

## ZOOPLANKTON STUDIES IN THE INDIAN OCEAN II. FROM THE ARABIAN SEA DURING THE POST-MONSOON PERIOD

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### ABSTRACT

Zooplankton abundance along the west coast during the months of November and December, 1976 was studied. Estimated zooplankton biomass in the surveyed region indicated an increase towards the northern region with a maximum abundance off Bombay. Copepods, chaetognaths, fish eggs and fish larvae had a higher density off the north western coast. Decapod larvae were better represented in the oceanic region and aggregations of the prawn larvae were seen around the Lakshadweep atolls. An unusual abundance of adult bathypelagic prawns - *Acantheephyra sanguinea* - was noted between Kalpeni and Androth islands. A comparison of the zooplankton abundance and estimated fish production of the west and east coasts for the post-monsoon period indicates that the west coast is more productive and has significantly higher zooplankton production which would presumably lead to a greater pelagic fishery resources.

### INTRODUCTION

Some features of the zooplankton abundance along the east coast of India based on R.V. *Gaveshani* cruises have already been reported (Nair, Peter and Paulinose, 1977). The present paper gives the results of some of the later cruises along the west coast of India during October-November, 1976. These surveys along the west coast cover the post-monsoon period and most of the stations occupied were located between 10°N to 20°N lat.

The Arabian Sea is considered to be more productive than the Bay of Bengal (Panikkar and Jayaraman, 1966; Nair, Samuel, Joseph and Balachandran, 1973). Prasad (1969) while studying the relative productivity of the Arabian Sea and the Bay of Bengal had concluded that the level of fertility is significantly higher in the Arabian Sea. Apart from these studies and that of Ponomareva and Naumov (1962), a comparative assessment of plankton abundance for the east and west coasts of India are few. Hence the recent study conducted along the east coast (Nair, Peter and Paulinose, 1977) and the present data from the west coast of India provide material for a comparative evaluation of the occurrence and relative abundance of zooplankton. The data are comparable since the surveys along the east and west coasts were conducted during the post-monsoon period (September October, November) and most of the stations, covered were located within the same latitudes.

### MATERIAL AND METHODS

The Xth cruise of R. V. *Gaveshani* covered stations along the southwest coast during 6-15 October, 1976 and the XIIth cruise along the northwestern coast from 15-28

November, 1976. The tracks of the two cruises and the station locations are shown in Fig. 1. Vertical samples of zooplankton were collected from most of the stations using an IOS net (Currie, 1963). During the Xth cruise, two sets of collections were made from deeper stations—one largely between 20–50 m upto the surface and the other from 500 m to the surface. During the XIIth cruise, depending upon the depth of the station, two hauls: (i) from the thermocline to the surface and (ii) from 150 m to the surface, were taken.

Eightythree samples were analysed for the numerical abundance of copepods, chaetognaths, decapod larvae, fish eggs and fish larvae. Since the stratified sampling

