

Benthic fauna around Mauritius island, southwest Indian Ocean

B S Ingole, Z A Ansari & A H Parulekar

National Institute of Oceanography, Dona Paula, Goa 403 004, India

Received 9 September 1991; revised 29 September 1992

Distribution of benthic fauna in the Exclusive Economic Zone of Mauritius was studied during September-October 1987. Mean faunal density (macro+meio) and dry weight biomass was 10848 no. m^{-2} and 228.8 mg.m^{-2} , respectively. The macrofauna was dominated by polychaetes (52%), bivalves (13.7%) and isopods (12.3%). Among other groups ophiuroids, amphipods and tanaidaceans were important. Meiofauna was dominated by nematodes (53.6%) and harpacticoids (15.9%) and occurred at all the depths. Over 60% of the fauna was concentrated in the top 4 cm depth of the sediment. Benthic biomass showed a general decline with an increase of water depth, and correlated positively with the chl-*a* of the surface water. The macro : meiofaunal biomass ratio indicated dominance of meiofauna in the deeper waters.

Present knowledge of the quantitative distribution of benthic invertebrates in the Indian Ocean is far from adequate. Biological studies in the central Indian Ocean show it as an area of high benthic biomass and biological productivity¹⁻³. The available data suggest that benthic production at the deep sea varies in accordance with the primary production of the overlaying water.

Mauritius island occupies the southwest sector of the Indian Ocean and benthic faunal community studies of its coast are scant. Sokolova⁴ classified the Mauritius water as eutrophic for benthic production. The present investigation is an attempt to collect more information on the quantitative benthic faunal composition and its distribution in relation to sediment characteristics, primary production and depth in the exclusive economic zone (EEZ) of Mauritius.

Materials and Methods

Present study covered regions (Fig. 1) between Mauritius and Rodrigues as well as Mauritius and Agalega island and sampling was made during the 35th cruise of *ORV Sagar Kanya* (15 Sept. to 12 Oct. 1987). Bottom samples were collected by van Veen grab (0.7 m^2 area with 40 cm depth) at 18 stations and by spade corer at 2 stations. Sub-samples of meiofauna (up to 3 replicates) were taken by inserting a small plexiglass coring device (4 cm diam.) of 35 cm length. Core samples were divided into 2 cm sections and preserved in 4% formalin-Rose Bengal solution. The animals contained in the sediment were separated using sieves

of $500 \mu\text{m}$ and $63 \mu\text{m}$ and biomass (dry weight) was determined.

Macrofauna were collected from grab/corer samples using a plexiglass quadrant (170 cm^2) and animals were separated by passing the sediment through a $500 \mu\text{m}$ sieve. Density was determined

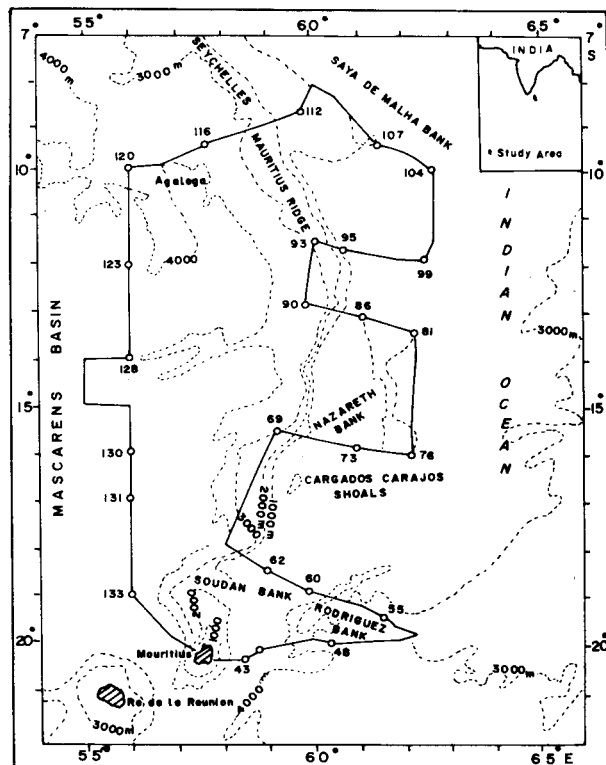


Fig. 1—Map showing the location of the sampling stations

by physical count of the individuals, the wet weight of the sample was also noted. Conversion of wet weight into dry weight was made. From each sample a small aliquot of sediment was used for analysis of particle size⁵.

