m2	%	No./m2	%
Pandora bilorata	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Prothaca staminea	---------	---------	---------	---------	226	0.34	226	0.28	226	0.34
Solen perambilis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Tellina modesta	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Tellinidae	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Transenella tantilla	75	0.1	2879	3.8	8136	12.38	1304	1.59	1695	2.51
Unidentified Bivalve Sp. 1	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Unidentified Bivalve Sp. 2	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Yoldia myalis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Admete gracilior	151	0.21	226	0.3	---------	---------	---------	---------	---------	---------
Alia tuberosa	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Batillaria zonalis	38	0.05	---------	---------	591	0.9	226	0.28	407	0.6
Crepidula adunca	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Cyclostremella concordia	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Cylichna attonsa	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Dentalium rectuis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Haminoea vesicula	---------	---------	226	0.3	355	0.54	377	0.46	452	0.67
Lacuna porrecta	226	0.31	1488	1.96	226	0.34	402	0.49	339	0.5
Nassarius fraterculus	---------	---------	---------	---------	316	0.48	---------	---------	---------	---------
Odostomia (Chrysallida) sp.	---------	---------	---------	---------	---------	---------	---------	---------	452	0.67
Odostomia (Odostomia) sp.	---------	---------	226	0.3	226	0.34	527	0.64	226	0.34
Solariella perambilis	---------	---------	---------	---------	---------	---------	226	0.28	226	0.34
Turbonilla sp.	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Anisogammarus pugettensis	75	0.1	1507	1.99	622	0.95	---------	---------	---------	---------
Eogammarus confericulus	---------	---------	452	0.6	791	1.2	---------	---------	---------	---------
Ampelisca pugetica	---------	---------	---------	---------	---------	---------	---------	---------	258	0.38
Photis brevipes	---------	---------	---------	---------	226	0.34	---------	---------	588	0.87
Amphilocus litoralis	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Monculodes sp.	---------	---------	---------	---------	---------	---------	339	0.41	251	0.37
Parapleustes sp.	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Pontogeneia sp.	---------	---------	---------	---------	---------	---------	---------	---------	355	0.53
Stenothoidae	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Orchomene cf pinguis	---------	---------	---------	---------	904	1.38	---------	---------	---------	---------
Corophium acherusicum	12957	17.63	5219	6.88	20287	30.86	2463	3	4737	7.02
Ampithoe valida	377	0.51	475	0.63	2809	4.27	301	0.37	---------	---------
Aorides intermedius	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Cheirimedeia macrodactyla	---------	---------	---------	---------	---------	---------	---------	---------	904	1.34
Ericthonius hunteri	1431	1.95	904	1.19	5817	8.85	377	0.46	226	0.34
Eohaustorius washingtonianus	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Eobrolgus spinosus	113	0.15	2991	3.94	3089	4.7	1458	1.78	2554	3.79
Eyakia robustus	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Rhepoxynius tridentata	---------	---------	---------	---------	---------	---------	---------	---------	226	0.34
Caprella laeviscula	---------	---------	226	0.3	1431	2.18	452	0.55	452	0.67
Caprella striata	---------	---------	---------	---------	---------	---------	226	0.28	226	0.34
Colanthura sp.	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Gnorimosphaeroma noblei	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Table 4 (Cont.)

	Bare		Ulva		Zjap		ZmarLow		ZmarHigh	
	No./m2	%	No./m2	%	No./m2	%	No./m2	%	No./m2	%
Idotea resecata	---------	---------	---------	---------	---------	---------	301	0.37	603	0.89
Idotea rufuscens	---------	---------	723	0.95	452	0.69	384	0.47	326	0.48
Munna fernaldi	---------	---------	1291	1.7	258	0.39	424	0.52	367	0.54
Synidotea bicuspida	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Synidotea nodulosa	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Eudorella sp.	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Leptocuma sp. 1	1620	2.2	4075	5.37	5454	8.3	1082	1.32	904	1.34
Leptocuma sp. 2	---------	---------	---------	---------	---------	---------	226	0.28	1978	2.93
Leucon sp.	3993	5.43	949	1.25	5962	9.07	1288	1.57	316	0.47
Oxyurostylis sp.	---------	---------	---------	---------	---------	---------	904	1.1	---------	---------
Leptochelia savigni	2373	3.23	24027	31.67	10127	15.4	30607	37.33	19907	29.52
Pancolus californiensis	5123	6.97	1294	1.71	4846	7.37	1950	2.38	640	0.95
Nebalia sp.	---------	---------	---------	---------	226	0.34	301	0.37	264	0.39
Anoplodactylus virintestinalis	---------	---------	2637	3.48	---------	---------	323	0.39	1017	1.51
Chironomidae	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Collembolla	414	0.56	---------	---------	---------	---------	226	0.28	226	0.34
Cancer magister	---------	---------	---------	---------	---------	---------	---------	---------	452	0.67
Hemigrapsus sp.	---------	---------	---------	---------	226	0.34	---------	---------	---------	---------
Majidae	---------	---------	226	0.3	---------	---------	---------	---------	---------	---------
Pinnixia tubicola	---------	---------	264	0.35	---------	---------	278	0.34	402	0.6
Amphiodia occidentalis	---------	---------	226	0.3	---------	---------	339	0.41	667	0.99
Leptosynapta clarki	---------	---------	1130	1.49	1130	1.72	708	0.86	1537	2.28
Lepasterias hexactis	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------
Nemertea	---------	---------	226	0.3	226	0.34	377	0.46	301	0.45
Enteroneusta	---------	---------	431	0.57	358	0.54	226	0.28	226	0.34
Sipunculida	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Bare = Unvegetated Intertidal
Ulva = Ulva covered sediment
Zj = Zostera japonica
ZmLow = Low Density Intertidal Zostera marina
ZmHigh = High Density Intertidal Zostera marina

Table 4 (Cont.)

	ZmSub		Shall		Inter		Deep	
	No./m2	%	No./m2	%	No./m2	%	No./m2	%
Barantolla americana	1538	4.79	896	1.87	339	1.7	30	0.24
Capitella sp.	339	1.05	---------	---------	---------	---------	---------	---------
Heteromastus filibranchus	---------	---------	---------	---------	---------	---------	15	0.12
Heteromastus filiformis	---------	---------	---------	---------	---------	---------	---------	---------
Mediomastus sp.	622	1.93	1209	2.52	326	1.64	347	2.73
Notomastus tenuis	226	0.7	---------	---------	226	1.13	30	0.24
Cossura soyeri	---------	---------	226	0.47	400	2.01	256	2.02
Arenicola pacifica	---------	---------	---------	---------	---------	---------	---------	---------
Nainereis uncinata	---------	---------	---------	---------	---------	---------	---------	---------
Scoloplos armiger	291	0.9	569	1.19	288	1.44	196	1.54
Armandia brevis	288	0.9	796	1.66	588	2.95	136	1.07
Aricidea neosuecica	---------	---------	3842	8.02	---------	---------	---------	---------
Paraonis gracilis	---------	---------	---------	---------	452	2.27	256	2.02
Pherusa plumulosus	226	0.7	---------	---------	226	1.13	---------	---------
Sphaerodoropsis sphaerulifer	---------	---------	---------	---------	258	1.3	45	0.36
Laonice cirrata	---------	---------	---------	---------	226	1.13	15	0.12
Malacoceros glutaeus	1140	3.55	339	0.71	---------	---------	---------	---------
Paraprionospio pinnata	---------	---------	452	0.94	706	3.54	30	0.24
Polydora ligni	---------	---------	---------	---------	---------	---------	---------	---------
Polydora quadrilobata	339	1.05	226	0.47	---------	---------	---------	---------
Polydora socialis	226	0.7	226	0.47	226	1.13	---------	---------
Polydora (Boccarida) pugetensis	---------	---------	---------	---------	---------	---------	15	0.12
Prionospio cirrifera	932	2.9	1733	3.62	1397	7.01	271	2.14
Prionospio steenstrupi	3164	9.85	1434	2.99	931	4.67	452	3.56
Pseudopolydora kempi	---------	---------	---------	---------	---------	---------	---------	---------
Spiophanes bombyx	---------	---------	819	1.71	---------	---------	15	0.12
Spio cirrifera	452	1.41	226	0.47	---------	---------	---------	---------
Streblospio benedicti	339	1.05	---------	---------	---------	---------	---------	---------
Magelona longicornis	---------	---------	---------	---------	377	1.89	166	1.3
Axiothella rubrocinta	497	1.55	276	0.58	226	1.13	---------	---------
Euclymene sp.	---------	---------	---------	---------	452	2.27	45	0.36
Maldane sarsi	---------	---------	---------	---------	---------	---------	30	0.24
Nichomache persona	---------	---------	---------	---------	---------	---------	---------	---------
Owenia fusiformis	3723	11.58	16242	33.9	6620	33.21	331	2.61
Chone mollis	904	2.81	---------	---------	339	1.7	15	0.12
Fabricia sabella	---------	---------	---------	---------	---------	---------	---------	---------
Chaetozone actuta	678	2.11	---------	---------	226	1.13	60	0.47
Cirratulus cirratus	678	2.11	---------	---------	---------	---------	---------	---------
Tharyx parvus	226	0.7	---------	---------	226	1.13	60	0.47
Pectinaria californiensis	---------	---------	---------	---------	339	1.7	15	0.12
Ampharete goesi brazhnikova	301	0.94	509	1.06	411	2.06	60	0.47
Asabellides lineata	---------	---------	---------	---------	---------	---------	45	0.36
Eupolymnia heterobranchia	565	1.76	226	0.47	---------	---------	---------	---------
Pista cristata	226	0.7	226	0.47	249	1.25	15	0.12
Polycirrus sp.	---------	---------	---------	---------	---------	---------	---------	---------
Terebellides stroemi	---------	---------	---------	---------	226	1.13	---------	---------

