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ON THE ECOLOGY OF THE INTERSTITIAL FAUNA INHABITING THE BHIMILIPATNAM COAST (BAY OF BENGAL)

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ABSTRACT

Ecological observations on the interstitial fauna inhabiting the Bhimilipatnam beach sands during 1977 (January-December) are discussed. Quantitative abundance of the different groups of invertebrates is furnished in relation to the varying hydrographical conditions. An attempt has been made to project the faunal homogeneity during the survey period.

INTRODUCTION

There exists a vast information on the ecological studies of the interstitial fauna from almost every part of the world beaches. Delamare-Deboutteville (1960), Swedmark (1964), Jansson (1968), Mc Intyre (1969), Pollock (1971), Hulings and Gray (1971), and Coull (1973) have reviewed the available literature on the various ecological aspects of the interstitial fauna. Considerable investigations on the interstitial organisms have been carried out along the Indian coasts, out of which most of the works deal with systematics (Aiyar and Alkunhi, 1944; Gnanamuthu, 1954; Krishna Swamy, 1957; Chandrasekhara Rao and Ganapati, 1968). However, information on the ecology of the interstitial organisms from the coasts of peninsular India are quite inadequate. Ganapati and Rao (1962) worked on the ecology of the interstitial fauna of the Waltair coast in some detail. Govindan Kutty and Nair (1966) presented a preliminary report on the interstitial organisms inhabiting the west coast of India. Mc Intyre (1968) gave a comparative picture of the meiofauna and macrofauna of the east coast of India. Panikkar and Rajan (1970) studied the ecology of the interstitial organisms in relation to the organic production in Cochin backwaters. In the present report a brief account of the ecological studies of the interstitial organisms inhabiting the sandy beach of Bhimilipatnam is given with emphasis on their quantitative distribution.

MATERIAL AND METHODS

Bhimilipatnam is situated on the east coast of India about 35 km north of Visakhapatnam (17°44′ N and 83°23′ E). The Bhimilipatnam coast has an extensive backwater system, and a small stream named Gousthani river empties into the Bay. The field station was selected opposite to the Light House Point, where the beach exhibits gradual gradient in the intertidal region (Fig. 1). The growth of the sand bars near the confluence of the Gousthani river mouth and the nature of beach profiles were explained in detail in the work of Dhanalakshmi, Khadar and Varadarajulu (1978). The substratum is made up of coarse sand in the middle of the beach, and near the water edge is often noticed fine sands interspersed with shelly gravel.

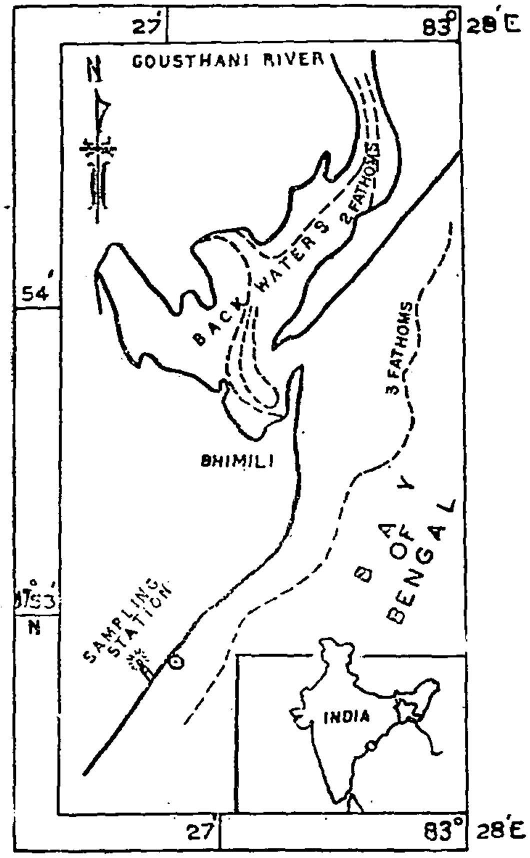

Fig. 1. Bhimilipatnam coast line showing sampling station.

The lower reaches of the beach are densely populated with algal colonies which are haphazardly distributed on the rock-ledges.

During the year 1977 (January–December), water and sand samples were collected fortnightly during the low tide period when the beach was accessible for proper investigation. Sampling was conducted at three different levels of the beach: 1. High Water Mark (HWM), 2. Mid Tide Level (MTL), and 3. Low Water Mark (LWM).

