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STUDIES ON THE INTERTIDAL MACROFAUNA OF THE SANDY BEACH AT KAVARATTI ATOLL (LAKSHADWEEP)

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ABSTRACT

The distribution of macrofauna in Kavaratti atoll is studied in the intertidal region for over a period of 13 months. Seasonal diversity in the faunal composition was not observed. The polychaete *Scoloplos* sp. and the bivalve *Mesodesma glabratum* were abundant in the middle zone. The settlement of the crustacean *Hippa adactyla* is almost throughout the year. Settlement of *M. glabratum* was in the premonsoon months, but some occurred in the postmonsoon months also. In the total biomass, polychaetes form a major constituent when compared to the bivalve *M. glabratum* and *H. adactyla* which occupy second and third position in the order of abundance. Mean biomass value during premonsoon was comparatively low than in the postmonsoon months. The high values are in accordance with the large number of specimens present in a particular season i.e. during postmosoon in this context. The total biomass value varied seasonally. Physical and chemical parameters are discussed in relation to the occurrence and abundance of the macrofauna.

Key-words : Macrofauna, Sandy beach, Atoll, Kavaratti, Lakshadweep.

INTRODUCTION

Earlier studies on the biological production processes and community interrelationship of the intertidal macrofauna of the temperate beach by Ansell and Trevallion (1967) and on two tropical beaches by Trevallion, Ansell, Sivadas, Narayanan (1970); Ansell, Sivadas, Narayanan, Sankaranarayanan and Trevallion (1972) I; Ansell, Sivadas, Narayanan and Trevallion (1972) II; Ansell, Sivadas, Narayanan and Trevallion (1972) III; Ansell, Sivadas, and Narayanan (1973) brought out very interesting features regarding the recruitment, growth and behaviour of the organisms in these two contrasting geographical localities. During frequent visits to Kavaratti atoll, Laccadive archipelago it was found that the configuration of the beach and the condition prevailing there are quite different and peculiar from the above beaches and therefore calls for a comparison. Bakus (1983) has elaborated the value of coral reefs for their educational and scientific interest besides their recreational and resource potential and aesthetic qualities.

Kavaratti, an atoll in Lakshadweep group is located along 10°35' N latitude and 72° 37' E longitude with an island on the east and lagoon on the west

(Fig. 1). Bordering the western margin of the lagoon is coral reef with a width of about 250 to 300 m excepting at the southwest points where it is more than 400 m wide. The general depth of the lagoon varies from 1.5 to 1.8 m at low water and 2.4 to 3.6 m at the highwater. The lagoonal shore of the island consists of a sandy beach though at some places the beach rocks are