Results and Discussion

The area investigated had brown and white ooze type of substrate with varying amounts of sand, silt and clay (Fig. 2). In general, the sediment collected from Rodrigues Bank and Seychelles-Mauritius Ridge was dominated by coarse fractions including coralline sand, while that of Saya de Malha Bank had broken shells and fragments with sand and silt. Mean percentages of sand, silt and clay in the area were 39.26, 32.51 and 28.23, respectively.

Density and biomass

The abundance (no. m^{-2}) of benthic fauna varied between 2290 and 38224 with an overall average density of 10848. High faunal density occurred in brown oozy silty sand and clayey silty bottom. The benthic biomass (mg.m^{-2}) varied from 22 to 1117 with an overall mean value of 229. A significant influence of depth on the faunal density and biomass was observed (Fig. 3). It was interesting to note that the fauna exhibited negative trend with increasing depth. Attempt made to correlate the faunal abundance with distance from the shore yielded no significant result. Earlier studies⁶ on abyssal benthos of the central Indian Ocean have reported a negative correlation between faunal abundance and depth and a positive correlation between faunal abundance and distance from the shore. Others have also reported a negative correlation between density and depth. To define a general relationship of the abundance of benthic fauna with depth, a least square regression or estimating equation has been calculated for all animal densities and biomass. The estimated equations were:

$$Y = 32044.1496 - 6.2287X; r = -0.8126; n = 20$$

(for density)

$$Y = 680.6789 - 0.1222X; r = 0.7133; n = 20$$

(for biomass)

From the slope it appears that the density changes are sharper than the biomass in relation to depth.

Benthic biomass observed in the present study is comparable to that reported elsewhere in the Indian Ocean⁷, and is well within the reported range of the world oceans for similar depths⁸. Variation in standing crop of benthos may be due to the changes in sediment texture and variation

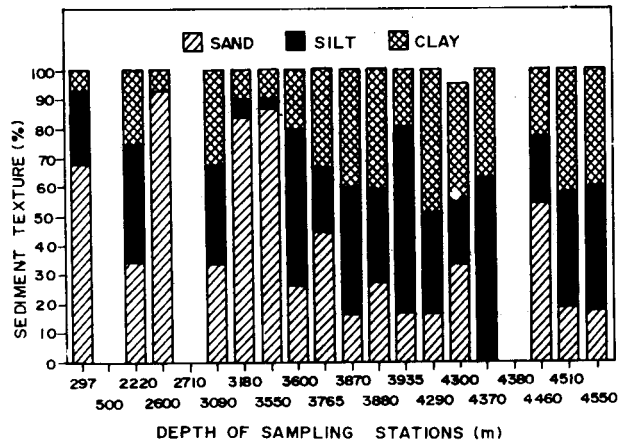


Fig. 2—Sediment texture (percent composition of sand, silt and clay)

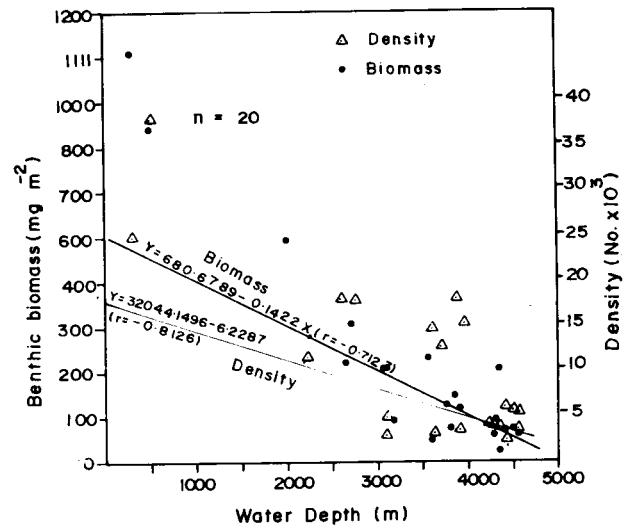


Fig. 3—Correlation of faunal density and biomass with water depth

in depth^{9,10}. Thomas¹¹ reported the importance of substratum in controlling the abundance of marine organisms and suggested that the abundance of sediment covering coarser bottom has pronounced effect on benthic biota.