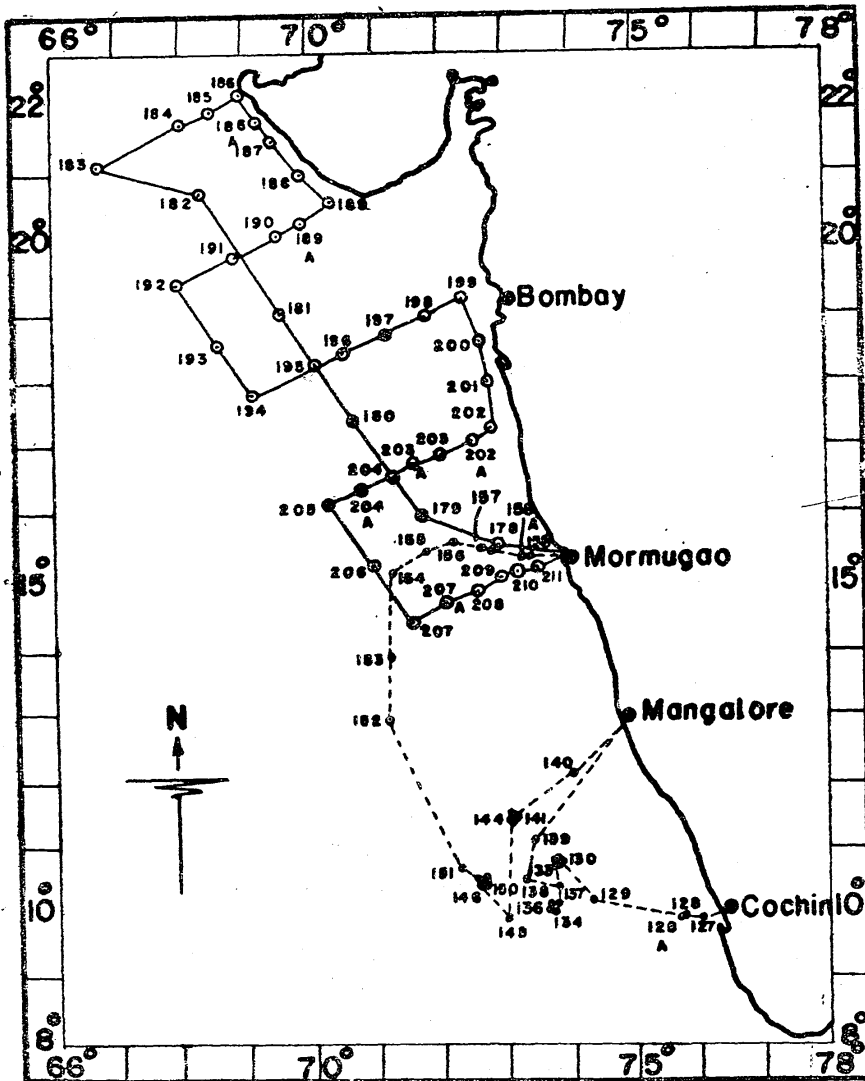


Fig. 1. Cruise tracks of R. V. Gaveshani cruises X and XII. Closed circles show stations occupied during the tenth cruise. Open circles indicate stations covered during the twelfth cruise.

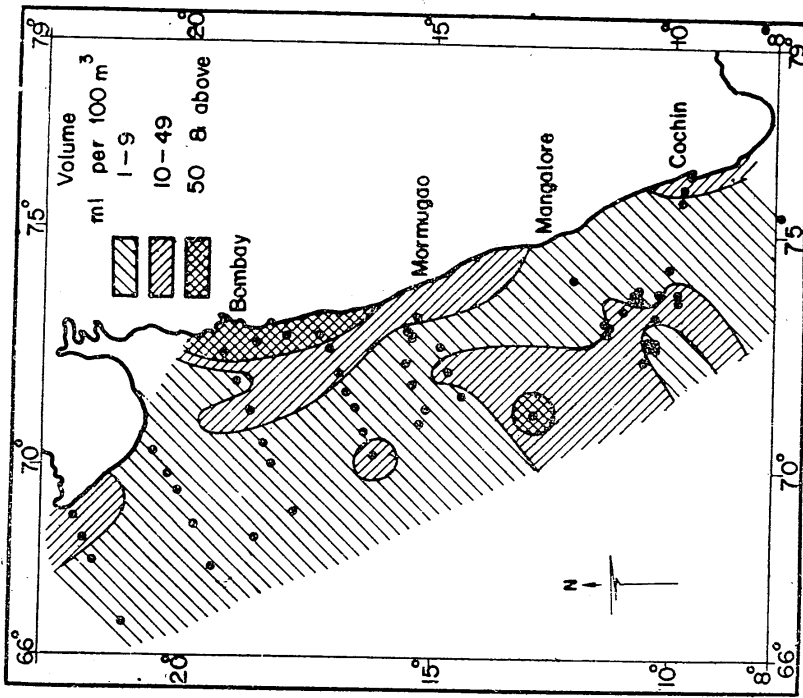


Fig. 2. Biomass distribution in the Arabian Sea.

