

Latitudinal range of epiplanktonic Chaetognatha and Ostracoda in the Western tropical Indian Ocean

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Abstract

An account of the chaetognath and ostracod species obtained from zooplankton samples collected along a transect in the Western Indian Ocean between 9°N–20°S and 57°18'–68°43'E in January–February 1981 is given. Species richness was maximum north of 10°S. The latitudinal variation of thirteen species of chaetognaths indicated that many of the typical Indo-Pacific species are restricted to the tropical zone with limited penetration into the subtropical region. All the sixteen species of planktonic ostracods were cosmopolitan. Based on the available information on the distribution of chaetognaths and ostracods, the species assemblages in the Indian Ocean are discussed.

Introduction

Chaetognaths and ostracods constitute an important component of marine zooplankton particularly in tropical and subtropical oceanic waters. Investigations on the chaetognaths of the Indian Ocean and adjacent seas have been reviewed by Alvarinho (1965) and Nair (1977, 1978) and the studies indicate some amount of zoogeographical zonation among the species. Studies on distribution of planktonic ostracods of the Indian Ocean are limited to a few reports (reviewed by George & Nair, 1980). The results of International Indian Ocean Expedition (IIOE) and some of the subsequent studies provide a fair picture of the ecology of most groups of zooplankton in the Indian Ocean. However, very few studies on the latitudinal variations of zooplankton communities exist. The present study covered a latitudinal range of about 29° and the results were used to identify the chaetognath and ostracod species characteristic of tropical/subtropical realms of the Indian Ocean.

The Indian Ocean has a unique position among the world oceans because the surface circulation in

the northern part (north of 10°S) under the influence of monsoon reverses every half year. The zone of monsoon gyre is separated from the subtropical gyre by a strong hydrochemical front with a band of low salinity stretching along 10°S from Timor to the north of Madagascar (Wyrtki, 1973). This front separates the high nutrient, low oxygen content waters of the monsoon gyre from the low nutrient, high oxygen content waters of the subtropical gyre.

Material and methods

During the 86th and 87th Cruise of R.V. *Gave-shani* from 18.1.1981 to 15.2.1981 zooplankton samples were collected along a transect which was predominantly north-south extending from 8°49'N, 68°43'E and 19°48'S, 57°18'E (Fig. 1). Thirteen vertical hauls were made from the upper 200 m during daytime using a HT net having a mesh size of 300 µm and mouth area of 0.25 m² (Tranter *et al.*, 1972) attached with a flow meter. Ostracods were identified from the entire sample. In the case of chaetognaths 50–75% fractions of the samples were

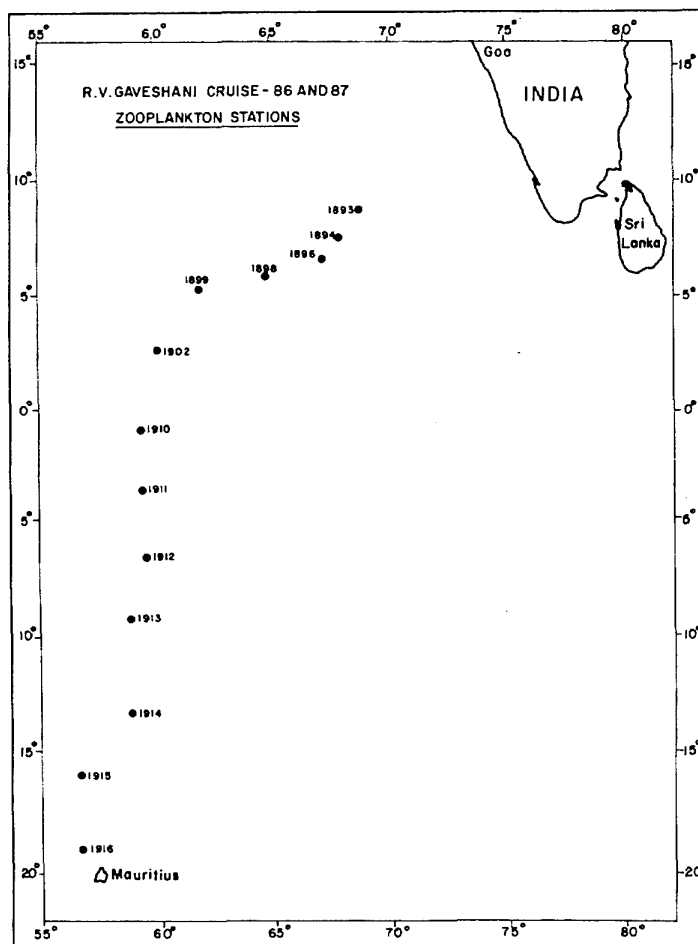


Fig. 1. Stations occupied in the Indian Ocean during the R.V. *Gaveshani* Cruises 86 and 87.