A perspex corer having an internal cross-sectional area of 10 cm^2 was used for the collection of the sand samples for quantitative analysis (Pennak, 1940). The corer tube was vertically thrust into the beach sand upto 10–30 cm and the top portion of the corer was tightly closed with a rubber bung. Later the corer was carefully removed from the substratum and 1 cm slices from the core were obtained by cutting with a spatula, without disturbing the entire sample. To each core sample was added 5% solution of formaldehyde as preservative and a few drops of Rose Bengal for necessary staining. In the laboratory, the meiofauna of each section of core was extracted by washing with 10% solution of magnesium chloride for at least seven times. Then the solution was filtered on a 62 μm diameter mesh size plankton cloth and the concentrated organisms were carefully collected in petridishes. Finally the refuse sediment was examined to make sure that no fauna were left behind. Later the organisms were sorted into different groups and numerically counted upto species levels.

The temperature of the air, adjoining sea water and the interstitial water was noted. Interstitial water samples were collected with the suction flask arrangement as suggested by Pennak (1940). Salinity determinations were made titrimetrically using the Knudsen's Tables, and the dissolved oxygen by the Winkler's method. Mechanical analysis of the sand was carried out with the help of the ASTM seives employing a mechanical shaker. Determinations of the salinity and dissolved oxygen content of the nearshore waters were also carried out to make a comparative study with the interstitial waters.

RESULTS AND DISCUSSION

Hydrographical features

The hydrographical parameters of the present study are represented in Fig. 2. The data are for the MTL collections only where the organisms were found to occur in great abundance.

The atmospheric temperature during the study period (Jan–Dec, 1977) fluctuated between 23 (January) to 29°C (June). The temperature of the adjacent water ranged between 23° to 28.5°C. The annual range of temperature in the interstitial system varied between 22.5 (January) to 33.0°C (June). There is a marked increase in the temperature in the top 5 cm of the beach sands than that observed at deeper layers of the sand bed. Sometimes even during cold season, a slight increase in temperature in the sediment has been registered which is obviously due to the convection of heat through the deeper layers of the sand bed (Johnson, 1965). Correspondingly, salinity of the interstitial water is high (34.67°/ₒₒ) during the summer month (May), in comparison to the lower salinity value (20.12°/ₒₒ), during the monsoon or stormy months (November). Decrease in salinity may be correlated with the dilution of capillary water by rain water or the effect of seepage system on the beach. In general, the oxygen content of the interstitial water is lower than the nearshore waters. Dissolved oxygen content in the sandy beach is dependent on the drainage of capillary water and evaporation of interstitial water in the surface layers due to temperature variation. The effect of rain water is known to bring about a marked increase in dissolved oxygen content of the interstitial system through seepage activity. In the present study most of the observations were made during bright sunshine hours when the temperature of the beach sands was considerably high. The effect of wave action also governs the distribution of interstitial organisms because of the abrasive action of the medium causing deleterious effect on the distribution of the fauna. Most of the meiobenthic organisms were observed to colonize the MTL where the optimum conditions for their better survival prevailed.