Table 4 (Cont.)

	ZmSub No./m2	%	Shall No./m2	%	Inter No./m2	%	Deep No./m2	%
Sternapsis scutata	---------	---------	226	0.47	404	2.02	241	1.9
Spirorbis spirillum	226	0.7	---------	---------	---------	---------	30	0.24
Chaetopteridae	---------	---------	---------	---------	226	1.13	---------	---------
Brania brevipharyngea	701	2.18	706	1.47	678	3.4	---------	---------
Exogene molesta	3797	11.81	1492	3.11	311	1.56	45	0.36
Syllis gracilis	---------	---------	6177	12.89	226	1.13	271	2.14
Pilargis berkelyae	---------	---------	---------	---------	---------	---------	15	0.12
Eteone longa	---------	---------	226	0.47	226	1.13	---------	---------
Eulalia (Eumida) tubiformis	226	0.7	226	0.47	226	1.13	15	0.12
Notophyllum tectum	---------	---------	---------	---------	---------	---------	---------	---------
Phylloduce maculata	226	0.7	226	0.47	452	2.27	---------	---------
Phylloduce multiseriata	---------	---------	---------	---------	226	1.13	---------	---------
Platynereis bicanaliculata	753	2.34	565	1.18	283	1.42	---------	---------
Nepthys caeca	---------	---------	226	0.47	---------	---------	15	0.12
Nepthys caecoides	226	0.7	243	0.51	---------	---------	---------	---------
Nepthys cornuta franciscana	---------	---------	---------	---------	607	3.05	331	2.61
Glycera americana	226	0.7	226	0.47	226	1.13	---------	---------
Glycera capitata	---------	---------	---------	---------	226	1.13	15	0.12
Glycera tesselata	---------	---------	---------	---------	---------	---------	---------	---------
Glycinde armiger	323	1	427	0.89	355	1.78	121	0.95
Lumbrineris californiensis	226	0.7	377	0.79	635	3.18	121	0.95
Onuphis elegans	---------	---------	352	0.73	301	1.51	15	0.12
Ophiodromus pugettensis	365	1.14	979	2.04	452	2.27	30	0.24
Protodorvillea gracilis	---------	---------	226	0.47	---------	---------	15	0.12
Schistomeringos pseudorubrovittata	1783	5.55	226	0.47	---------	---------	---------	---------
Harmothoe imbricata	532	1.65	814	1.7	226	1.13	15	0.12
Harmothoe lunulata	---------	---------	---------	---------	---------	---------	---------	---------
Unidentified Polynoidea	---------	---------	---------	---------	---------	---------	15	0.12
Pholoe minuta	313	0.97	610	1.27	243	1.22	45	0.36
Aphroditidae	---------	---------	---------	---------	---------	---------	15	0.12
Unidentified Polychaete Sp. 1	---------	---------	---------	---------	---------	---------	15	0.12
Unidentified Polychaete Sp. 2	---------	---------	---------	---------	226	1.13	---------	---------
Tubificoides foliatus	6180	19.23	3120	6.51	517	2.59	362	2.85
Tubificidae sp. 2	---------	---------	---------	---------	---------	---------	---------	---------
Amphichaeta sp.	---------	---------	---------	---------	---------	---------	---------	---------
Grania paucispina	2486	7.74	2712	5.66	---------	---------	---------	---------
Acila castraensis	226	0.7	904	1.89	2380	11.94	1522	11.98
Clinocardium nuttallii	226	0.7	845	1.76	490	2.46	30	0.24
Corbula sp.	---------	---------	---------	---------	---------	---------	---------	---------
Crytptogemma ?	---------	---------	---------	---------	---------	---------	30	0.24
Lucina tenuisculpta	291	0.9	387	0.81	404	2.02	1055	8.3
Lyonsia californica	---------	---------	226	0.47	226	1.13	---------	---------
Macoma nasuta	331	1.03	362	0.75	339	1.7	30	0.24
Macoma sp.	---------	---------	---------	---------	---------	---------	30	0.24
Mysella tumida	2394	7.45	6177	12.89	678	3.4	738	5.81
Nuculana hamata	---------	---------	---------	---------	226	1.13	121	0.95

Table 4 (Cont.)

	ZmSub No./m2	%	Shall No./m2	%	Inter No./m2	%	Deep No./m2	%
Pandora bilorata	---------	---------	---------	---------	226	1.13	---------	---------
Prothaca staminea	226	0.7	---------	---------	---------	---------	15	0.12
Solen perambilis	---------	---------	226	0.47	396	1.98	---------	---------
Tellina modesta	---------	---------	271	0.57	313	1.57	45	0.36
Tellinidae	---------	---------	---------	---------	---------	---------	---------	---------
Transenella tantilla	766	2.38	1481	3.09	3284	16.47	2727	21.47
Unidentified Bivalve Sp. 1	---------	---------	---------	---------	226	1.13	---------	---------
Unidentified Bivalve Sp. 2	---------	---------	---------	---------	---------	---------	45	0.36
Yoldia myalis	---------	---------	---------	---------	352	1.76	30	0.24
Admete gracilior	226	0.7	---------	---------	1356	6.8	---------	---------
Alia tuberosa	226	0.7	---------	---------	226	1.13	---------	---------
Batillaria zonalis	226	0.7	---------	---------	---------	---------	---------	---------
Crepidula adunca	---------	---------	---------	---------	---------	---------	---------	---------
Cyclostremella concordia	226	0.7	226	0.47	226	1.13	---------	---------
Cylichna attonsa	---------	---------	---------	---------	226	1.13	---------	---------
Dentalium rectuis	---------	---------	---------	---------	264	1.32	45	0.36
Haminoea vesicula	226	0.7	226	0.47	---------	---------	---------	---------
Lacuna porrecta	591	1.84	---------	---------	---------	---------	45	0.36
Nassarius fraterculus	---------	---------	---------	---------	226	1.13	---------	---------
Odostomia (Chrysallida) sp.	593	1.85	706	1.47	537	2.69	151	1.19
Odostomia (Odostomia) sp.	1130	3.52	226	0.47	---------	---------	---------	---------
Solariella perambilis	226	0.7	452	0.94	---------	---------	---------	---------
Turbonilla sp.	---------	---------	---------	---------	---------	---------	30	0.24
Anisogammarus pugettensis	---------	---------	---------	---------	---------	---------	---------	---------
Eogammarus confericulus	226	0.7	---------	---------	---------	---------	---------	---------
Ampelisca pugetica	254	0.79	608	1.27	226	1.13	---------	---------
Photis brevipes	735	2.29	6482	13.53	537	2.69	75	0.59
Amphilocus litoralis	---------	---------	---------	---------	---------	---------	---------	---------
Monculodes sp.	291	0.9	226	0.47	---------	---------	15	0.12
Parapleustes sp.	---------	---------	226	0.47	---------	---------	---------	---------
Pontogeneia sp.	271	0.84	---------	---------	---------	---------	181	1.42
Stenothoidae	226	0.7	---------	---------	---------	---------	---------	---------
Orchomene cf pinguis	226	0.7	475	0.99	---------	---------	---------	---------
Corophium acherusicum	316	0.98	1017	2.12	329	1.65	15	0.12
Ampithoe valida	396	1.23	---------	---------	---------	---------	---------	---------
Aorides intermedius	791	2.46	---------	---------	---------	---------	---------	---------
Cheirimedeia macrodactyla	226	0.7	2797	5.84	570	2.86	60	0.47
Ericthonius hunteri	1865	5.8	---------	---------	---------	---------	---------	---------
Eohaustorius washingtonianus	---------	---------	301	0.63	---------	---------	---------	---------
Eobrolgus spinosus	2097	6.53	542	1.13	226	1.13	---------	---------
Eyakia robustus	---------	---------	---------	---------	1130	5.67	362	2.85
Rhepoxynius tridentata	---------	---------	1114	2.32	1078	5.41	30	0.24
Caprella laeviscula	2147	6.68	452	0.94	339	1.7	30	0.24
Caprella striata	1808	5.63	---------	---------	---------	---------	---------	---------
Colanthura sp.	---------	---------	226	0.47	226	1.13	---------	---------
Gnorimosphaeroma noblei	---------	---------	226	0.47	---------	---------	---------	---------