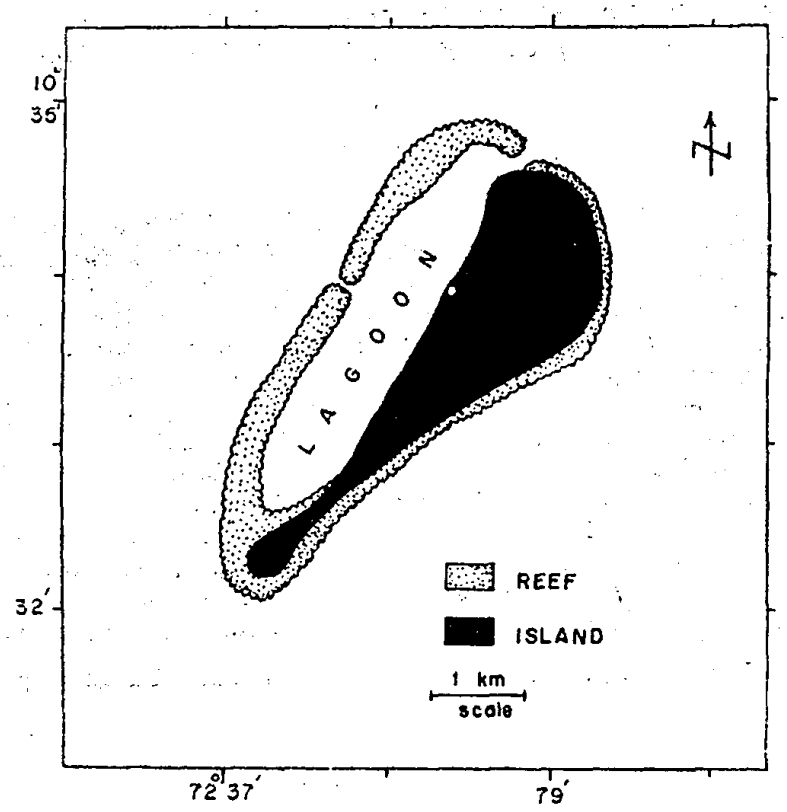


Fig. 1. Map of Kavaratti atoll showing study area (white circle)

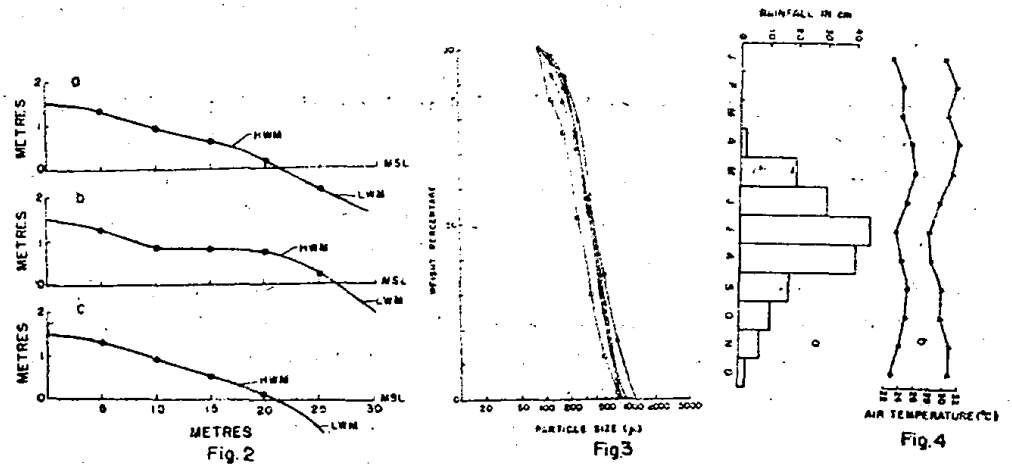
exposed during low tide. The south eastern seaward shore of the island is marked by storm beaches consisting of coral pebbles and boulders piled up well above the high tide mark. The lagoon side of the beach slopes from about low water neap tide and has a luxurious growth of macrophytes *viz.*, two species of sea grass *Thalassia hemprichii* and *Cymodocea isoetifolia* forming a bed extending to a distance of 100 m in the lagoon. At the ebb, grass bed becomes partially exposed and often decayed pieces of these are seen piled up in the beach.

MATERIAL AND METHODS

The samplings were conducted in the beach during premonsoon and post-monsoon periods when the beach conditions were almost stable. Monthly samplings have been carried out between March 1975 and May 1976 except during June and July 1975 due to heavy monsoon. The sampling stations were located along a transect from high water mark to the low water mark at

an interval of 2 m. A metal quadrat (1/10 m^2) was forced into the sand to a depth of approximately 16 cm and the sand was scooped and sieved through a 1 mm mesh sieve. The fauna retained was sorted alive at the site and then preserved in 5% formalin. In the laboratory, the number of individuals of each species and the wet biomass of each group were determined for each sample. In the preparation of sample for weighing, excess external water was blotted and the shells of the bivalve *Mesodesma glabratum* were removed beforehand. The biomass is represented as wet weight. Beach profile studies, sand grain size analysis were also done along with physico-chemical factors. Beach profiles were taken on three occasions. The results are shown in Figs. 2 a-c.

Sand samples for granulometric analysis were taken from five stations starting from the berm of the beach and at two metre intervals along the transect. Cumulative curves were plotted for each of the sample (Fig. 3) and median diameters and sorting coefficients calculated. Two sorting coefficients are given, one defined as the square root of the quotient of the first and third quartiles, for comparison with calculation made by Mc Intyre (1968) and Mc Intyre and Eleftheriou (1968) for various tropical and temperate beaches, and the other, Qd ϕ defined as (ϕ_3 and ϕ_1) /2 where ϕ_3 is $\log_2$ of the third quartile and ϕ_1 is $\log_2$ of the first quartile (Krumbein, 1934).



