DIVERSITY OF BENTHIC FAUNA IN COLEROON ESTUARY, SOUTH EAST COAST OF INDIA

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ABSTRACT

An attempt was made to study the benthic biodiversity in Coleroon estuary, Southeast coast of India. Monthly sampling was done in five stations, (station I to station V) for a period of one year from May 2011 to February 2012. Water quality parameters temperature, salinity, pH, DO and TOC were estimated. As regards biological entity, there were four benthic faunal groups of this; polychaetes topped the list in terms of abundance in all stations followed by crustaceans, bivalves and gastropods. As many as 62 species of benthic macrofauna were recorded in the study area (44 species of polychaetes, 6 species of crustaceans, bivalves and gastropods came next in the order of abundance with 7 and 5 species respectively). The maximum population density of macrofauna was recorded in station II and minimum in station V. The species diversity ranged from 2.22 to 4.30; species richness from 2.35 to 5.27 and species evenness from 0.88 to 0.98. The maximum diversity indices was recorded in station II and minimum in V.

INTRODUCTION

In the estuary, benthos plays an important role in ecosystem processes such as nutrient cycling (food for bottom feeding fin and shellfishes), pollution metabolism, dispersion and secondary production (Parulekar et al., 1980; Amar, et al., 2011). They provide key linkages between primary producers and higher trophic levels in the marine food chains some are economically important in their own right. The benthic environment converts the input of detrital matter into output of benthic food for fishes (e.g. flat fish) and crustaceans. It is a well-etched fact that there is always a nexus between the benthic standing crop and the production of exploited demersal fishes and crustaceans (Kaiser et al., 2001). The structure of benthic fauna and their role as the principal food sources for the fishes have been documented by various workers (Fujioka et al., 2007; Murugesan 2002). Because of their high productivity and organic matter input, estuarine systems are hospitable for feeding and reproduction of many species of fish and invertebrates, in at least one stage of life (Day et al., 1989). The benthos includes a set of animals belonging to a variety of invertebrate groups including polychaetes, molluscs, crustaceans, and nemertine worms, and which have direct relationships with consolidated or unconsolidated bottoms. These organisms act to aerate and remobilize sediment, promote decomposition and transfer energy to other components of the food web (Hutchings 1998). They regulate and alter the physical, chemical, and biological agents and therefore have a strong structuring effect (Day et al., 1989).

Benthic biodiversity assume very great significance from the point of view of ecosystem health. It as the collection of genomes, species and habitats occurring as interacting components in a geographically defined area. Biodiversity can be used in all levels of biological organization, ranging from a measure of the genetic variability of the population to the diversity of major ecosystem (Kapur and Jain 2004). The diversity, distribution and relative abundance of various organisms in the marine environment are influenced by the physico-chemical properties of the sediments and water. It composed of two elements: (i) richness and (ii) evenness. The richness and evenness of benthic communities reflect selective pressure that shape diversity within communities (Muthuvelu et al., 2013). The Coleroon estuary receives copious supply of freshwater during monsoon and also during premonsoon period, when water is released from the river Cauvery for irrigation purposes. It is connected to the river Vellar on the northern side by the Buckingham canal and in this region a network of canals are formed with rich mangrove vegetation. The tide influence is felt over a distance of about 15kms in the upstream. The depth of the estuary near the mouth is about 5-7m during high tide while in low tide nearly 4-5m, which enables both mechanized and non-mechanized vessels enter the estuary and Pazhayar fish landing centre. In view of the facts given above, presently an attempt was made with a view to study the benthic biodiversity in the selected stations of Coleroon estuary.

MATERIALS AND METHODS

Study area and sampling design

In the present study, five stations were fixed; it covers a distance of about 10.9 km from the Coleroon mouth and to fifth station (Fig. 1). Samples were taken monthly from May 2011 to February 2012 at five sampling stations (St-I to St-V). Station 1 were located near Coleroon mouth (11°21′57"7N and 79° 49′77"7E), station II station is fixed at Kattur 3.1 Km upstream from first station (11°21′932"7N and 79°48′171"7E), station III is situated in a place called Vellamanal, located 2.1Km away from second station...
(11°22′450″N and 79°47′186″E), station IV was fixed at diverging point of this estuary which is 2.5 km upstream from third station (11023′105″N and 79°46′064″E) and station V station was fixed at Alakudi. 3.2 km upstream from the fourth station, the distance between the Coleroon mouth and fifth station is 10.9km (11°21′793″N and 79°45′260″E).