The results obtained by several authors in different ocean regions indicate that food availability is the major factor controlling distributional patterns of deep sea benthos. Detritus and bacteria form the main food for deep sea benthos. Detritus is produced mainly in the euphotic zone and reaches benthos after passing through the benthopelagic zone. The absolute amount of organic matter reaching seafloor therefore, depends on the level of primary production in the surface water. A clear indication of the effect of surface productivity is given by the regression of benthic bio-

mass on chl-*a* concentration¹². The biomass and chl-*a* data of the present study was subjected to regression analysis (Fig. 4) which gave a good correlation and yielded regression equation of:

$$Y = -41.0492 + 27.2227X; r = 0.9308; n = 12.$$

Therefore, in accordance with the general productivity of the ocean, the bottom fauna also varied in its biomass.

In the tropical ocean the area of high benthic biomass are characterised by the highest influx of available organic material as food¹³. The present study area falls under the tropics of high biological productivity which can sustain high benthic biomass⁴. The accumulation of benthic food varies according to the depth of water column and this could be responsible for differences in benthic standing crop at different depths having different substrata as observed in the present study.

Macrofauna

Macrofauna comprised of 10 major faunal groups. Average percentage contribution for the major groups was—polychaetes 52, pelecypods 13.8, isopods 12.3, ophiuroids 5.8, tanaidaceans 5.2, amphipods 4.9, gastropods 2.3, brachiopods 1.5, echiurid worms 1.2, and sipunculids 0.7. Polychaetes were the most important macrobenthic group with 100% prevalence and were followed by peracarid crustaceans and molluscs (Table 1). Among crustaceans the isopods occurred more frequently than either amphipods or tanaidaceans. Agglutinating rhizopod protozoans were also encountered in a number of samples. However, due to their composite structure the density could not be ascertained. Such rhizopod masses have been reported from abyssal depths of north Pacific¹³ and other parts of Indian Ocean⁶.

The abyssal benthic fauna of present study area is quite rich and its abundance and distribution follows similar pattern reported earlier from central Indian Ocean⁶ and other seas¹⁴. Polychaetes showed continuous distribution and were recorded at all depths but other groups had discontinuous distribution. Some earlier studies on deep sea benthos have reported distinct boundaries between diverse assemblages¹⁵ while others have found few consistent discontinuity¹⁶, as in the present study.

Meiofauna

Among meiofauna the nematodes with a 100% prevalence and 53.6% average composition and harpacticoids with a 100% prevalence and 15.9%

composition were the important major groups. Ostracods, turbellarians and foraminiferans were less important numerically and did not occur regularly in the samples. The analysis of the core samples at selected stations indicate that meiofauna was present only 12 cm depth into the sediment (although the cores were taken upto 35 cm depth) and $\geq 70\%$ of the specimens were found between the surface and 6 cm depth with bulk (45%) confined to top 2 cm (Fig. 5). However, this general decrease is not a rule and even intermediate reversals in faunal densities do occur.

High copepod and ostracod density was recorded in the coarser sandy silty sediment. In earlier studies distribution of harpacticoids and ostracods have been directly related to the particle size and amount of silt present in the sediment¹⁶ and high density of copepods have been reported in coarser sediment. Thus it appears that these groups will be profoundly influenced by changes in particle size.

