

## Copepod composition along southwest and southeast coasts of India.

ROSAMMA STEPHEN

National Institute of Oceanography, Regional Centre, Kochi - 682 018, India.

**Abstract** - Subsequent to the International Indian Ocean Expedition zooplankton collections were made by plankton nets other than the IOSN. However during cruises 8 - 13 of R.V. *Gaveshani* zooplankton samples were collected with IOSN from southwest and southeast coasts of India. Two sets of samples, one from upper layer of thermocline to surface and second set from 500 m to surface were made. Copepod fauna from these collections were studied in relation to the hydrographical properties of the water column. The bulk of the population above thermocline was composed of Paracalanidae forming about 27.6% to 76.7%. Pöccilostomatoids namely Oncaidae and Corycaidae together with the cyclopoid Oithonidae constituted 16.6% to 43.5% in the upper stratum sampled. Though twenty species of calanoids frequently occur above thermocline only a few species namely *Canthocalanus pauper*, *Nannocalanus minor*, *Undinula vulgaris*, *Euchaeta* spp., species of Eucalanidae, *Scolecithricella ctenopus*, *Lucicutia flavicornis*, *Canadacia catula* and *Heterorhabdus papilliger* were the regular components. In collections from 500 - 0 m *Pleuromamma indica* was the most dominant calanoid species and formed 37.7% of calanoid and 19% of total population. Paracalanidae constituted only 7.2%, but Clausocalanidae contributed 9.3% of copepods. Species of Eucalanidae were well represented comprising 14.8%. Members of Actididae, Lucicutiidae and Heterorhabdidae were also significant components in the deeper layers.

### INTRODUCTION

Unstability of physical properties is well pronounced in coastal environments against stability and homogeneity of oceanic environment. The climatic conditions and geographic configurations of the continents to an extent govern the hydrography of coastal waters. The northern part of the Indian Ocean is unique in exhibiting the semi-annual reversal of surface currents. The west and east coasts of India differ in climatic conditions. The west coast is influenced by the southwest and northeast monsoons, and the east coast only by the northeast monsoon. Rich biological production associated with upwelling had been reported from the west coast (PRASAD, 1969; PANIKKAR and RAO, 1973). There are a few studies on zooplankton biomass along the west and east coasts of India (e.g. MENON and GEORGE, 1977; NAIR *et al.*, 1977 & 1978; PETER AND NAIR, 1978, NAIR *et al.*, 1981).

Much attention has been given to studies on copepods, a major zooplankton component, from the west coast (STEPHEN, 1979; MADHUPRATAP and HARIDAS, 1990; MADHUPRATAP *et al.*, 1990). Little attention has been given to copepods of the east coast (SARASWATHY and SANTHAKUMARI, 1981) and comparative studies are very few (STEPHEN, 1984; MADHUPRATAP and HARIDAS, 1986). Subsequent to the International Indian Ocean Expedition, zooplankton samples were collected with nets other than the Indian Ocean Standard Net (IOSN) making comparisons difficult. This account deals with the copepods collected with IOSN from the west and east coasts of India.

### MATERIAL AND METHODS

Zooplankton samples collected during five cruises of R.V. *Gaveshani*, two in the Bay of Bengal from 24th August to 2nd October 1976 and three along the west coast of India from 6th October to 18th December, 1976 were used. The stations are shown