Figs. 2-4 Beach profile at the sampling station during March & Sept. 1975 and Jan. 1976 (fig. 2); Cumulative curves for sand particle size analysis (fig. 3); and rainfall(a) & temp. (b) (max. x, min. ● at Kavaratti.

The sorting coefficient which is less than 2.5 shows that the sediment is well sorted. The quantitative variation is negligible for the first two points and the last two points. However, the middle point always showed a lesser quartile variation in both the quartiles. For the third quartile the 4th and 5th point values are considerably higher than the first and second points.

RESULTS AND DISCUSSION

Physical and chemical parameters have been investigated in detail whenever possible. The random studies in the lagoon did not show much significant

Table I. Particle size analysis of sand from Kavaratti beach.

Station	Metres below berm	Medium particle size (μ)	First Quartile (μ)	Third Quartile (μ)	Qd ϕ	So
1	Berm	380	240	480	0.560	1.06
2	2 m	380	215	480	0.550	1.09
3	4 m	380	180	370	0.500	1.07
4	6 m	380	210	600	0.565	1.08
5	8 m	430	215	610	0.750	1.11

seasonal change (Table II). Some of the characteristics have been observed earlier (Qasim and Sankaranarayanan, 1970; Qasim, Bhattathiri and Reddy, 1972; Sankaranarayanan, 1973).

The islands of the Lakshadweep group has a tropical climate and based on the weather the year may be divided into three seasons. Southwest monsoon brings heavy rainfall which sets in by the middle of May and lasts towards the middle of September. However, the onset may change within a range of about 10/15 days. An examination of the data of rainfall during the years 1971-75 shows that the Lakshadweep area gets widespread rainfall during July-August (Fig. 4).

The average temperature and rainfall based on the observations over five years up to 1975 have been plotted using data of Indian tide table (Fig. 4). The mean monthly air temperature for the area shows slight variation between months. The low temperature during the year occur at the time of monsoon, which brings in heavy rainfall. The distribution of rainfall during the different months of the year was found to vary considerably in the years observed. Temperature of the sand at surface and at varying depths depend on factors such as wind, beach slope, exposure of the beach and the surf water temperature. The tidal conditions of Kavaratti have been described using a periodical data from the nearest available island *viz.*, Minicoy. The tides are of a mixed type with a strong semidiurnal influence. The diurnal inequality is large (Fig. 5) The maximum predicted spring-tide amplitude is more or less equal during the three months (i.e. March, August and November) varying from 1.1 m to 1.35 m.

The observations made on physical and chemical parameters during the study are summarised in Table II.

The beach at Kavaratti is almost flat and is composed of fine sand. The fauna though poor in variety is rich in abundance. Five faunal groups *viz.*, Polychaetes, Bivalves, Decapods, Amphipods and Isopods were recorded in which the last two groups form minor constituents in number and biomass. The whole intertidal region may be classified into three zones. The upper, the middle and

Table II. Summary of physical and chemical measurements made at Kavaratti beach during March 1975 to April 1976.

Measurements	1975			1976
	Premonsoon	Monsoon	Postmonsoon	Premonsoon
Width of the beach	26 m	—	30 m	25 m
Width of the intertidal area	9 m	—	10 m	11 m
Mean sand particle size	380 m			
Temperature (°C) :				
Air	29	31	31.5	—
Water	33	—	31	—
Sand surface	30.5-32.0	28.0-32.0	29.8-34.0	25.0-28.0
5 cm below surface	30.0-31.5	28.0-32.0	29.0-31.5	25.0-27.5
10 cm below surface	29.0-30.5	27.8-30.2	27.5-30.2	25.0-27.5
Salinity (‰) :				
Lagoon water (surface)	34.34	34.45	34.65	—
pH :				
Lagoon water (surface)	8.10	8.00	8.20	—

