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# Distribution and abundance of macrobenthic polychaetes along the South Indian coast

**Amar S. Musale and Dattesh V. Desai***

National Institute of Oceanography, Council of Scientific and Industrial Research,

Dona Paula, Goa- 403 004, India

*Email:ddattesh@nio.org

**Abstract** Macrobenthic polychaetes play significant role in marine benthic food chain. A study was carried out to observe the abundance and diversity of soft bottom macrobenthic polychaetes along the Indian coast along with observations on sediment characteristics. The present study indicated an increase in the polychaete diversity as compared to earlier reports. 63 different forms of polychaetes were identified along the coast, which constitute the bulk of the fauna. 38 species of polychaetes showed higher abundance along the west coast, whereas 25 species along the east coast. Seabed composition showed a high spatial variation in its composition along the coast. Occurrence of *Prionospio pinnata* and *Capitella capitata* the deposit feeders and indicators of organic pollution suggested the sampled area is organically rich. Polychaete abundance was found to be higher along the west coast and was attributed to loose texture of sediment due to high sand and sandy silt resulting in higher interstitial space for organisms to harbor. Canonical correspondence analysis (CCA) showed that majority of polychaete species preferred low organic carbon and preferred either sandy silt or sandy clay substratum. The polychaete abundance was less at high organic carbon areas can be attributed to avoidance of organisms to organic matter, being a possible indication that high organic matter adversely affects the polychaete abundance and distribution.

**Keywords** Polychaete • Macrobenthos • Indian coast • Pollution indicator • Organic carbon

## Introduction

Soft bottom macrobenthic communities are key components in the functioning of coastal and marine ecosystems (Lu 2005). These bring about considerable changes in physical and chemical composition of sediments, especially in the water-sediment interface (Gaudencio and Cabral 2007; Shou et al. 2009). Macrofauna in marine sediments play an important role in ecosystem processes such as nutrient cycling, pollutant metabolism, dispersion and burial and secondary production (Snelgrove 1998). Macrobenthos are residents of sediment surface with abundant oxygen and organic carbon. Among macrobenthos, polychaetes are one of the important organisms.

Polychaetes are bristle-bearing segmented worms belonging to phylum Annelida, class Polychaeta. Polychaetes being the most dominant groups in benthic infaunal communities contribute about 80% to the total macrobenthic community and their diet include microbial (bacteria, microalgae, protists and fungi), meiobial and organic substance (Shou et al. 2009). In the trophic system, benthic fauna plays a significant role as they exploit all forms of food available in the sediment and form an important link in the energy transfer (Crisp 1971, Shou et al. 2009). Polychaetes form an important component in the marine food chain especially for bottom fish and some mammals as they form an important source of food for demersal fish (Parulekar et al. 1982; Herman et al. 2000).

Polychaetes are also being used for biomonitoring program as organic pollution indicators to check the health of the marine environment (Remani et al. 1983; Warwick and Ruswahyuni 1987; Jayaraj et al. 2007). It was only after 1970, the work on marine soft bottom macrobenthos along the Indian coast has been carried out by several workers (Parulekar et al. 1975; Ansari et al. 1977; Harkantra et al. 1980; Jayaraj et al. 2007).

Sediment parameters like grain size, organic content and food availability are among the important factors affecting benthic community structure (Sanders 1958; Kari 2002). The present study was conducted to determine the diversity and distribution of the soft bottom polychaetes along the south east and west coast of India. Observations were also made on macrobenthos belonging to other groups. Sediment characteristics were evaluated to understand their influence on macrobenthos.

## Materials and methods

Sampling was carried out during December 2006 to January 2007 from 13 different locations viz. Mormugao, Karwar, Mangalore, Cannanore, Calicut, Kochi, Trivandrum along the west coast and Pondicherry, Chennai, Nellore, Nizamapatnam, Machilipatnam and Kakinada along the east coast of

India (Fig.1). The samples were collected onboard CRV-*Sagar Sukti*. Sediment samples were collected in triplicate (n=3) by operating van Veen grab ($0.04m^2$). The sampling depth ranged from 26-28m. The samples were washed separately through 500µm nylon mesh at sea, transferred to plastic containers and preserved in 5% formaldehyde in sea water containing rose bengal stain and were transferred to laboratory. Macrobenthic polychaetes were identified up to species level while other fauna such as crustaceans, molluscs, echinoderms, oligochaetes, nemertines, sipuncula and fish larvae were recorded. The identification was done with the help of stereo zoom microscope following available identification keys (Day 1967; Gosner 1971). Numerical abundance of each species was recorded and expressed as $no.m^{-2}$. Organic carbon and percentage composition of sediment (sand, silt and clay) was determined by standard titration method and pipette analysis respectively (Wakeel et al. 1956; Buchanan 1984). Organic carbon was expressed as percentage of sediment dry weight.

Polychaetes reflect the ecological and environmental status and were calculated in terms of number of individuals or specimens (N), number of species (*S*), total abundance (*A*), Margalef species richness (*d*), Pielou's eveness (*J'*), Shannon index (*H'*) at each site (Clarke and Gorley 2001). Bray Curtis similarity for species diversity for all the species belonging to macrobenthic polychaetes was determined analytically by PRIMER-v5. One-way ANOVA was carried out to see the variation in the abundance of polychaete macrobenthos at different stations. Canonical Correspondence Analysis (CCA) was performed to evaluate the relationship between sediment characteristics (sand, silt, clay & OC) and macrobenthic polychaetes and for the species belonging to genus Prionospio (ter Braak, 1995) using the Multi-Variate Statistical Package version 3.1 (Kovach, 1998).

**Results**

Sediment texture and Organic carbon

Sediment texture analyses indicated a diverse nature of substratum along the entire sampled area. The percentage of sand was more than silt and clay along the west coast of India, at Mormugao, Kochi and Trivandrum. In rest of the west coast stations sediment texture is sandy-silt except at Calicut where silty-clay sediment was observed (Fig 2). Along the east coast of India, southern stations (Pondicherry, Chennai and Nellore) dominated by sand while northern stations (Nizamapatnam, Machilipatnam and Kakinada) showed silt-clay substratum (Fig. 2).

The organic carbon for sediment ranged from 0.11-3% along the west coast of India. The minimum organic carbon was recorded at Cannanore and maximum at Calicut. Along the east coast it ranged from 0.59% at Nellore to 1.3% at Machilipatnam (Fig. 3).

Polychaete abundance and diversity

A significant variation ($p<0.009$; One-way ANOVA) in the abundance of polychaetes was observed in different stations. In general the abundance was more along the west coast compared to east coast. The maximum abundance of polychaetes was observed at Kochi (4475 no.$m^{-2}$) followed by Trivandrum (2675 no.$m^{-2}$) and Calicut (2550 no.$m^{-2}$) (Fig. 4a). At Mormugao and Cannanore 1675 and 1050 no.$m^{-2}$ polychaetes were recorded respectively. The polychaete abundance was minimum at Karwar (200 no.$m^{-2}$). Along the east coast maximum abundance of polychaetes was observed at Pondicherry (1650 no.$m^{-2}$). Rest of the stations showed comparatively lower abundance of polychaetes and minimum was at Chennai (125 no.$m^{-2}$) (Fig. 4a).