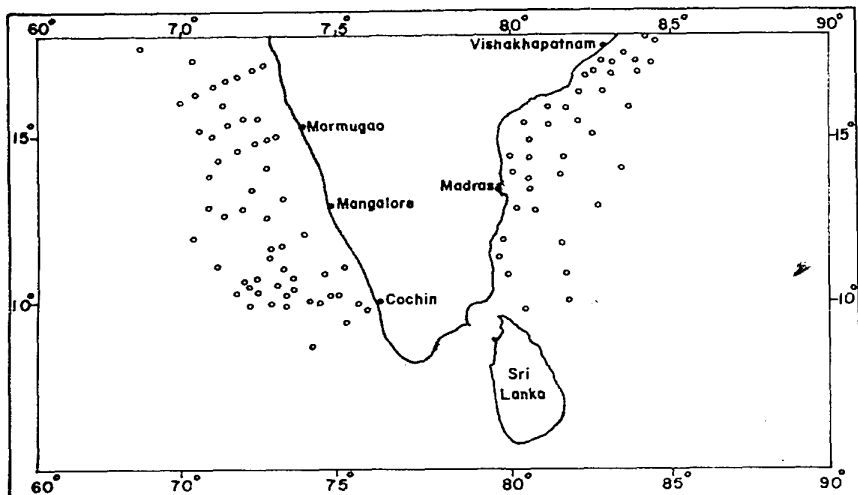


Fig. 1 A

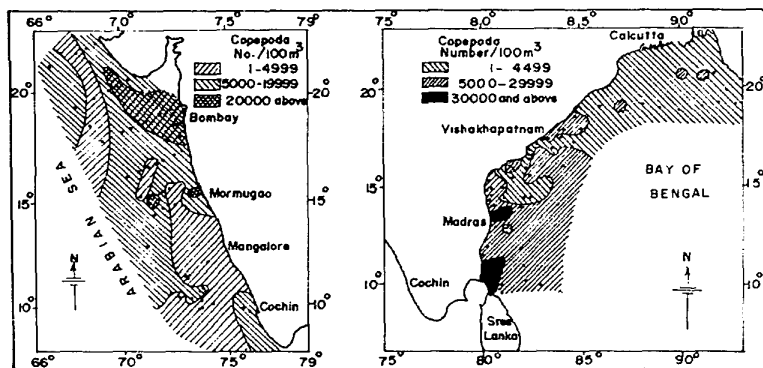


Fig. 1 B

Fig. 1A. Location of stations selected for the study, 1B. General copepod distribution (reproduced from Nair *et al.* 1977 and 1978).

in Fig. 1A. Fifty six samples from east coast and 62 samples from west coast were analysed. Vertical collections were made with the Indian Ocean Standard Net. Two sets of samples, one from the upper layer of thermocline to surface and another from 500 m to surface were taken. In one cruise from Arabian Sea samples were taken from the upper layer of thermocline to surface and from 150 m to thermocline. The area studied, between 18°N and 9°N was divided into 3 sections of 3° latitudes. The total copepod distribution along the west and east coasts is shown in Fig. 1B.

## RESULTS

Hydrographical features of the two areas for the period of study are given in Fig. 2 a & b. In west coast the surface temperature recorded was 29°C. There was no marked fluctuation in surface temperature from north to south. Temperature in 500 - 0 m varied between the 3 sectors; in the northern regions higher temperature of 23.4°C and 23.0°C was observed but only 19.1°C was observed in the southern section of the west coast. Salinity also was high > 35 ‰ in northern region but low values of 34.6 ‰ was observed in the southern regions. Dissolved oxygen values were comparatively low in the southern side in the upper stratum sampled. A reverse trend was observed in the Bay of Bengal. Low surface temperature of 28.5°C was observed in northern sector. Lowest salinity of 30‰ was also recorded in the northern sector which gradually increased southward upto 34‰.

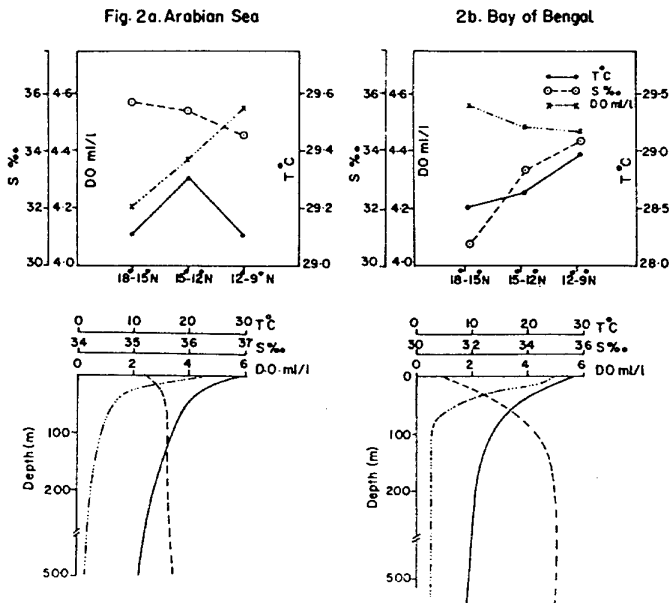


Fig. 2. Temperature, salinity and dissolved oxygen for the 3 sectors and vertical distribution (mean values) in 500 - 0 m. a - Arabian Sea, b - Bay of Bengal.