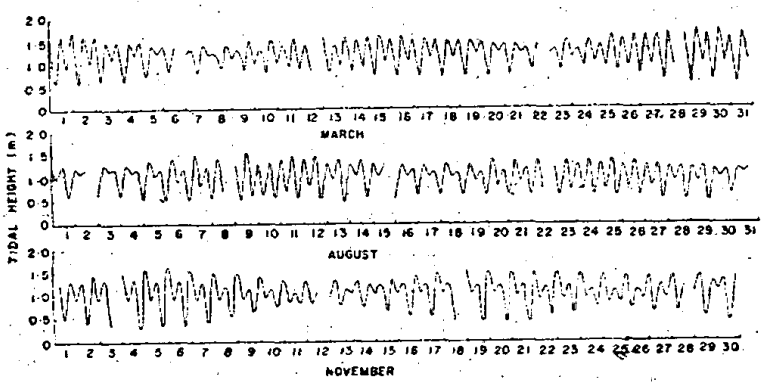


Fig. 5. Predicted tides for Kavaratti for different months

the lower zone and accordingly the faunal composition also varies. The characteristics of zones in the beach at Kavaratti suit well with that of the description of the same at Tulear by Pichon (1967).

The organisms of the macrofauna also show three different spatial distribution on the beach. The upper zone between the high water mark and the wash zone is dominated by the presence of amphipods, isopods and the megalopa of ocypode crabs. The middle zone which is the most productive part of the beach located between wash zone and low water mark, is mostly occupied by polychaetes, the bivalve *M. glabratum* and the anomuran mole crab *H. adactyla*. However, among these, the most dominant group is the polychaetes. The other two are migratory and move over the beach according to the tide. *H. adactyla* being an active migrant occasionally escapes from the quadrat. However, their presence cannot be overlooked. In the present study, the greatest contribution

to the total biomass comes from this zone. Philip (1974) has observed at Cochin beach that a very rich macrofauna exists in the mid tide zone when compared to the other zones. Occasionally a burrowing sipunculid is also seen in this area which is not quantitatively assessed in the present investigation because their burrows go beyond 16 cm limit of the depth of the quadrat. However, their occasional appearance reveal that their contribution to the intertidal biomass cannot be ignored. The lower zone is rather poor in the macrofauna. The polychaetes are present in this zone though much less in number. Both *M. glabratum* and *H. adactyla* are also occasionally present in this zone. At Kavaratti certain unidentified fish fingerlings were also observed burried in the sand showing frequent migratory habits along the tide. Though these fishes have not been quantitatively assessed, their occurrence in this area indicate that they form an important biomaterial contributing to the food for the invading predators of the intertidal zone.

The upper zone is partially dry except during high water. All the samplings were done during the low tide, and the berm was mostly inhabited by isopods, amphipods and occasionally by megalopa of ocypods. The isopod species were found in almost all the collections from the high tide mark. The abundance of isopods is noticed on three occasions during the period under study wherein the number per metre transect was 180 in September and January and 200 in February. The number of specimens varied from 40 to 200/m transect, the maximum biomass obtained being 3.00 g/m transect (Fig 6 a & b). The maximum numbers were recorded in the months of January/February when the biomass was correspondingly high. The increase in biomass soon after post-monsoon apparently shows a settlement either during early premonsoon or monsoon period (Fig. 6 b). The frequent appearance and disappearance of isopods during sampling make it rather difficult to predict their distribution pattern on the beach. Ansell, Sivadas, Narayanan, Sankaranarayanan and Trevallion (1972) observed the presence of isopod *Eurydice sp.* throughout the year at Shertallai and Cochin and the numbers and biomass of this species rose towards the end of monsoon months. Govindankutty and Nair (1966) described occasional and erratic distribution of isopods in the Cochin and nearby beaches. Gauld, Bagenal and Connel (1953); Scott (1960) observed on the beach at St. Kilda (Scotland) one species of isopod viz., *Eurydice pulchra* leach which is abundant with numbers recording up to 7380/m^2 and four other species from the sand occurring in fewer numbers.

Amphipods are represented in small numbers from the intertidal region with maximum numbers of 60/m transect occurring in October, representing a biomass of 0.9 gm wet weight (Fig. 6c and d). The work conducted on intertidal amphipods from the Indian coast by Surya Rao (1974) shows that the intertidal region is a favourable habitat for amphipods. This holds true for Kavaratti beach also.

Though a detailed study of the ocypod crabs was not conducted, the megalopa stage of ocypod collected during sampling shows that two recruitments

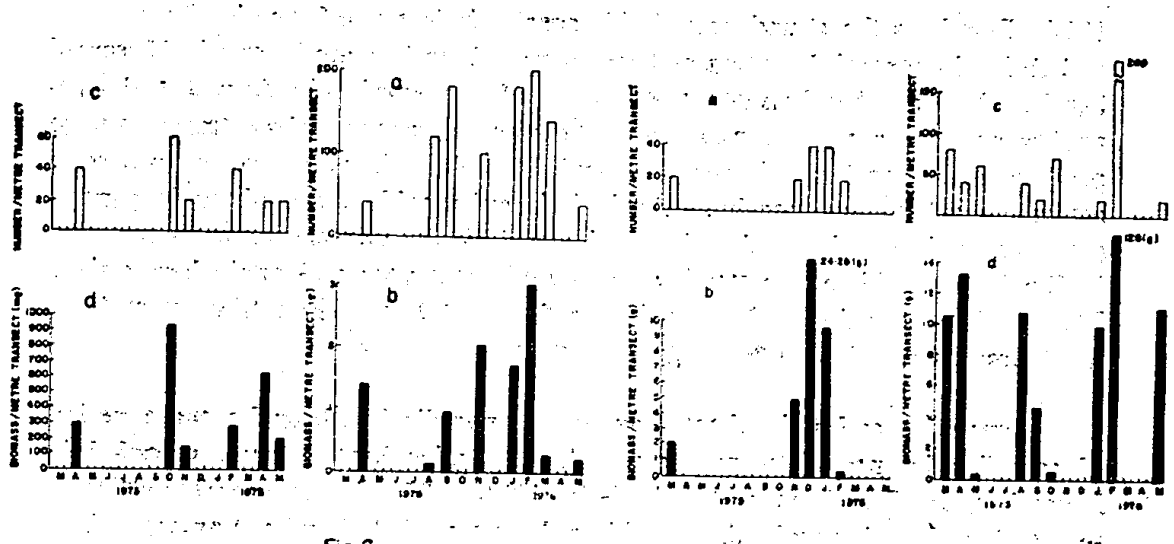


Fig.6

Fig.7

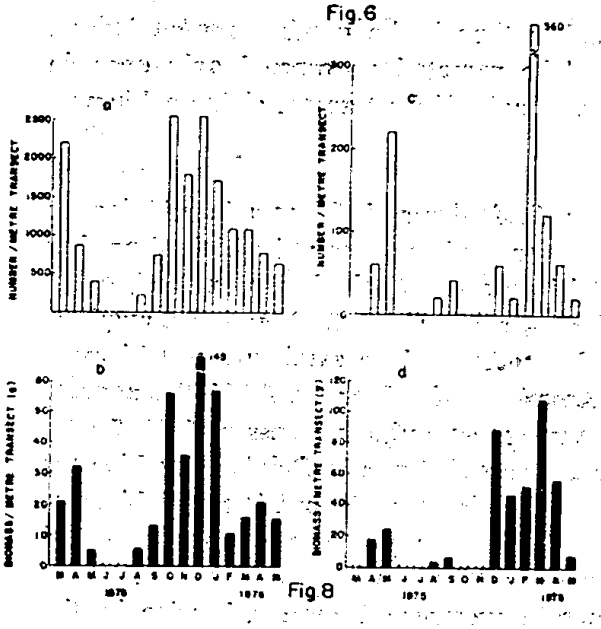


Fig.8

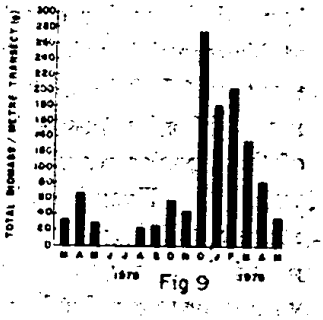


Fig 9

Figs. 6-8. Number of species & biomass/m transect of Isopod sp. (6a & b); Amphipod sp. (6c & d); Megalopa of Ocypode (7a & b); *Hippa adactyla* (7c & d); *Scoloplos sp.* (8a & b) and *Mesodesma glabratum* (8c & d) respectively.

Fig. 9. Total biomass of the macrofauna during diffierent months.

take place, one in the premonsoon and the other in the postmonsoon season (Fig. 7 a). A maximum biomass of 24.26 gm/m transect was recorded in December (Fig. 7 b). Ocypods being an active migrant, could not be investigated in detail. However, observing their burrows and their frequency on the beaches it can be seen that they are quite plentiful in the beach of Kavaratti. Trevallion, Ansell, Sivadas and Narayanan (1970) observed many burrows of ocypod crabs in the high tide zone at Shertallai beach.

Hippa adactyla formed a major component of the fauna in the beach. The highest number per metre transect was recorded in the month of February,

1976. Based on the abundance of this species it is clear from the figures 7, c and d that in general, breeding and recruitment is rather continuous in Kavaratti beach. The number biomass relationship of the species in August and September suggests a poor representation during monsoon when compared to premonsoon months. A steady growth is taking place in the premonsoon settlers in subseuqent months. Again it is quite evident that there is a post-monsoon settlement in the beach as evidenced by the appearance of young ones in October and this group steadily grows until next year and attain larger size. The numbers recorded at Kavaratti ranged from 20 to 240/m transect and the wet biomass from 0.3 to 128.12 g/m transect.

Nematodes and Oligochaetes appeared sporadically throughout the period of sampling in negligible numbers. A few oligochaetes were recorded in December, 1975, February and April in 1976. The largest number (100/m transect) collected was in April, with a biomass of 3.5 g/m transect. The highest biomass obtained was in December though the number recorded from the transect was only 20/m transect. The nematodes occurred only once in May 1975 and the number represented was only 40/m transect giving a biomass of 0.06 g.

Polychaetes belonging to the genera *Scoloplos* and *Glycera* in addition to certain unidentified polychaetes were also reported at Kavaratti which altogether formed the major constituent of the total biomass. *Scoloplos* sp. was observed at Kavaratti beach throughout the period of study (Fig. 8 a) and the numbers went to 2560 in October and 2540 in December. The maximum wet biomass *viz.*, 145 g/m transect was noted in December. In January, 1976 the number of this species recorded was 1720/m transect representing a biomass of 56.5 g/m transect. Eventhough the greatest number recorded was in October, the biomass represented is only 55.5 g/m transect. The increase in number and biomass noted in the postmonsoon period may denote the presence of newly settled young ones or further growth of the early settlers collected in the samples (Fig. 8 b). *Glycera* sp. which is poorly represented appeared twice in the lower zone in January and March, showing a biomass of 0.014 g in January and 0.004 g in March. Though negligible in numbers certain unidentified polychaetes were also collected twice during the premonsoon period. These forms do not make a very significant contribution to the biomass but collectively the maximum number recorded was 280/m transect occurring in October and representing a biomass of 0.122 g wet weight per metre transect.

Ansell, Sivadas, Sankaranarayanan and Trevallion (1972) noted a maximum number of polychaetes consisting mainly of *Glycera alba* in March and December in Shertallai beach and the other three polychaetes species *Lumbriconeries latreilli, Onuphis eremitta* and *Scoloples marsupialis* appeared in maximum numbers in the postmonsoon and early premonsoon periods. Similarly from Cochin beaches, Philip (1974) has recorded *Glycera alba, Glycera longipinnis* and *Nerine cirratulus* with high concentrations in the mid tide level. The

presence of Polychaete *Scoloplos* sp. throughout the year at Kavaratti presumably indicate their greater tolerance to local conditions and the availability of food. Such an adaptation to varying ecological conditions is quite common among polychaetes as evidenced by their continuous presence in the tropical beaches of Shertallai (Ansell, Sivadas, Narayanan, Sankaranarayanan and Trevallion, 1972).

