

## Quantitative Distribution of Benthic Fauna on the Inner Shelf of Central West Coast of India\*

ARUN H. PARULEKAR

National Institute of Oceanography, Panaji

Received 11 July 1973; revised received 22 August 1973

One hundred ninety-eight benthos samples, from 34 stations situated along 7 transects, were examined to study the quantitative distribution of macrobenthic fauna on the inner shelf of the Central West Coast of India. The average biomass values indicated a higher concentration of macrobenthos near the coast than at greater depths. The population density also decreased with increasing depth. The benthic organisms were unevenly distributed at various depths and the individual faunal assemblage exhibited a positive substratum selectivity. Amongst the ten faunal subgroups observed in the present investigation, the annelids were most dominant and in order of biomass and population density, followed closely by molluscs. Crustaceans and echinoderms were present in low population density and biomass.

THE role of benthic fauna in the food of demersal fishes is well recognized<sup>1</sup>. The Central West Coast of India, between 18° and 13°N, holds rich demersal fishery resources<sup>2-4</sup> with maximum exploitation on the inner shelf. Very little<sup>5,6</sup> is known about the quantitative distribution of macrobenthic fauna along this part of the Arabian Sea.

The present paper gives an account of the quantitative distribution of macrobenthic fauna in 5-40 m depth zone of area situated between Vengurla (15°51'N; 72°38'E) in north and Malpe (13°21'N; 73°32'E) in the south (Fig. 1). The physiographical features of the Central West Coast of India have been described earlier<sup>7</sup>.

### Materials and Methods

Material for this study was obtained during December 1971 to May 1972 from 34 stations, situated along 7 transects (Fig. 1), and in all 198 samples were examined. Each transect, running perpendicular to the coast, was sampled at 5, 10, 20, 30 and 40 m depth interval by using a 0.2 m<sup>2</sup> Van Veen Grab. At each depth, duplicate samples were obtained. A 0.5 mm mesh size stainless steel screen was used for sieving the sediments. The organisms retained on the screen were sorted, identified, enumerated and, later, preserved in 5% neutralized sea water formalin for further examinations. Biomass values are presented on dry weight measurements. For estimating biomass, the shells of molluscs as well as of echinoids were removed. The crustaceans were treated with 5% HCl for dissolving exoskeleton whereas polychaetes and other tube-building species were removed from the tubes. The dry weights were determined after drying in an oven at 95°C until constant weight was obtained (4-8 hr). Substratum type has been determined by visual examination and the classification of Sanders<sup>8</sup> is followed.

\*This paper is a contribution under the project No. 201.1 (Biological productivity of waters along the Central West Coast of India) of the Biological Oceanography Division, NIO.

### Results and Discussion

*Biomass variations* — Quantitative distribution of macrobenthic fauna as assessed from the average biomass values at various depths is shown in Fig. 2a (curve 1). The values are highest in the 5 m depth zone, but show a steep fall, reaching minimum, in 10 m depth zone. Poor benthic fauna in 10 m depth line is probably due to severe impact of flow of rivers which give rise to unfavourable ecological conditions on this part of the Arabian

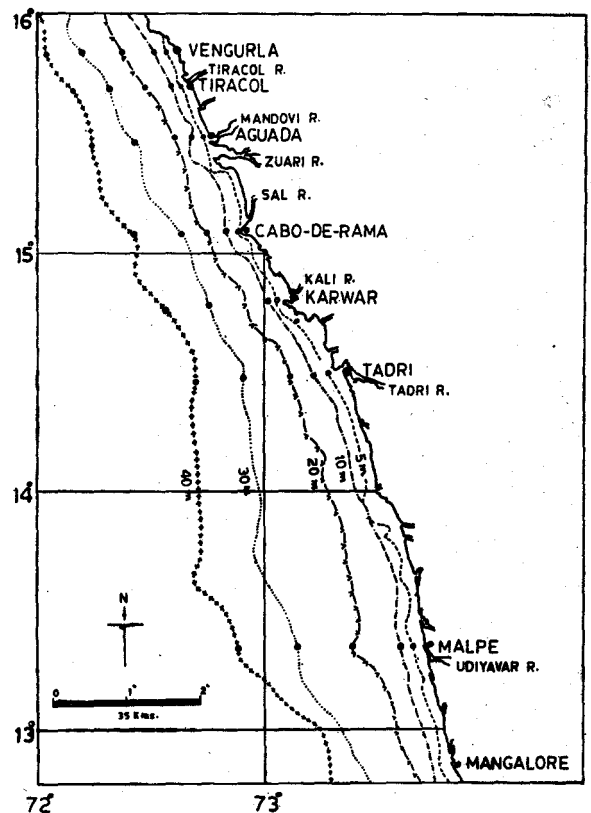


Fig. 1 — Map of Central West Coast of India, with depth profile and station positions

Sea coast<sup>9</sup>. The average biomass values improve considerably in 20 m depth zone but, thereafter, show gradual decrease towards the greater depths of 30 and 40 m.

The biomass values (g/m<sup>2</sup>) at 5 m depth zone along all the transects vary from 0.2 (Aguada) to 32 (Malpe) (Table 1). The values indicate rich benthic fauna at both the northern and the southern extremities, of the area investigated, with low values in the intermediate areas. Neymann<sup>6</sup> has observed

a region of low benthic fauna, in the 20-100 m depth zone, at approximately 15°S (in the vicinity of Goa). The 10 m depth line, as evidenced from low benthic biomass values, is a zone of poor benthic fauna. In 20 m depth zone, the quantitative distribution (0.3-16.5 g/m<sup>2</sup>) of macrobenthos, while showing considerable improvement in benthic fauna of 10 m, gives an idea of uneven nature of animal distribution. Another interesting feature of the quantitative distribution of macrobenthos in 20 m are the observed high biomass values (16.5 g/m<sup>2</sup>) at Aguada transect. These values reflect on the observed high demersal fish catches in the 20 m depth off Aguada<sup>4</sup>. In greater depths of 30 and 40 m the overall macrobenthic faunal distribution is of lower magnitude with localized variations but the biomass never exceeds 4.5 g/m<sup>2</sup>.

**Benthic fauna** — The quantitative distribution of benthic faunal groups, as determined by biomass and numerical abundance, is shown in Fig. 2. In order of biomass and population density, the annelids are the most dominant component of macrobenthic fauna at various depths of the Central West Coast of India. At all the stations, the annelids vary from 0.5 (10 m) to 6.5 (5 m) and from 14 (40 m) to 33 (5 m) in biomass (g/m<sup>2</sup>) and number (n/m<sup>2</sup>) respectively. Thus, both in biomass and population density, the annelids go on decreasing from lesser to greater depths. In overall percentage, they account for 50% by biomass and 57% by numerical count of the macrobenthic fauna.

The next important faunal group is the molluscs. In weight and number, they represent 40% (biomass) and 31% (number) of the total benthic fauna. The maximum concentration of this faunal group is in 5 m depth zone, where they even surpass annelids, quantitatively. Desai<sup>10</sup> has also observed dominance of molluscs in the benthic population of nearshore region off Cochin on the south-west coast of India. In the greater depths of 10 to 40 m, the distribution of molluscan benthic fauna exhibits a similar pattern as annelids.

Crustaceans are recorded from all the depths (Fig. 2), except 10 m, but their biomass and population density is considerably low. The other constituent of the macrobenthic fauna of the Central West Coast of India is the echinoderms. They are observed only in two depth zones of 20 and 40 m, but with the low biomass and numerical count of 0.2 g/m<sup>2</sup> and 6 n/m<sup>2</sup> respectively.

**Animal-sediment relationship** — It has been well established<sup>11-13</sup> that the qualitative and the quantitative distribution of the benthic fauna has a direct relationship with the type of bottom, and the physical nature of the substratum acts as a limiting factor to a greater extent.

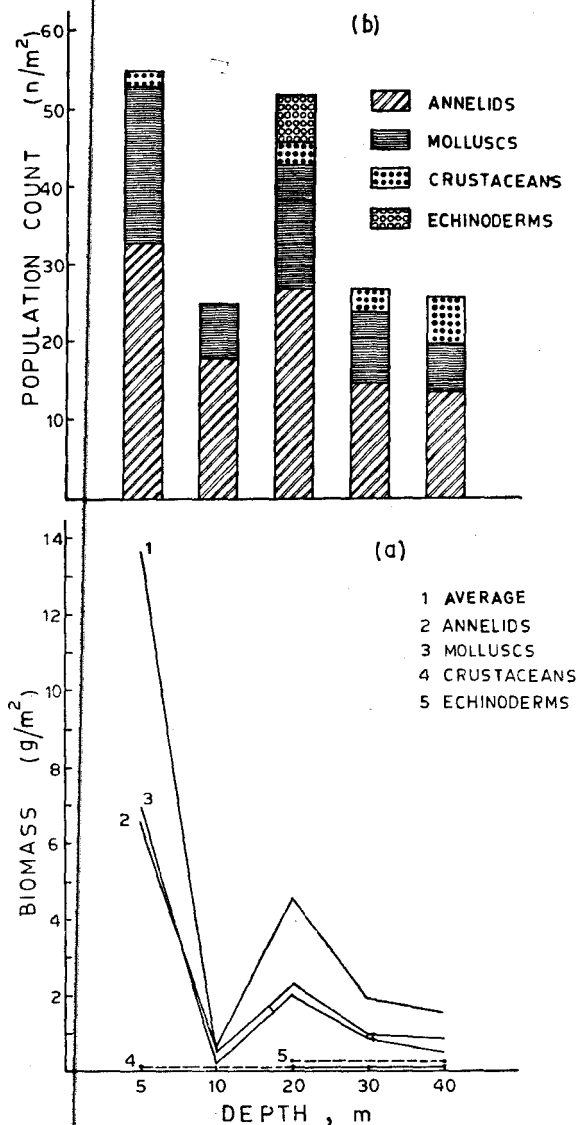


Fig. 2 — (a) Average and faunal groupwise biomass distribution of macrobenthos at various depths on the inner shelf of the Central West Coast of India; (b) population density of important macrobenthic faunal groups at various depths on the inner shelf of the Central West Coast of India

TABLE 1 — AVERAGE BIOMASS VALUES (g/m<sup>2</sup>) AT VARIOUS DEPTHS ALONG DIFFERENT TRANSECTS OFF CENTRAL WEST COAST OF INDIA

Depth zone m	Vengurla	Terekhol	Aguada	Cabo-de-Rama	Karwar	Tadri	Malpe
5	30.5	3.8	0.2	×	7.60	7.8	32.0
10	0.4	2.1	1.3	0.1	0.05	0.6	0.2
20	0.7	0.3	16.5	5.6	2.80	0.4	6.0
30	0.6	0.3	3.3	3.5	3.50	1.0	1.5
40	0.8	2.3	1.3	0.1	4.40	1.4	0.4

TABLE 2 — RELATIONSHIP BETWEEN AVERAGE BIOMASS (g/m<sup>2</sup>) OF BENTHIC ORGANISMS AND THE TYPE OF SUBSTRATUM

Faunal group	Type of substratum		
	Sandy mud	Black silty clay	Green silty clay
Depth zone, m:	5	10-20	30-40
Polychaetes	6.575	2.844	1.890
Pelecypods	3.982	1.665	0.708
Gastropods	3.012	0.305	0.502
Scaphopods	—	0.249	0.205
Isopods	0.030	—	—
Amphipods	0.090	—	—
Decapods	—	0.100	—
Stomatopods	—	—	0.138
Echinoidea	—	0.110	—
Holothuroidea	—	0.115	—

Data on the quantitative distribution of the macrobenthic fauna of the Central West Coast of India reveals that the faunal assemblage (Table 2) exhibits a relationship with a particular type of sediment. The area investigated is characterized by 3 distinct sediment types. In the nearshore region of 5 m depth zone, there is uniformly sandy mud bottom, whereas in 10-20 m depth zone, the soft bottom is made up of black silty-clay, except at Aguada transect where the sandy mud extends into this depth zone. In the greater depths of 30 and 40 m (Table 2) there is dominance of green silty-clay sediment.

