CHAPTER-4

DISTRIBUTION OF BENTHOS
Benthos, like all other organisms, are seldom distributed uniformly and even relatively homogenous areas of sediment can contain dispersed patches of fauna. Dispersion is an act in both life and generation cycles of benthos, which bring out the essence in the meaning of ecology. The act of dispersion displays the urge of organisms to settle in favourable habitats. Practically, the stimulus initiating the act of dispersion can be variation in salinity, oxygen level, sediment organic carbon, sediment texture, temperature etc.

Unlike the three dimensional pelagic habitat of plankton, benthic organisms are adapted for an association with a two-dimensional habitat or substrate, superficially more analogous to that of the land. While a planktonic existence requires a small size and a specific gravity close to that of the seawater, benthic life allows a free variety of size, shape and density. Calcareous shells, elongated, stalked and branched body forms and the development of appendages like cilia and bristles and body musculature, which enable movement over, into and through the sediment, are characteristic of benthic organisms (Bhat, 1984).

Benthic production is known to be vital trophic linkage in the coastal waters. The important feature of production by all sorts of benthic organisms from micro to macrofauna is the reactivation of matter, which rains over the bottom of the sea in the form inassimilable for most pelagic animals. The detritus, fecal pellets and decaying parts of plants and animals are those forms of matters, which yield nutrition to the benthic biota. In a normal benthic food chain, the organic matter is colonized by
microorganisms, which are grazed by meiobenthos, which in turn are preyed over by the macrobenthos, which form food for the fishes and crustaceans.

A few years ago, the study of benthos was primarily the province of basic research and emphasis was laid on satisfying the scientific curiosity as to life history studies on non-commercial bottom animals, their physiology, composition and abundance. But in the recent past, the trophic and environmental importance has made the benthic faunal ecology, an interesting topic of research.


The foraminifera are comparatively large protozoa, living almost in the sea. The majority lives in ocean bottom, moving about sluggishly over the mud and ooze on the ocean floor. The majority measures less than one millimeter, although larger forms may frequently reach several millimeters (Kudo, 1986).

Kumar and Manivannan (2000), studied benthos in the Palk Bay and reported that the occurrence of benthic species is controlled to an extent by physical factors, viz., depth, temperature, amount of light, turbidity of the water; chemical factors of water, viz., salinity, dissolved oxygen and available elements; biological factors, viz., available food supply and characters of the bottom sediments. Similar observations were reported earlier by Walton (1964), Rao & Rao (1979), Naidu et al. (1984), Nigam (1987), Nigam & Theide (1983) and Khare et al. (1995).
List of meiobenthos encountered during the study period.

**Taxa**

1. Foraminifera
2. Diatom
3. Coelenterata
4. Nematoda
5. Polychaeta
6. Copepoda

List of macrobenthos encountered during the study period.

**Taxa**

1. Coelenterata
2. Nematoda
3. Polychaeta
4. Decapoda
5. Gastropoda
6. Bivalvia
7. Pisces

Density of meiobenthos (No/10 cm²) and macrobenthos (No/m²) at the study stations:

The density of each benthic group at five study stations is depicted in tables 21 to 30 and figures 31 to 40.

**Station-1:**

At this station, the meiobenthos (tables 21a and 21b; figures 31a and 31b) were dominated by nematodes followed by polychaetes and foraminiferans. The members of foraminifera fluctuated between 2 No/10 cm² (Oct. 2001) and 114 No/10 cm² (Apr. 2001); diatom, 1 No/10 cm² (Oct. 2001) and 76 No/10 cm² (Apr. 2001);
coelenterata, 1 No/10 cm² (Jun. 2001) and 38 No/10 cm² (Apr. 2001); nematoda, 9 No/10 cm² (Sep. 2001) and 417 No/10 cm² (Apr. 2001); polychaeta, 4 No/10 cm² (Sep. 2001) and 360 No/10 cm² (Apr. 2001) and copepoda, 1 No/10 cm² (Jul. 2001) and 57 No/10 cm² (Apr. 2001).