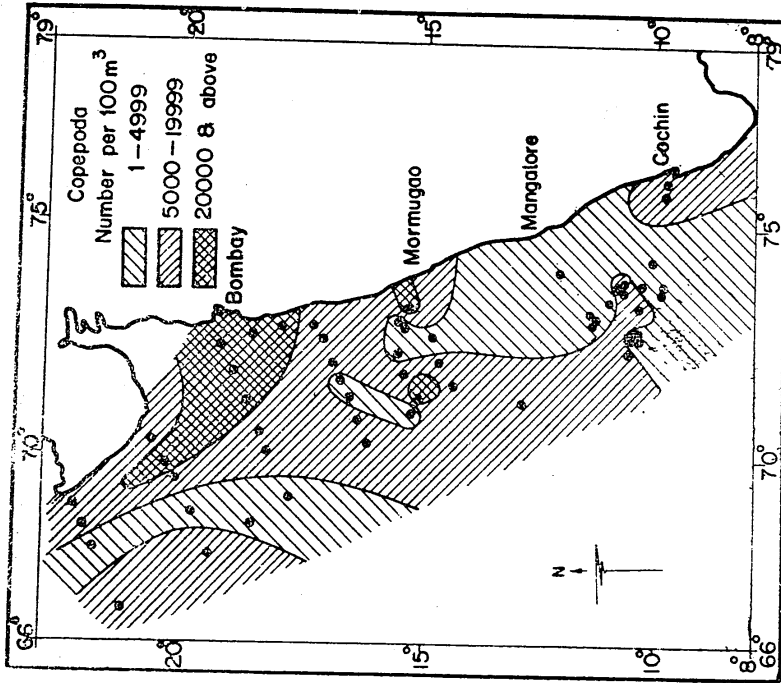


Fig. 3. Distribution of Copepoda in the Arabian Sea.

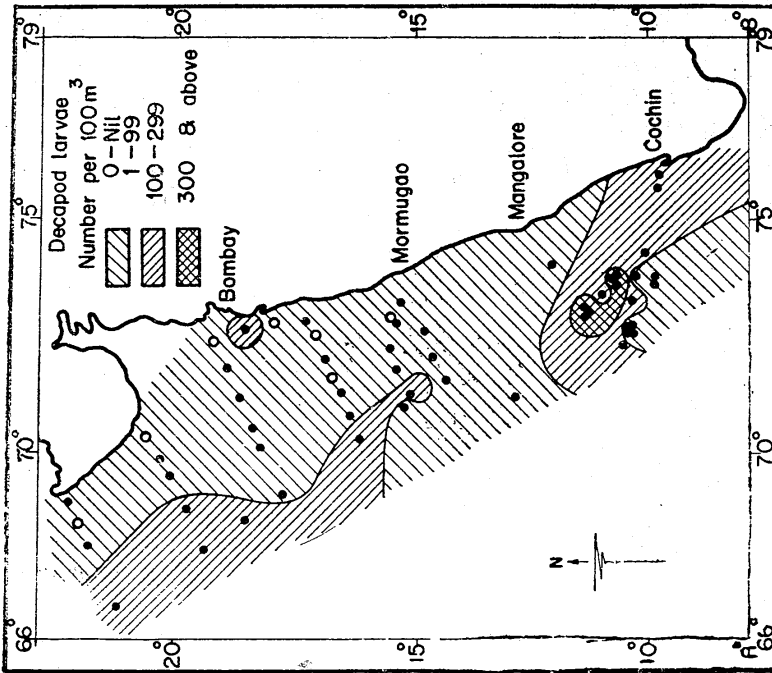


Fig. 5. Distribution of decapod larvae in the Arabian Sea.