**Samples collection**

The environmental parameters were measured using standard methods. Temperature was measured using a thermometer with +0.50C accuracy; salinity by Hand refractor meter (Atago co. Ltd, Japan); pH by hand pH pen (Eutech Instrument, Singapore) and dissolved oxygen was estimated using Winkler’s method by Strickland and Parsons and total organic carbon was analysed by El-Wakeel and Riley (1956) method. The sediment was washed over sieves with meshes of 0.5mm, and the macrofauna retained were fixed in 4% formaldehyde, preserved in 70% ethanol, and then identified and counted. Subsequently, the organisms were stained with Rose Bengal solution (0.1g in 100ml of distilled water) for greater visibility during sorting. All the species were sorted, enumerated and identified to the advanced level possible with the consultation of available literature. Polychaetes (Fauvel (1953); Day 1967), crustaceans (Barnes, 1980), amphipods (Lyla et al., 1999), gastropods (Rajagopal et al., 1998) and bivalves (Shanmugam et al., 1997) were first segregated into group level and then identified to species level with the help of standard taxonomic references.

**Statistical analyses**

Further, the data were approached to various statistical tools namely univariate method (Shannon-Wiener index, Margalef index and Pielou’s index) available in PRIMER (ver. 6.) statistical software (Clark and Gorly 2001).

**RESULTS**

**Physico-chemical parameters**

The water temperature varied from 26°C to 28°C with minimum during monsoon (November 2011) at station IV and maximum during summer (June 2011) at station I; salinity ranged from 26.5 to 30psu with minimum during monsoon (December 2011) in station V and maximum during summer (May 2011) in station I; water salinity recorded decreasing trend from station I to V; pH fluctuated between 7.5 and 7.9 with minimum during monsoon (December 2011) in station V and maximum during summer (May 2011) in station I; dissolved oxygen from 2.5 to 4.7 ml/l with minimum during summer (May 2011) in station V and maximum during monsoon (December 2011) in station II; total organic carbon varied from 1.78 to 9.53mgc/g with minimum during summer (May 2011) in station V and maximum during summer (June 2011) at station I; salinity ranged from 26.5 to 30psu with minimum during monsoon (December 2011) in station II; total organic carbon varied from 1.78 to 9.53mgc/g with minimum during summer (May 2011) in station V and maximum during monsoon (December 2011) in station I, varied between 1534 and 6876nos m⁻²; in station II, varied from 1813 to 8087nos m⁻²; in station III, ranged from 1454 to 6574nos m⁻²; in station IV from 1344 to 6394nos m⁻²; and station V, varied from 1212 to 5697nos m⁻² (Fig. 3). Among the stations, the maximum density was recorded in station II and minimum in station V. Season-wise variation of the benthic density, the minimum was recorded during monsoon (November & December) and maximum during summer (May & June).

![Image](image_url)

**Population density of benthic macrofauna**

With respect to population density of macro benthic organisms, in station I varied between 1534 and 6876nos m⁻²; in station II, varied from 1813 to 8087nos m⁻²; in station III, ranged from 1454 to 6574nos m⁻²; in station IV from 1344 to 6394nos m⁻²; and station V, varied from 1212 to 5697nos m⁻² (Fig. 3). Among the stations, the maximum density was recorded in station II and minimum in station V. Season-wise variation of the benthic density, the minimum was recorded during monsoon (November & December) and maximum during summer (May & June).
Percentage composition of benthic macrofauna

In the present study, polychaetes formed the dominant group by constituting 57% of the total benthic organisms recorded. Crustaceans formed the second dominant group with a percentage of 17%; bivalves and gastropods came next with 14%, 12% respectively (Fig. 4).

Diversity indices

The results of diversity indices calculated for the stations-wise and season-wise are given in the Table-1. The species diversity (H’) varied from 2.22 to 4.30 with minimum in station V (November) and maximum in station II (June); species richness (d) fluctuated between 2.35 to 5.27 with minimum value in station V (December) and maximum in station II (May); species evenness (J’) varied from 0.88 to 0.98 with maximum value in station II (June) and minimum in station V (December).