Table 4 (Cont.)

	ZmSub No./m2	%	Shall No./m2	%	Inter No./m2	%	Deep No./m2	%
Idotea resecata	301	0.94	---------	---------	---------	---------	---------	---------
Idotea rufuscens	693	2.16	1356	2.83	---------	---------	---------	---------
Munna fernaldi	226	0.7	464	0.97	407	2.04	30	0.24
Synidotea bicuspida	226	0.7	339	0.71	---------	---------	---------	---------
Synidotea nodulosa	452	1.41	2891	6.03	339	1.7	---------	---------
Eudorella sp.	---------	---------	662	1.38	2093	10.5	60	0.47
Leptocuma sp. 1	339	1.05	339	0.71	---------	---------	---------	---------
Leptocuma sp. 2	226	0.7	1808	3.77	339	1.7	75	0.59
Leucon sp.	226	0.7	710	1.48	659	3.31	---------	---------
Oxyurostylis sp.	---------	---------	316	0.66	738	3.7	45	0.36
Leptochelia savigni	6395	19.9	4201	8.77	377	1.89	---------	---------
Pancolus californiensis	452	1.41	339	0.71	226	1.13	---------	---------
Nebalia sp.	728	2.27	226	0.47	226	1.13	---------	---------
Anoplodactylus virintestinalis	778	2.42	226	0.47	---------	---------	---------	---------
Chironomidae	---------	---------	---------	---------	---------	---------	---------	---------
Collembolla	---------	---------	---------	---------	---------	---------	---------	---------
Cancer magister	---------	---------	452	0.94	---------	---------	---------	---------
Hemigrapsus sp.	---------	---------	---------	---------	---------	---------	---------	---------
Majidae	452	1.41	---------	---------	---------	---------	---------	---------
Pinnixia tubicola	362	1.13	226	0.47	226	1.13	15	0.12
Amphiodia occidentalis	969	3.01	1388	2.9	1298	6.51	286	2.25
Leptosynapta clarki	1198	3.73	969	2.02	---------	---------	---------	---------
Lepasterias hexactis	301	0.94	---------	---------	---------	---------	---------	---------
Nemertea	264	0.82	271	0.57	226	1.13	30	0.24
Enteroneusta	---------	---------	---------	---------	---------	---------	---------	---------
Sipunculida	---------	---------	226	0.47	226	1.13	---------	---------

ZmSub = Subtidal Zostera marina
Shall = Shallow Subtidal (<5m)
Inter = Intermediate Depth Subtidal (5-20m)
Deep = Deep Subtidal (>20m)

Table 5. Taxa Dominance by Habitat

Taxa	Habitat: Intertidal				Subtidal				
	Unveg.	Ulva	Zjap	Zmar Low	Zmar High	Zmar	Shall	Inter	Deep
Barantolla americana	+	+	+	8	+	+	+	+	+
Mediomastus sp.	+	+		+	+	+	+	+	8
Aricidea neosuecica							6		
Malacoceros glutaeus	+	7	+	5	9	+	+		
Paraprionospio pinnata							+	+	+
Dipolydora quadrilobata		+	9	+	+	+	+	+	
Prionospio cirrifera					+	+	+	5	+
Prionospio steenstrupi						5	+	10	5
Pseudopolydora kempi	9								
Streblospio beendicti	3	3	+	+			+		
Axiothella rubrocincta		+	+	6	10	+	+	+	
Owenia fusiformis	+		+	+		4	1	1	10
Fabricia sabella	1		10	+					
Exogene molesta	8	2	4	2	2	3	+	+	+
Syllis gracilis							3	+	+
Nepthys cornuta franciscana	+							+	9
Tubificoides foliatus	4	5	+	3	3	2	7	+	6
Grania paucispina		4		9	5	6	+		
Lucina tenuisculpta						+	+	+	3
Mysella tumida	+	+		+	8	7	4	+	4
Transenella tantilla	+	+	3	+	+	+	+	2	1
Acila castraensis					+	+	+	3	2
Ademete gracilior	+	+				+		6	
Photis brevis			+		+	+	2	+	+
Corophium acherusicum	2	6	1	4	4	+	+	+	+
Cheirimedeia macrodactyla				+	+	+	9	+	
Ericthonius hunteri	+	+	6	+	+	10			
Eobrolgus spinosus	+	10	+	10	6	9	+	+	
Eyakia robustus								8	7
Rhephoxynius tridenta					+		+	9	+
Caprella laeviscula		+	+	+	+	8	+	+	+
Synidotea nodulosa						+	8	+	
Eudorella sp.			+				+	4	+
Leptocuma spp.	10	8	7	+	7	+	+		
Leucon sp.	6	+	5	+	+	+	+	+	
Leptochelia savigni	7	1	2	1	1	1	5	+	
Pancolus californiensis	5	+	8	7	+	+	+	+	
Amphioda occidentalis		+		+	+	+	+	7	+
Leptosynapta clarki	+	+	+	10	+	+			

+ = Present but not in top 10 numerical dominants

Zjap = Zostera japonica   Zmar= Z. marina   Shall= Shallow   Inter=Intermediate

Table 6. Results of Bartlett's Test for Homogeneity of Variance

A. TAXA

CHI-SQUARE TESTS OF EQUALITY OF VARIANCES

	ORIGINAL	SQUARE ROOT	LOG 10	D.F.
MAXIMUM VARIANCE	40.500	1.604	0.238	4
MINIMUM VARIANCE	1.300	0.023	0.001	4
POOLED VARIANCE	12.371	0.178	0.012	
CHI-SQUARE	45.173	60.000	131.124	34
PROBABILITY	0.100177	0.004769	0.000000	

B. ABUNDANCE

CHI-SQUARE TESTS OF EQUALITY OF VARIANCES

	ORIGINAL	SQUARE ROOT	LOG 10	D.F.
MAXIMUM VARIANCE	31544.200	21.952	0.776	4
MINIMUM VARIANCE	91.700	0.550	0.006	4
POOLED VARIANCE	8519.785	8.680	0.054	
CHI-SQUARE	81.754	42.717	85.696	34
PROBABILITY	0.000016	0.150264	0.000000	

