Microfaunal Studies in the Sediments of Northern Part of Cochin Estuary

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Abstract— Ten surface and one core sediment samples were collected from the backwaters of Cochin, Kerala, southwest coast of India, in order to study the systematics and distribution of microauna. The microfauna were separated from the sediments applying standard micropaleontological techniques. A total of 3 Ostracod species belonging to 3 genera and 2 families were identified. Sediment parameters such as $CaCO_3$, organic matter and sand-silt-clay ratio were estimated for the surface as well as core samples in order to determine the relationship between substrate and Ostracoda populations, and to evaluate the favored substrate of dominant species populations. The down core distribution of sediment parameters and ostracod assemblages is presented.

I. INTRODUCTION

Estuaries, being an ecotone between the sea and freshwater, perform several important ecological functions, including biodiversity conservation. They regulate the water regime, act as natural filters for contaminants and play an important role in the bio-geochemical dynamics of nutrients, primary productivity and bacterial processes (Sobolewski, 1999). In the Cochin backwaters, the estimated annual consumption by the zooplankton herbivores is approximately 25 per cent of the total primary production. Benthos plays a vital role in the food chain and recycling of essential elements like, Carbon, Nitrogen and Phosphorus in the ecosystem. The objective of the present study is to evaluate the distribution of Ostracoda in the Cochin backwaters and infer the microenvironmental conditions in which they thrived.

2.1 Study area

The study area is mainly concentrated in the mouth of periyar river from Panambukadu. The River Periyar, the longest river of the state is considered to be the lifeline of central Kerala. The total length is about 300Kms (244 Kms in Kerala) with a catchment area of 5396Sq.Kms (5284 Sq.Kms in Kerala). The total annual flow is estimated to be 11607 Cubic meters. The river has a maximum width of 405m and is located between latitude 9°15'50" and longitude 76°7'38". Cochin Estuary lies in between two major islands namely Vallarpadam and Willingdon islands on the coast of Arabian Sea. Cochin Port makes popular the estuary and it lies in these two islands.

2.2 Materials and Methods

In order to study the ostracod distribution in the backwaters of Cochin both surface and subsurface samples were collected from the Cochin estuary. ten surface samples and one core were collected from different locations. The locations of the samples were recorded using GPS (Table2.1 and 2.2). The samples were collected with a motor boat and a PVC corer.

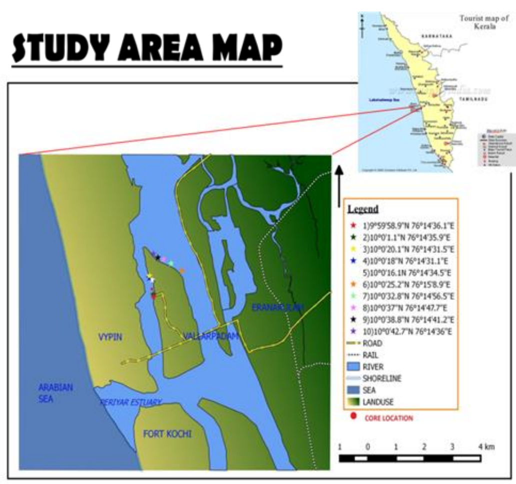


Fig. 2.1 Study area with sample locations.

Tab.2.1 Core Sample location

Sample	Core length (cm)	Latitude	Longitude
PKC	103	$10^0$0'0.2"N	$76^0$14'34.7"E

Tab.2.2 Surface sample’s locations.

Sample No.	Sample Name	Latitude	Longitude
1	PKS1	9⁰59’58.9”N	76⁰14’36.1”E
2	PKS2	76⁰14’36.1”E	76⁰14’35.9”E
3	PKS3	10⁰0’20.1”N	76⁰14’31.5”E
4	PKS4	10⁰0’18”N	76⁰14’31.1”E
5	PKS5	10⁰0’16.1”N	76⁰14’34.5”E
6	PKS6	10⁰0’25.2”N	76⁰15’8.9”E
7	PKS7	10⁰0’32.8”N	76⁰14’56.5”E
8	PKS8	10⁰0’37”N	76⁰14’47.7”E
9	PKS9	10⁰0’38.8”N	76⁰14’41.2”E
10	PKS10	10⁰0’42.7”N	76⁰14’36”E

Core sample was lithologged and subsampled. Based on the observation during geological logging, the litholog then prepared. The core sample was subsampled into 21 subsamples at different intervals. The sediment samples were analyzed to determine the organic matter, $CaCO_3$ and sand-silt-clay ratio. The organic matter was estimated by adopting a methodology suggested by Gaudette *et al.*, (1974). The $CaCO_3$ analysis was done by using Piper method (1947). Sand, silt and clay percentages were calculated using a combination of sieving and pipette procedure, the latter in accordance with Krumbein and Pettijhon (1938). Trilinear plots were prepared based on the description by Trefethen’s (1950) and the textural nomenclature therein.