analyzed for the common species and the entire sample for rare species. Latitudinal variations in the abundance of the various species of chaetognaths and ostracods are plotted in Figs. 2 & 3. Previous reports pertaining to chaetognaths and ostracods from the Indian Ocean were used to augment the present data for obtaining various species assemblages.

Results and discussion

Environmental conditions

The period of investigation represented the north-east monsoon (mid-October to mid-April) in the northern Indian Ocean (north of 10°S). During this period the surface drifts take an anticlockwise direction and the currents are set westerly. Temperature variation in the 200-0 m water column (12.49-28.60 °C) was fairly uniform throughout the period of study. North of 10°S the surface salinity varied

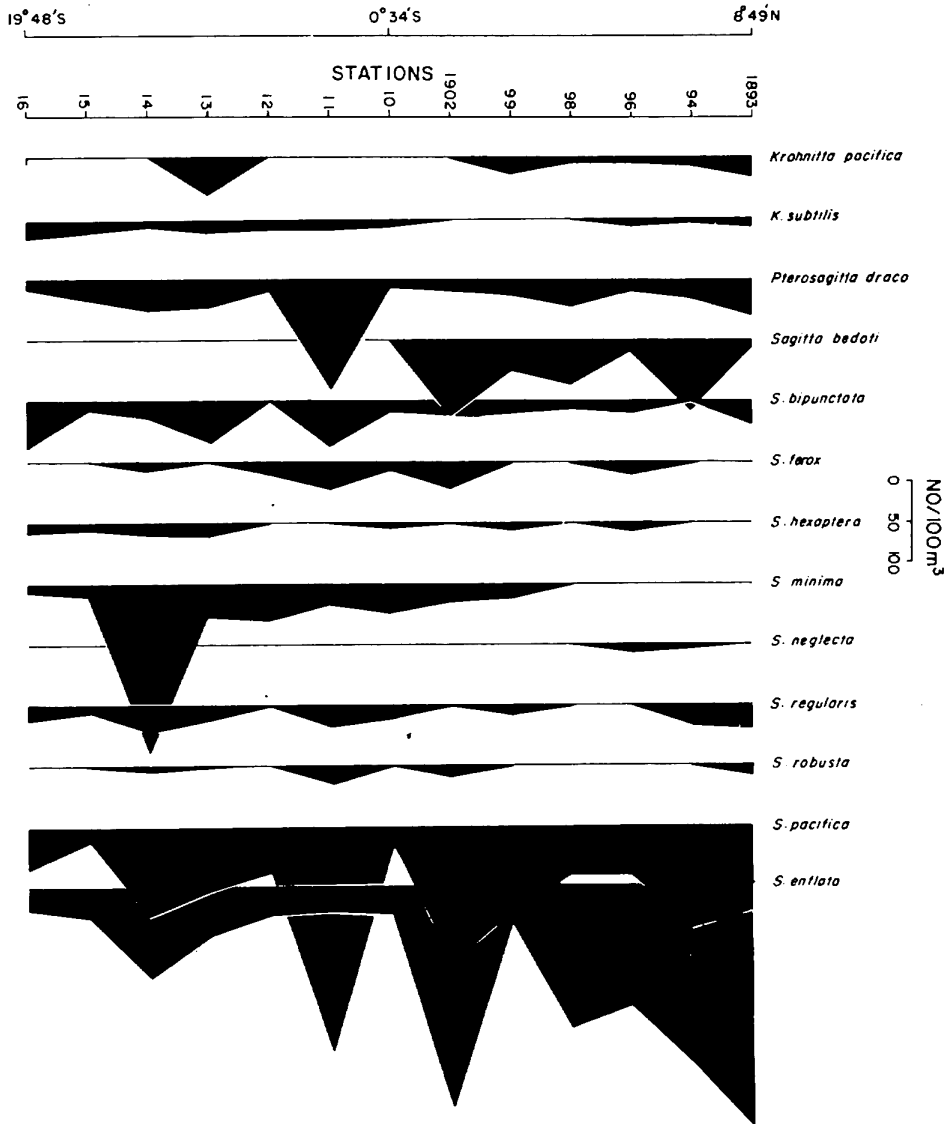


Fig. 2. Abundance and latitudinal variations of different species of chaetognaths.