Macrobenthos exhibited the dominance of polychaetes followed by nematodes and bivalves (tables 22a and 22b; figures 32a and 32b). The densities of macrobenthos (No/m²) at this station are as follows. Coelenterata, 3 No/m² (Sep. 2001) and 73 No/m² (Dec. 2000); nematoda, 17 No/m² (Sep. 2001) and 559 No/m² (Feb. 2001); polychaeta, 65 No/m² (Sep. 2001) and 1541 No/m² (Jan. 2001); decapoda, 4 No/m² (Aug. 2001) and 81 No/m² (Jan. 2001); gastropoda, 7 No/m² (Aug. 2001) and 175 No/m² (Jan. 2002); bivalvia, 14 No/m² (Sep. 2001) and 291 No/m² (Jan. 2002) and pisces, 4 No/m² (Aug. 2001) and 33 No/m² (Oct. 2000).

Station-2:

The density of meiobenthic fauna is as follows (tables 23a and 23b; figures 33a and 33b). Foraminifera varied between 3 No/10 cm² (Sep. 2001) and 164 No/10 cm² (Apr. 2001); diatom, 2 No/10 cm² (Sep. 2001) and 159 No/10 cm² (May 2001); coelenterata, 1 No/10 cm² (Sep. 2001) and 48 No/10 cm² (Dec. 2000); nematoda, 12 No/10 cm² (Sep. 2001) and 491 No/10 cm² (Apr. 2001); polychaeta, 2 No/10 cm² (Sep. 2001) and 418 No/10 cm² (Apr. 2001); copepoda, 1 No/10 cm² (Aug. 2001) and 41 No/10 cm² (Apr. 2001).

Macrobenthos, showed the dominance of polychaetes at this station also (tables 24a and 24b; figures 34a and 34b). The densities of various groups of macrobenthos are as follows. Coelenterata, 4 No/m² (Sep. 2001) and 262 No/m² (Dec.
nematoda, 25 No/m² (Aug. 2001) and 582 No/m² (Dec. 2001); polychaeta, 95 No/m² (Sep. 2001) and 1663 No/m² (Jan. 2002); decapoda, 5 No/m² (Aug. 2001) and 118 No/m² (Jan. 2001); gastropoda, 4 No/m² (Sep. 2001) and 125 No/m² (Dec. 2001); bivalvia, 17 No/m² (Sep. 2001) and 293 No/m² (Feb. 2001); pisces, 2 No/m² (Sep. 2001) and 59 No/m² (Jan. 2001).

**Station-3:**

At this station, once again the meiobenthos community was dominated by nematodes (tables 25a and 25b; figures 35a and 35b). The ranges of density of the different groups of meiobenthos are as follows. Foraminifera, 2 No/10 cm² (Jul. 2001) to 64 No/10 cm² (Feb. 2001); diatom, 1 No/10 cm² (Jul. 2001) to 67 No/10 cm² (Jan. 2002); coelenterata, 1 No/10 cm² (Aug. 2001) to 17 No/10 cm² (May 2001); nematoda, 9 No/10 cm² (Aug. 2001) to 339 No/10 cm² (Apr. 2001); polychaeta, 4 No/10 cm² (Aug. 2001) to 160 No/10 cm² (Apr. 2001); copepoda, 1 No/10 cm² (Jul. 2001) to 40 No/10 cm² (Apr. 2001).