Altogether 63 forms of polychaetes were identified during the study. Species belonging to genus Prionospio, Magelona, Capitella and Lumbreneries were widely distributed along the coast along with *Diopatra neapolitana*. Polychaetes belonging to genus Magelona are most dominant at Kochi (3100 no.$m^{-2}$) compared to the other stations while *Glycera* sp. (425 no.$m^{-2}$), *Nephtys* sp. (200 no.$m^{-2}$) and *Cirratulus* sp. (350 no.$m^{-2}$) were abundant at Trivandrum (Table 1). It was observed that some macrobenthic polychaete species were found restricted to the west coast. The dominant amongst them are *Ancistrosyllis constricta*, *Cirratulus cirratus*, *Aricidea assimilis*, *Nephtys polybranchia*, *Lumbriconeris notocirrata*, *Cossura coasta* and *Polydora* sp. Similarly some species were restricted to the east coast namely *Amphiarete* sp., *Magelona* sp., *Nephtys capensis* and *Glycera longipinis*, however the abundance of these species were less (Table 1). The CCA biplot for macrobenthic polychaetes (Fig. 4b), the two axes explained 79.99% of the relationship between macrobenthic polychaetes and sediment variables. Silt, clay and organic carbon were the most important sediment variables influencing macrobenthic polychaete species abundance. *Heteromastus filiformis*, *Dorvillea* sp., *Ninoe* sp. and *Notomastus aberans* preferred clayey substratum whereas *Ancistrosyllis constricta* preferred silt. *Prionospio* sp.1, *Glycera* sp., *Sternaspis scutata*, *Cirratulus* sp., *Nephtys* sp.2, *Onuphis* sp. preferred higher organic carbon values. The results depicted that group II polychaete species were favored by high organic carbon and silt and group III polychaete species were favored by higher percentage of clay. This signifies that species indicated in group I preferred low percentage of clay and those in group IV preferred lower organic carbon and silt. This indicates that majority of polychaete species (group I and IV) preferred low organic carbon and preferred either sandy-silt or sandy-clay substratum. On the basis of Bray-Curtis similarity index which is applied for macrobenthic polychaete abundance, Cannanore and Calicut were grouped into one cluster and Nellore and Nizamapatnam as the second cluster at 50% similarity. Rest of the stations, Chennai, Mormugao, Kochi, Karwar, Mangalore, Trivandrum, Pondicherry, Machilipatnam and Kakinada were dissimilar at this level (Fig. 6).

Polychaetes belonging to the genus Prionospio were most abundant and widely distributed along the study area. This genus which is mostly represented by deposit feeders was the dominant genus in west and east coast except at Chennai and Machilipatnam and it was observed that their occurrence was not substratum specific and also they were found dominating both at low and high organic carbon areas (Fig. 5a). In CCA biplot for abundant polychaete sp. *Prionospio* sp.2 preferred higher organic carbon, silt and clay whereas *Prionospio cirrifera* preferred lower values of organic carbon, silt and clay (Fig. 5b).

The species diversity of polychaete was estimated based on Margalef species richness (d), and Shannon index (H'). Along the west coast species richness value ranged from 0.188-3.421 (Karwar to Trivandrum), and along the east coast it was 0.828-2.56 at Chennai and Nellore respectively. Shannon index (H') values ranged from 0.376-2.858 along the west coast from Karwar to Trivandrum and 1.609-2.690 at Chennai and Nellore respectively along the east coast (Table 2). In general the richness and diversity was higher in the region where the substratum was sandy followed by silty clay.

Other macrobenthic fauna

Among the other macrobenthic fauna, crustaceans (crabs, amphipods, prawn larvae, cumacea and tanaids), molluscs (gastropods and bivalves), echinoderms, oligochaetes and fish larvae were recorded along with nemertine and sipuncula (Fig. 7a). The other macrobenthic fauna were more uniformly distributed along the east coast (Fig. 7a). It was observed that along the west coast except for Mormugao, rest of the regions showed dominance of macrobenthic polychaetes. However, along the east coast the abundance of other macrobenthic fauna was almost similar and in Machilipatnam and Kakinada other groups dominated the macrobenthic population (Table 3). Sipuncula were found at Kochi and Trivandrum in west coast while along the east coast they were reported from Nellore, Machilipatnam and Kakinada. Oligochaetes and fish larvae were encountered from Kakinada and Nizamapatnam (Fig. 7a). Bray-curtis similarity index showed two clusters and one single individual station. First cluster comprised Kochi, Mormugao, Trivandrum, Nizamapatnam, Pondicherry, Machilipatnam, Kakinada, Chennai and Nellore whereas second cluster comprised of Mangalore, Cannanore and Calicut. Karwar was dissimilar to the other stations (Fig. 7b).

**Discussion**

The present study indicates higher polychaete diversity as compared to the earlier reports (Harkantra et al. 1982; Saraladevi et al., 1999). It was noticed that west coast of India is rich in polychaetes in terms of total abundance and diversity than the east coast. This was clear from table 3, as west coast stations except Trivandrum showed higher percentage of polychaetes and at stations, Karwar, Mangalore, Cannanore and Calicut their contribution to the total macrobenthos was more than 90%. From the results it has also been pointed out that 38 species of polychaetes showed higher abundance along the west coast compared to 25 species, showed higher abundance along east coast. Similar observations were made by earlier workers for the west coast (Parulekar and Wagh 1975; Harkantra et al. 1980; Ingole et al. 2002). A possible reason for this may be due to geo-physical process i.e. south west monsoon wind-driven upwelling leading to nutrient enrichment along the west coast (Goes et al. 1992), thus making Arabian sea along the west coast more productive than the Bay of Bengal. High abundance of polychaetes can also be attributed to high saline waters compared to east coast. Vizakat (1991) while studying the ecology and community structure of soft bottom macrobenthos of Konkan, along west coast of India suggested recolonization of benthos when salinity increased indicating higher salinities positively influence the benthic population.

Sea bed composition (sand, silt and clay) indicated a diverse nature of the benthic substratum along the study area. It was sandy at Mormugao, Kochi and Trivandrum whereas Karwar, Mangalore, Cannanore and Calicut showed a combination of silt and clay along the west coast of India. Pondicherry and Nellore, on the other hand, were sandier, and Nizamapatnam, Machilipatnam and Kakinada were more silty and clayey along the east coast. Increased percentage of fine sediment may help to retain organic matter.  The incidence of high species diversity and total abundance of polychaetes along the west coast might be attributed to loose texture of sediment character due to high content of sand. Similarly, Ansari et al. (1977) reported high density and biomass of polychaetes are associated with sandy substrate. Generally water content of the sediments reflect an increase in the fine particles (mud and clay) which can retain more water than coarse particles (sand and gravel). Such fine deposits or particles were commonly composed of decomposable organic constituents. As the organic content represents an important direct or indirect food source for benthic organisms, elevated organic matter may result in an enhancement of benthic metabolism (Gray 1981; Meksumpun and Meksumpun 1999). However this metabolic increase causes a marked decline in sediment oxygen content (Pearson 1980) leading to anoxic conditions. Thus organically rich sediments may inhibit some benthic invertebrates. This may be the reason for the high abundance and diversity of polychaetes along the west coast, which constituted sand as the major composition in the sediment. Harkantra et al. (1985) also observed that in clayey-sand and sandy substrate, faunal abundance is rich whereas only clay showed poor abundance. The specificity of fauna to the type of substratum largely depends upon the feeding habits. Fine particles of clay might result in clogging of the feeding apparatus of the filter feeders hence its avoidance of the fine particle size substrata although adequate supply of food is available (Harkantra 1982; Jayaraj et al. 2007). Palacin et al. (1991) also reported higher abundance of benthos in sandy sediment and low density in greater sedimentation area from Mediterranean Bay.