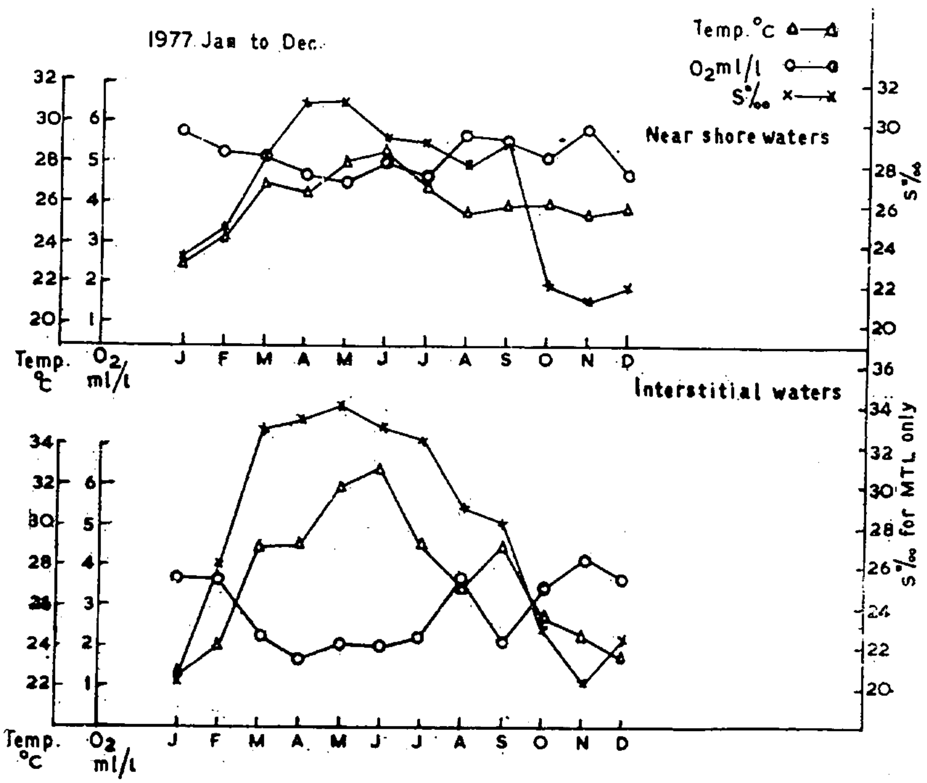

Fig. 2. Hydrographic features.

Temperature has got direct correlation with the meiofaunal abundance as most taxa are seasonal in occurrence and increase in numbers fairly during the summer months (Hulings and Gray, 1976). This is well recongnised in relation to the abundance of most groups of organisms in general and more akin to the abundance of organisms such as copepods, nematodes, polychaetes, oligochaetes and turbellarians in particular. Temperature also affects the abundance of organisms indirectly by controlling the salinity and dissolved oxygen content of the interstitial waters. The sudden decrease in temperature and salinity during November and December has shown marked decrease in the abundance of the fauna. In both these months the prevalence of stormy and rainy conditions made the fauna to get either washed away or vanish due to sudden and sharp fall in both salinity and temperature by creating disturbances in the microenvironment.

Alongwith the hydrographical conditions, the nature of the substratum and the grain size also play a significant role in the distribution of the fauna. In the present study MTL showed a sorted grade of sand (200 μm) and the substratum was also considerably porous with all possible conditions for the better colonisation of the interstitial organisms.

Faunal assemblage

Rao (1968) has stated that almost 400 species of invertebrates were encountered in the interstitial environment and only 20% occurred sufficiently in large numbers while the rest of the forms being numerically small. Animals belonging to various phyla right from Protozoa to Echinodermata are known to occur in the marine interstices. Based on the continuity of their occurrence and faunal homogeneity about 12 groups were selected (as represented in Table I) for continuous quantitative study. The occurrence of nematodes, copepods, polychaetes, archiannelids, oligochaetes, foraminifers, turbellarians, nemertines and gastrotrichs is continuous throughout the year whereas the kinorhynchs, isopods, mysidaceans, tardigrades and coelenterates are found to occur only in sparse numbers. Forms like ostracodes and rotifers are found to inhabit in calm and fairly stable benthic substrata.

Owing to prevalence of more or less favourable conditions around the MTL, organisms which are delicate and bear bristles etc. such as copepods, annelids and nematodes are found in abundance. The LWM exhibits the leaching of substratum by wave action and the interstitial system often gets clogged either with detritus or drained material, which is quite unfavourable for the distribution of the interstitial organisms. The HWM characterised by lesser porosity and prevalence of anoxic condition in the interstitial system is observed to be unfavourable for the organisms to dwell (Rao, 1968).

The results of quantitative studies are given in Table I. The organisms were identified mostly upto generic level and in some cases upto species. A check list of the important organisms encountered during the course of study is appended. The numerical abundance of the organisms is expressed as number of individuals per 10 cm², which is taken as a unit. Based on the quantitative studies made during the year 1977 on faunal characteristics, the abundance of the organisms is considered to be high during the summer months and a decline in the number of organisms is noticed during winter months. The data are presented in the from of a Trellis Diagraum (Fig. 3) to show the faunal homogeneity (Sanders, 1960) for the study period. During the summer months

Table I. Quantitative analysis of interstitial fauna at Light House station of Bhimilipatnam (1977). Animal abundance expressed as individuals/10 cm².

FAUNA	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Foraminifera	24	24	16	20	30	30	24	30	21	20	18	10
Turbellaria	16	26	16	33	22	12	16	13	8	16	12	12
Nematoda	34	46	64	102	104	82	80	61	80	72	54	27
Nemertinea	4	12	4	6	4	3	2	—	2	2	4	7
Gastrotricha	16	6	22	10	12	14	—	11	4	2	6	3
Kinorhyncha	—	—	—	4	3	2	1	3	2	1	—	—
Archiannelida	8	6	16	29	32	17	8	7	10	8	8	7
Oligochaeta	16	20	24	65	22	5	12	12	10	12	13	12
Polychaeta	6	8	12	48	36	28	16	26	28	6	18	17
Copepoda	20	28	30	52	80	72	68	40	28	14	16	18
Tardigrada	2	—	—	8	6	4	2	8	4	2	4	2
Rotifera	4	2	8	4	2	2	6	6	4	6	2	3
Total	150	178	212	381	353	271	235	217	201	161	155	118