Polychaetes were abundant among macrobenthos as in earlier stations (tables 26a and 26b; figures 36a and 36b). The densities of the macrobenthic groups are as follows. Coelenterata, 5 No/m² (Sep. 2001) and 155 No/m² (Dec. 2000); nematoda, 26 No/m² (Aug. 2001) and 530 No/m² (Jan. 2001); polychaeta, 72 No/m² (Aug. 2001) and 1078 No/m² (Jan. 2002); decapoda, 7 No/m² (Jul. 2001) and 120 No/m² (Jan. 2002); gastropoda, 5 No/m² (Sep. 2001) and 123 No/m² (May 2001); bivalvia, 10 No/m² (Sep. 2001) and 246 No/m² (May 2001) and pisces, 7 No/m² (Aug. 2001) and 59 No/m² (Oct. 2000).
Station-4:

The trend of distribution of meio and macrobenthos at this station did not vary much from those at the earlier stations. The density of these two types of benthos showed the minimum values during the monsoon period and recolonisation of the benthic communities during post-monsoon and pre-monsoon was observed by the greater values of benthos density.

The density values of meiobenthos are as follows (tables 27a and 27b; figures 37a and 37b). Foraminifera fluctuated between 2 No/10 cm² (Sep. 2001) and 49 No/10 cm² (Apr. 2001); diatom, 1 No/10 cm² (Sep. 2001) and 34 No/10 cm² (Jan. 2002); coelenterata, 1 No/10 cm² (Aug. 2001) and 18 No/10 cm² (May 2001); nematoda, 8 No/10 cm² (Sep. 2001) and 501 No/10 cm² (Apr. 2001); polychaeta, 5 No/10 cm² (Sep. 2001) and 185 No/10 cm² (May 2001); copepoda, 1 No/10 cm² (Oct. 2001) and 35 No/10 cm² (May 2001).

The density values of macrobenthos are as follows (tables 28a and 28b; figures 38a and 38b). Coelenterata ranged from 6 No/m² (Aug. 2001) to 170 No/m² (Dec. 2000); nematoda, 25 No/m² (Aug. 2001) to 616 No/m² (Mar. 2001); polychaeta, 83 No/m² (Aug. 2001) to 1204 No/m² (Jan. 2002); decapoda, 6 No/m² (Aug. 2001) to 48 No/m² (Nov. 2000); gastropoda, 7 No/m² (Jul. 2001) to 265 No/m² (Jan. 2001); bivalvia, 13 No/m² (Jul. 2001) to 294 No/m² (May 2001) and pisces, 7 No/m² (Jul. 2001) to 96 No/m² (Nov. 2000).

Station-5:

The density values of meiobenthos are as follows (tables 29a and 29b; figures 39a and 39b). Foraminifera varied between 3 No/10 cm² (Jul. 2001) and 64 No/10
cm² (Apr. 2001); diatom, 1 No/10 cm² (Sep. 2001) and 47 No/10 cm² (Dec. 2000); coelenterata, 1 No/10 cm² (Aug. 2001) and 43 No/10 cm² (Apr. 2001); nematoda, 12 No/10 cm² (Sep. 2001) and 330 No/10 cm² (Apr. 2001); polychaeta, 4 No/10 cm² (Sep. 2001) and 170 No/10 cm² (Apr. 2001) and copepoda, 2 No/10 cm² (Oct. 2001) and 32 No/10 cm² (Apr. 2001).


Discussion:

The month wise density of meio and macrobenthic taxa is given in tables 21 to 30 and figures 31 to 40. The trend of distribution of benthos in different study stations during the study period remained almost same. Every group of meio and macrobenthos fluctuated in different seasons in a similar pattern at all the study stations, indicating the uniformity in the environment of the fishing grounds and the combined effect of the ecological parameters on the life of meio and macrobenthos.

Sudarshana (1983) recorded bimodal distribution of benthos in Karwar waters and reported that the sedentary life of benthic organisms permit a variety of size, shape, biomass and density. Unlike the moving stocks of the world ocean, benthos have evolved methods and ecological adjustments to remain, colonize and reproduce on the part of the seabed where their larvae get settled. The permeability for radiation over a wide space for benthos is not as practicable as for the plankton or nekton due to the restraints posed by living styles. Dispersion seems to be solely conducted by larval wandering though the movement of adult forms is not entirely insignificant. This characteristic substrate affinity of benthos results in the large variations of density and biomass in response to the seasonal changes in the environment.