Some polychaete species were restricted to the west coast such as *Ancistrosyllis constricta*, *Cirratulus cirratus*, *Aricidea assimilis*, *Nephtys polybranchia*, *Lumbriconeris notocirrata*, *Cossura coasta* and *Polydora* sp. Amongst these *Nephtys polybranchia* and *Lumbriconeris notocirrata* are carnivores and rest are deposit feeding polychaetes. *Nephtys* sp. is an active predator mainly feed on the small crustaceans, molluscs and other polychaetes. They possess jaws which could be used for seizing the prey (Pettibone 1963; Fauchald and Jumars 1979). It was reported that stable conditions allow many specialized species to be present in the areas, but competition for the sparse food is probably severe, which lead to low densities (Duineveld et al. 1991).

Despite from macrobenthic polychaetes, other macrobenthic forms which were dominant along the coast were crustaceans followed by molluscs, echinoderms and sipuncula. It was also observed that the density of other macrobenthic forms was more along the east coast, except at Trivandrum and Mormugao where the density of crustaceans was high. Such observations were also reported from the west coast of India by Ingole et al. (2002), Parulekar and Wagh (1975). A transition in the community structure was reported by Jayaraj et al. (2008) with a change in the sediment texture and depth. Other macrobenthic faunas especially crustaceans found dominant over the other macrobenthic groups along the east coast at Machilipatnam and Kakinada. Along the south west coast of India demersal fisheries is more rich from the regions of 20-30 m. Higher biomass in higher depths of 15 to 30 m was reported (Kurian 1971). Parulekar et al. (1982) reported that areas around 30 m depth mainly supported high benthic production. Sediment composition is most important to the marine benthic organisms (Sanders 1958, Ingole et al. 1998) which provides shelter and food in the form of organic matter (Gray 1981). However, higher organic carbon is reported to cause a decline in species diversity, abundance and biomass, possibly due to the oxygen depletion and build up of toxic by-products such as ammonia and sulphide (Jørgensen 1977; Revsbech and Jørgensen 1986; Snelgrove and Butman 1994; Hyland 2005). Low diversity in shallow area can also be attributed to the depletion of oxygen by organic matter in the upwelling areas (Sanders 1968).

The density of polychaetes was generally less at high organic carbon area except few species (Fig. 4b) providing a possible indication that, high organic content adversely affect the polychaete abundance and distribution. Jayaraj et al. (2007) reported that benthos especially polychaetes were low in high organic matter (>3%) areas. Organic matter beyond 6% is noticed to be anoxic. Harkantra et al. (1982) reported that organic matter beyond 4% adversely affected the macrobenthic organisms. In conditions of high organic carbon, diversity of the polychaetes is expected to be low. Similarly, results from all the study site is observed to be true except Calicut which shows both high organic content (3 %) and comparatively higher abundance of polychaetes (2550 no.$m^{-2}$) with dominance of deposit feeders belonging to genus Prionospio, indicating that these species can withstand high organic carbon area and can be indicators of organically enriched area. Harkantra (1982) made a similar observation in which he stated that low and high value of organic content shows poor fauna and median values show rich fauna.

From the present study, Trivandrum in west coast has highest diversity index followed by Pondicherry and Nellore in east coast, indicating these areas to be ideal and environment is healthy for different species of polychaetes to thrive. This observation is also supported by the Shannon index (H’) and species richness (d) values which are in the range of 2.5-3.5. For healthy environment H’ and d are considered to be in the range of 2.5 to 3.5 (Magurran 1988). Along the remaining stations H’ and d values are below 2.5 signifying the unhealthy status of the prevailing environment. While, Karwar has the lowest value of H’ and d (0.37 and 0.1 respectively) supported by very low abundance of macrobenthos. On the other hand, members of the family Spionidae (*Prionospio* sp.) and Capitellidae (*Capitella capitata*) were widely distributed along the southwest coast and east coast respectively. While member of Eunicidae (*Diopatra neapolitana*) occurred in Mormugao and Trivandrum along the west coast and they were also found widely distributed along northern east coast (from Nellore to Kakinada). Jayaraj et al. (2008) also made a similar report on the high occurrence of *Prionospio* sp. from the south-west coast. The incidence of these species indicates these areas are organically polluted. Remani et al. (1983) reported two species belonging to the genus Prionospio (*P. polybranchiata* and *P. pinnata*) in the Cochin backwaters at a municipal discharge point and suggested that these deposit feeding polychaetes to be favored by the organic enrichment. It can be pointed out here that CCA biplot indicated Prionospio sp2 preffered higher organic carbon. Elias et al. (2005) also indicated *Prionospio* sp. as an indicator of organic enrichment in subtidal areas. *Capitella capitata* has been regarded as an excellent indicator of pollution or environmental disturbance (Eagle and Rees 1973; Halcrow et al. 1973; Grassel and Grassel 1974; Grassel and Grassel 1976). These observations suggest that the sampled area is organically enriched. Higher abundance of polychaete along the west coast can be attributed to loose texture of sediment due to high sand with higher interstitial space for polychaetes to harbor. Less abundance of polychaetes at high organic carbon areas is attributed to avoidance of these organisms to organic matter, being a possible indication that high organic matter adversely affects the abundance and distribution of macrobenthos.

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Table 1. Abundance of macrobenthic polychaete species in different stations.

| Species | Sps. code | Mormugao | Karwar | Mangalore | Cannanore | Calicut | Kochi | Trivandrum | Pondicherry | Chennai | Nellore | Nizamapatnam | Machilipatnam | Kakinada |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Prionospio pinnata* | PrioP | 700 | 175 | 200 | 750 | 650 | 750 | 125 | 50 | | | | | 75 |
| *Prionospio cirrifera* | PrioC | 25 | | | | | | 150 | 525 | | | | | |
| *Prionospio* sp.1 | PrioS1 | | | | 75 | 1175 | | 600 | | | 25 | 25 | | |
| *Prionospio* sp.2 | PrioS2 | | | | | 525 | | 50 | 175 | | | 25 | | |
| *Magelona cincta* | MagC | 150 | | 25 | | | 2900 | | | | 100 | 25 | 25 | 25 |
| *Magelona rosea* | MagR | | | | | 25 | 200 | | | | 25 | | | 25 |
| *Magelona* sp. | MagS | | | | | | | | | | | 50 | | |
| *Glycera alba* | GlyA | 325 | | 25 | | | 100 | 250 | | | 25 | | | |
| *Glycera longipinis* | GlyL | | | | | | | | | | 25 | | | 25 |
| *Glycera* sp. | GlyS | | | | 50 | 25 | | 175 | | | 25 | 50 | | |
| *Nephtys polybranchia* | NepP | 50 | 25 | | | | | 50 | | | | | | |
| *Nephtys capensis* | NepC | | | | | | | | 75 | | | | | 25 |
| *Nephtys* sp.1 | NepS | | | 50 | | | | 100 | 125 | | | | 25 | |
| *Nephtys* sp.2 | Nep2 | | | | | | | 50 | | | 75 | 50 | | |
| *Cirratulus cirratus* | CirrC | | | 25 | | | | 200 | | | | | | |
| *Cirratulus filiformis* | CirrF | | | | | | | 125 | 25 | | | | | |
| *Cirratulus* sp. | CirrS | | | | | 75 | | 25 | 25 | 25 | 25 | 25 | | 25 |
| *Ancistrosyllis constricta* | AncC | | | 100 | 150 | 50 | 150 | 25 | | | | | | |
| *Ancistrosyllis parva* | AncP | | | | | | | | 50 | | | | | |
| *Diopatra neopolitana* | DioN | 25 | | | | | | 25 | | | 50 | 200 | 25 | 175 |
| *Capitella capitata* | CapC | | | | 25 | | | 75 | 75 | | 100 | 50 | 100 | 25 |
| *Lumbriconereis notocirrata* | LumN | 75 | | | | | | | | | | | | |
| *Lumbriconereis latreilli* | LumL | | | | | | 75 | | 75 | | | | | 25 |
| *Lumbreneris aberrans* | LumA | | | | | | | | | | 25 | 25 | | 25 |
| *Lumbreneris* sp. | LumS | | | | | | | 25 | | 25 | 100 | | 25 | |
| *Orbinide* | Orb | | | | | | | 175 | 25 | | | | | |
| *Glycinde oligodon* | GlycinO | 150 | | | | | | | | | | | | 25 |
| *Paraonide* sp. | ParaoS | | | | | | 150 | | 25 | | | | | |
| *Aricidea assimilis* | AricA | 50 | | | | | | 100 | | | | | | |
| *Mediomastus capensis* | MedC | | | | | | | 25 | 25 | | | | 25 | 25 |
| *Mediomastus* sp. | MedS | | | | | | | | 25 | | | | | |
| *Amphiarete* sp. | AmphS | | | | | | | | 125 | | | | | |
| *Onuphis* sp. | OnuS | | | | | | | 50 | | | 25 | 25 | | |
| *Euclymene annandalei* | EuclA | | | | | | | | | | | | | 100 |