C. BIOMASS

CHI-SQUARE TESTS OF EQUALITY OF VARIANCES

	ORIGINAL	SQUARE ROOT	LOG 10	D.F.
MAXIMUM VARIANCE	28.141	0.869	0.117	4
MINIMUM VARIANCE	0.005	0.002	0.001	4
POOLED VARIANCE	1.920	0.116	0.022	
CHI-SQUARE	291.882	159.107	109.225	34
PROBABILITY	0.000000	0.000000	0.000000	

Table 7. Results for Nested One-Way ANOVA's

Taxa Richness

Error Source	df	Sums of Squares	Mean Square	F-Value	P-Value
Habitat	6	1771.520	295.253	2.075	0.8850
Station (Habitat)	28	3894.480	142.303	11.503	0.0001
Residual	140	1732.000	12.371		

Abundance (Square Root Transformed)

Error Source	df	Sums of Squares	Mean Square	F-Value	P-Value
Habitat	6	1492.868	248.811	5.358	0.0009
Station (Habitat)	28	1300.173	46.435	5.296	0.0001
Residual	140	1227.584	8.768		

Table 8. Results of One-Way ANOVA's (No Nesting)

Taxa Richness

Error Source	df	Sums of Squares	Mean Square	F-Value	P-Value
Habitat	8	1200.398	150.050	5.405	0.0001
Residual	119	3303.602	27.761		

Abundance (Square Root Transformed)

Error Source	df	Sums of Squares	Mean Square	F-Value	P-Value
Habitat	8	2500.005	312.501	9.947	0.0001
Residual	119	3738.572	31.417		

Biomass (Kruskall-Wallis Test)

Error Source	df	No. Groups	No. Ties	H	P-Value
Biomass	8	9	0	40.116	0.0001

Table 9. ANOVA Results for Vertical Distribution Data

Taxa Richness

Error Source	df	Sums of Squares	Mean Squares	F-Value	P-Value
Habitat	6	439.669	73.278	7.7760	0.0001
Vertical	4	4671.920	1167.980	0.0012	0.0001
Habitat *Vertical	24	226.160	9.423	0.7610	0.7788
Residual	140	1733.200	12.380		

Abundance (Square Root Transformed)

Error Source	df	Sums of Squares	Mean Squares	F-Value	P-Value
Habitat	6	192.952	32.159	7.9230	0.0001
Vertical	4	2672.714	668.179	0.0016	0.0001
Habitat *Vertical	24	374.036	15.585	3.8400	0.0001
Residual	140	568.230	4.059		

Biomass (Scheirer-Ray-Hare extension of the Kruskal-Wallis test)

Error Source	df	Sums of Squares	Mean Squares	H-Value	P-Value (Chi Sq.)
Habitat	6	46680.180	7780.030	132.934	< 0.001
Vertical	4	158172.100	39543.025	47.276	< 0.001
Habitat *Vertical	24	29314.420	1221.434	8.750	> 0.05
Residual	140	196178.800	1401.277		

Table 10. Dendrogram for Normal Clustering of Padilla Bay Infauna

```
                      Similarity

          0.9      0.5      0.0        -0.5      -1.0


A         --------------------I
                              I-----------------I
B         --------------------I                 I
                                                I
C         --------------------------I           I-----------------------------------I
                                    I-----------I                                   I
D         --------------------------I                                               I
                                                                                    I
                                                                                    I
E         -----------------------------I                                            I
                                       I-----------I                                I
F         -----------------------------I           I                                I
                                                   I--------------------------------I
G         -----------------------------------------I

          0.9      0.5      0.0        -0.5      -1.0
```

Table 11. Dendrogram for Inverse Clustering of Padilla Bay Infauna

```
                                                                    Similarity

                             0.75      0.50        0.25      0.00          -0.25           -0.50


     Barantolla americana     --------------------I
     Malacoceros glutaeus     -----------I--I     I--I
     Eobrolgus spinosus       -----------I  I-----I  I
     Axiothella rubrocinta    --------------I        I-----I
I    Pancolus californiensis  -----------------------I     I
     Corophium acherusicum    -----------I-----------I     I---------------------------I
     Leptocuma sp. (1)        -----------I                 I                           I
     Exogene molesta          --I--I                       I                           I
     Leptochelia savigni      --I  I-----------------------I                           I
     Tubficoides foliatus     -----I                                                   I--------------I
                                                                                       I              I
     Dipolydora quadrilobata  --------------------I--I                                 I              I
     Brania brevipharyngea    --------------------I  I                                 I              I
II   Ampithoe valida          -----------------------I----------------I                I              I
     Ericthonius hunteri      -----------------I-----I                I----------------I              I
     Leucon sp.               -----------------I                      I                               I
                                                                      I                               I
     Streblospio benedicti    --------------------I-------------------I                               I
III  Fabricia sabella         --------------------I                                                   I
                                                                                                      I
     Mediomastus sp.          --------------------------I-------I                                     I
     Grania paucispina        --------------------------I       I                                     I
     Owenia fusisformis       --------------I--------I          I--------------I                      I
IV   Mysella tumida           --------------I        I-------I  I              I                      I
     Transenella tantilla     --------------------I--I       I--I              I----------------------I
     Amphioda occidentalis    --------------------I          I                 I
     Photis brevipes          -------------------------------I                 I
                                                                               I
V    Acila castraensis        --------------I----------------------------------I
     Eudorella sp.            --------------I
```

Table 12. Station Groups Resulting From Normal Classification of Padilla Bay Infauna

Station Group A

Station	Habitat	Depth (m)	Sediment
42	Unveg.	Intertidal	Gravel+Sand
72	Unveg.	Intertidal	ND
6	Z. jap.	Intertidal	ND
212	Z. jap.	Intertidal	ND
50	Z. jap.	Intertidal	ND
93	Ulva	Intertidal	ND
98	Ulva	Intertidal	ND
214	Z. jap.	Intertidal	ND
68	Z. jap.	Intertidal	ND
45	Z. jap.	Intertidal	ND
55	Z. jap.	Intertidal	Muddy Sand
220	Unveg.	Intertidal	ND
85	Ulva	Intertidal	ND
92	Ulva	Intertidal	Muddy Sand
69	Z. jap.	Intertidal	Muddy Sand
211	Low Z. mar.	Intertidal	ND
73	Low Z. mar.	Intertidal	ND
216	Z. jap.	Intertidal	ND
44	Z. jap.	Intertidal	Muddy Sand
52	Z. jap.	Intertidal	ND
47	Z. jap.	Intertidal	ND
51	Z. jap.	Intertidal	Muddy Sand

Station Group C

Station	Habitat	Depth (m)	Sediment
9	Ulva	Intertidal	ND
74	Ulva	Intertidal	ND
12	High Z. mar.	Intertidal	ND
48	Subtidal Z. mar	<2	Muddy Sand
6	High Z. mar.	Intertidal	Sand
203	Subtidal Z. mar.	<2	Sand
43	Subtidal Z. mar.	<2	ND
58	Subtidal Z. mar.	<2	ND
31	Subtidal Z. mar.	<2	Muddy Sand
153	Shallow	5.0	Muddy Sand
4	High Z. mar.	Intertidal	Muddy Sand
28	Subtidal Z. mar.	<2	ND
150	Shallow	5.0	
16	Subtidal Z. mar.	<2	ND
226	Subtidal Z. mar.	<2	Sand
17	Subtidal Z. mar.	<2	ND
60	Subtidal Z. mar.	<2	ND
201	Subtidal Z. mar.	< 2	Sandy Mud

Station Group B

Station	Habitat	Depth (m)	Sediment
209	Unveg.	Intertidal	Sand+Mud
213	Unveg.	Intertidal	Muddy Sand
215	Unveg.	Intertidal	ND
210	Z. jap.	Intertidal	Muddy Sand