In the present study, both meio and macrobenthos showed bimodal distribution, i.e., in pre and post-monsoon, higher density and during monsoon, the density recorded was less. The density of meiobenthos recorded was maximum during post-monsoon season where as that of macrobenthos was maximum during pre-monsoon season.

The meiobenthos at all the study stations were found in more number during post-monsoon period, especially in December and January. Pre-monsoon season showed lesser number of meiobenthic groups, when compared with the density of meiobenthos during post-monsoon season. During monsoon season, the density of meiobenthos was found to be gradually declining from June to September.

This pattern can be considered as bimodal distribution of the meiobenthos, i.e., lower values of density during monsoon season and considerably higher values during pre and post-monsoon periods. This pattern of variation in the distribution of the
meiobenthos may be due to the unfavourable conditions during monsoon season and recolonization of the benthic assemblage soon after monsoon as the benthos get comfortable environment like relatively balanced ecological factors. Bhat (1984) observed similar trend in variations of benthic density. Benthic studies on the west coast of India are by Neyman (1969), Parulekar et al (1976), Ansari et al (1977) and Kuttiamma (1980).

The meiobenthic taxa, which were present almost throughout the year, were foraminifera, diatom, nematoda, polychaeta and copepoda. Meiobenthic coelenterates were less in number when compared with the other groups and were absent in a few months of the different seasons during the study period. The rare occurrence of coelenterates may be due to inability to withstand the extreme environmental conditions and fluctuations in the different environmental parameters. Rajiv (1987) studied the distribution, factor analysis and ecology of benthic foraminifera within inner shelf regime of Vengurla-Bhatkal sector along west coast of India and concluded that a general hyposaline environment prevails in the study area and geographical distribution of well-known hyposalinal species can be used to study the spread of brackish water along the coastal area.

The group nematoda dominated in the density of meiobenthos, followed by polychaeta. Members of foraminifera and diatoms though occupied the place after nematoda and polychaeta, were found in considerable number. The groups, which made their appearance almost throughout the study period, were copepods and coelenterates. Tietjen (1980) studied the population structure and species composition of the free-living nematodes inhabiting the sands of the New York Bight Apex.
Ansari (1978), observed the same pattern in the distribution of meiobenthos while studying the meiobenthos from the Karwar region. Observations of similar pattern were made by Sudarshana (1983). He reported that nematoda exhibited an absolute dominance by number and were found to occur in all the stations and also in all the replicate samples throughout the period of study. The stress of southwest monsoon season reduced the number of nematodes. However, he did not find much polychaetes in meiobenthos study samples and found that foraminifera and diatoms were considerable in number. He observed harpacticoid copepods in more numbers among copepods. Elmgren (1978) studied the structure and dynamics of Baltic proper. Ansari & Parulekar (1981) studied the meiofauna of the Andaman Sea.

Bhat (1984) found that coelenterates were least in density list of meiobenthos. According to his observations, nematodes occupied first position among meiobenthos, copepods being second, foraminifera in third place and so on.

Among macrobenthic taxa, the pattern of distribution of different groups did not vary much. In each of the stations, the density of macrobenthos exhibited similar trend in different seasons. Once again, like the meiobenthos, the macrobenthic fauna too showed reduced numbers during the onset of southwest monsoon. Pre and post-monsoon periods might have provided encouraging surroundings for the recolonization and stabilization of these taxa, so that their number gradually increased after the southwest monsoon season. The density of macrobenthos was relatively more in post-monsoon season.
The dominating group among macrobenthos was polychaeta, followed by nematoda. It appeared as though it was just an interchange of their places within macrobenthic list compared to meiobenthos.