Micro paleontological studies are the studies of the micro organisms which are present in the sediment or water. These studies are done under microscope to identify the micro organisms present in the sediments. To start this study samples which are divided into each 2.5 cm are taken. These samples are taken in the china disc and to it a solution of 3 parts of water and one part of hydrogen peroxide is added. This was kept for 6-8 hr for disintegration of the clay or removal of the clay from the shell. After 6-8 hr these sample are washed using 230 ASTM mesh to separate the clay particles from the samples. This was then dried in the oven at below 500c and study was done under microscope.

III. RESULTS AND DISCUSSION

Sand silt clay analysis in core sample shows that the upper part of the core is dominated by sand and the concentration of silt and clay is less. The maximum amount of sand is seen at depth of 5, 10, 14, 17, 27, and 36 centimeters. The nature of sediment is sand with clay, mud shows maximum at a depth of 67, 72, 78, 90, and 103 centimeters. The bottom core sediments are mud with little amount of sand. This shows that the mud is dominating in this area (Tab.3.1), (Fig.3.1).

Table.3.1 Down core correlation of sediment nature.

Sample Name	Depth (Cm)	Sand (%)	Mud (%)	$CaCO_3$ (%)	OC (%)
PKC 1	0-5	86.8	13.2	5	1.02439
PKC 2	5-10	84.8	15.2	5	0.621951
PKC 3	10-14	77.4	22.6	3	0.073171
PKC 4	14-17	67.6	32.4	4.5	0.695122
PKC 5	17-22	79.8	20.2	5.5	1.353659
PKC 6	22-27	55.6	44.4	5.5	1.207317
PKC 7	27-31	82.2	17.8	7	0.585366
PKC 8	31-36	64	36	4.5	0.512195
PKC 9	36-40	71	29	4.5	0.256098
PKC 10	40-44	66.6	33.4	3	0.286944
PKC 11	44-48	69.2	30.8	1	0.286944
PKC 12	48-52	40.6	59.4	1.5	0.932568
PKC 13	52-57	26.8	73.2	1.5	1.97561
PKC 14	57-62	29	71	1	2.085366
PKC 15	62-67	11.4	88.6	3	2.268293
PKC 16	67-72	13.6	86.4	2.5	2.268293
PKC 17	72-78	13.2	86.8	2	2.231707
PKC 18	78-84	4.8	95.2	0.5	1.390244
PKC 19	84-90	38.4	61.6	0.5	0.645624
PKC 20	90-96	17.2	82.8	1	1.219512
PKC 21	96-103	23	77	1	1.646341

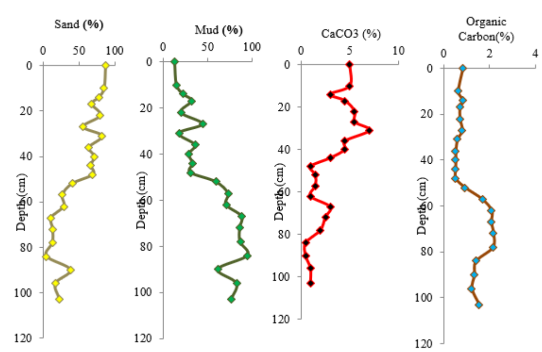
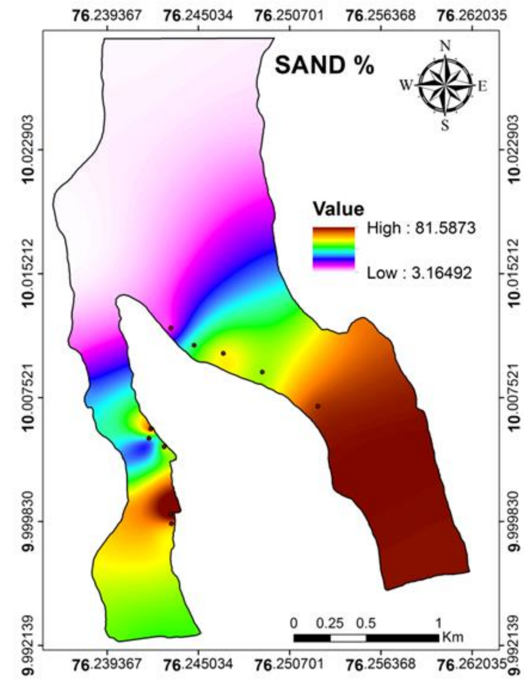


