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Macrobenthic Composition and Diversity in the Coastal Waters of Mangalore, South-West Coast of India

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Abstract The present study was carried out over a period of 8 months from Oct 2012 to May 2013 at monthly intervals. Three stations were selected along Chitrapur, Mangaluru at 3 different depth contours viz., 4m (St 1), 8m (St 2) and 12m (St 3) where the industries, Boulique Aniline Soda Factory (BASF) and Mangalore Refineries and Petro Chemical Limited (MRPL) discharge their effluents. The macrobenthic density ranged between 255 to 1,83,680 nos/m^2. The highest density was recorded in Nov (St 3) while the lowest was recorded in Feb (St 2). It is observed that the macrobenthic population increased with increased depth and St 3 (12m) had highest number of macrobenthos as it is located away from the discharge point. The macrobenthic composition were represented by 7 groups namely Molluscs, Echinodermata, Polychaetes, Echiuroids, Sipunculids, Coelenterates and Miscellaneous in order of their abundance. In general the species diversity, evenness and richness ranged from 1.04 to 2.97, 0.75 to 0.93 and 0.68 to 2.08 respectively. The species diversity, evenness and richness were high at St 1 compared to St 2 and 3. Seasonally higher species diversity, evenness and richness were recorded during pre-monsoon season compared to post-monsoon months. The present area of study can be classified as moderately polluted as the diversity indices were between 1 and 3 which indicates moderate pollution.

Keywords Macrobenthos, Diversity, Abundance, Mangalore, South-west coast.

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Introduction

The coastal waters are extensively used for exploitation of marine resources and also for disposal of domestic sewage and industrial effluents causing greater environmental stress (Mohan et al. 2004). In view of increased urbanization and industrialization along the coastal waters of Dakshina Kannada district, Karnataka, west coast of India, an intensive coastal water monitoring program was initiated to recognize the impact on coastal water ecosystem due to the above two activities. Macrobenthic community plays an important role in aquatic ecosystems as primary and secondary consumers (Seyed et al. 2010). Scientific studies on benthic fauna are indispensable for proper understanding and management of any aquatic system, as they from an important link in the food chain at different trophic levels in an ecosystem. Macrobenthic community analysis is a part of international standards for the assessment of marine habitat quality, such as the European Union Water Frame Work Directive (Rosenberg et al. 2004). Among the three major communities of marine environment, the studies of benthic communities are found to be the

Fig. 1. Map showing the location of sampling station.

indicators of pollution (Anbuchezhian et al. 2009, Ramkumar et al. 2010). Hence the present study was carried out to recognize the impact of treated effluents on benthic communities in the coastal waters off Mangalore.

Materials and Methods

In the present investigation, 3 stations were selected along Chitrapur, Mangaluru at 3 different depth contours viz., 4m, 8m and 12m (Fig. 1) and were designated as St 1, 2 and 3 respectively. 2 industries, Boulique Aniline Soda Factory (BASF) and Mangalore Refineries and Petro Chemical Limited (MRPL)discharge their effluents in this area. The present study was carried out over a period of 8 months from Oct 2012 to May 2013 at monthly intervals during the cruises of the fishing vessel M.F.V.

Dolphin of the College of Fisheries, Mangaluru. It was possible to conduct the study only for 8 months because the other 4 months of the year (June-Sept) experienced heavy rainfall due to south west monsoon and during this period fishing and other activities in the sea are banned.

Standard thermometer and pH meter (WTW pH 320) were used to measure the temperature of the water and pH respectively. Dissolved oxygen, salinity and ammonia were estimated following standard methods (APHA 1995). Sediment samples were collected using Peterson grab with a mouth area of 0.1 m^2. The sediment sample was passed through a sieve of 0.5 mm mesh size to collect macrobenthos.Numerical estimation of benthos was carried out and fauna were identified up to generic level and presented as No. m^{-2}. Diversity indices such as species richness (d) and evenness (J^T) were calculated (shanon and weaver 1949 and Pielou 1975).

Results and Discussion

Environmental parameters

One of the main goals to study the benthic ecology has been to understand the mechanisms regulating the relationships between physico-chemical parameters and organisms (Aller et al. 2001). The surface water temperature varied from 29.43 to 32.37 ^{0}C. It is evident from the data that the surface water temperature was lowest during Jan and reached a maximum in the month of March. Salinity of surface waters fluctuated from 29.27 to 33.13 ppt. The lower salinity recorded during October could be due to the influence of south west monsoon while higher values recorded in the month of April and May could be due to the greater evaporation during the peak summer season. The dissolved oxygen content of the surface waters fluctuated from 3.19 to 7.61 mg/l with an annual variation of 4.42 mg/l. The ammonia values fluctuated between 1.7 and 12.91 µg-at/l.

Macrobenthos

Faunal composition

The macrobenthic composition were represented by 7 groups namely Echiuroids, Sipunculids, Polychaetes, Coelenterates, Molluscs, Echinodermata and Miscellaneous (Table 1). In station 1 (4 m) mollusks were found to be the dominant group. 13 species of mollusks were identified under this group and the unidentified ones were grouped under other mollusks. Among these, bivalve spats contributed to 50.42% followed by *Arca* (7.63%) and *Donax* (4.27%). Echinodermata emerged as the second largest group where the egg cases of echinoderms contributed to 20.93%. Polychaetes ranked third contributing to 6.5% followed by Echiuroids (0.23%), Sipunculids (0.17%), Miscellaneous (0.12%) and Coelenterates (0.03%).

Table 1. Percentage composition of different groups of macrobenthos at different stations.

