

## ECOLOGY OF BENTHIC PRODUCTION IN THE COASTAL ZONE OF GOA

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### ABSTRACT

Qualitative and quantitative differences in the spatial and temporal distribution and production of benthic macrofauna in pre- and post-monsoon were observed and the differences are discussed in relation to the environmental factors.

The fauna was comprised of Polychaeta (58.5%), Mollusca (18.1%), Crustacea (9.1%), Echinodermata (7.1%) and other minor taxa (7.3%). Population count and biomass varied from 25 to 7823 m<sup>-2</sup> ( $\bar{x}$  = 1256 m<sup>-2</sup>) and 0.2 to 2251.25 g m<sup>-2</sup> ( $\bar{x}$  = 67.07 g m<sup>-2</sup>) respectively. The higher biomass was mainly contributed by the brown mussel *Perna indica*.

It is deduced that the benthic standing crop could possibly sustain a high yield of demersal fish catch than what is being exploited at present.

### INTRODUCTION

Earlier studies on the benthic communities from the Goa coast mainly deal with spatial variations (Parulekar, 1973; Ansari, Parulekar, Harkantra and Ayyappan Nair, 1977 and Ansari, Parulekar and Jagtap, 1980) and no information is available on the seasonal variation in the bottom living communities. Hence, the present study on the ecology, distribution and production of benthic fauna in relevance to demersal fishery resources of coastal zone of Goa, was undertaken.

### MATERIAL AND METHODS

Five stations located on the 10 m depth contour along 60 km stretch of Goa coast (Fig. 1) were surveyed from October 1977 to May 1978, for recording monthly observations. Collection, processing and analysis of environmental and benthic data were done by following the procedure as reported earlier (Parulekar, Nair, Harkantra and Ansari, 1976), and the biomass values are based on wet weight, excluding hard parts.

### RESULTS AND DISCUSSION

The benthic macrofauna were represented by 5 major taxa. Polychaeta which dominated (58.5%) the fauna had the following genera: *Amphrodita*, *Eurythoe*, *Nereis*, *Lumbriconereis*, *Perinereis*, *Marphysa*, *Gonida*, *Glycera*, *Diopatra* and *Pectinaria*. Next in order of abundance were Molluscs (18.2%) which were mainly represented by *Perna indica*, *P. viridis*, *Paphia textile*, *Macra cuneata*, *Pholas orientalis*, *Cardium edule*, *Arca furtosa*, *Siliqua albida*, *Nucula* sp., *Tellina* sp., *Umboonium vestiarium*, *Nerita polita*, *Cerithium morus*, *Cerethidea fluviatilis*, *Turritella* sp., *Telescopium telescopium* and *Oliva* sp. Crustacea accounted for 9.1% of the total macrofauna and were

represented by *Mysis* sp., *Acetes* sp., *Metapenaeus* sp., *Penaeus* sp., *Alpheus* sp., *Limnoria* sp. and Brachyuran crabs—*Charybdis* sp. and *Xenothalmus* sp. Besides this—representatives of Isopods, Stomatopods, Amphipods, Copepods, Harpacticoids and Cumacea were also present. Brittle star (*Ophiothrix* sp.) and Sea urchin (*Echinus* sp.) represented Echinodermata. Hydrozoa, Sipunculida and Nemertea which were grouped as 'other' together constituted 7.3%. The pattern of spatial and temporal distribution of different faunal constituents exhibited graded diversity and was most evident at stations 4 and 5 and partially less at other stations (Fig. 2). At respective stations, occurrence of different taxa were consistent as far as the distribution of dominant faunal group, i.e., polychaeta were concerned. However, total presence or absence of certain groups at some of the sampling sites in certain months were observed. Polychaeta were absent in October at stations 2 and 4 and in January only at st. 4. The occurrence of other faunal taxa showed wide variation and were site specific. Accordingly, Crustacea were more prevalent at station 4 whereas Cumacea were observed at st. 4 only. Similary, Mollusca largely contributed by *P. indica* were dominant at st. 5. Echinoderms occurred at sts. 1, 2, 3 and 5 whereas other groups had stray occurrence.