Tietjen (1969) studied estuarine meiofauna and there are many literature on estuarine macrofauna (Warwick, 1975; Young & Young, 1978 and Larsen, 1979), Sudarshana (1983), in his studies on the community ecology of macro and meiobenthos in Karwar bay, found that among macrobenthos, polychaetes showed an absolute dominance over all the other taxa. However, he reported that except polychaetes, other macrobenthic communities were more or less equally represented in stations. Harkantra et al (1982) studied macrobenthos of the shelf off northeastern Bay of Bengal. Harkantra & Parulekar (1987) studied macrobenthos off Cochin and reported that macrobenthos mainly composed of polychaeta, crustacea, mollusca, sipuncula, nemertinea and echinodermata.

After these two major groups seen at the top of the list, bivalves seemed to be the next abundant taxa as their number was considerably high. Gastropoda was the next group to follow. Decapods though found in good number at all stations and occupied the place after the gastropods in density, were absent in few months of different seasons, especially in last three stations. This kind of disturbance in the distribution of decapods may be due to the combined effect of unfavourable conditions and excessive trawling, which imposed pressure on sensitive decapods resulting in disappearance of this group.

Coelenterates and pisces were the last two groups in the density of the macrobenthos. The overall observation of the density values of the coelenterata and
pisces showed that the coelenterates were dominating over pisces in density, in most of the months of different seasons at various study stations. Coelenterates were not present in some of the months of the study period and also in first station, this group was not as regularly seen as in other stations. Pisces, in some of the months, outnumbered the coelenterates. Pisces did not appear regularly throughout the study period. But, when made their appearance, they were found in considerable numbers.

Irregularities in occurrence of pisces were found to be common in all the study stations. The fourth station showed slightly more number of the pisces than other stations. The late monsoon period and also the initial months of the post-monsoon season were found to be favourable for the pisces as they were found in good numbers during these periods.

Shetty (1989), in his studies on the ecological aspects of domestic sewage disoposal on the intertidal macrobenthos of Karwar, also found the dominant group among macrobenthos to be polycahetes followed by other groups.

This varied distribution of various groups of macro and meiobenthos at the fishing grounds as clearly represented in the tables and figures, show that different groups of taxa of benthos have different types of responses to their immediate environment. It can be deduced from the above observations that depending on the nature of the ecological parameters and changes in the environment during different seasons and artificial changes induced by human activities, the occurrence and distribution of the benthic community also varies as also has been observed by Bhat (1984).
Table 21a. Monthly variation in meiofenthos density (No/10 Cm²) at station-1.

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Table 21b.

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Table 22a. Monthly variation in macrobenthos density (No/m²) at station-1.

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Table 22b.

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Table 23a. Monthly variation in meiobenthos density (No/10 Cm²) at station-2.

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Table 29a. Monthly variation in meiobenthos density (No/10 Cm²) at station-5.

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Table 30a. Monthly variation in macrobenthos density (No/m$^2$) at station-5.

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Fig. 31a. Monthly variation in meio-benthos density at station-1

Fig. 31b.
Fig. 32a. Monthly variation in macrobenthos density at station-1

![Graph showing monthly variation in macrobenthos density at station-1]

Fig. 32b.

![Graph showing monthly variation in macrobenthos density at station-2]
Fig. 33a. Monthly variation in meiobenthos density at station-2

Fig. 33b.
Fig. 34a. Monthly variation in macrobenthos density at station-2

Fig. 34b
Fig. 35a. Monthly variation in meiobenthos density at station-3

Fig. 35b.
Fig. 36a. Monthly variation in macrobenthos density at station-3

Fig. 36b
Fig. 37a. Monthly variation in meiobenthos density at station-4

Fig. 37b.
Fig. 38a. Monthly variation in macrobenthos density at station-4

Fig. 38b
Fig. 39a. Monthly variation in meiobenthos density at station-5

Fig. 39b
Fig. 40a. Monthly variation in macrobenthos density at station-5

Fig. 40b