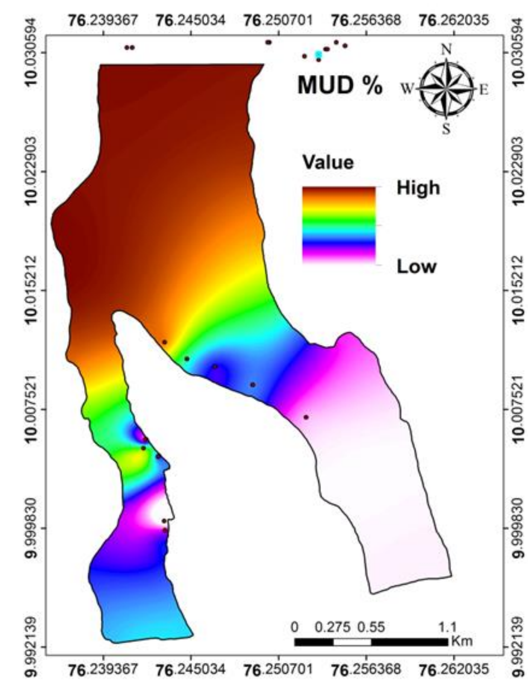
Fig. 3.1 Down core correlation of sediment nature.

In surface sediments, sand shows maximum in the south eastern part of the study area and moderate concentration in the central part. Whereas sand percentage is minimum in the north part of the study area. Silt concentration shows maximum in the north western part and minimum in the southern part of the study area. Clay size sediments are minimum at the southern part of the study area (Tab.3.2), (Fig.3.2). Calcium carbonate is moderate in the top of the core and it increases at 22 to 32 centimeters of the core and in bottom calcium carbonate is again decreases. . This shows that the calcium carbonate will be less when the sand is high and calcium carbonate will be high when sand is less. Sand and $CaCO_3$ is showing positive correlation, i.e as sand percentage increases the percentage of CaCO3 is increase. In the case of mud and OC, they are showing positive correlation, as the percentage of OC increases the percentage of mud increases. In case of $CaCO_3$, it is negatively correlated with OC percentage and mud percentage and positively correlated to the sand percentage. The comparison diagram shows near positive correlation between sand and $CaCO_3$ in the surface distribution of the sediments. Mud and Organic carbon reflects the same relation. Previous studies have shown that the Organic carbon of sediment is significantly associated with microbial activity during decomposition of vegetation and nutrient materials.

Table.3.2 Distribution of sand, mud, $CaCO_3$ and OC in surface samples.

SAMPLE	SAND (%)	MUD (%)	CaCO3 (%)	OC (%)
PKS1	60.8	39.2	5	1.463415
PKS2	77.8	22.2	1.5	1.353659
PKS3	65.4	34.6	1	1.353659
PKS4	31	69	2.5	2.268293
PKS5	49.4	50.6	3	1.646341
PKS6	68	32	4.5	1.207317
PKS7	47.2	52.8	4	3.768293
PKS8	52.4	47.6	2.5	1.865854
PKS9	38.2	61.8	4.5	2.121951
PKS10	12.8	87.2	5	4.756098