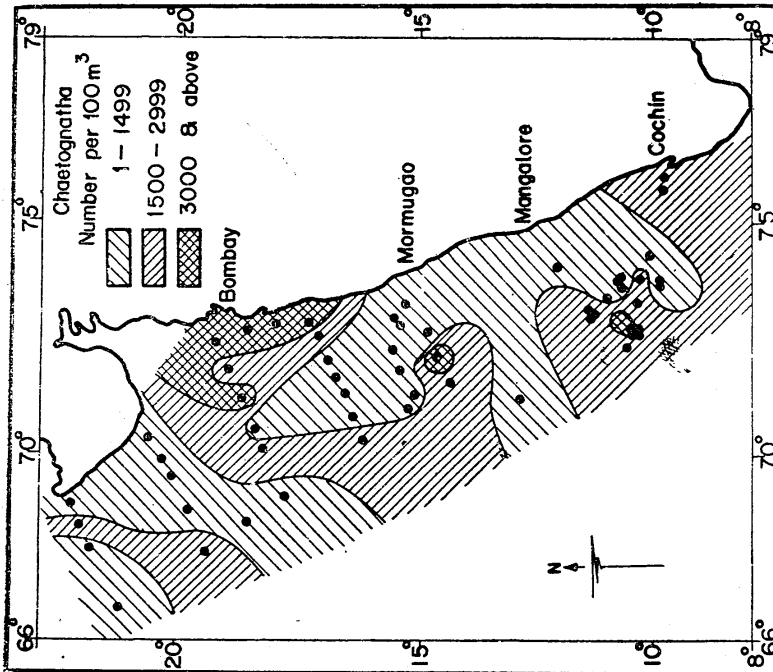


Fig. 4. Distribution of Chaetognatha in the Arabian Sea.

### *Zooplankton studies in the Indian Ocean*

for the two cruises were different for deeper stations, only the samples from the upper 50 m were considered for the quantitative evaluation. One of the main purposes of this study was the comparison of zooplankton production of the west coast with that of the east coast of India studied earlier during the same season. Hence the region under investigation was divided into three areas according to latitudes, as was done during the previous study (Nair, Peter and Paulinose, 1977). The areas cover three regions (i) between 17° 55' to 20° 32' N lat., (ii) between 15° 10' N to 17° 55' N lat. and (iii) between 10° N to 15° 10' N lat.

#### HYDROGRAPHY

High temperature and high salinity, seasonal reversal in circulation induced by the two monsoons and the presence of oxygen minimum layer below the surface are some of the characteristic features of the Arabian Sea. Gallagher (1966) studied the seasonal regime of currents in the Arabian Sea and considered the fall-transition taking place from about the first of October and usually lasting upto the end of November. The counter clockwise circulation of the fall-transition is weaker compared to the clockwise circulation of the spring transition. The 500 m water column sampled includes the surface (0-100/150 m), the subsurface (100/150-400m) and a part of the intermediate(400-600 m) water masses of the Arabian Sea.

The surface salinity and temperature at the time of collection did not indicate much variation, the salinity values ranged from 33.05 to 36.61‰ and temperature from 27.5° to 30.6° C.

#### RESULTS

##### *Biomass*

Estimated values of zooplankton displacement volumes were utilised for the preparation of the biomass chart (Fig.2). The general pattern indicated a northward increase in the biomass values. High concentrations of zooplankton were noticed off Bombay at stations 119, 200 and 201, the values being 100/100 m<sup>3</sup>, 124/100 m<sup>3</sup> and 100/100 m<sup>3</sup> respectively. Zooplankton production in the three regions was calculated. For eliminating the effect of extreme values obtained from a few stations, geometric mean was worked out. The estimated values for the areas 1, 2 and 3 were 10.07/100 m<sup>3</sup>, 8.90/100 m<sup>3</sup> and 8.91/100 m<sup>3</sup> respectively showing an increase towards the northern region.

The time of collection being an important factor, mean biomass values were computed for 6 hourly intervals and the values given below suggest maximum incidence during 1800 to 0000 hours.

<i>Time of collection</i>	<i>Mean biomass (ml/100 m<sup>3</sup>)</i>
0000-0600	18.9
0600-1200	18.8
1200-1800	16.0
1800-0000	31.9