The population density at different stations and through different months varied from 25 to 7825 m<sup>-2</sup> with a high mean value of 1256 m<sup>-2</sup>. The population count showed striking spatial and temporal variation and accordingly, no uniform pattern could be observed for the abundance of fauna at different stations and in different months. However, the mean values were higher during premonsoon (Table I). At station 2, 3 and 5, a single population maxima either in post-monsoon (st. 2) or in premonsoon

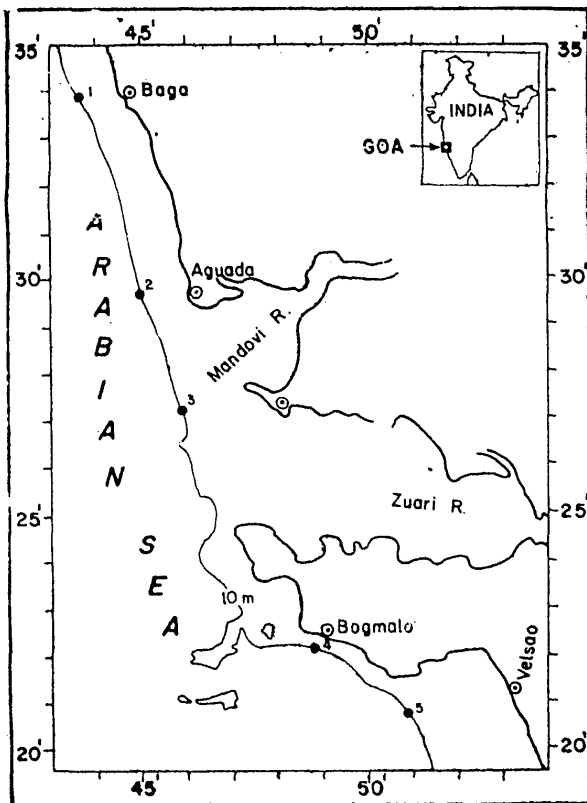


Fig. 1. Map showing the station position.

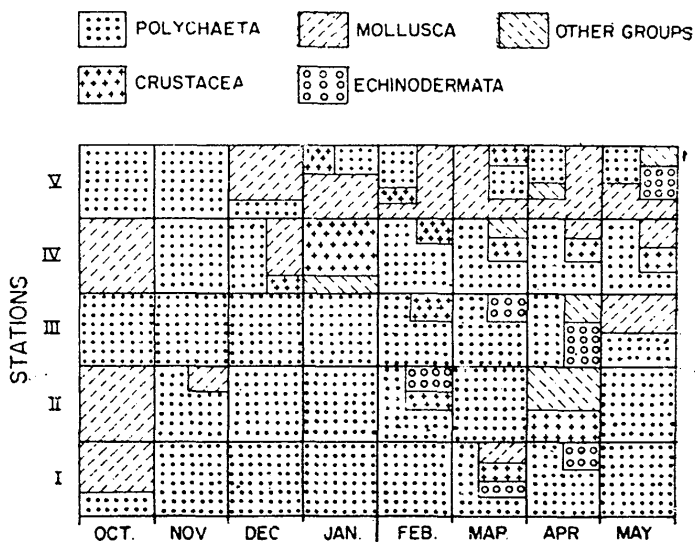


Fig. 2. Monthly benthic faunal composition in percentage at different stations (Each square indicate 100%).