Vertical distribution

Deep water meiofauna is generally concentrated to a relatively thin surface layer of the bottom deposits because of the availability of food and oxygen. Earlier, Ansari & Parulekar¹⁰ and Thiel² re-

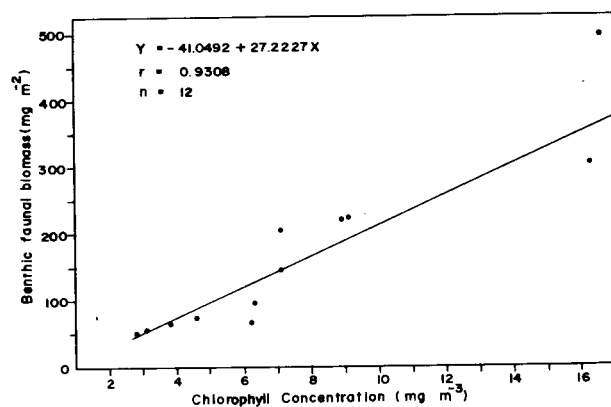


Fig. 4—Correlation of benthic biomass with surface chlorophyll *a* concentrations

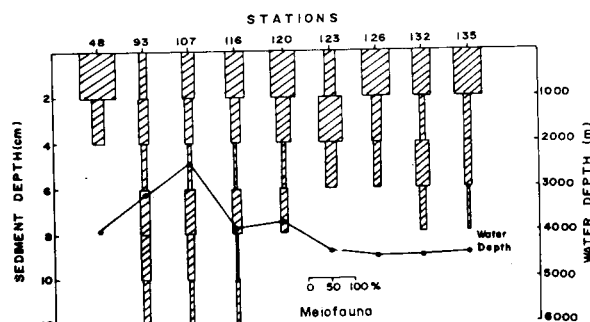


Fig. 5—Vertical distribution of meiofauna

Table 1—Composition of benthic fauna at the selected stations

Station No.	Sampling Depth (m)	Macrofauna (%)										Meiofauna (%)					
		Polychaeta	Echitrida	Sipunculids	Amphipoda	Tanaidacea	Isopoda	Pelecypoda	Gastropoda	Ophuroidea	Brachiopoda	Nematoda	Harpacticoida	Ostracoda	Turbellaria	Foraminifera	Others
43	4550	52.3	-	-	2.6	12.3	16.2	8.6	-	5.2	2.8	48.9	16.7	6.7	6.5	12.6	8.6
48	3880	57.2	-	1.6	1.8	-	11.2	11.2	-	5.6	-	52.2	9.5	2.9	7.7	-	27.7
69	3600	43.4	-	2.2	12.3	8.9	16.5	16.4	-	-	2.5	42.8	18.3	3.4	-	19.6	19.3
73	296	36.2	5.4	-	5.2	2.1	5.5	35.2	8.3	-	3.3	50.6	22.8	-	-	14.6	8.6
76	3180	60.5	1.8	-	8.6	10.2	-	9.7	-	4.9	3.3	45.2	32.4	-	-	20.1	2.3
81	3550	71.1	-	-	-	2.9	9.5	7.5	4.5	4.4	-	48.5	23.8	-	-	27.7	-
86	2710	48.8	3.2	2.6	1.8	5.5	7.5	18.4	7.8	4.5	-	46.2	12.3	3.7	12.8	14.2	24.9
93	3090	51.6	1.4	-	10.0	-	20.1	12.3	-	-	4.6	60.5	8.2	-	8.2	25.3	8.9
99	2600	48.3	2.8	3.2	2.4	-	12.4	24.3	6.4	-	-	48.4	26.3	-	-	-	-
107	2220	44.5	4.9	-	2.8	1.8	-	30.4	9.7	5.9	-	43.3	4.9	11.9	14.3	-	25.6
112	500	30.8	2.2	3.2	4.6	4.6	6.4	48.2	-	-	4.7	52.5	20.7	-	-	18.5	8.3
116	3870	49.3	-	-	9.6	3.2	8.2	16.4	4.7	3.9	4.7	63.6	11.3	6.6	9.2	-	9.3
120	3765	54.4	-	-	6.2	-	12.2	14.9	-	12.3	-	61.3	9.7	-	-	-	10.8
123	4380	56.3	2.6	-	4.9	2.3	2.9	10.4	1.6	18.2	0.8	49.6	33.2	-	17.2	-	-
126	4460	48.5	-	-	-	12.3	18.9	2.8	-	11.3	6.2	55.3	12.2	10.5	13.2	-	8.8
127	4510	42.2	-	-	-	6.6	26.3	-	1.8	23.1	-	59.6	9.7	3.9	20.3	-	6.5
128	4300	60.3	-	-	3.6	-	22.4	3.7	-	5.2	4.8	84.3	7.2	4.5	16.6	-	7.4
129	4290	72.6	-	-	1.2	-	18.5	-	-	7.7	-	68.2	8.7	-	7.2	-	15.9
132	3935	58.6	-	-	12.3	19.5	2.3	2.3	-	7.7	-	58.2	12.5	6.4	7.2	-	15.7
135	4370	54.3	-	1.6	7.8	12.4	8.3	3.6	-	2.0	-	53.6	18.2	2.2	10.3	-	15.7
\bar{x}		52.1	1.2	0.7	4.9	5.2	12.3	13.8	2.3	5.8	1.5	53.6	15.9	3.1	7.6	8.5	11.2
\pm		10.3	1.8	1.2	4.1	5.6	8.1	12.3	3.4	6.2	2.1	7.4	8.3	3.7	6.8	10.2	8.3

ported 70 to 80% of meiofauna in the upper 2 cm of the sediment with an exponential decrease in density below this depth in Andaman Sea and western Indian Ocean respectively. The present study shows that the fauna could penetrate to a maximum depth of 12 cm (Fig. 5). However, reports for Pacific Ocean¹⁷ show that deep sea meiobenthos can penetrate to a depth of 30 cm. Nematodes and turbellarians are capable of penetrating deeper into the anoxic sediment layer. Penetration of fauna to deeper layer may be the result of feeding pressure and predation by macrobenthos as suggested earlier.

Since the different areas of Mauritius EEZ showed variations in benthic standing crop, it was tried to estimate the difference in total resource use by the benthic fauna in the five geomorphologically distinguished submerged Bank/ridge areas of the present study [namely Mauritius Island (sts 43 to 62), Nazareth Bank (sts 69 to 90), Saya de Malha Bank (sts 99 to 112) Seychelles-Mauritius ridge (sts 93, 95 and 116), and Mascarens Basin (sts 120 to 133)]. Meiofauna has a metabolic rate roughly five times that of macrofauna¹⁸. For comparative purpose a rough metabolic index was calculated by multiplying the meiofauna biomass by 5 and adding it to the macrofaunal biomass. The total energy use for meio and macrofauna was calculated (Table 2). The estimated values showed great deal of differences. The values are about 3 times higher in Seychelles Ridge and 2 times higher in Nazerath Bank than Mauritius Bank. However, the Saya de Malha Bank and Mascarens Basin showed similarity with Mauritius Bank in energy use.

Biomass relationship between macro and meiofauna at different depths showed macrofauna dominated in depths < 3000 m (Fig. 6). In deeper waters, as the macrofauna impoverished, the ratio shifts in favour of meiofauna which generally dominates in the depth above 4000 m with some exceptions. It has been suggested¹⁹ that in areas of very low benthic food supply, such as deep sea, the meiofauna are at an advantage over macrofauna, since they can better utilise the limited food resources in the form of particulate matter. When food input increases, the macro and meiofauna also increases, leading to a stable condition where further increase is not possible since macrofauna feed on meiofauna.