Groups/Species	Stations		
	1	2	3
Echiuroids	0.23	0.05	0.00
Sipunculids	0.17	0.09	0.07
Polychaetes	6.50	1.58	0.40
Coelenterates	0.03	0.37	0.06
Molluscs			
Arca	7.63	0.85	0.37
Babylion	0.00	0.00	0.28
Bivalve Spats	50.42	81.83	57.98
Cardium	0.00	0.27`	0.06
Cavolinia	0.17	0.00	0.00
Cerithedia	2.32	1.50	5.72
Dentalium	0.44	4.63	15.06
Donax	4.27	1.14	1.32
Meritrix	1.63	4.17	3.01
Oliva	0.15	0.00	0.02
Patella	0.20	0.07	0.00
Surcula	0.41	0.20	1.61
Turitella	0.26	0.53	0.41
Umbonium	2.84	1.62	13.03
Other Molluscs	0.00	0.03	0.01
Echinodermata			
Astropecten	0.29	0.02	0.00
Ophiocoma	1.02	0.36	0.33
Egg Cases	20.93	0.61	0.18
Miscellaneous			
Crab	0.09	0.02	0.10
Shrimp	0.00	0.02	0.00
Fish	0.03	0.03	0.00

In station 2 (8 m) mollusks again formed the domi-

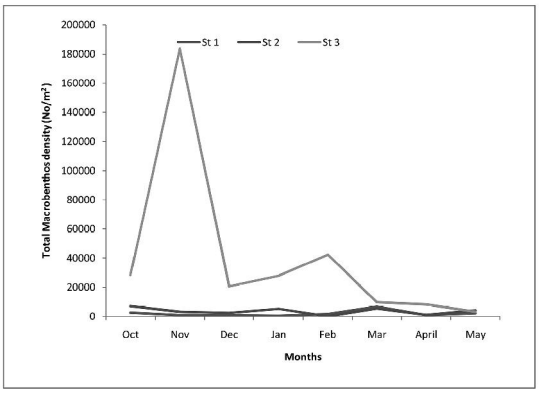

Fig. 2. Population density of macrobenthos at different stations.

nant group with bivalve spats forming 81.83% followed by *Dentalium* (4.63%) and *Meritrix* (4.17%). Poly-chaetes formed the second largest group contributing to 1.58% followed by Echinodermata (0.99%), Coelenterates (0.37%), Sipunculids (0.09%), Miscellaneous (0.07%) and Echiuroids (0.05%).

Even in station 3 (12 m) mollusks formed the major group. Spats of bivalves were abundant forming 57.98% followed by *Dentalium* (15.06%) and *Umbonium* (13.03%). Echinodermata formed the second largest group contributing to 0.51% followed by polychaetes (0.40%), Sipunculids (0.07%), Coelenterates (0.06%) and Miscellaneous (0.10%). It was observed that Echiuroids were totally absent in St 3.

Population density

The macrobenthic density ranged between 255 to 1,83,680 nos/m^2 (Fig. 2). The highest density was recorded in Nov (St 3) while the lowest was recorded in Feb (St 2). It is observed that the macrobenthic population increased with increased depth. St 3 (12m) is away from the discharge point of treated effluents and thus had good representation of macrobenthos. This is in agreement with Mohan et al. (2004). Seasonally greater abundance was recorded both in pre and post-monsoon season at different stations.

Diversity indices

The monthly variations in diversity indices are shown in Table 2. In general the species diversity, evenness and richness ranged from 1.04 to 2.97, 0.75 to 0.93 and 0.68 to 2.08 respectively. The species diversity, evenness and richness were high at St 1 compared to St 2 and 3. Seasonally higher species diversity, evenness and richness were recorded during pre-monsoon season compared to post-monsoon months. Similarly Seyed et al. (2010) recorded higher diversity indices during summer season in Sulakh region, Qeshm Island, Iran. The present area of study can be classified as moderately polluted as the diversity indices recorded was 1-3 which indicates moderate pollution (Sarkar et al. 2016).

Impact of environmental parameters on distribution of macrobenthos

Environmental factors are the main factors which in-

Table 2. Diversity indices of macrobenthos during the study period.

Months	Station 1			Station 2			Station 3		
	Species diversity (H^1)	Species Evenness (J^1)	Species Richness (D^1)	Species diversity (H^1)	Species Evenness (J^1)	Species Richness (D^1)	Species diversity (H^1)	Species Evenness (J^1)	Species Richness (D^1)
Oct	1.42	0.83	0.88	1.21	0.84	0.68	1.08	0.8	1.49
Nov	2.39	0.89	1.48	1.33	0.85	0.74	1.06	0.75	1.31
Dec	2.89	0.89	2.08	1.33	0.82	0.83	1.04	0.8	1.55
Jan	1.09	0.80	0.68	1.11	0.80	0.69	1.11	0.86	1.75
Feb	2.32	0.93	1.06	1.73	0.85	1.07	1.13	0.86	1.72
Mar	2.8	0.92	1.74	1.23	0.84	0.69	1.56	0.85	1.15
Apr	2.97	0.92	1.66	1.75	0.85	1.09	1.54	0.86	1.16
May	2.69	0.92	1.38	1.48	0.84	0.83	1.74	0.8	1.03

fluences the distribution of macrofaunal communities. The temperature can exert its influence on the chemical characteristics of water which in turn determine the density and distribution of benthic organisms. Salinity is one of the important key factors which determine the composition of biological component in the marine environment (Anvar 1997). The temperature of the water and salinity were high during pre-monsoon and post-monsoon period when macrobenthic population was found to be high. Thereby this clearly indicates that temperature and salinity are important environmental parameters influencing the distribution of macrobenthos population density. These observations are in good agreement with the findings of Anbuchezhian et al. (2009) along the coastal belt of Thondi, South East coast of India and Sasikala et al. (2017) along the Point Calimere of South East coast of India.

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