Table 1. Continued

| Species | Sps. code | Mormugao | Karwar | Mangalore | Cannanore | Calicut | Kochi | Trivandrum | Pondicherry | Chennai | Nellore | Nizamapatnam | Machlipatnam | Kakinada |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sternaspis scutata* | SterS | | | | | | 25 | | | 25 | | 25 | 25 | |
| *Syllis* sp. | SyllS | | | | | | | 50 | 25 | | 25 | | | |
| *Sabella* sp. | SabS | | | | | | 25 | 50 | | 25 | | | | |
| *Cossura coasta* | CosC | | | | | 25 | 50 | | | | | | | |
| *Maldane sarsi* | MaldS | | | 25 | | | | 25 | | 25 | | | | |
| *Polydora* sp. | PolyS. | 50 | | | | | 25 | | | | | | | |
| *Terebellide* sp. | TereS. | | | | | | | 25 | 25 | | | | | 25 |
| *Amphiglena mediterranea* | AmpM | | | | | | | | 50 | | | | | |
| *Dorvillea* sp. | DorS | | | | | | | | | | | | 50 | |
| *Hesione pantherina* | HesiP | | | 25 | | | | 25 | | | | | | |
| *Onuphis eremita* | OnuE | | | | | | | 50 | | | | | | |
| *Paralacydonia paradoxa* | PrlP | | | | | | | | 50 | | | | | |
| *Pectinaria neopolitana* | PectN | | | | | | | 25 | | | | | | |
| *Euphrasine myrtosa* | EuphrMr | | | | | | | | | | 25 | | | |
| *Heteromastus filiformis* | HetrF | | | 25 | | | | | | | | | | |
| *Notomastus aberans* | NotAb | | | | | | | | | | | | 25 | |
| *Ninoe* sp. | NinS | | | | | | | | | | | | 25 | |
| *Scoloplos* sp. | ScolS | 25 | | | | | | | | | | | | |
| *Phyllodoce malmgreni* | PhylM | | | | | | | 25 | | | | | | |
| *Goniada emerita* | GonEr | | | | | | | | | | | | | 25 |
| *Goniada incerta* | GonIn | | | | | | 25 | | | | | | | |
| *Harmethoe imbricata* | HarmIm | 25 | | | | | | | | | | | | |
| *Levensenia* sp. | LevS | | | | | | | | 25 | | | | | |
| *Sabellides* sp. | SabelS | | | | | | | | 25 | | | | | |
| *Pista* sp. | PistaS. | | | | | | | | | | 25 | | | |
| *Terebellide stroemi* | TerS | | | | | | | | | | 25 | | | |
| *Serpula* sp. | SerS | 25 | | | | | | | | | | | | |
| *Flabelligera* sp. | FlabS. | | | | | | | | | | 25 | | | |
| *Eurythoe* sp. | EuryS | | | | | | | | 25 | | | | | |
| **Total** | | 1675 | 200 | 500 | 1050 | 2550 | 4475 | 2675 | 1650 | 125 | 725 | 575 | 350 | 650 |

Table 2. Number of Species (S), number of specimens (N), Margalef species richness (d), Pielou's eveness (J'), Shannon index (H) of macrobenthic polychaetes along the west and east coast of India.

| Stations | S | N | d | J' | H'(loge) |
|---|---|---|---|---|---|
| Mormugao(W) | 13 | 1675 | 1.61 | 0.73 | 1.88 |
| Karwar | 2 | 200 | 0.18 | 0.54 | 0.37 |
| Mangalore | 9 | 500 | 1.28 | 0.82 | 1.81 |
| Cannanore | 5 | 1050 | 0.57 | 0.58 | 0.94 |
| Calicut | 8 | 2550 | 0.89 | 0.64 | 1.34 |
| Kochi | 12 | 4475 | 1.30 | 0.50 | 1.26 |
| Trivandrum | 28 | 2675 | 3.42 | 0.85 | 2.85 |
| Pondicherry(E) | 22 | 1650 | 2.8 | 0.82 | 2.53 |
| Chennai | 5 | 125 | 0.82 | 1 | 1.60 |
| Nellore | 18 | 750 | 2.56 | 0.93 | 2.69 |
| Nizamapatnam | 12 | 575 | 1.73 | 0.87 | 2.17 |
| Machlipatnam | 10 | 350 | 1.53 | 0.93 | 2.14 |
| Kakinada | 15 | 675 | 2.14 | 0.89 | 2.42 |

Table 3. Percentage composition of polychaetes and other groups of macrobenthos along the west and east coast of India

| Stations | Polychaete (%) | Other groups (%) |
|---|---|---|
| Mormugao | 50.38 | 49.62 |
| Karwar | 100 | 0 |
| Mangalore | 91.78 | 8.22 |
| Cannanore | 96.5 | 3.5 |
| Calicut | 95.31 | 4.69 |
| Kochi | 68.14 | 31.86 |
| Trivandrum | 28.46 | 71.54 |
| Pondicherry | 50.78 | 49.22 |
| Chennai | 59.01 | 40.99 |
| Nellore | 52.13 | 47.87 |
| Nizamapatnam | 58.7 | 41.3 |
| Machilipatnam | 44.19 | 55.81 |
| Kakinada | 43.88 | 56.12 |

**Captions for Figures:**

Fig.1 Map showing sampling stations along the Indian coast

Fig.2 Spatial variation in the sediment texture (percentage) along the coast

Fig.3 Spatial variation in organic carbon (percentage) along the coast

Fig.4 (a) Spatial variation in the abundance of macrobenthic polychaete along the coast.

Fig.4 (b) Canonical correspondence analysis (CCA) showing polychaete species abundance and their relationship to sediment characteristics.

Fig.5 (a) Distribution and abundance of species belonging to genus Prionospio along the coast

Fig.5 (b)Canonical correspondence analysis (CCA) showing dominant polychaete (Prionospio sp.) and their relationship to sediment characteristics.