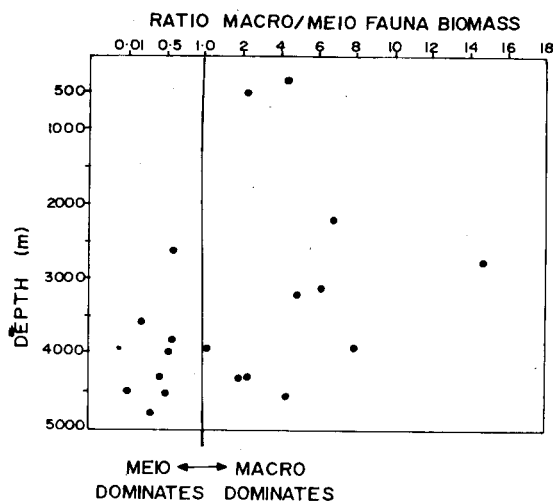


Fig. 6—Macro to miofauna biomass ratios in EEZ of Mauritius

Table 2—Benthic metabolic index in the EEZ of Mauritius

	Biomass (g.m ⁻²)		Metabolic index		Σ	Ratio over Mauritius Island
	Meio (benthos feeders)	Macro	5 × Meio	1 × Macro		
Mauritius Island (Sts 43 to 62)	61.77	48.62	308.85	48.62	356.62	1
Nazareth Bank (Sts 69 to 90)	97.04	102.69	485.20	102.69	587.89	1.65
Saya de Malha Bank (Sts 99 to 112)	35.10	206.31	175.50	206.31	381.81	1.07
Seychelles						
Mauritius Ridge (Sts 93, 95 & 116)	114.23	264.11	571.15	254.11	825.26	2.31
Mascarens Basin (Sts 120 to 133)	41.80	27.92	290.00	27.92	317.92	0.89

The rich fishery of Mauritius Bank can be linked with rich values of standing crop of benthos and high productivity in this region³. The nature of the sediment in the area being sandy and silty, it is possible to do trawling to exploit the population of deep sea shrimps. It is however, important to mention that this data is based on the first survey of the EEZ of Mauritius. Subsequent surveys would help delineating the exploitable fishing grounds of this region.

Acknowledgement

We are grateful to Dr. B.N. Desai, Director, for facilities. Thanks are due to Drs B Nagendranath, Shyam Prasad and J.I. Goes for providing the data on sediment texture and chlorophyll *a*.

References

- 1 Bruun A F, *Nature Lond*, 177 (1956) 1105.
- 2 Thiel M, *Veroeffentlichungen Inst fuer Meeresforschung Bremerhaven*, 2 (1966) 131.
- 3 Humphrey G F, *Bruun Memorial lecture Tech Ser*, 40 (IOC, UNESCO) 1972, 1.
- 4 Sokolova M N, *Mar Biol*, 16 (1972) 1.
- 5 Folk R L, *Petrology of sedimentary rocks*, (Hemphills, Austin, Texas) 1968, 107.
- 6 Parulekar A H, Harkantra S N, Ansari Z A & Matondkar S G P, *Deep-Sea Res*, 29 (1982) 1531.
- 7 Neymann A A, Sokolova M N, Vinogradova N G & Pasternak F A, in *The biology of Indian Ocean*, edited by B Zeitschel, (Springer-Verlag, Berlin) 1973, 467.
- 8 Zenkevitch L A, Barsanova N G & Belyaev G M, *Dan SSR*, 130 (1960) 54.
- 9 Parulekar A H & Ansari Z A, *Indian J Mar Sci*, 10 (1981) 280.
- 10 Ansari Z A & Parulekar A H, *Indian J Mar Sci*, 10 (1981) 285.
- 11 Thomas M L H, *Studies on the benthos of Bedford river, Prince Edward Island*, Ph.D. thesis, Dalhousie University, Halifax, Canada, 1970.
- 12 Mann K H, *Ecology of coastal waters: A system approach*, (University of California Press, Los Angeles) 1982, pp. 256.
- 13 Thiel H, in *The sea*, edited by G T Rowe, (Wiley, New York) 1983, 167.
- 14 Jumars P A & Hessler R R, *J Mar Sci*, 34 (1974) 547.
- 15 Haedrich R L, Rowe G T & Polloni P T, *J Mar Sci*, 33 (1975) 191.
- 16 Sanders H L, Hessler R R & Hampson G R, *Deep-Sea Res*, 12 (1965) 845.
- 17 Coull B C, *Oecologia (Berl)*, 4 (1970) 341.
- 18 Gerlach S A, *Oecologia (Berl)*, 6 (1971) 176.
- 19 Elmgren R, *Cont Asko Lab Univ Stockholm*, 14 (1976) 1.