from 35.05 to 35.58‰ while towards the southern area the values decreased to 34.48–34.61‰. In general, concentration of nutrients was low (nitrate < 1 $\mu\text{g} - \text{at/l}$; Phosphate < 0.2 $\mu\text{g} - \text{at/l}$) in the isothermal layer (Madhupratap, in press). An increase in nutrient concentrations was observed in the surface

layers in the equatorial region and again at about 10°S (nitrate \sim 3 $\mu\text{g} - \text{at/l}$; Phosphate \sim 0.5 $\mu\text{g} - \text{at/l}$). This increase in nutrient values coupled with relatively shallow mixed layer are probably indicative of weak upwelling around these places (Madhupratap, in press).

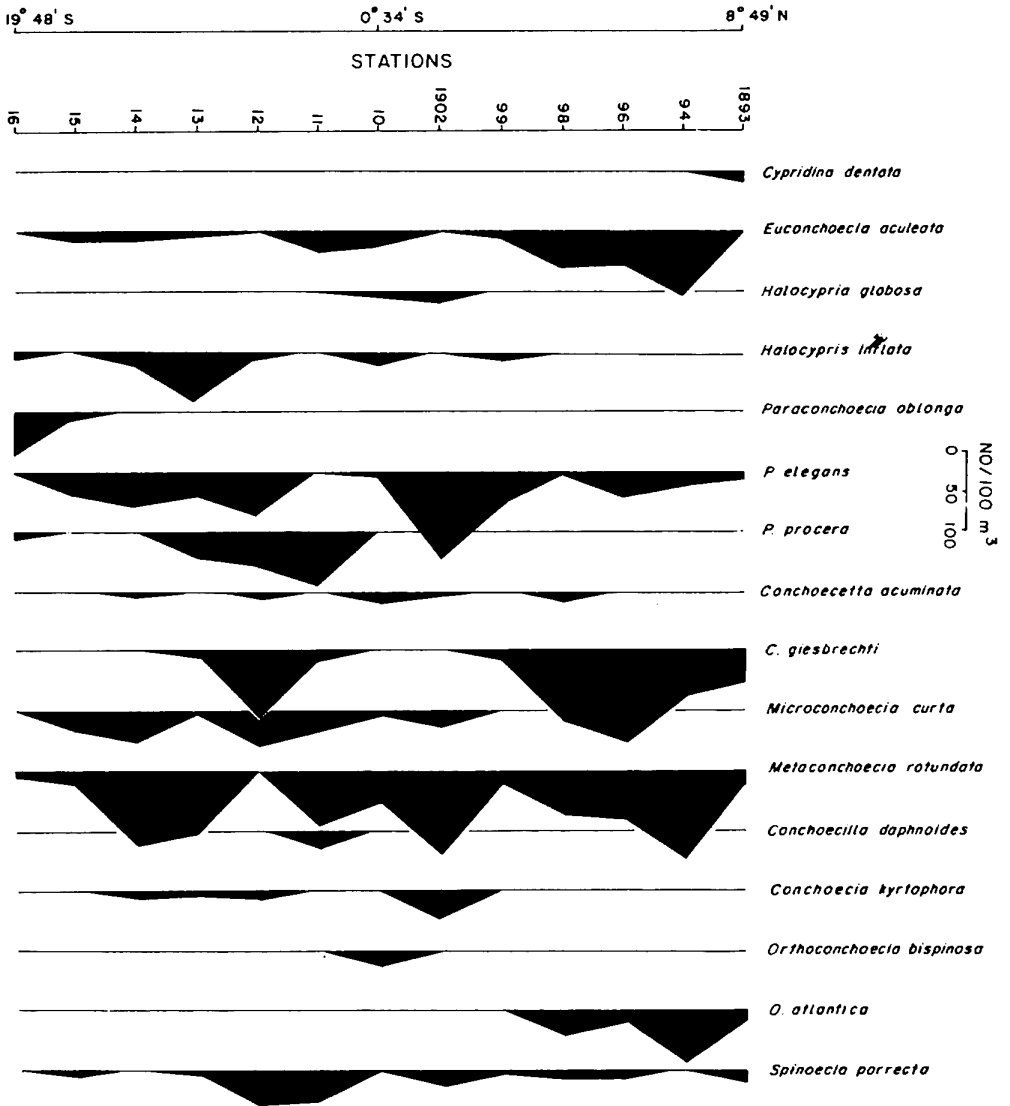


Fig. 3. Abundance and latitudinal variations of different species of ostracods.