Table I. Monthly population count,  $m^{-2}$  and biomass,  $g m^{-2}$  (in parentheses) at different stations.

| St. No. | Post - monsoon |                |                |                  | Pre - monsoon     |                 |                 |                  |
|---------|----------------|----------------|----------------|------------------|-------------------|-----------------|-----------------|------------------|
|         | Oct.           | Nov.           | Dec.           | Jan.             | Feb.              | Mar.            | Apr.            | May              |
| 1       | 75<br>(2.63)   | 50<br>(0.63)   | 1025<br>(2.75) | 50<br>(0.38)     | 875<br>(0.50)     | 3825<br>(3.12)  | 1900<br>(5.90)  | 300<br>(0.75)    |
| 2       | 120<br>(0.95)  | 2925<br>(8.1)  | 125<br>(1.90)  | 275<br>(2.5)     | 450<br>(3.75)     | 75<br>(1.62)    | 100<br>(2.75)   | 75<br>(2.00)     |
| 3       | 50<br>(0.25)   | 100<br>(1.5)   | 200<br>(2.00)  | 25<br>(0.20)     | 400<br>(5.50)     | 3000<br>(7.73)  | 375<br>(13.63)  | 250<br>(2.50)    |
| 4       | 50<br>(0.45)   | 2200<br>(2.00) | 1500<br>(0.25) | 75<br>(0.63)     | 1050<br>(5.13)    | 6125<br>(9.95)  | 1660<br>(8.50)  | 1150<br>(105.25) |
| 5       | 60<br>(0.45)   | 225<br>(2.00)  | 25<br>(0.25)   | 7050<br>(100.70) | 7825<br>(2251.25) | 2500<br>(11.25) | 1550<br>(50.50) | 600<br>(20.50)   |
| Mean    | 71<br>(1.00)   | 1100<br>(4.0)  | 575<br>(7.14)  | 1495<br>(20.88)  | 2120<br>(453.23)  | 3100<br>(6.73)  | 1115<br>(17.23) | 475<br>(26.25)   |

Table II. Environmental parameters at different stations in post and pre-monsoon.

| St. No. | Post-monsoon   |                  |                  |                 | Pre-monsoon    |                  |                  |                 |
|---------|----------------|------------------|------------------|-----------------|----------------|------------------|------------------|-----------------|
|         | Salinity (ppt) | Temperature (°C) | D. oxygen (ml/l) | Org. Carbon (%) | Salinity (ppt) | Temperature (°C) | D. oxygen (ml/l) | Org. Carbon (%) |
| 1       | 31.25          | 25.1             | 3.93             | 2.17            | 33.22          | 25.9             | 3.41             | 2.41            |
| 2       | 29.44          | 25.5             | 4.31             | 2.22            | 31.72          | 26.1             | 3.91             | 2.58            |
| 3       | 28.31          | 25.6             | 4.47             | 2.36            | 30.12          | 26.8             | 3.89             | 3.85            |
| 4       | 32.13          | 24.9             | 3.75             | 1.44            | 33.95          | 26.2             | 2.91             | 1.65            |
| 5       | 30.68          | 24.5             | 4.97             | 2.60            | 33.41          | 25.7             | 3.83             | 3.65            |
| Mean    | 30.36          | 25.1             | 4.29             | 2.16            | 32.48          | 26.2             | 3.59             | 2.62            |

(sts. 3 and 5) was observed. In contrast, two maxima, coinciding with pre- and post-monsoon, were observed at sts. 1 and 4. Exceptionally, high population count of above  $7000 m^{-2}$  as observed at st. 5 in January-February, was due to heavy settlement of brown mussel *P. indica*.

Corresponding to the population count, the biomass also displayed spatial and temporal variations. The biomass values varied from  $0.2$  to  $2251.25 g m^{-2}$  at all the stations in different months and had a high mean value of  $67.07 g m^{-2}$ . High biomass values (Table I) had no direct relationship with the numerical abundance of fauna but depend on the size of the animal. Accordingly, though the difference in the population count at stations 5 in January and February was  $775 m^{-2}$ , the biomass difference was  $2120.55 g m^{-2}$  mainly due to occurrence of mussels, crabs and prawns.