The molluscan fauna on the Kavaratti beach was scanty and was represented by a single bivalve species *viz*. *Mesodesma glabratum* which was second to polychaetes in numerical abundance. On many beaches, molluscs are not represented at all (Taylor, 1971). From Inhaca, MacNae and Kalk (1962) have recorded only *Donax faba*. Similarly, on Aldabra (Taylor, 1971) and on Diego Garcia (Stoddart and Taylor, 1972) the bivalve *Actodea glabrata* is the only inhabitant of beaches. However, Mc Intyre (1970) mentioned that nine species were recorded on sandy beaches in Scotland. At Kavaratti also earlier workers Namboodiri & Sivadas, 1979) recorded only *M. glabratum*.

The bivalve *M. glabratum* was found to occur frequently though not regularly in the samplings. However, their continued presence in the beach is revealed while random collections were made. The maximum density of *M. glabratum* occurred in the middle zone. It is generally found burried in the sand at a depth of 2-3 cm. *M. glabratum* migrates up and down the beach with rise and fall of the tide, almost all the times maintaining its position in proximity to the waters' edge. This species formed 34.64% of the total biomass for the whole period of study. The maximum density of this species recorded was 220/m transect observed in May 1975 and 360/m transect in February 1976. Thus premonsoon months appear to be more productive (Fig. 8 c).

The population density indicates that during the monsoon and postmonsoon period the animals in the beach grow in size contributing to the larger biomass. To get a clear picture of the distribution and abundance of the four common faunal groups, the biomass of the individual species are represented in Figs. 7 b, 7 d, 8 b, and 8 d.

Including the minor forms the total biomass for the whole period under study (Fig. 9) ranged from 20.71 to 273.70 g/m transect with a monthly average value of 90.47 g/m transect. The maximum value was found in December and the minimum in August. The distribution of the biomass of the three major groups per m^2 at Kavaratti beach along a transect from high water mark to the level of the wash zone is shown in the Figs. 10 a-c.

An important finding in respect of the total number of animals and the biomass shows that both the values in the late monsoon period i.e. August and September were low when compared to the other two seasons. Only isopods dominate numerically in these months. However, the numerical abundance

of all the dominant groups was noticed in the postmonsoon and early premonsoon period and the maximum biomass was observed between December and April.

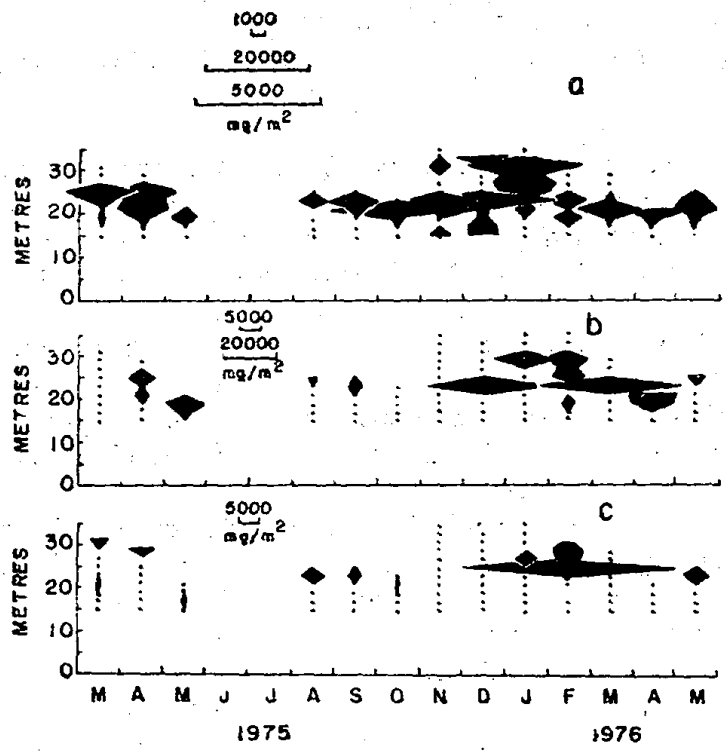


Fig. 10. The distribution of the major components in the macrofauna observed at Kavaratti beach. (a) *Scoloplos* sp. (b) *Mesodesma glabratum* and (c) *Hippa adactyla* (represented as biomass/m², ●– stations sampled but animals not recovered).

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