Above the thermocline 67 copepod taxa were observed. Table 1 gives the composition of major taxa above thermocline in the three sectors of Arabian Sea and Bay of Bengal. The bulk of the population above thermocline was composed of Paracalanidae

forming about 27.6% to 76%. The family Eucalanidae was a regular component but formed only 4-18.4%. Temoridae constituted 4% to 22% in the east coast. But in a few coastal stations in the Bay of Bengal where maximum numbers of copepods were found, Temoridae outnumbered all other copepods. Oithonidae and Oncaeiidae were found in high numbers especially along the northern section of west coast. The poecilostomatoids and cyclopoids together constituted 6.2% - 15.3% of the population above thermocline and upto 16.6% - 43.5% in some stations along the west coast. Preponderance of Oncaeiidae was well evident along the west coast. Fig. 3 A & B illustrates the distribution of major copepod taxa above thermocline in the three sectors of Arabian Sea and Bay of Bengal. *Canthocalanus pauper*, *Nannocalanus minor*, *Undinula vulgaris* and *Cosmocalanus*

Table 1. Percentage composition of major copepod taxa above thermocline. (A - Arabian Sea, B - Bay of Bengal).

Major copepod taxa	18° - 15°N		15° - 12°N		12° - 9°N	
	A	B	A	B	A	B
Calanidae	5.1	3.6	6.8	3.8	4.8	3.6
Eucalanidae	3.8	18.4	6.6	13.1	8.5	16.7
Paracalanidae	48.1	52.9	44.3	55.6	56.2	35.2
Clausocalanidae	0.6	0.1	0.2	0.1	0.2	1.3
Euchaetidae	2.6	1.0	2.8	0.8	4.4	1.2
Scolecithricidae	3.0	0.5	0.6	0.3	1.7	0.1
Lucicutiidae	0.4	0.2	0.3	0.5	4.9	0.6
Heterorhabdidae	0.1	0.1	0.6	0.1	0.3	0.1
Augaptilidae	0.2	0.1	0.1	0.1	0.1	0.1
Candaciidae	1.0	1.0	0.4	0.5	1.7	0.2
Temoridae	0.6	5.6	7.4	11.6	2.0	22.1
Centropagidae	1.3	3.2	0.1	2.0	1.0	10.0
Pontellidae	1.1	3.5	0.8	2.9	0.7	0.9
Acartiidae	1.4	2.1	0.5	2.6	0.8	1.8
Oncaeiidae	15.3	1.8	12.3	2.1	6.2	1.6
Corycaeiidae	5.1	1.2	10.4	1.0	3.0	2.6
Sapphirinidae	2.1	0.7	0.5	0.4	0.6	0.1
Oithonidae	6.3	2.0	4.5	0.9	1.9	0.6
Harpacticoidae	0.8	1.8	0.2	0.1	0.3	0.2

Table 2. Percentage of major copepod taxa in 0 - 500 m.

Taxa	Percentage
Calanidae	2.3
Eucalanidae	14.8
Paracalanidae	7.2
Clausocalanidae	9.3
Aetideidae	9.0
Euchaetidae	7.6
Scolecithricidae	6.2
Metrididae	19.0
Augaptilidae	3.0
Lucicutiidae	4.5
Heterorhabdidae	4.2
Temoridae	3.2
Candaciidae	0.8
Centropagidae	0.7
Pontellidae	0.2
Acartiidae	0.3
Poecilostomatidae	5.2
Cyclopoidae	2.1
Harpacticoidae	0.1
Mormonillidae	0.2

*darwini* were regular components. *Cosmocalanus darwini* and *Euchaeta wolfendeni* were observed in higher numbers along west coast. Members of *Labidocera* and *Centropages* were better represented in the east coast. Immature specimens of *Pleuromamma* were sparsely encountered in the samples above thermocline.

Table 2 shows the composition of major taxa that appear below the thermocline. Distribution of species of Paracalanidae is extended into deeper layers constituting about 10% of calanoids and 7.2% of total population. *Pleuromamma indica* was the most dominant form constituting 37.7% of the calanoid population and 19.9% of total copepods. Clausocalanidae were observed in high densities (13.5%). Species of Eucalanidae contributed 17.8% of the calanoids and 14.8% of total copepods. Members of Aetideidae, Scolecithricidae, Phaennidae, Augaptilidae, Heterorhabdidae and Candaciidae were regular components. *Mesorhabdus brevicaudatus* and *Heterostylitis longicornis* were recorded from the southern regions of Bay of Bengal and Arabian Sea. *Lubbockia* spp. and *Conaea rapax* were well represented in the deeper collections. Mormonillidae was also recorded from this water column.