Fig.6 Dendrogram for hierarchical clustering of macrobenthic polychaetes with Bray–Curtis similarity indices

Fig.7 (a) Abundance of other groups of macrobenthos reported from different stations along the coast
Fig.7 (b) Dendrogram for hierarchical clustering of other groups of macrobenthos with Bray–Curtis similarity indices

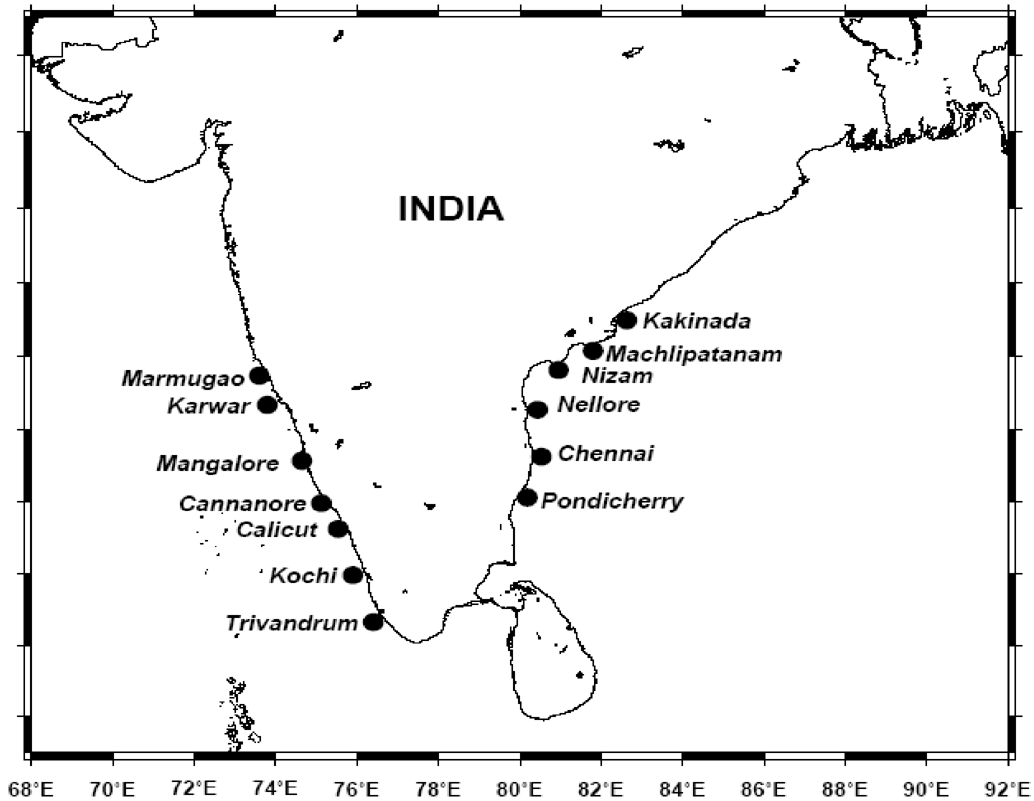

INDIA
Kakinada
Machlipatanam
Nizam
Nellore
Chennai
Pondicherry
Marmugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
24°N
22°N
20°N
18°N
16°N
14°N
12°N
10°N
8°N
6°N
68°E
70°E
72°E
74°E
76°E
78°E
80°E
82°E
84°E
86°E
88°E
90°E
92°E

Figure 1

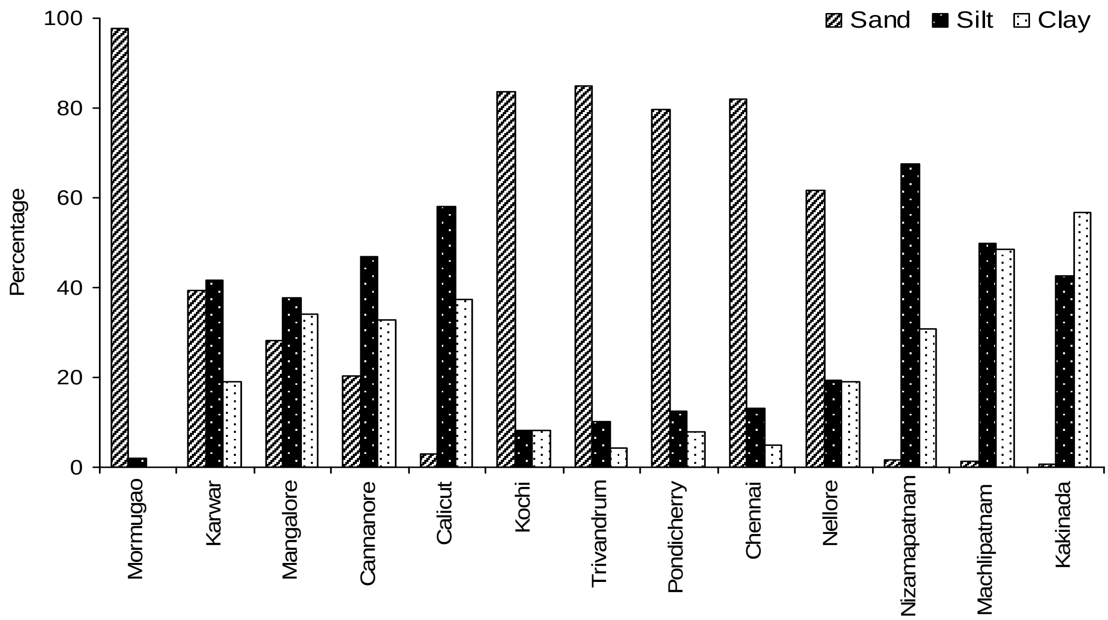

Sand
Silt
Clay
100
80
60
40
20
0
Percentage
Mormugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
Pondicherry
Chennai
Nellore
Nizamapatnam
Machlipatnam
Kakinada

Figure 2

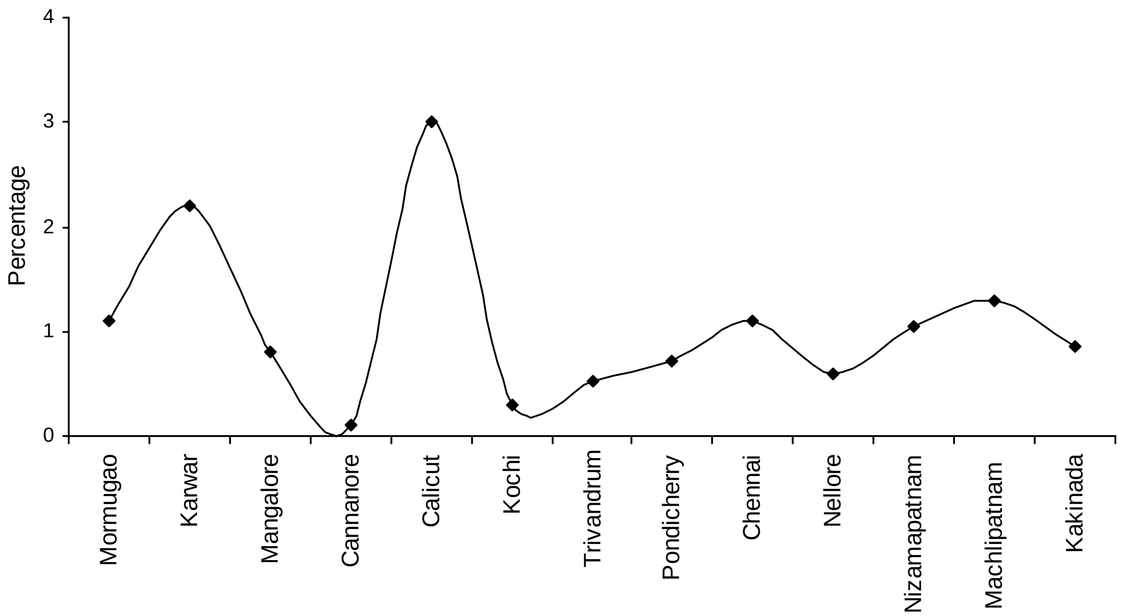
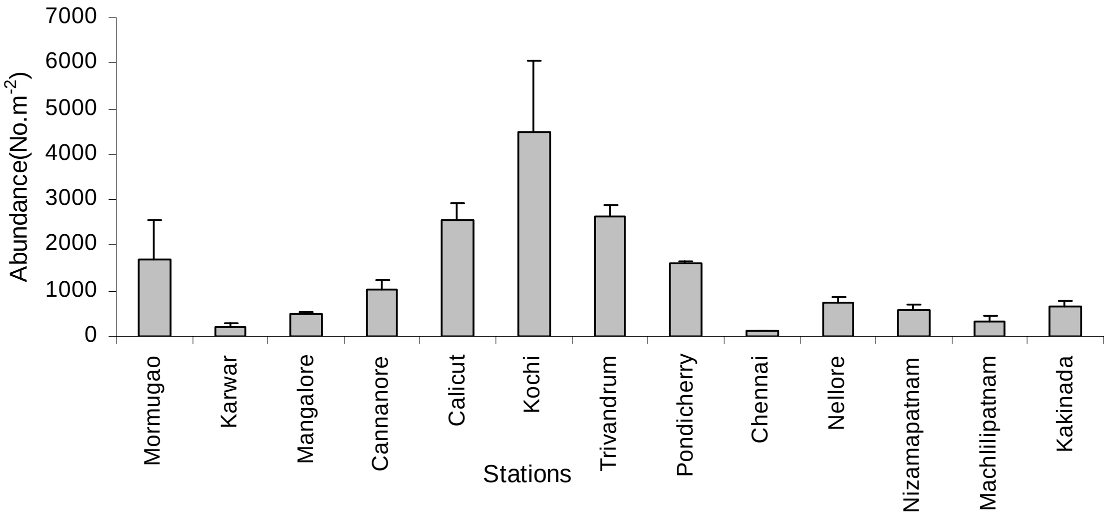

4
3
2
1
0
Percentage
Mormugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
Pondicherry
Chennai
Nellore
Nizamapatnam
Machlipatnam
Kakinada

Figure 3



7000
6000
5000
4000
3000
2000
1000
0
Abundance(No.m-2)
Mormugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
Pondicherry
Chennai
Nellore
Nizamapatnam
Machlilipatnam
Kakinada
Stations


Figure 4(a)

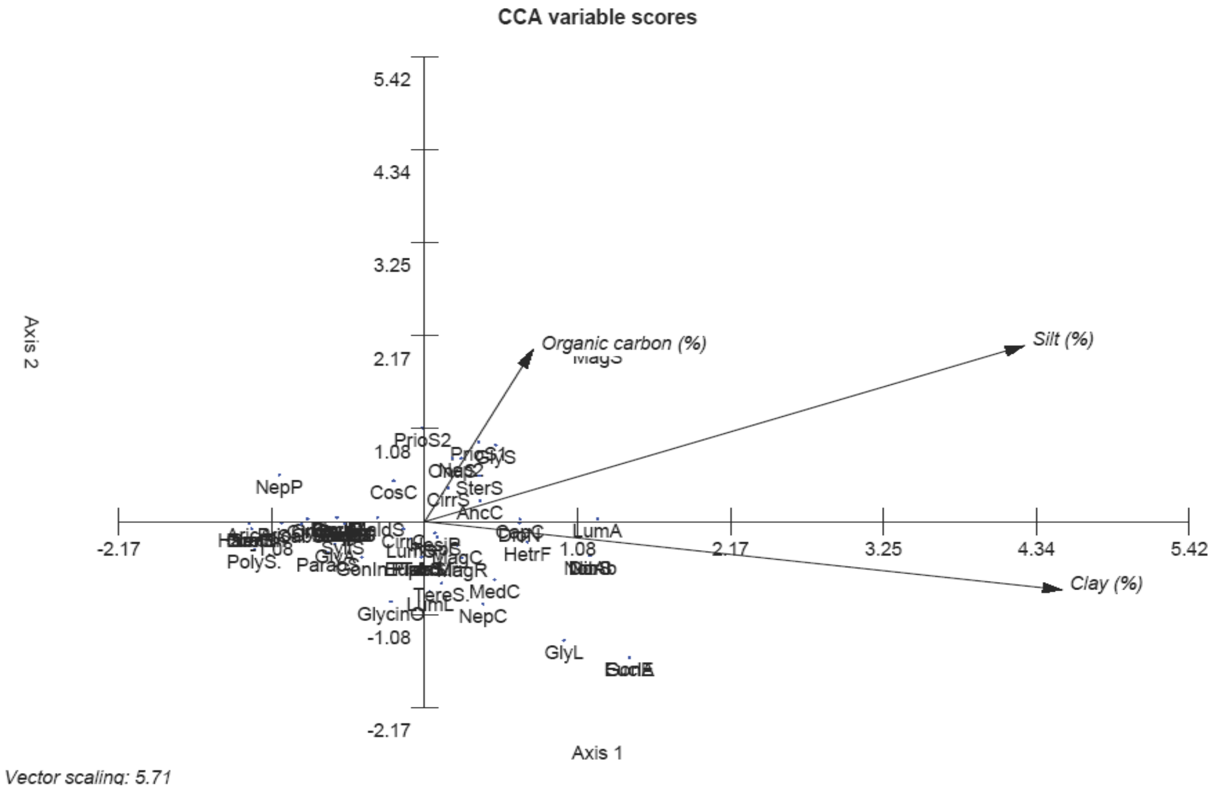
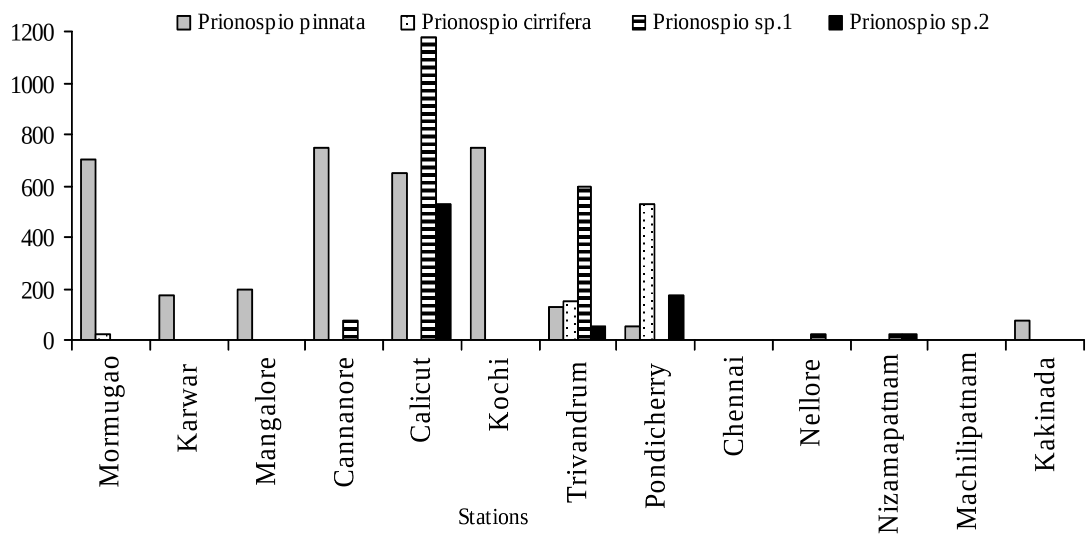

CCA variable scores
Axis 1
Axis 2
Organic carbon (%)
Silt (%)
Clay (%)
Vector scaling: 5.71
NepP
CosC
PrioS2
SterS
AncC
CirrS
LumA
HetrF
MagS
MedC
NepC
GlyL
GlycinO
PolyS.
TereS.
-2.17
1.08
2.17
3.25
4.34
5.42
-1.08

Figure 4(b)



Prionospio pinnata
Prionospio cirrifera
Prionospio sp.1
Prionospio sp.2
1200
1000
800
600
400
200
0
Mormugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
Pondicherry
Chennai
Nellore
Nizamapatnam
Machilipatnam
Kakinada
Stations


Figure 5(a)

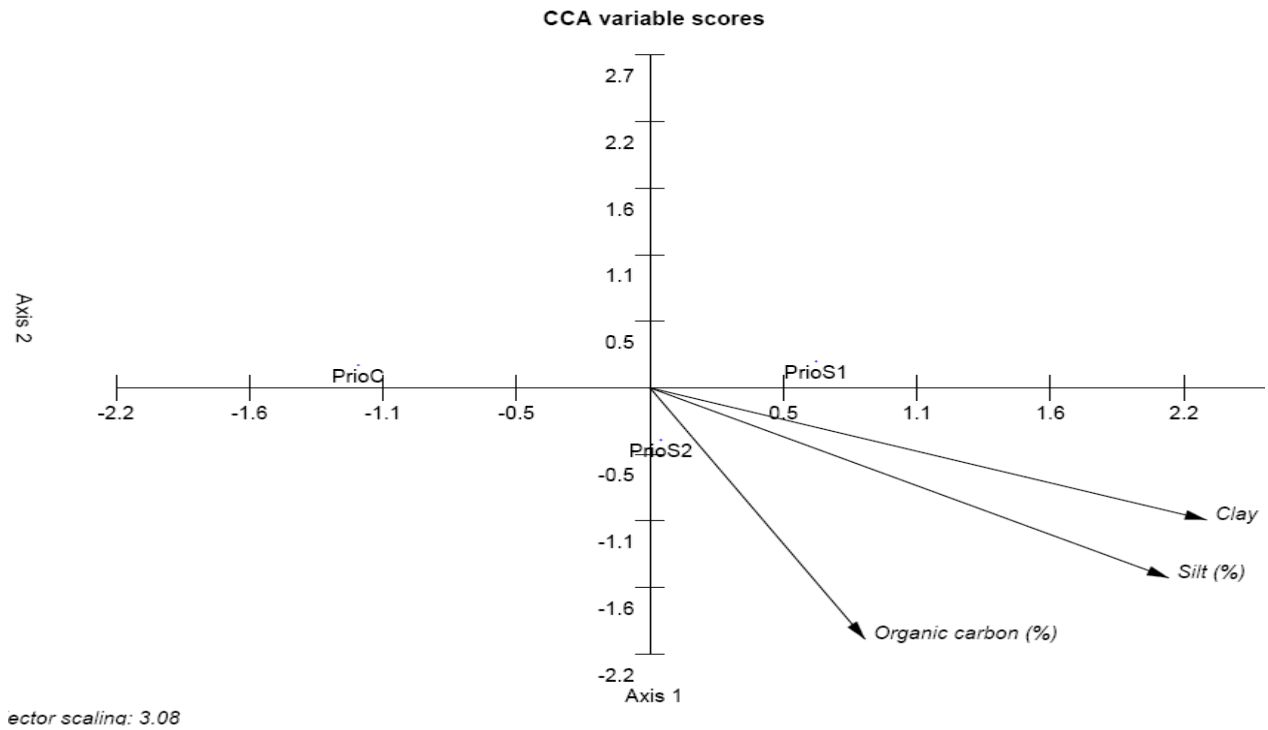

CCA variable scores
2.7
2.2
1.6
1.1
0.5
-0.5
-1.1
-1.6
-2.2
-2.2
-1.6
-1.1
-0.5
0.5
1.1
1.6
2.2
Axis 2
Axis 1
PrioC
PrioS1
PrioS2
Clay
Silt (%)
Organic carbon (%)
ector scaling: 3.08

Figure 5(b)

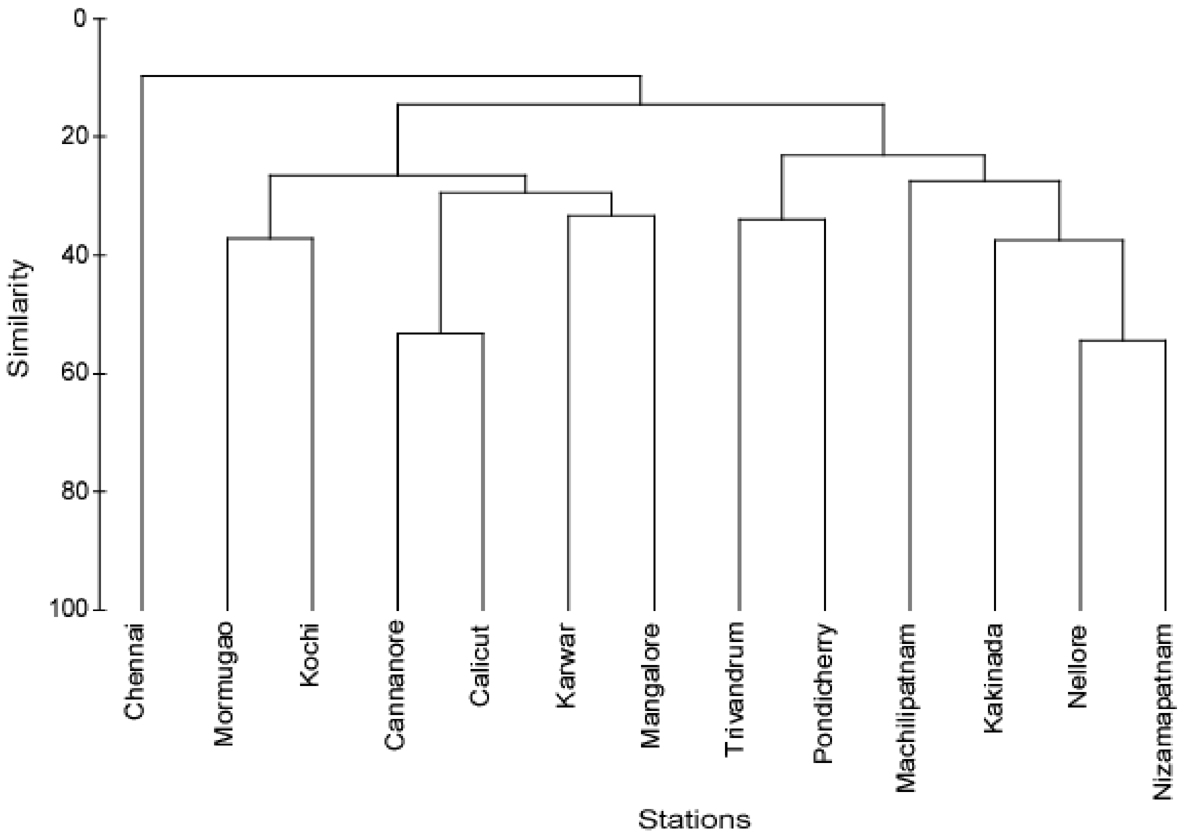
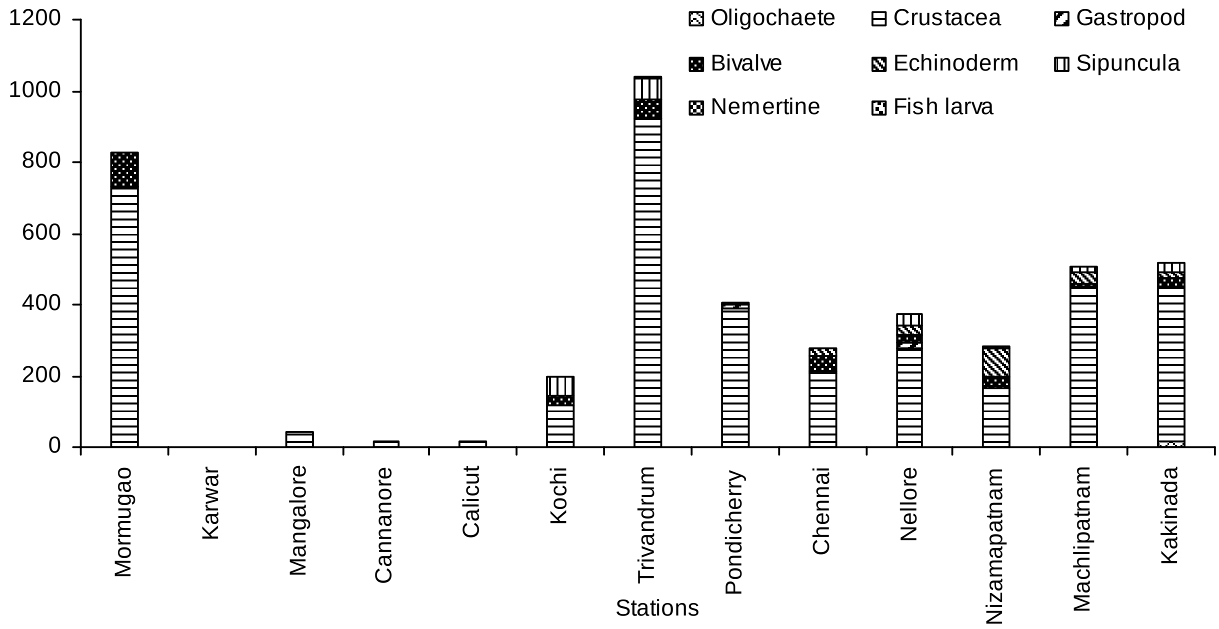

Similarity
0
20
40
60
80
100
Chennai
Mormugao
Kochi
Cannanore
Calicut
Karwar
Mangalore
Trivandrum
Pondicherry
Machilipatnam
Kakinada
Nellore
Nizamapatnam
Stations

Figure 6



1200
1000
800
600
400
200
0
Oligochaete
Crustacea
Gastropod
Bivalve
Echinoderm
Sipuncula
Nemertine
Fish larva
Mormugao
Karwar
Mangalore
Cannanore
Calicut
Kochi
Trivandrum
Pondicherry
Chennai
Nellore
Nizamapatnam
Machlipatnam
Kakinada
Stations


Figure 7(a)

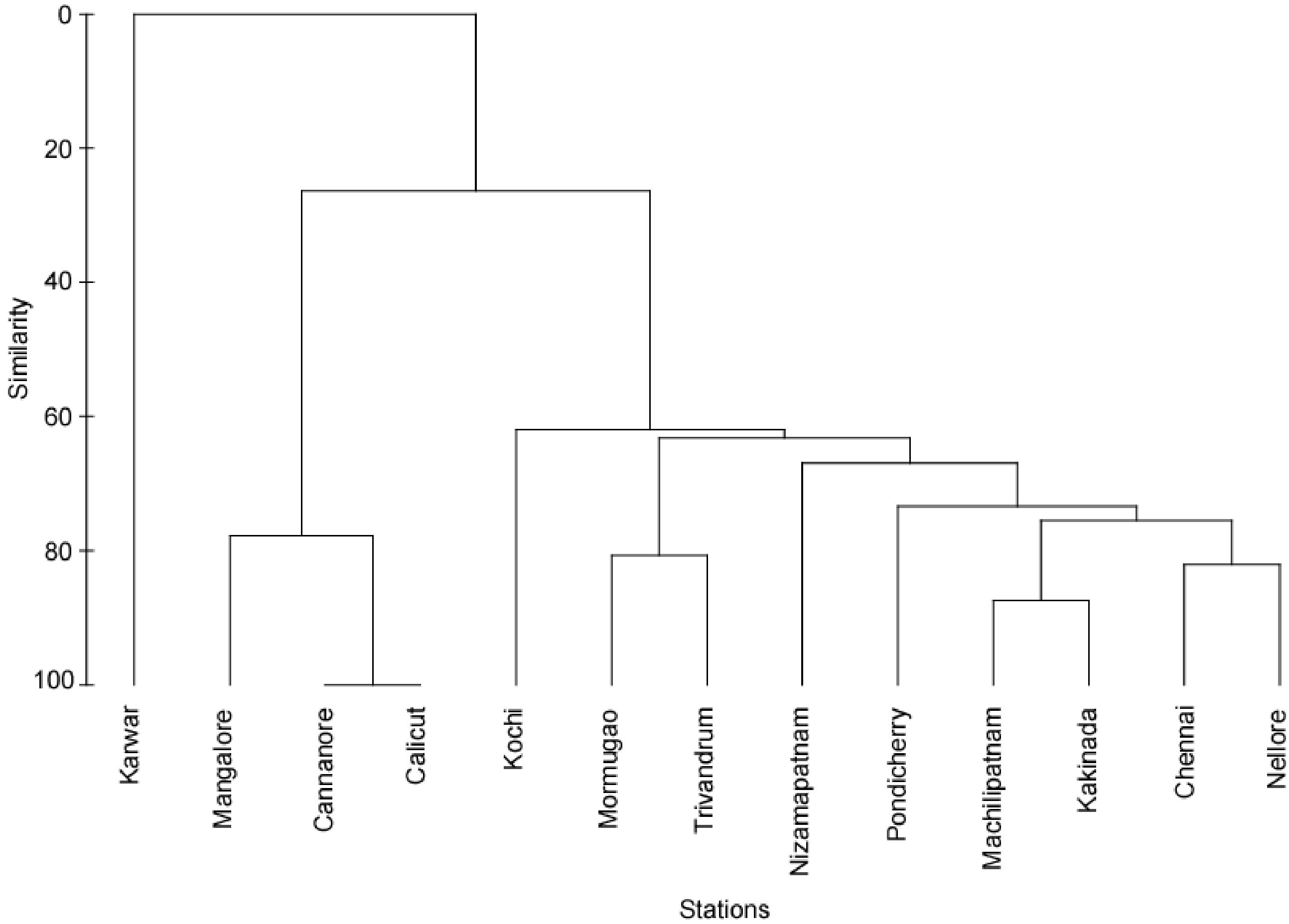

0
20
40
60
80
100
Similarity
Karwar
Mangalore
Cannanore
Calicut
Kochi
Mormugao
Trivandrum
Nizamapatnam
Pondicherry
Machilipatnam
Kakinada
Chennai
Nellore
Stations

Figure 7(b)