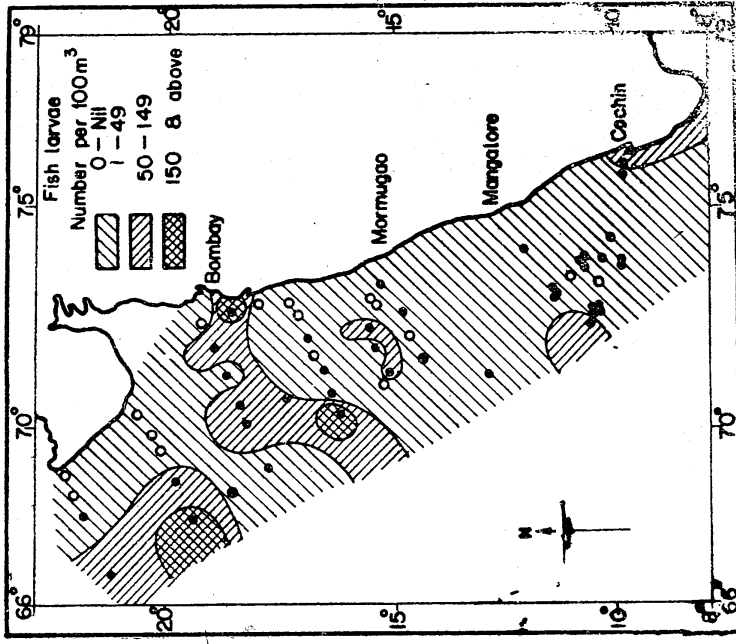


Fig. 7. Distribution of fish larvae in the Arabian Sea.

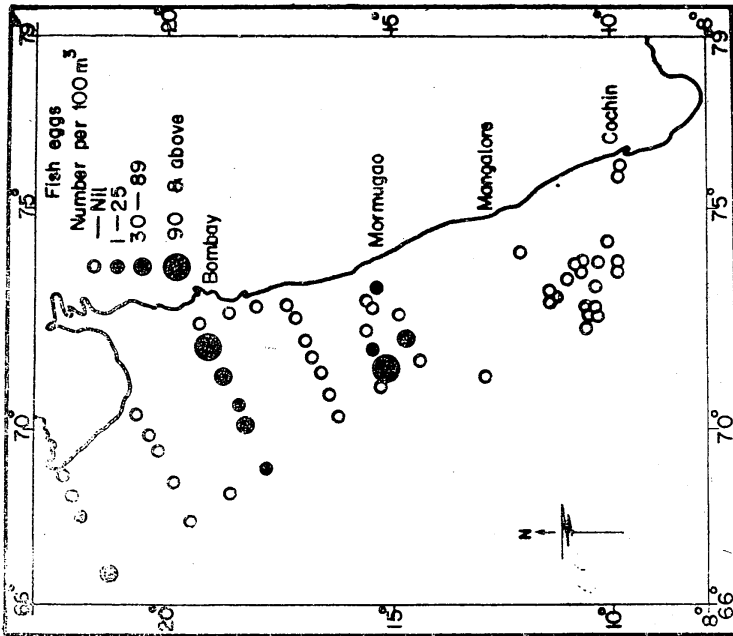


Fig. 6. Distribution of fish eggs in the Arabian Sea.

### *Copepoda*

Copepods dominated at all the stations except at station 149. Fig.3 shows their abundance along the west coast during these months. The northern part of the surveyed region sustained a higher population density. The maximum density of 67,600/100 m<sup>3</sup> was reported at station 197, off Bombay coast.

### *Chaetognatha*

The distribution of chaetognaths is shown in Fig. 4. They were second in numerical abundance and also had a better representation towards the northern region. Highest recorded value was 17,000/100 m<sup>3</sup> from the station 201. At station 149, off Cochin they were dominant.

### *Decapod larvae*

The spatial abundance of decapod larvae (Fig. 5) indicated a relatively low density along the coastal region excepting off Cochin and off Bombay. Their population density was greater outside the 200 m line. A greater concentration of decapod larvae was seen in the areas around Lakshadweep Atolls and maximum number was 800/100 m<sup>3</sup> from the station 141.

From the stations 137 and 138 unusual occurrence of adult bathypelagic prawn identified as *Acanthephyra sanguinea* and belonging to the family Hoplophoridae (Caridea) has been noted. Deep red in colour, and length ranging from 65 to 120 mm, these specimens included several gravid females indicating that the species is breeding in this area.