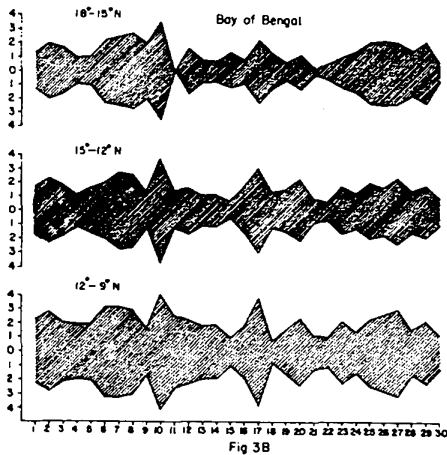
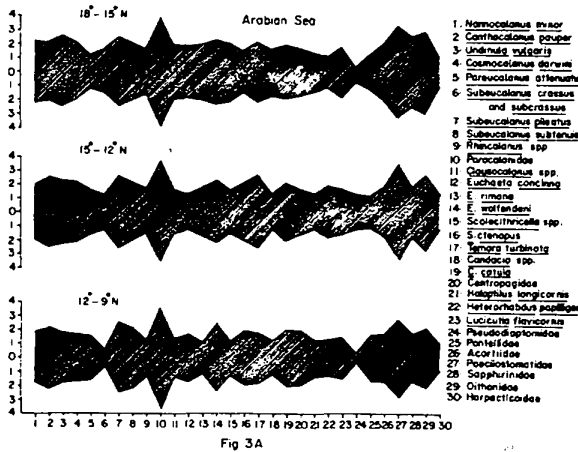


Fig. 3A & B. Composition of copepods in the Arabian Sea and Bay of Bengal respectively.

## DISCUSSION

The samples in the present study are taken during the southwest monsoon period from the Bay of Bengal and during the postmonsoon period in the Arabian Sea. Wind induced upwelling of limited extent is reported from the Bay of Bengal (SASTRY and RAO, 1981). In the present study copepod population was conspicuously high in Bay of Bengal, maximum value 90100/100 m<sup>3</sup> and high densities above 30,000/100 m<sup>3</sup> were recorded from coastal stations of the southern section (Fig. 1 A & B). Along the west coast high density above 20,000/100 m<sup>3</sup> were obtained only from the northern sectors NAIR *et al.*, (1978). MADHUPRATAP *et al.*, (1990) had shown that the numerical abundance of copepod population within the upwelling area far exceed that outside. Members of Paracalanidae, Eucalanidae and Calanidae are persistent groups along the west and east coast which thrive well in the upper layers throughout the year. They are the main herbivores which can flourish together without competition, because Paracalanidae feeds on fine particles and the other two groups feed on large particles (MULLIN, 1966). Species like *Temora turbinata* are opportunistic species positively related to the abundance of phytoplankton and other particulate matter (PAFFENHOFFER *et al.*, 1988). During the study period density of *T. turbinata* was very high in the Bay of Bengal. The increase in this species along with the other persistent groups might have caused higher population in the Bay of Bengal. Swarming of *T. turbinata* had been reported from west coast associated with monsoon (STEPHEN, 1979, HARIDAS *et al.*, 1980).

Among the species that are frequent above thermocline, *Nannocalanus minor*, *Cosmocalanus darwini*, *Euchaeta rimana* and *E. wolfendeni* showed preference to high saline waters (35 ‰) of west coast, and the southern section of east coast (Fig. 3 A&B). In the study of Euchaetidae of IOE TANKA (1973) also observed *E. rimana* and *E. wolfendeni* to avoid the low saline waters of northern Bay of Bengal. The neritic population of Centropagidae and Pontellidae was found to flourish well in the low saline waters of Bay of Bengal during the present study. Higher density of copepods observed along the east coast in this study was due to the increase in *Temora turbinata* due to low scale upwelling of the east coast during southwest monsoon (SASTRY and RAO, 1981). Another striking feature in the distribution is the preponderance of poecilostomatoids and cyclopoids along the west coast, constituting about 16.6% to 43.5% of the copepod population in some stations. These two observations agree well with the findings of PAFFENHOFFER *et al.* (1988) in which they had reported the succession of copepods along the continental shelf of USA during upwelling. In their study abundance of *T. turbinata* indicated recently upwelled waters which is followed by an increase in Oncaeidae and Oithonidae lasting for longer duration in older upwelled waters. The composition of copepods along east coast is influenced by the low scale upwelling during the study period and that of the west coast showed the species combination of older upwelled waters. However the complexities in the composition of pelagic copepods and the affinity of a single or a group of species to changing hydrographical properties can be unravelled by studying the population from simultaneous collections of east and west coasts.

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