there occurred about 381 organisms per 10 cm² and their abundance gradually decreased towards the winter months to 161 individuals per 10 cm². As a result of the severe cyclonic storm which occurred during November, 1977 there has been a sharp depletion in the faunal composition during the following month. This is clearly observed in the December, 1977 when only 118 organisms per 10 cm² were represented in the numerical counts against 381 individuals observed in April, 1977. The fauna were observed to recolonize during the postmonsoon and summer conditions. These observations are in accordance with the studies made by Bush (1966) in the sandy beaches of Miami. Thus depending upon the climatic and hydrographical conditions the distribution of interstitial organisms varies both in time and space (Jansson, 1966).

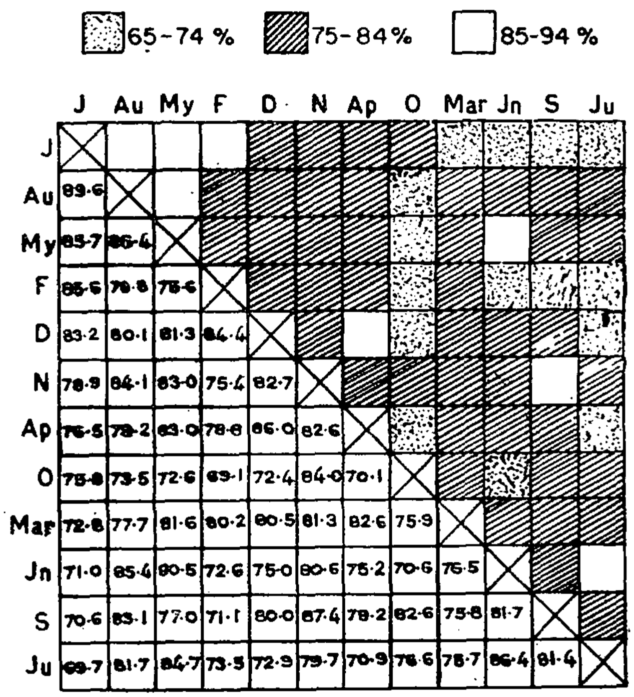

Fig. 3. Trellis diagram showing the degree of faunal similarity in one year (12 samples) from station at Bhimilipatnam light house.

CHECK LIST OF INTERSTITIAL ORGANISMS

1. *Coelenterata: Halammohydra octopodides* Remane, 1927.
2. *Turbellaria: Convoluta saliens* (Graff, 1882), *Convoluta* sp., *Macrostomum* sp., *Coelogynopora aculeata* Ax, 1951, *Monocelis lineata* (O. F. Muller, 1774), *Otoplana* sp.

3. *Gastrotricha:* *Macrodasys caudatus* Remane, 1927, *Macrodasys* sp, *Paradasys turbanelloides* Boaden, 1960, *Turbanella* sp.. *Chaetonotus atrox* Wilke, 1954, *Xenotrichula subterranea* Remane, 1934.

4. *Kinorhyncha:* *Cateria styx* Gerlach, 1956, *Echinoderes bengalensis* (Timm,. 1958).

5. *Oligochaeta:* *Enchytraeoides* sp., *Marionina* sp.

6. *Polychaeta:* *Pisione gopalai* Alikunhi, 1941, *Pisione complexa* Alikunhi, 1947, *Pisionidens indica* Aiyar and Alikunhi, 1940. *Hesionides gohari* Hartmann-Schroder, 1960, *Hesionides arenarius* Friedrich, 1937.

7. *Archiannelida:* *Nerilla antennata* Schmidt. 1863. *Polygordius madrasensis* Aiyar and Alikunhi, 1944. *Protodrilus indicus* Aiyar and Alikunhi, 1944, *Trilobodrilus* sp., *Saccocirrus cirratus* Aiyar and Alikunhi, 1944.

8. *Harpacticoida (Copepoda):* *Arenopontia subterranea* Kunz, 1937, *Arenosetella germanica* Kunz, 1937, *Asellopsis arenicola* Chappuis, 1954. *Leptastacus* sp. *Nitocra* sp., *Stigmatidium arenosetelloides* Noodt, 1958.

9. *Tardigrada:* *Batillipes pennaki* Marcus, 1946, *Stygarctus bradypus* Schulz, 1951

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