Environmental characteristics of the area surveyed are shown in Table II. Salinity value varied from  $28.31$  to  $33.41‰$  at all the stations, showing higher values during pre-monsoon. Temperature and organic carbon content also followed similar trend of distribution and showed mean values of  $25.6°C$  and  $2.39\%$  respectively. Muddy bottom had high organic carbon content than the sandy substrate (Tables II and III). Dissolved oxygen values were comparatively lower during premonsoon with mean value of  $3.94 ml/l$  (Table II).

Table III. Sand, silt and clay percentage at different stations in post and pre-monsoon.

| St. No. | Post - monsoon |       |       |                  | Pre - monsoon |       |       |                 |
|---------|----------------|-------|-------|------------------|---------------|-------|-------|-----------------|
|         | Sand           | Silt  | Clay  | Sediment nature  | Sand          | Silt  | Clay  | Sediment nature |
| 1       | 41.96          | 33.04 | 25.00 | sand, silty-clay | 38.75         | 39.75 | 21.50 | sandy silt      |
| 2       | 20.50          | 49.63 | 29.50 | clayey mud       | 19.25         | 47.55 | 32.70 | clayey silt     |
| 3       | 27.50          | 50.40 | 21.35 | sandy silt-clay  | 25.55         | 48.40 | 26.25 | clayey silt     |
| 4       | 71.00          | 18.50 | 10.45 | silty sand       | 60.50         | 23.30 | 16.25 | silty sand      |
| 5       | 40.00          | 49.60 | 10.35 | sandy silt       | 36.50         | 45.70 | 17.80 | sandy silt      |

Seasonal changes in substratum characteristic are shown in Table III. No significant variation in sand, silt and clay fractions at any station was observed, though at each station percentage composition of sand, silt and clay varied considerably and gave rise to six broad type of substratum (Table III).

The subtidal invertebrate macrobenthic fauna from the coastal zone of Goa representing 5 major taxa showed wide range of spatial and temporal variation in biomass and population count. The biomass production was higher than reported for nearshore regions along the central west coast of India (Parulekar, 1973; Ansari, Parulekar, Harkantra and Ayyappan Nair, 1977 and Harkantra, Ayyappan Nair, Ansari and Parulekar, 1980). An assessment of the environmental impact on the macrobenthic population along the coastal zone of Goa explains the variation in abundance and production through different seasons. Environmental conditions during later part of post and through premonsoon season comes as an impetus for the production, settlement and growth of macrofauna which has direct relevance to the benthic fauna in time and space. The findings are in conformity with the earlier reports (Parulekar, Dhargalkar and Singbal, 1980 and Harkantra, 1975), that there are distinct seasonal changes in the distribution of benthic fauna in the estuaries and nearshore regions of the central west coast of India, mainly due to environmentally induced high physiological stresses. The post-monsoon season is characterized by initial settlement followed by secondary colonization, growth and structural development of benthic community.

The coastal zone of Goa, as elsewhere, is important for the commercial exploitation of living resources as a large part of the annual marine fish catch comes from the nearshore regions. The demersal catch which contributes about 30% of the total (Ca 25,000 tons) is exploited, mostly from waters within the depth range of 20 m and the estimated yield is 1885.6 kg km<sup>-2</sup> (Parulekar and Dalal, 1978). The benthic standing crop and the abundance of demersal fish catch along the continental shelf of west coast of India are reported (Harkantra, Nair, Ansari, and Parulekar, 1980) to have positive correlation. The result on benthic biomass, from the present investigation indicates that with an average biomass of 67.07 g m<sup>-2</sup>, the estimated annual biomass production for the area surveyed will be approximately 780 tons or 13,420 kg km<sup>-2</sup> (Sanders, Goudsmit, Mill and Hampson, 1962). The annual macrobenthic production of 13.42 tons km<sup>-2</sup> supports a demersal fish catch of 1.88 tons km<sup>-2</sup> with the conversion efficiency of 14.1% from the secondary to tertiary level. The benthic standing crop can sustain a higher yield of demersal fish, than being exploited at present.

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