An analysis of the data of the present investigation, as shown in Table 2, indicates the nature of benthic fauna in relation to different type of sediments. The polychaetes, occurring at various depths, exhibit a preference for sandy mud with decreasing abundance in silty-clay type of sediments. Amongst molluscs, the subgroups, pelecypoda and gastropoda, are abundant in sandy mud, but like polychaetes exhibit diminishing distribution in silty-clay substratum. It is seen that the 'elephant-tusk' (Scaphopoda) shells avoid colonization in sandy mud and exhibit preference for silty-clay sediments.

The crustacean faunal subgroups as represented by isopods, amphipods, decapods and stomatopods are essentially epifaunal elements. Being detritophages<sup>14</sup>, the distribution of such animals is more related to the availability of detritus in the substratum, rather than to the physical nature of the sediment<sup>1</sup>. Moreover, being epifaunal organisms, their abundance is governed by interaction of some more environmental factors, which are beyond the scope of the present investigation.

The echinoderms, as represented by 'sea urchins' (echinoidea) and 'sea cucumbers' (holothuroidea), despite their low population density exhibit a selectivity for black silty-clay substratum and accordingly are restricted in distribution to only 10-20 m depth zone.

A résumé of the results obtained in the present investigation brings out the uneven distribution of macrobenthic fauna at various depths. The results also corroborate earlier observations<sup>1,5,6,15</sup> wherein it was inferred that the benthic population density decreases with increasing depths, a phenomenon consistent with the general distribution pattern of the biomass of benthic organisms in other regions of Indian Ocean, as well. The uneven distribution of the macrobenthic fauna in the present context cannot be fully explained but a full-scale ecological approach, will enable to understand, not only the intricacies of quantitative distribution but will also help in the proper assessment of benthic standing crop, in relation to demersal fishes of this part of the Central West Coast of India.

#### Acknowledgement

Sincere thanks are due to Dr N. K. Panikkar, Director, for facilities and permission to participate in the project. Grateful acknowledgements are made to Dr S. N. Dwivedi for initiating the project and for encouragement. Thanks are also due to Dr B. N. Desai for critical appraisal of the manuscript.

#### References

1. SAVICH, M. S., *Oceanology*, **12** (1972), 113.
2. RAO, K. V., *Proc. Symp. Living Resour. of Seas Around India*, Vol. 18 (Mar. Biol. Ass. India, Mandapam), 1968.
3. RAO, K. V. & DORAIRAJ, K., *Indian J. Fish.*, **15** (1968), 1.
4. PRABHU, M. S. & DHAWAN, R. M., *Nat. Inst. Oceanogr. India, Publ.*, 1972, 1.
5. BELYAYEV, G. M. & VINOGRADOV, N. G., *Dokl. Akad. nauk SSSR*, **138** (1961), 5.
6. NEYMANN, A. A., *Oceanology*, **9** (1969), 861.
7. PANIKKAR, N. K., PARULEKAR, A. H. & UNTAWALE, A. G., *Seminar — Indian continental shelf, Panaji, Goa* (Indian Geophysical Union), 1971.
8. SANDERS, H. L., *Bull. Bingham oceanogr. Coll.*, **15** (1956), 345.
9. LON'HURST, A. R., *Second Int. Oceanogr. Congr., Moscow*, (Abstracts), 1966, 27.
10. DESAI, B. N., *J. Bombay nat. Hist. Soc.*, **68** (1971), 355.
11. SANDERS, H. L., *Limnol. Oceanogr.*, **3** (1958), 138.
12. JOHNSON, R. G., *Mar. Geol.*, **11** (1971), 93.
13. BLOOM, S. A., SIMON, J. L. & HUNTER, V. D., *Mar. Biol.*, **13** (1972), 43.
14. NEYMANN, A. A., SOKOLOVA, M. N., VINOGRADOV, N. G. & PASTERNAK, F. A., *The biology of the Indian ocean* (Springer-Verlag, Berlin), 1971.
15. SOKOLOVA, M. N. & PASTERNAK, F. A., *Dokl. Akad. nauk SSSR*, **144** (1962), 103.