Distribution

a. Chaetognath. Chaetognaths occurred in all the samples and contributed 4.5% of the total counts. Population of chaetognaths showed limited variation (119–624/100 m³) with maximum density at st. 1902, just north of the equator.

The 13 species identified from the collections were *Krohnitta pacifica* (Aida), 1897; *K. subtilis* (Grassi), 1881; *Pterosagitta draco* (Krohn), 1853; *Sagitta bedoti* Béraneck, 1895; *S. bipunctata* Quoy and Gaimard, 1827; *S. enflata* Grassi, 1881; *S. ferox* Don Caster, 1903; *S. hexaptera* d'Orbigny, 1843; *S. minima* Grassi, 1881; *S. neglecta* Aida, 1897; *S.*

pacifica Tokioka, 1940; *S. regularis* Aida, 1897 and *S. robusta* Don Caster, 1903. All the species are epiplanktonic in the Indian Ocean (Alvarinho, 1965; Nair, 1977). *S. enflata*, *S. pacifica*, *P. draco* and *S. bipunctata* were the most common species in the collections (Fig. 2). In general, total counts and species richness of chaetognaths were higher at stations north of 5°S.

Between 0 and 10°N *S. enflata* was the predominant species but from the equator to 10°S it was replaced as the dominant species by *S. pacifica*. South of 10°S either *S. bipunctata* or *S. minima* was the dominant species. The genus *Krohnitta* was fairly well represented in the collections. *K. pacifica* was more common north of the equator, whereas *K. subtilis* was generally more abundant towards the southern latitudes; a similar trend occurred in the IIOE collections (Nair, 1978). *S. bedoti* and *S. neglecta* were limited to north of the equator; both are typical Indo-Pacific species (Alvarinho, 1970) commonly found in the coastal waters and northern part of the Indian Ocean (Nair, 1977). In contrast, *S. minima* was confined to south of 5°N and was the dominant species at St. 1914. Earlier observations indicate that in the northern Indian Ocean *S. minima* is mesoplanktonic and towards south they become more epiplanktonic (Nair, 1978). *P. draco* and *S. ferox* had population maxima in the equatorial belt whereas *S. hexaptera* occurred in small numbers along the whole transect.

b. Ostracoda. Ostracods were recorded from all the stations and they contributed 2.6% of the total zooplankton population. Ostracod counts ranged from 75 to 344/100 m³ with maximum towards the northern end of the transect at St. 1894. The sixteen species of planktonic ostracods identified from the collections were *Cypridina dentata* (Muller, 1906); *Euconchoecia aculeata* (Scott, 1894); *Halocypria globosa* Claus, 1874; *Halocypris inflata* (Dana, 1849); *Paraconchoecia oblonga* Claus, 1891; *P. elegans* (Sars, 1865); *P. procera* (Muller, 1894); *Conchoecetta acuminata* Claus, 1891; *C. giesbrechii* (Muller, 1906); *Microconchoecia curta* (Lubbock, 1860); *Metaconchoecia rotundata* (Muller, 1890); *Conchoecia kyrtophora* Muller, 1906; *Orthoconchoecia bispinosa* (Claus, 1891); *O. atlantica* (Lubbock, 1856); *Spinoecia porrecta* (Claus, 1891) and *Conchoecilla daphnoides* Claus, 1891. *C. dentata* belongs to the family Cypridinidae and the other 15

to the family Halocyprididae. Species richness was maximum north of 10°S. In general, there was a specific pattern of dominance in the latitudinal disposition of different ostracod species. *C. giesbrechii* was dominant between 10°N to 5°N, *P. elegans* from 5°N to equator and *M. rotundata* from equator to 13°S. South of 13°S, there was no specific pattern of species dominance.

C. dentata is known to be exceedingly abundant in the Arabian Sea (George & Nair, 1980), but in the present collection the species was recorded only at the most northerly station (Fig. 3). *H. globosa* occurred only in the equatorial belt. The geographic distribution of *H. inflata* extended from 5°N to the southern part of the surveyed region. *M. curta* was represented south of 3°N. *E. aculeata* was spread over to the entire area with maximum population north of 6°N. Distribution of *O. atlantica* was limited to north of 5°N agreeing with previous records (George & