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DISTRIBUTION OF OSTRACODA AND FORAMINIFERA FROM SEDIMENTS OF CHILIKA LAGOON, ODISHA, EAST COAST OF INDIA

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ABSTRACT

In order to understand the distribution of microfaunal assemblages, ostracoda and foraminifera from Chilika Lagoon, Odisha, East coast of India, a preliminary study is done, collecting 11 surface and 2 core samples from the area. Ostracoda and foraminifera assemblages from the study area were qualitatively and quantitatively analyzed from the southern part of the lagoon. All the sediment samples, (both core and grab) were subjected to standard micropaleontological techniques, so as to record the occurrence of Ostracoda and Foraminifera. A total of eleven Ostracoda species belonging to ten genera namely *Jankeijcythere, Hemicytheridea, Bradleya, Tanella, Paijenborchella, Phlyctenophora, Neomonoceratina, Xestoleberis, Bairdoppilata, Loxoconcha* belonging to nine families have been identified from the sediments. The genus *Loxoconcha* is outnumbering other Ostracoda genera in the area. Ten foraminifera species belonging to six genera namely *Ammonia, Quinqueloculina, Triloculina, Asterorotalia, Elphidium, Pararotalia* belonging to six families have been also identified, with *Ammonia* as the abundant species. The colour of the foraminiferal tests is pale to whitish, which indicates a normal oxygenated condition. The species of both microfauna recorded are characteristic of shallow, brackish water and tropical in nature. It is observed that silt and sandysilt are more accommodative substrates for the population of Ostracoda, however foraminfera are not showing any such relations. The sedimentation texture pattern reveals a moderate to low energy condition of deposition in the lagoon.

Keywords: Distribution, Ostracoda, Foraminifera, Sedimentological parameters, Chilika Lagoon.

INTRODUCTION

Despite of the challenges faced till recent times, microfossil studies are regaining its importance now a days, since they are economically viable in determining the environmental as well as the ecological changes in the past. Merged with other branches of geology like sequence stratigraphy, geomorphology, geochemistry etc., the field is now evolving from conventional research. Being abundant and diverse, tiny Crustaceans Ostracoda are having a long fossil record ranging from Ordovician to Recent, possessing a dorsally hinged, bivalved carapace (Hussain and Kalaiyarasi, 2010). The nature of bottom sediments like grain size, coefficient of sorting and the presence and absence of bottom vegetation have an impact on the Ostracoda (Puri, 1966). Foraminifera are exclusively marine organisms and are single-celled organisms. In ecological studies, Foraminifera assemblages could be used as an important proxy. The both forms are used in different perspective by micropaleontologists to have a better view of the environment. But for Jain (1976) paper, in which six Ostracod specimens were reported, there is no detailed research work on Ostracoda from the Chilika lagoon.

However, sticking to the basic idea, the distribution and identification of the microfossils, which is the preliminary work in the domain, this work carries the ostracoda and foraminifera assemblages present from the Chilika lagoon. To have a database on the distribution of microfossils from the area, the present study could be useful. Emphasizing mainly on distribution, the work has also been focusing on sedimentological aspects also.

MATERIALS AND METHODS

A field work was conducted in the study area to collect and examine the sediments. A total of 11 surface and 2 core samples have been collected for foraminiferal and ostracoda studies (Fig.1). The geographical location of the Chilika lagoon lies in between 19^{0} 28' and 19^{0} 54' N and 85^{0} 5' and 85^{0} 38' E. Even though Chilika lagoon is the largest of its kind in India with a wide range of aquatic diversity which spreads over three districts of Odisha, namely Puri, Khurda and Ganjam of East coast of India (Ramsar site no. 229), the studies were very few on microfossils in the lagoon. Bathymetry survey indicates extreme shallow depths in the northern sector, with less than 1.5 m in a large area. The southern sector of the lagoon has recorded the maximum depth of 3.9 m. Salinity in the southern zone decreases during the post monsoon period and in winter as northern winds facilitate mixing of water with rest of the lagoon.

The core samples retrieved were up to a length of 105 cm (Core I) and 35.5 cm (Core II) by using PVC pipe, and it is further sub sampled into 47 samples at 3 cm interval. All the sediment samples were subjected to standard micropaleontological techniques, so as to record the occurrence of Ostracoda and Foraminifera. Calcium carbonate and organic matter in the sediment samples were determined by adopting a methodology suggested by Piper (1947) and Gaudette *et al.* (1974), respectively. Sand, silt and clay percentages were calculated using a combination of sieving and pipette procedure, the later in accordance with Krumbein and Pettijhon (1938). Trilinear plots were prepared and description has been given based on Trefethen's (1950) textural nomenclature. The handpicked faunal specimens from each sample (10gm of sediment) were transferred to 24-chambered micropaleontological slides and mounted over a thin layer of tragacanth gum according to the family, genus and species, wherever possible. The different genera and species were identified; type specimens of each species were selected and transferred to round punch microfaunalslides with cover slips.

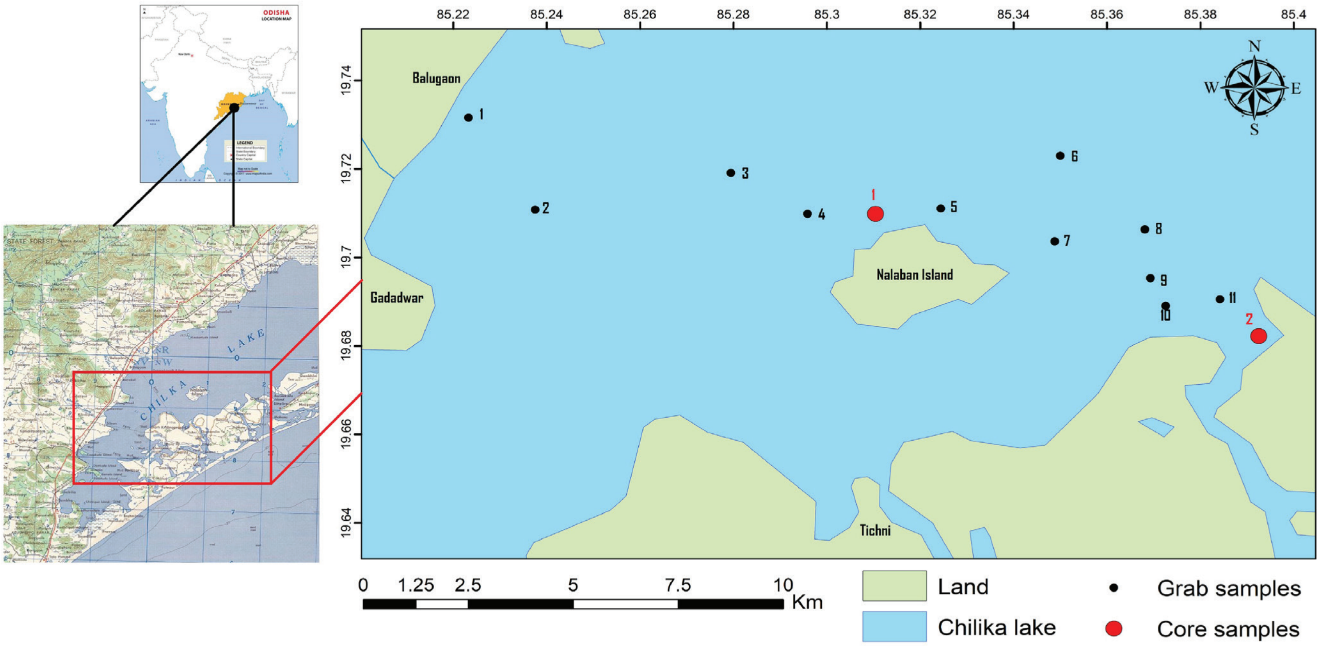

Fig.1 Sample location map of the study area.

RESULTS AND DISCUSSION

Organic matter content was determined for all the 58 samples including 11 surface and 2 core samples collected. The organic matter content in the sediments from the surface of Chilika Lagoon ranges from 0 % to 2% and 4.97-6.63% in core 1 and 5.13-6.46 in core 2 (Table 1, 2 and 3). Overall, the organic matter content in all surface sediment samples is less when compared to the subsurface samples. The rate of deposition of organic matter depends upon the production within the upper layers and the rate of destruction during descent through the water column. Abundant supply of oxygen will cause decomposition of the organic matter that has reached the bottom (Fig 2).

It has been found that the calcium carbonate in the sediments of Chilika Lagoon ranges from 1 to 7.5%, 1 to 33% in core 1 and 2.5 to 27.5 in core (Table 1, 2 and 3). It is understood that the calcium carbonate content in this area is one of the important parameters, which governs the population of Ostracoda and foraminifers, especially its spatial distribution. The major sources of carbonate in the sediments of the study area are the shells and broken shell fragments of organisms, molluscs and also due to dilution of biogenic calcite by detrital material in the sediments (Fig. 2).

The classification proposed by Hartmann and Puri (1974) has been followed in the present study for Ostracod, through which 11 ostracod taxa belonging to 10 genera of the order Podocopida have been identified. The species are *Jankeijcythere mckenziei, Loxoconcha* sp., *Loxoconcha megapora indica, Bradleya* sp., *Hemicytheridae reticulata*, *Tanella gracilis, Paijenborchella* sp., *Neomonoceratina iniqua, Phlyctenophora orientalis, Bairdoppilata alcyonicola* and *Xestoleberis variegata.* Species like *Taenella gracilis, Loxoconcha megapora indica* are also found in Mandvi beach, west coast of India (Jain, 1978) in which *Taenella gracilis* is a common form.

The widely utilized classification proposed by Loeblich and Tappan (1987) has been followed in the present study of foraminiferal identification, through which 10 foraminiferal species belonging to 6 genera, 5 families, 3 super families and 3 suborders of the order Foraminiferida have been identified. The species are *Ammonia beccarii, Ammonia tepida, Ammonia convexa, Pararotalia calcar, Pararotalia nipponica, Asterorotalia inflata, Elphidium hispidulum, Elphidium excavatum, Quinqueloculina seminulum, Triloculina trigonula.* No SEM photographs are provided as all the species recorded are well established.

Trilinear plots indicate the textural distribution of the surface sediments reveals the predominance of sandysilt and silt in surface sediments, Clay and sandy clay in core 1 and clay in core 2 (Table 1, 2 and 3). Silt shows moderate energy condition and clay shows low energy condition of deposition. From the

Table 1. Estimated values of $CaCO_3$, OM, Sand, Silt and clay percentage of Chilika Lagoon surface sediments.

Sample No	CaC03%	OM%	SAND%	SILT%	CLAY%
1	4.5	1.35	2.24	97.14	0.62
2	7.5	1.15	20.05	78.29	1.66
3	3.5	0.95	16.58	82.94	0.48
4	3	0.7	35.02	58.67	6.31
5	1	1.65	22.4	76.66	0.94
6	1	0.8	18.54	78.57	2.89
7	3	2	3.02	96.6	0.38
8	3.5	1.95	26.6	31.5	41.9
9	2	1.4	24.82	52.26	22.92
10	5.5	1.2	3.02	49.78	47.2
11	1	1.3	41.12	58.58	0.3
Maximum	7.5	2	41.12	97.14	47.2
Minimum	1	0.7	2.24	31.5	0.3
Average	3.227	1.31	19.4	69.18	11.41

Table 2. Estimated values of $CaCO_3$, OM, Sand, Silt and clay percentage of Chilika Lagoon sub surface sediments of core 2.

Depth in cm	CaCO3%	OM%	SAND%	SILT%	CLAY%
0-3	26	6.46	3.6	0.3	96.1
3-6	25	6.46	7.07	0.9	92.03
6-9	4	5.13	16.42	0.72	82.86
9-12	7.5	5.37	10.53	2.97	86.5
12-15	16.5	5.78	11.14	2.4	86.46
15-18	2.5	5.91	17.7	3.5	78.8
18-21	23.5	5.95	15.4	0.7	83.9
21-24	27.5	5.81	15.9	7.2	76.9
24-27	8	5.44	18.06	0.88	81.06
27-30	27	5.61	10.1	4.6	85.3
30-33	3.5	5.95	4.32	0.62	95.06
33-36	2.5	5.54	15.99	2.5	78.33
Maximum	27.5	6.46	18.06	7.2	96.1
Minimum	2.5	5.13	3.6	0.3	76.9
Average	14.45	5.78	12.18	2.27	85.27

above observations, it may be inferred that the organisms could accommodated themselves with the available substrate, the silt and clay.

CONCLUSION

This preliminary study of micropaleontology from Chilika lagoon reveals that the ostracod species characteristic of thermospheric shallow waters under less-dense, warm (> 10° C) waters. The occurrence of characteristic of brackish water ostracod species *viz., Jankeijcythere mckenziei, Hemicytheridea reticulata*, *Loxoconcha megapora indica* in the lagoon marks the brackish water biofacies. These species are dominant particularly in the middle portion of the south of the lagoon, where brackish water environment persists. The occurrence of innershelf species such as *Bradleya* sp., *Neomonoceratina iniqua*, *Xestoleberis variegata*, *Phlyctenophora orientalis* in this brackish water environment may be due to the tidal influence. The taxa mentioned above are quiet often seen in outer lagoon towards Bay of Bengal. The colour of foraminiferal and ostracod specimens is pale to white indicating a normal oxygenated environment deposition of sediments.

Sedimentological studies like sand, silt, clay, organic matter percentage and calcium carbonate percentage has been carried out to derive a meaningful conclusion. The $CaCO_3$ content in core 1 is higher than core 2 because of the dilution of biogenic calcite by detrital material in sediments, broken shell fragments etc. Higher concentration of OM in core 1 of the study area attributed to river runoff and considerable volume of organic debris retained on the overlying water column. An abundant supply of organic matter in water column, relative rapid rate of accumulation of fine grained material would have favored for high organic matter in bottom sediments. The sediment texture of the study area; clay indicates low energy condition and silt to sandysilt infers intermediate energy condition. The inflow of riverine input might have changed the sediment types.

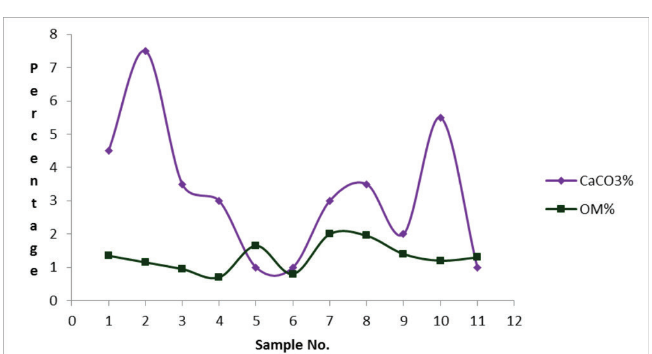

Fig. 2. Calcium Carbonate % and OM% in the surface sediments of Chilika lagoon.

Table 3. Estimated values of $CaCO_3$, OM, Sand, Silt and clay percentage of Chilika Lagoon Core 1 sediments

DEPTH (cm)	$CaCO_3$%	OM%	SAND%	SILT%	CLAY%
0-3	1	4.97	18.52	0.38	81.1
3-6	2.5	5.47	14.89	0.81	84.3
6-9	2.5	5.37	12.5	1.3	86.2
9-12	4	5.5	16.95	1.65	81.4
12-15	2	5.77	14	6.4	79.6
15-18	1.5	5.3	10.1	3.6	86.3
18-21	14.5	5.14	14.7	3.8	81.5
21-24	15.5	6.63	27.22	0.92	71.86
24-27	1	5.14	20.86	4.51	74.63
27-30	8	5.4	15.1	5.2	79.7
30-33	9.5	5.37	14.6	4.2	81.2
33-36	8.5	5.3	14.6	5.1	80.3
36-39	4	6.4	19.1	4.5	76.4
39-42	4	6.33	15.53	5.02	79.45
42-45	3	6.36	15.85	4.12	80.03
45-48	4.5	5.89	12.18	0.42	87.4
48-51	1	5.96	24.15	6.4	69.45
51-54	2.5	6.33	22.14	7.64	70.22
54-57	2.5	6.18	32.84	0.5	66.66
57-60	9	6	17.48	12.4	70.12
60-63	12.5	6.11	15.28	10.5	74.22
63-66	33	6.11	19.52	8.3	72.18
66-69	8	6.22	20.74	1.02	78.24
69-72	9.5	5.66	13.2	6.2	80.6
72-75	8.5	6.55	11.5	25.2	63.3
75-78	10	6.4	26.3	2.5	71.2
78-81	2	6.28	13.4	5.2	81.4
81-84	6.5	6.25	15.49	5.11	79.4
84-87	1	6.1	19.68	0.5	79.82
87-90	8	6.43	16.17	1.23	82.6
90-93	2.5	6.06	17.06	1.54	81.4
93-96	3	6.55	57.49	2.21	40.3
96-99	2	5.98	56.2	2.3	41.5
99-102	3.5	6.17	57.25	4.15	38.6
102-105	9.5	6.55	60.32	4.12	35.56
Maximum	33	6.63	60.32	25.2	87.4
Minimum	1	4.97	10.1	0.38	35.56
Average	6.3	5.94	22.08	4.54	73.37

Various sediments characteristics affect the distribution and diversity of foraminifera. Fine sand, clay, silt, organic matter and calcium carbonate of the sediments are the important determining factors of abundance and species richness of foraminifera. Sediments rich in fine sand and clay have higher density and diversity of foraminifera than the coarse grain

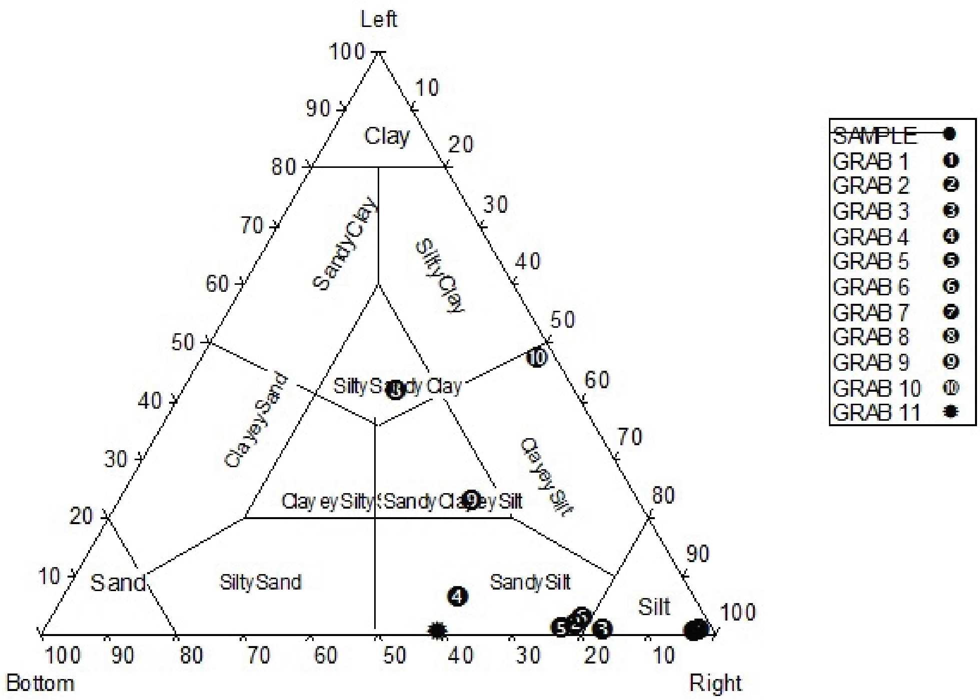

Fig. 3. A, B and C Trilinear plot for surface samples, core 1 and core 2, respectively (After Trfethen, 1950).

Table 4. Checklist of Foraminifera and Ostracoda in Cilika lagoon.

Check list of Ostracoda	Check list of Foraminifera
Bairdoppilata alcyonicola Maddocks, 1969	*Ammonia beccarii* Linné, 1758
Bradleya sp.	*Ammonia convexa* Collins, 1958
Jankeijcythere mckenziei (Annapurna and Rama Sarma, 1995)	*Ammonia tepida* Cushman, 1926
Loxoconcha sp.	*Asterorotalia inflata* Millett, 1904
Loxoconcha megaporaindica Jain, 1978	*Elphidium excavatum* Terquem
Hemicytheridea reticulata Kingma, 1948	*Elphidium hispidulum* Cushman, 1936
Neomonoceratina iniqua Brady, 1868	*Pararotalia calcar d'Orbigny,1826*
Paijenborchella sp.	*Pararotalia nipponica* Asano,1936
Phlyctenophora orientalis Brady, 1868	*Quinqueloculina seminulum* Linne, 1758
Tanella gracilis Kingma 1948	*Triloculina trigonula* Lamarck, 1804
Xestoleberis variegata Brady (1880)	

sands. In the present study, less abundance and diversity of foraminifera found southern part of the lagoon are correlated to the presence of fewer amounts of fine sand and clay in the sediment composition. Organic matter plays an important role in controlling the distribution of foraminifera. In the present study, it was observed that the southern part of sediment was coarser and the concentration of organic matter was low, so also the foraminifera distribution is lower in amount. Calcium carbonate also influences the distribution of foraminifera. In the present study also, a direct relationship was observed between the calcium content and abundance and diversity of foraminifera. The species of *Ammonia* was abundant on the south of the lagoon, where calcium content was more. It is evident for the fine sand, clay, organic matter and calcium carbonate play an important role in controlling the diversity and distribution of foraminifera in each estuaries.

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