Station Group E

Station	Habitat	Depth (m)	Sediment
136	Shallow	4.5	Sand
134	Shallow	5.0	Sand
139	Deep	55.0	Gravelly Sand
500	Deep	53.0	Gravelly Sand
140	Deep	63.0	Sand
144	Deep	26.0	Muddy Sand
143	Deep	27.0	Gravelly Sand
141	Deep	72.0	Gravelly Mud
65	Subtidal Z. mar.	<2	Muddy Sand

Station Group F

Station	Habitat	Depth (m)	Sediment
106	Shallow	4.5	Sand
129	Shallow	5.5	Muddy Sand
107	Shallow	4.5	Muddy Sand
108	Shallow	8.0	Muddy Sand
133	Shallow	5.5	Muddy Sand
127	Shallow	5.5	Sand
149	Shallow	5.0	Muddy Sand
151	Shallow	5.0	Muddy Sand
110	Shallow	5.5	Muddy Sand
130	Shallow	5.5	Muddy Sand
109	Intermediate	9.0	Sandy Mud
113	Intermediate	8.5	Sandy Mud
124	Intermediate	9.0	Muddy Sand
137	Intermediate	11.0	Sand
148	Intermediate	10.0	Gravel+Sand
145	Deep	46.0	Muddy Sand
152	Shallow	6.0	Sand
142	Deep	23.0	Sand

Table 12 Continued.

Station Group D

Station	Habitat	Depth (m)	Sediment
223	Ulva	Intertidal	ND
222	Ulva	Intertidal	Sand
71	Ulva	Intertidal	Muddy Sand
219	Ulva	Intertidal	ND
224	Ulva	Intertidal	ND
218	Ulva	Intertidal	ND
67	Ulva	Intertidal	Muddy Sand
221	Ulva	Intertidal	Muddy Sand
202	Ulva	Intertidal	ND
34	Low Z. mar.	Intertidal	ND
33	Low Z. mar.	Intertidal	Sand
36	Low Z. mar.	Intertidal	ND
37	Low Z. mar.	Intertidal	ND
54	Low Z. mar.	Intertidal	ND
49	Low Z. mar.	Intertidal	ND
61	Low Z. mar.	Intertidal	Muddy Sand
14	High Z. mar.	Intertidal	ND
57	High Z. mar.	Intertidal	Sand
22	High Z. mar.	Intertidal	ND
30	Z. jap.	Intertidal	ND
18	High Z. mar.	Intertidal	Sand
27	High Z. mar.	Intertidal	ND
200	Low Z. mar.	Intertidal	ND
217	Low Z. mar.	Intertidal	ND
204	High Z. mar.	Intertidal	Muddy Sand
15	High Z. mar.	Intertidal	ND
46	High Z. mar.	Intertidal	Muddy Sand
62	Subtidal Z. mar.	<2	ND
225	Subtidal Z. mar.	<2	ND
56	Low Z. mar.	Intertidal	ND
208	High Z. mar.	Intertidal	ND
53	Low Z. mar.	Intertidal	Muddy Sand
61	Low Z. mar.	Intertidal	Muddy Sand
207	Low Z. mar.	Intertidal	Sandy Mud
11	High Z. mar.	Intertidal	ND
206	High Z. mar.	Intertidal	ND
70	Low Z. mar.	Intertidal	ND
59	Subtidal Z. mar.	<2	Muddy Sand

Station Group G

Station	Habitat	Depth (m)	Sediment
111	Intermediate	15.0	Sandy Mud
116	Intermediate	19.0	Sandy Mud
117	Intermediate	21.0	Sandy Mud
115	Intermediate	17.5	Sandy Mud
112	Intermediate	19.0	Sandy Mud
114	Intermediate	16.0	Sandy Mud
120	Intermediate	20.0	Sandy Mud
123	Deep	25.0	Sandy Mud
121	Intermediate	20.0	Sandy Mud
119	Intermediate	19.0	Sandy Mud
125	Intermediate	12.0	Sandy Mud
122	Intermediate	20.0	Sandy Mud
147	Intermediate	10.0	Sand+Mud
126	Deep	25.0	Sandy Mud
132	Deep	33.0	Sandy Mud
138	Deep	24.0	Muddy Sand
131	Deep	33.0	Sand
146	Deep	26.0	Sand
501	Deep	59.0	Sand

ND = No data
Depths as meters below Mean Low Water

Table 13. Detrended Reciprocal Correspondence Results

Axis	Eigenvalue
1	0.7139
2	0.2760
3	0.2186
4	0.1163

Table 14. Sediment Summary and Field Notes

Station	Habitat	Site	Gravel	Sand	Silt/Clay	MMS	Organic %	Notes
42	Unvegetated	Intertidal	40.91	42.05	17.04	0.471	1.339	Gravel
72	Unvegetated	Intertidal						Sandy with very sparse Z. japonica at boat ramp
209	Unvegetated	Intertidal	5.92	41.56	52.51	0.053	4.672	Soft
213	Unvegetated	Intertidal	0.00	71.21	28.79	0.099	1.918	
215	Unvegetated	Intertidal						Sparse Z. japonica
220	Unvegetated	Intertidal						Firm Mud
67	Ulva	Intertidal	0.00	83.97	16.03	0.190	1.722	
71	Ulva	Intertidal	0.66	65.05	12.28	0.061	2.551	
74	Ulva	Intertidal						
75	Ulva	Intertidal						
82	Ulva	Intertidal	0.00	49.99	50.01	0.037	2.937	Dense
85	Ulva	Intertidal						Mixed with Enteromorpha
91	Ulva	Intertidal						
92	Ulva	Intertidal	0.30	59.60	40.11	0.050	3.155	
93	Ruppia/Ulva	Intertidal						Sparce Intertidal Z. marina and Ulva present
98	Ulva	Intertidal						
202	Ulva	Intertidal						
205	Ulva	Intertidal	0.00	86.50	13.50	0.126	1.759	
218	Ulva	Intertidal						
219	Ulva	Intertidal						
221	Ulva	Intertidal	0.00	70.82	29.18	0.075	2.662	
222	Ulva	Intertidal	0.00	86.64	13.46	0.120	1.812	Ulva dominant with Ruppia, Z. marina and Enteromorpha
223	Ulva	Intertidal						Sandy
224	Ulva	Intertidal						Dense with Ruppia
30	Zostera japonica	Intertidal						
44	Zostera japonica	Intertidal	0.92	73.61	25.47	0.091	2.787	
45	Zostera japonica	Intertidal						
47	Zostera japonica	Intertidal						Sparse with Z. marina
50	Zostera japonica	Intertidal						
51	Zostera japonica	Intertidal	3.67	71.25	25.08	0.260	1.602	
52	Zostera japonica	Intertidal						
55	Zostera japonica	Intertidal	5.15	46.38	48.47	0.049	2.874	
63	Zostera japonica	Intertidal						

Table 14 (Cont.).

Station	Habitat	Site	Gravel	Sand	Silt/Clay	MMS	Organic %	Notes
68	Zostera japonica	Intertidal						
69	Zostera japonica	Intertidal	0.00	70.30	29.69	0.111	2.288	Very Dense
210	Zostera japonica	Intertidal	4.36	56.29	39.36	0.085	2.305	Sandy; North of boat ramp
212	Zostera japonica	Intertidal						Sandy; At State Park
214	Zostera japonica	Intertidal						
216	Zostera japonica	Intertidal						
33	Zostera marina	Low Density Intertidal	0.97	83.01	16.02	0.350	1.404	
34	Zostera marina	Low Density Intertidal						
36	Zostera marina	Low Density Intertidal						
37	Zostera marina	Low Density Intertidal						
53	Zostera marina	Low Density Intertidal	0.52	80.91	18.57	0.167	2.360	
54	Zostera marina	Low Density Intertidal						
56	Zostera marina	Low Density Intertidal						
61	Zostera marina	Low Density Intertidal	1.66	76.92	21.42	0.165	2.024	
64	Zostera marina	Low Density Intertidal	0.00	79.49	20.51	0.170	1.625	
70	Zostera marina	Low Density Intertidal						
73	Zostera marina	Low Density Intertidal						Soft
200	Zostera marina	Low Density Intertidal						
207	Zostera marina	Low Density Intertidal	0.00	31.73	68.27	0.041	3.790	
211	Zostera marina	Low Density Intertidal						Soft; at State Park
217	Zostera marina	Low Density Intertidal						
4	Zostera marina	High Density Intertidal	0.00	60.80	39.20	0.046	3.124	
6	Zostera marina	High Density Intertidal	0.00	86.34	13.66	0.165	2.068	
11	Zostera marina	High Density Intertidal						
12	Zostera marina	High Density Intertidal						Sandy
14	Zostera marina	High Density Intertidal						
15	Zostera marina	High Density Intertidal						
18	Zostera marina	High Density Intertidal	0.00	90.40	9.60	0.183	1.622	
22	Zostera marina	High Density Intertidal						
27	Zostera marina	High Density Intertidal						
46	Zostera marina	High Density Intertidal	1.29	73.49	25.22	0.320	2.177	
49	Zostera marina	High Density Intertidal						
57	Zostera marina	High Density Intertidal	3.61	82.49	13.90	0.200	1.821	

Table 14 (Cont.).

Station	Habitat	Site	Gravel	Sand	Silt/Clay	MMS	Organic %	Notes
204	Zostera marina	High Density Intertidal	0.00	70.52	29.48	0.086	8.957	
206	Zostera marina	High Density Intertidal						
208	Zostera marina	High Density Intertidal						
16	Zostera marina	Subtidal						
17	Zostera marina	Subtidal						
28	Zostera marina	Subtidal						
31	Zostera marina	Subtidal	0.00	61.27	38.73	0.056	3.407	
43	Zostera marina	Subtidal						
48	Zostera marina	Subtidal	0.00	67.87	32.12	0.115	2.312	
58	Zostera marina	Subtidal						
59	Zostera marina	Subtidal	3.58	75.95	20.47	0.204	2.672	
60	Zostera marina	Subtidal						
62	Zostera marina	Subtidal						
65	Zostera marina	Subtidal	0.00	35.78	64.22	0.020	4.918	
201	Zostera marina	Subtidal	0.00	46.52	53.49	0.051	4.571	
203	Zostera marina	Subtidal	0.00	86.92	13.08	0.131	2.009	
225	Zostera marina	Subtidal						
226	Zostera marina	Subtidal	0.00	84.54	15.45	0.113	1.939	
106	Shallow	4.5 m	0.00	100.00	0.00	0.170	3.337	
107	Shallow	4.5 m	0.00	76.75	23.25	0.132	1.936	
108	Shallow	5 m	0.00	67.76	32.24	0.190	1.763	
110	Shallow	5.5 m	0.00	52.46	47.54	0.080	3.184	
127	Shallow	5.5 m	0.00	83.14	16.86	0.425	0.993	
129	Shallow	5.5 m	0.00	64.64	35.36	0.073	3.891	
130	Shallow	5.5 m	0.00	76.96	23.04	0.167	1.285	
133	Shallow	5.5 m	0.00	74.15	25.86	0.077	1.992	
134	Shallow	5 m	0.00	90.39	9.61	0.440	0.922	
136	Shallow	4.5 m	0.30	91.34	8.36	0.500	0.939	
149	Shallow	5 m	0.00	74.57	25.43	0.081	1.919	
150	Shallow	5 m	2.70	92.59	4.70	0.500	0.928	
151	Shallow	5 m	0.00	70.59	29.42	0.116	2.442	
152	Shallow	6 m	0.00	87.05	12.95	0.230	1.266	

Table 14 (Cont.).

Station	Habitat	Site	Gravel	Sand	Silt/Clay	MMS	Organic %	Notes
153	Shallow	5 m	0.06	63.65	36.29	0.063	3.163	Z. marina present
109	Intermediate	9 m	0.00	30.31	69.69	0.026	5.525	
111	Intermediate	15 m	0.00	23.46	76.53	0.015	7.240	
112	Intermediate	19 m	0.00	17.14	82.86	0.014	5.458	
113	Intermediate	8.5 m	0.00	24.98	75.03	0.018	7.408	
114	Intermediate	16 m	0.06	15.85	83.58	0.012	5.792	
115	Intermediate	17.5 m	0.00	17.92	82.08	0.013	6.518	
116	Intermediate	19 m	0.05	8.64	91.30	0.009	6.055	
117	Intermediate	21 m	0.69	23.73	75.57	0.016	6.262	
119	Intermediate	19 m	0.37	17.06	82.57	0.013	5.553	
120	Intermediate	20 m	0.40	41.18	58.43	0.030	4.858	
121	Intermediate	20 m	0.53	21.46	78.01	0.014	6.100	
122	Intermediate	20 m	0.71	14.75	84.53	0.014	5.036	
124	Intermediate	9 m	0.00	81.78	18.21	0.198	1.658	
125	Intermediate	12 m	0.35	24.75	74.89	0.013	5.882	
137	Intermediate	11 m	0.36	85.73	13.92	0.216	1.466	
147	Intermediate	10 m	0.49	48.84	50.67	0.039	3.843	
148	Intermediate	10 m	0.00	74.97	25.02	0.079	2.487	
123	Deep	25 m	0.00	15.54	84.46	0.012	5.753	
126	Deep	25 m	0.42	23.02	76.57	0.017	5.559	
131	Deep	33 m	0.00	72.78	27.21	0.107	2.442	
132	Deep	33 m	0.11	45.47	54.42	0.040	4.120	
138	Deep	24 m	0.93	54.96	44.12	0.047	4.035	
139	Deep	55 m	46.92	40.38	12.70	1.200	1.690	
140	Deep	63 m	4.24	83.93	11.84	0.297	1.460	
141	Deep	72 m	4.62	10.91	84.47	0.009	2.392	
142	Deep	23 m	0.43	94.67	4.90	0.440	1.144	
143	Deep	27 m	5.69	65.15	29.15	0.120	2.486	
144	Deep	26 m	4.14	76.61	19.25	0.136	2.322	
145	Deep	46 m	5.14	79.02	15.84	0.500	0.947	
146	Deep	26 m	0.94	61.38	37.68	0.065	2.695	
500	Deep	53 m	7.16	83.97	8.87	0.334	1.435	
501	Deep	59 m	0.27	71.71	28.02	0.137	3.084	

Table 15. Sediment Profile Imagery Results

Station	Habitat	SPI Photograph	Sediment	Penetration (cm)	Apparent RPD (cm)	Notes
106*	Shallow					
107*	Shallow					
108	Shallow	+	Sandy	7.6	1.5	Large Burrow
110	Shallow	+	Muddy Sand	18.3	6.1	Many Tubes on Surface
127	Shallow	+	Sand	6.1	-	Large Burrow/Onuphid Tubes?
129	Shallow	+	Muddy Sand	20.0	3.0	Large burrow (Ophiroid?) Maldanid burrow, Feeding Voids.
130	Shallow	+	Sand	5.5	1.8	
133	Shallow	+	Muddy Sand	18.6	4.3	2 Feeding Voids, 1 Worm
134	Shallow	+	Sand	7.3	-	Maldanid Tube, Sand Ripples
136	Shallow	+	Sand	7.3	-	
149	Shallow	+	Sandy Mud	11.0	3.0	Ulva mat, Maldanid Tubes
150	Shallow	+	Sand	3.7	-	Sprigs of Seagrass
151	Shallow	+	Sandy Mud	9.8	3.7	Jacknife Clam, Seagrass Blades
152	Shallow	+	Sand	4.3	-	Sprigs of Seagrass
153	Shallow	+	Sand	9.1	3.0	Seagrass, Algae

* No Data

Table 15 Continued.

Station	Habitat	SPI Photograph	Sediment	Penetration (cm)	Apparent RPD (cm)	Notes
109	Intermediate	+	Muddy Sand	4.9	2.4	
111	Intermediate	+	Muddy Sand	6.7	2.4	RPD Patchy
112	Intermediate	+	Mud + Sand	12.8	2.4	RPD Patchy, Fecal Casts
113*	Intermediate					
114	Intermediate	+	Mud +Sand	14.0	2.4	Fecal Casts
115	Intermediate	+	Mud + Sand	12.8	1.8	Feeding Void
116	Intermediate	+	Mud + Sand	11.5	1.8	Feeding Void, Burrow Opening Fecal Casts?
117	Intermediate	+	Mud	18.3	4.3	Feeding Void
120	Intermediate	+	Mud	15.2	2.4	Feeding Void, Fecal Casts
121	Intermediate	+	Mud	17.7	2.4	Feeding Void, Deep Burrow
122	Intermediate	+	Mud	29.4	3.7	Feeding Void, Fecal Cast Deep Burrows
125	Intermediate	+	Mud	20.1	3.7	Fecal Casts
137*	Intermediate					
147*	Intermediate					
148	Intermediate	+	Sand	5.5	-	

Table 15 Continued.

Station	Habitat	SPI Photograph	Sediment	Penetration (cm)	Apparent RPD (cm)	Notes
123	Deep	+	Mud	17.1	1.2	Burrows Present 2 cm Dark Layer just under surface
126	Deep	+	Mud	20.1	3.0	Feeing Voids, No layering
131	Deep	+	Sand	7.3	-	
132	Deep	+	Sandy Mud	13.4	3.0	Feeding Voids
138	Deep	+	Mud	18.3	2.4	Feeding Voids, Large Burrow
139*	Deep					
140*	Deep					
141*	Deep					
142*	Deep					
143*	Deep					
144*	Deep					
145*	Deep					
146*	Deep					
500	Deep	+	Sand	5.5	-	Much debris, Several Burrows
501	Deep	+	Sand	2.4	-	Much debris, Some Burrows

Table 16. Padilla Bay Nekton Food Habit Collections

Species	Collection Site	Size (mm)	No.	Mean SL*(mm)	SL Range (mm)
English Sole	Deep	100-150	30	134.7	110-147
English Sole	Deep	150-200	30	165.9	151-189
English Sole	Intermediate	50-100	26	90.7	73-99
English Sole	Intermediate	100-150	30	124.3	103-149
English Sole	Intermediate	150-200	17	168.4	151-196
Blackbelly Eelpout	Deep	100-150	30	132.3	112-149

*SL = Standard Length

Table 17. English Sole (50-100 mm) Feeding Habits- Intermediate Depth Sites

Major Taxa	Prey Items	Sieve Size (mm) 0.5	1	2	3.35	6.3	
Polychaete	Owenia fusiformis	-	46	18	-	11	
	Prionospio steenstrupi	-	2	-	-	-	
	Ampharetidae	12	-	-	-	-	
	Armandia brevis	2	2	-	-	-	
	Nepthys cornuta	-	4	-	-	-	
	Syllidae	1	-	-	-	-	
	Exogene molesta	-	1	-	-	-	
	Nereidae	-	2	-	-	-	
	Onuphidae	-	1	-	-	-	
	Glycinde armiger	1	-	-	-	-	
	Glycera sp.	-	-	-	-	1	
Mollusc	Clinocardium nutalli	1	1	3	-	-	
	Mysella tumida	2	12	-	-	-	
	Macoma nasuta	-	1	1	-	-	
	Solen perambilis	-	2	2	-	-	
	Transenella tantilla	4	-	2	-	-	
	Yoldia myalis	-	2	-	-	-	
	Tellina sp.	1	-	2	-	-	
	Siphon	1	1	-	-	-	
	Admete gracilator	5	1	-	-	-	
	Cyclostremella sp.	2	2	-	-	-	
Crustacea	Synidotea nodulosa	1	4	-	-	-	
	Pancolus californiensis		1	-	-	-	-
	Ampelisca pugetica	-	-	1	-	1	
	Cheirimedeia macrodactyla	1	-	1	-	-	
	Corophium sp.		15	-	-	-	-
	Monoculodes sp.	-	1	-	-	-	
	Orchomene pinguis	-	1	-	-	-	
	Photis brevis	-	14	-	-	-	
	Pontogeneia sp.	-	2	-	-	-	
	Eudorella ?	5	11	-	-	-	
	Leptocuma sp.	1	-	-	-	-	
	Leucon sp.	1	-	-	-	-	
	Oxyurostylis sp.	-	1	1	-	-	
	Crabs	-	12	-	-	-	
	Ostracods	6	18	-	-	-	
Echinoderm	Amphioda occidentalis	-	4	-	-	-	

Table 18. English Sole (100-150 mm) Feding Habits. Intermediate Depth Sites

		Sieve Size (mm)					
Major Taxa	Prey Items	0.5	1	2	3.35	6.3	
Polychaete	Owenia fusiformis	-	85	15	5	5	
	Laonice cirratata	-	-	-	1	-	
	Ampharetidae	-	1	-	-	-	
	Sternapis scutata	-	4	-	-	-	
	Pectinaria californiensis	-	1	-	-	-	
	Armandia brevis	-	1	-	-	-	
	Nepthys caecoides	-	-	1	-	-	
	Nepthys cornuta	-	7	-	-	-	
	Harmothoe lunulata	-	-	1	-	-	
	Lumbrineris californiensis	-	-	-	-	1	
Mollusc	Clinocardium nutalli	-	-	-	1	-	
	Lucina tenuisculpta	-	4	-	-	-	
	Solen perambilis	-	1	-	-	-	
	Transenella tantilla	-	15	8	-	-	
	Yoldia myalis	-	5	7	-	-	
Crustacea	Synidotea nodulosa	-	2	-	-	-	
	Ampelisca pugetica	-	1	2	-	-	
	Cheirimedeia macrodactyla		-	4	-	4	-
	Corophium sp.	-	1	-	-	-	
	Eobrolgus spinosus	-	2	-	-	-	
	Eyakia robustus	-	8	1	1	-	
	Photis brevis	-	16	1	-	-	
	Rheophoxynius tridentata	-	2	-	-	-	
	Caprella laeviscula	-	1	-	-	-	
	Caprellidae.	-	-	1	-	-	
	Eudorella ?	-	97	2	1	3	
	Oxyurostylis sp.	-	9	2	-	-	
	Leptochelia savigni	-	2	-	-	-	
	Crabs	-	2	-	1	1	
	Ostracods	-	18	-	-	-	
Echinoderm	Amphioda occidentalis	-	14	-	15	-	

Table 19. English Sole (150-200 mm) Feeding Habits. Intermediate Depth Sites

Major Taxa	Prey Items	Sieve Size (mm) 0.5	1	2	3.35	6.3
Polychaete	Owenia fusiformis	-	23	14	5	31
	Prionospio steenstrupi	-	6	-	-	1
	Ampharetidae	-	1	-	-	-
	Euclymene sp.	-	-	-	-	1
	Maldanidae	-	1	-	-	-
	Sternapis scutata	-	-	1	5	12
	Pectinaria californiensis	-	1	-	-	-
	Nepthys cornuta	-	1	-	-	-
	Lumbrineris californiensis	-	-	1	-	3
	Glycinde armiger	-	-	-	-	1
Mollusc	Acila castraensis	-	1	-	-	-
	Clinocardium nutalli	-	-	-	1	-
	Lucina tenuisculpta	-	-	2	-	-
	Lyonsia californesisi	-	-	-	-	1
	Macoma sp.	-	-	-	-	2
	Tellina modesta	-	1	-	-	-
	Transenella tantilla	-	2	4	-	-
	Yoldia myalis	-	1	2	-	1
Crustacea	Ampelisca pugetica	-	1	1	-	-
	Cheirimedeia macrodactyla	-	10	8	-	1
	Eyakia robustus	-	6	3	-	-
	Rheophoxynius tridentata	-	2	-	-	-
	Eudorella ?	-	11	3	-	1
	Oxyurostylis sp.	-	1	-	-	-
	Crabs	-	-	1	-	-
	Ostracods	-	5	-	-	-
Echinoderm	Amphioda occidentalis	-	-	3	1	8

Table 20. English Sole (100-150 mm) Feeding Habits. Deep Sites

		Sieve Size (mm)				
Major Taxa	Prey Items	0.5	1	2	3.35	6.3
Polychaete	Owenia fusiformis	-	4	-	-	-
	Laonice cirrata	-	-	-	-	1
	Nepthys cornuta	-	1	-	-	-
Mollusc	Acila castraensis	-	2	2	2	-
	Lucina tenuisculpta	-	7	1	-	
	Nuculana hamata.	-	-	-	1	-
	Transenella tantilla	-	14	12	-	
	Yoldia myalis	-	-	14	4	
Crustacea	Ampelisca pugetica	-	-	-	-	-
	Cheirimedeia macrodactyla	-	2	-	-	-
	Eudorella ?	-	17	-	-	-
Echinoderm	Amphioda occidentalis	-	3	2	2	1

Table 21. English Sole (150-200 mm) Feeding Habits. Deep Stes

		Sieve Size (mm)				
Major Taxa	Prey Items	0.5	1	2	3.35	6.3
Polychaete	Owenia fusiformis	-	-	-	3	-
	Laonice cirrata	-	-	1	-	-
	Sternapis scutata	-	-	1	1	-
	Unidentified sp. 1	-	-	-	1	1
Mollusc	Acila castraensis	-	-	2	2	1
	Lucina tenuisculpta	-	1	-	-	-
	Nuculana hamata.	-	-	1	-	-
	Transenella tantilla	-	12	-	16	-
	Yoldia myalis	-	-	-	22	1
	Dentalium rectuis	-	-	-	-	1
Crustacea	Caprella striata	-	-	-	-	1
	Eyakia robustus	-	-	-	1	-
	Eudorella ?	-	-	-	4	-
Echinoderm	Amphioda occidentalis	-	2	6	5	3

Table 22. Blackbelly Eelpout (100-150 mm) Feeding Habits. Deep Sites

Major Taxa	Prey Items	Sieve Size (mm) 0.5	1	2	3.35	6.3
Polychaete	Owenia fusiformis	-	-	1	-	-
	Sternapis scutata	-	2	-	-	-
	Sphaerodoropsis sphaerulifer	-	1	-	-	-
Mollusc	Lucina tenuisculpta	-	10	-	-	-
	Transenella tantilla	-	2	-	-	-
	Yoldia myalis	-	15	15	3	-
Crustacea	Ampelisca pugetica	-	-	1	-	-
	Eyakia robustus	-	40	1	-	-
	Cheirimedeia macrodactyla	-	3	4	-	-
	Photis brevipes	-	1	-	-	-
	Eudorella ?	-	131	4	-	-
	Oxyurostylis sp.	-	-	1	-	-
	Ostracods	-	137	-	-	-
	Shrimp	-	-	-	-	1

Table 23. Comparison of Puget Sound Infaunal Community Structure

	Habitat								
	Intertidal					Subtidal			
	Unveg.	Ulva	Zjap	Zmar Low	Z. mar High	Z. mar	Shall	Inter	Deep
Total Taxa	32	58	62	70	75	88	86	88	78
Taxa Average ($0.0045m^2$)	13.5	15.8	17.2	19.5	22.0	22.2	23.9	17.5	16
Diversity (H')	2.36	3.03	3.26	2.78	3.20	3.90	3.64	3.98	3.25
	1.87[1]		0.79[4]	0.72[4]			3.49[5]	3.81[6]	
	2.36[2]								4.26[7]
Abundance (k/m2)	71.2	78.5	78.1	97.2	89.8	33.6	38.7	19.2	12.3
	42.4[1]	48[3]	1.4[4]	6.0[4]			17.4[5]	12.9[6]	
	33.0[2]		0.4[8]					4.8[7]	
	0.8-2.8[8]						28.4[9]	6-13.0[9]	
Biomass (g-wet/m2)	12.3	67.7	352.4	261.5	317.3	213.9	155.5	370.1	101.6
	371[1]							782[5]	76[6]
	415[2]								
	100-800[8]		240[8]				3655[9]	74-146.0[9]	

Zjap = Zostera japonica   Zmar= Z. marina   Shall = Shallow   Inter=Intermediate

[1] Nyblade (1979) - Data for Protected Fine Sand Habitat (Jamestown + MLW)
[2] Nyblade (1979) - Data for Protected Medium Sand Habitat (Jamestown MLW)
[3] Woodin (1974)
[4] Riggs (1983)
[5] Nyblade (1979) - Data for Protected Fine Sand Habitat (Jamestown -5 m)
[6] Nyblade (1979) - Data for Protected Fine Sand Habitat (Jamestown -10m)
[7] Barreca (1982) - Data summed for stations A, B and C (- 9m)
[8] Smith and Webber (1978) - Data for 1' MLW (assumed Z. japonica) and +3' and +6' MLW (assumed unvegetated)
[9] Smith (1979)

Table 24. Comparison of Puget Sound Infaunal Species Composition (Rank Order)

	Habitat								
	Intertidal					Subtidal			
Taxa	Unveg.	Ulva	Zjap	Zmar Low	Zmar High	Zmar	Shall	Inter	Deep
Fabricia sabella	1								
Pygospio elegans	2[1]								
Cirriformia spirobranchiata			3[4]		+[4]				
Notomastus tenuis	+[8]		+[8]		1[4]				
Pseudopolydora kempi	+,+[8]		4[4]		+[4]				
Battilaria zonalis	+		+, 2[4],+[8]	+	+	+	+		
Malacoceros glutaeus	+,3[1], 4[2]	+	+	5	+,+[4]	+	+	+[5]	
Axiothella rubrocincta	+[2]	4[3]	+	+	+	+	+,+[5]	+[6], +[7]	
Gammaridae	+[1], +[2]						3[5]	1[6]	
Leptochelia sp.	+,+,+[2]	1,1[3]	2,1[4]	1	1	1	5,2[5]	+,+[6]	
Platynereis bicanaliculatum	+[2]	+,3[3]	+	+	+	+	+,+[5]	+,+[6], +[7]	
Eteone longa	4[1]						+	+	+
Capitella capitata	5[2],+[8]	+,+[3]	+,+[4],+[8]		3[4]			+[5]	+[7]
Exogene lourei/molesta	+,3[2]	2,2[3]	4	2	2	3	+,2[5]	+,3[6], +[7]	+
Transenella tantilla	+,5[1], 2[2]	+	3,+[4],+[8]	+	+,+[4]	+	+	2.+[7]	1
Corophium sp.	2,+[8]	+	1,1[4],+[8]	4	4	+	+	+	+
Lumbrineris sp.	+[2]	5[3]	+	+	+	+	+	+.+[7]	+
Glycinde sp.	+,+[8]	+	+,+[8]	+	+,+[4]	+	+	+,+[6], 5[7]	+
Macoma nasuta	+[2],+[8]	+	+[8],+[4]	+	+,+[4]	+	+,+[5]	+,+[6]+[7]	+
Oligochaeta	4,1[1], 1[2]	4,5	+	3	3,5,4[4]	2	+	+,+[5]	+,+[6], +[7]
Mediomastus sp.	+,+[2]	+	+	+	+	+	+,5[5]	+.4[6],+[7]	+
Mysella tumida	+	+		+	+,+[4]	+	4,4[5]	+,+[6], 3[7]	4
Owenia fusiformis	+		+	+	2[4]	4	1,+[5]	1,+[6], 2[7]	+
Amphioda sp.		+		+	+,+[4]	+	+	+,4[7]	+
Paraphoxus sp.			5[4]					+[7]	
Tellina modesta					+[4]		+	+,+[6], +[7]	+
Lucina tenuisculpta						+	+	+, +[7]	3
Prionospio steenstrupi						5	+	+,+[5]	5,+[6], +[7]

+ = Present but not in top 5
[1] Nyblade (1979) - (Jamestown + MLW)
[2] Nyblade (1979) - (Jamestown MLW)
[3] Woodin (1974)
[4] Riggs (1983)
[5] Nyblade (1979) - (Jamestown -5 m)
[6] Nyblade (1979) - (Jamestown -10m)
[7] Barreca (1982)
[8] Smith and Webber (1978)