DISCUSSION

In the present study, the maximum temperature was recorded during May & June and minimum during November & December at all stations. The variation could be attributed to the tidal action, community metabolism, and evaporation. The temperature can exert its influence on the chemical characteristics of interstitial water, which in turn determine the density and distribution of benthic organisms. The variation in the temperature changes in seasons due to monsoonal weather as reported by Saravanan, (1999) and Murugesan (2002). Salinity is known to be one of the most important environmental parameters controlling the faunal composition in the marine ecosystem. In the present study, the maximum salinity was recorded during May and the minimum...
was recorded during December. Generally the higher salinity is due to evaporation and the lower due to the dilution brought by rainfall and land runoff. The similar observations were made by Murugesan et al. (2011); Muthuvelu et al. (2013). In the present study, the higher water pH was observed in May and lower in December. The variation could be attributed to the influence of fresh water and photosynthetic activity. According to Svendrup et al. (1942) the variation of pH in estuary water is due to the changes of temperature, salinity and carbon dioxide. Dissolved oxygen is a significant parameter in explaining especially species diversity and population density and suggests oxygen threshold (Diaz et al., 1995). The maximum dissolved oxygen was observed during December and minimum during May in all the stations. Dissolved oxygen play an important role in the marine environment especially in benthic ecosystem. The variation in dissolved oxygen level may be attributed to the salinity variation. Similar range of DO values were reported earlier by Murugesan (2002); Muthuvelu et al. (2013).

With respect to benthic fauna, the maximum number of species (54 species) was recorded in station II and in station V. As station V is situated at the lower reaches of river sediment nature play a key role in distribution of organisms. Therefore, there was a reduction in species number. The population density of macrofauna is governed by various environmental variables such as temperature, salinity, pH and dissolved oxygen (Muthuvelu et al., 2013). In the present study, the density of macrobenthos showed pronounced monthly variations in all the stations. The macro benthic density revealed that the minimum was recorded during November & December and maximum in May & June months in all the stations. The density ranged between 1813 and 8087 nos m⁻². December month registered low density followed by gradual increase during June and peak in during May. The variations mainly due to the monsoons impacts as reported earlier by Murugesan (2002) and Aruljothi selvi (2004) in Vellar estuary; Jagadeesan (1986) and Raveenthiranath Nehru (1990) in Coleroon estuary; Ingle et al. (2002) in Chilka lake. Therefore, the results of above works lend support to the findings of the present study. Variation in density and species composition between stations are mainly owing to various physico-chemicals and environmental factors prevailing in this environment besides wide fluctuations in nature of the substratum and total organic carbon are also important factors influencing the abundance of benthos.

Among the benthic faunal groups recorded, polychaetes were found to be the dominant group in all the stations. The preponderance of polychaetes in a benthic sample was reported earlier by many researchers (Murugesan, 2002; Aruljothi, 2004; Murugesan et al., 2011; Muthuvelu et al., 2013). Dominance of polychaetes in terms of density and species composition in diverse ecological niches is due to their high degree of adaptability to a wide range of environmental factors. The other faunal groups such as crustaceans, bivalves and gastropods came next in the order of abundance and percentage composition. Species diversity is a simple and useful measure of a biological system (Reading and Croy, 1985). Sanders (1968) found a high level of agreement between the species diversity and nature of environment and hence the measure of species diversity is regarded as an ecologically powerful tool. In the present study, a marked monthly variation in the Shannon diversity was noticed with minimum value (2.22) in station V during December and maximum (4.30) in station II during May. Murugesan (2002) stated that the estuarine environment is far more dynamic than the fully marine and therefore, there may be a wide range of variation in the diversity of benthos of an estuary. Shannon diversity around three is considered to be good from the health point of view and the range recorded in the present study vouch safe for the healthy nature of the estuary. Similar seasonal pattern of diversity was evident in the reports of Raveenthiranath Nehru (1990) in Coleroon estuary, Sebastin Raja (1990) in Sunnambar estuary and Maurer et al. (1995) in UK waters. As in species diversity, species richness values were also low during December in station V and high during May in station V. The reason is that, it is easier to tolerate low salinity at high temperature than at low temperature (Sanders, 1968) and as a result more neritic forms are able to flourish in tropical estuaries than the temperate waters (Panikker, 1940). Hence, the high species richness noticed during May month might be ascribed to the entry of marine forms in to the estuary and the low values could be attributed to the drastic change in level of salinity during December month. The trend with respect to richness values of the present study is in harmony with the studies made by Raveenthiranath Nehru (1990), Jagadeesan and Ayyakkannu (1992) in Coleroon estuary; Sebastin Raja (1990) in Sunnambar estuary; Murugesan (2002) and Aruljothi selvi (2004) in Vellar estuary. The evenness measure (J') largely followed the trend observed in the species diversity. As in the species diversity, the minimum value was found during monsoon season in station I and maximum during summer in station V. In short, based on the data collected in five different stations of Coleroon estuary, it is clearly indicated that the faunal composition and abundance are varied in relation to stations and months. More importantly, there was a reduction in faunal abundance towards lower reaches of the estuary. This study also warrants a detailed study on benthos so as to find out the temporal variations owing to anthropogenic and natural disturbances in benthic faunal diversity in the study area.

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