### *Fish eggs*

The incidence of fish eggs was noted in 16.9% of the samples. The eggs were totally absent off the south-west coast (Fig. 6). Maximum density was 525/100 m<sup>3</sup> at station 154, located off Mormugao.

### *Fish larvae*

Fig. 7 represents the distribution of fish larvae in the region surveyed. A preponderance has been noticed towards the northern region particularly off the Bombay coast. Densities amounting to 200/100 m<sup>3</sup> were obtained from stations 192 and 200.

## DISCUSSION

The overall zooplankton production along the west coast during the months October and November appears to increase towards the northern part of the region under study. This feature is evident from the distribution charts of total zooplankton and the other groups studied excluding decapod larvae. In the area 3 only few stations were occupied off the Mangalore coast and this may probably have biased the biomass values in this region.

Contrary to the findings of a greater abundance of decapod larvae in the inshore areas along the east coast (Nair, Peter and Paulinose, 1977), the decapod larvae were more abundant in the offshore stations along the west coast. The south-west coast of India is considered to be rich in decapod larvae by Menon and Paulinose (1973). The

present data also indicate that the area between Mangalore and Cochin particularly around the Lakshadweep Seas has the maximum density of these larvae. The current pattern prevalent during the period might be influencing their high concentrations in the Lakshadweep Sea. The surface currents in the Arabian Sea during October form an eddy around the Lakshadweep Atolls (Gallagher, 1966) probably favouring the congregation of these larvae in the area by retaining the larvae already present around the atolls for a longer period.

The west coast of India is considered to be more productive than the east coast (Prasad, 1969) and the contributions from the Bay of Bengal to the annual fish landings of India is only 4,31,868 tonnes as compared to 9,90,825 tonnes from the Arabian Sea (MPEDA, 1975). The available data from the *Gaveshani* collections tend to support this view. Table I gives a comparative account of zooplankton abundance along with fish landing data for the east and west coasts of India. In a broad sense, if abundance of plankton is considered an index of fertility of the sea, it would also indirectly reflect the fishery potential of the concerned regions. Along the west coast, the amount of zooplankton production was higher in the period under study. The mean biomass for the west coast is nearly double that of the east coast during the same period. It is noteworthy that the estimated marine fish production for the west coast during the period September–November 1976 shows an identical trend (CMFRI, 1976). While there is a southward increase in the zooplankton production along the east coast the trend is somewhat reversed along the west coast (Table I).

A review of the data on plankton production and its relation to fisheries along the two coasts of India suggests that high concentration of fish occur in areas of high plankton production which in turn are the areas of enrichment (Prasad, 1969). The pelagic fisheries show a direct relationship to zooplankton production (Subramanyan, 1959; Sudarsan, 1964). Nearly two-thirds of the marine fish landings along the Indian coasts are contributed by pelagic fisheries (Banerji, 1973). Hence it would appear that a large

Table I. A comparison of zooplankton abundance and fish landings of the east and west coasts of India for the post-monsoon period in 1976.

Biomass* / fish landings**	West coast	East coast
Biomass at area 1	10.07	7.81
Biomass at area 2	8.90	8.12
Biomass at area 3	8.91	8.42
Biomass irrespective of areas	19.39	11.83
Biomass during day	17.40	9.95
Biomass during night	25.40	13.40
Fish landings		
September–November 1976	294456 (73.25%)	107506 (26.75%)

\* Mean biomass expressed as ml/100 m<sup>3</sup>.

\*\* Fish landing in tonnes.



scale shoaling of pelagic fishes like sardines and mackerel occurs along the west coast where there is higher zooplankton abundance. The relatively low incidence of pelagic shoaling fishes along the east coast associated with the scarcity of zooplankton is thus evident. The extensive upwelling occurring along certain areas of the west coast and a wider continental shelf probably account for the higher zooplankton production along the west coast.

#### ACKNOWLEDGEMENT

Authors are thankful to Dr. S.Z. Qasim, Director, National Institute of Oceanography and Dr. M. J. George, Scientist, NIO, for their critical comments on the manuscript. They are also thankful to the scientists on board *Gaveshani* who made these samples available.

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