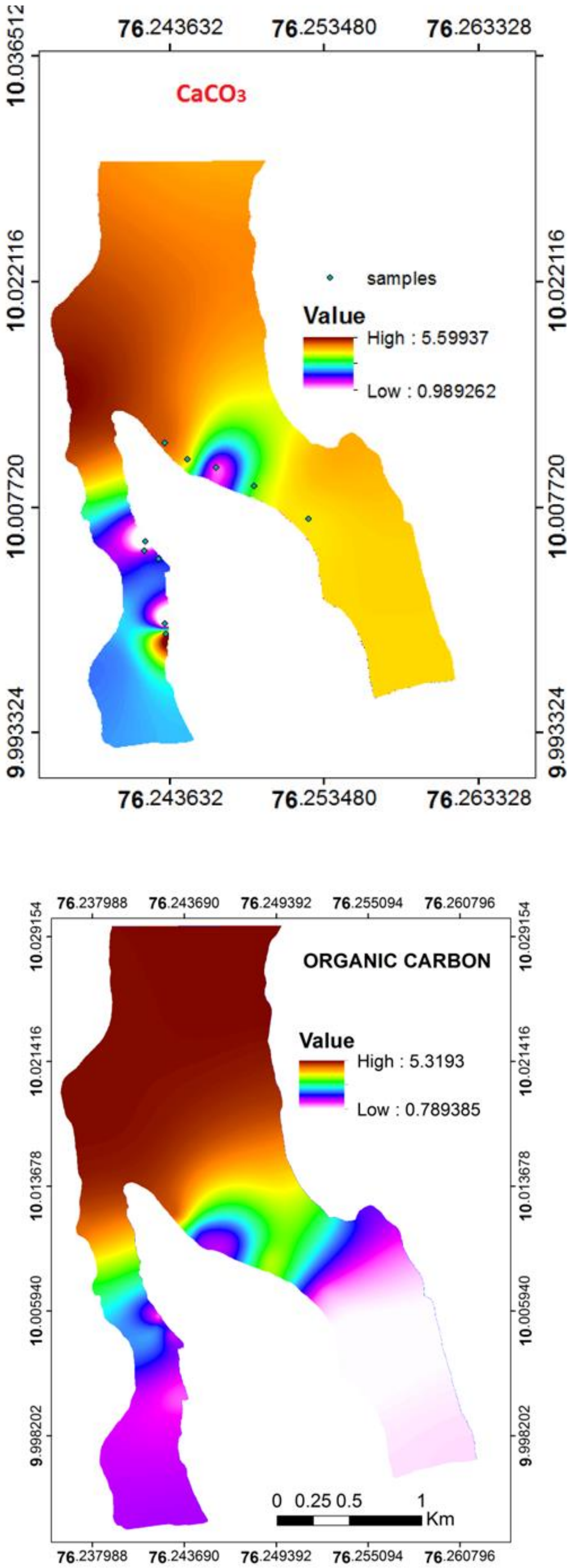


Fig .3.2 Surface distribution of Sand-mud-$CaCO_3$-OC

More organic matter is produced which leads to a greater flux through the water column and ultimately greater accumulation in sediments. Sediments underlying high productivity areas have higher % Organic carbon. Less oxygen changes the degradation rate or pathway of C degradation. Sediments in low oxygen and anoxic basins have high % of Organic carbon.

- MICROPALEONTOLOGY

Nearly 25 – 35% of biogenic material present in the surface sediments and is dominated by shells and shell fragments of Gastropods and other macro fauna. Very few micro fauna found in the surface samples. Whereas in the core sediments, near surface sediments shows less amount of biogeous content and toward depth its shows increasing trend. Ostracoda found in the bottom core sediments. This indicates the unsuitability of ecological signature in near surface of the study area for the survival of microorganisms. The classification proposed by Hartman and Puri (1974) has been followed resulting in the identification of 3 ostracoda species belonging to 3 genera, 2 families, 1 superfamily and 1 sub-order of the order Podocopida. The occurrence of species such as *Jankeijcythere mckenziei*, is attributed to the prevailing tropical backwater environment (Arul *etal*., 2003; Anil Bhandari and Singh (2006); Ganesan and Hussain, 2010). The presence of *Keijella reticulata* in the backwaters of Cochin may be due to the tidal influence (Al. Abdul Razzaq *et al*., 1983; Whatley and Quanhong, 1987 and 1988). *Hemikrithe* sp.is a cosmopolitan species (Witte, 1993).

- SEDIMENT CHARACTERESTICS AND OSTROCOD POPULATION

The CaCO3 content, organic matter and nature of the substrate of the sediment samples reflects on the population abundance and distribution of microfauna (Yassini and Jones, 1995). The organic content in the surface samples ranges from 0.12% to 4.7%, whereas the organic content of the core ranges from 0.07% to 2.26%. In the surface sediments, more organic matter is measured in the silty substrate.

- SUBSTRATE

In the present study it is observed that there is a strong relation between ostracods and sediment substrate. Ostracods thrive in sand and clay rather than silt (Annapurna and Rama Sarma, 1982). The nature of bottom sediments and the presence or absence of bottom vegetation, affects the distribution of ostracods. Consequently, diverse sedimentary facies support distinct ostracod assemblages (Puri, 1966).

IV. CONCLUSION

In the Cochin backwaters sediments, distribution of sand and $CaCO_3$ show positive relation. Mud and Organic carbon reflects the same relation. More organic content is produced which leads to a greater flux through the water column and ultimately greater accumulation in sediments. Based on this data it is found that ostracods favour silty-sandy substrate environments. The low values of organic matter recorded in the surface of the backwaters of Cochin are due the ssediments underlying low productivity. Organic matter appears to have impact on the distribution of Ostracoda fauna. The benthic ostracod fauna recorded is characteristic of a tropical, brackish to epi-neritic environment and few warm, shallow marine species occur in the backwaters of Cochin, may be due to the tidal influence.

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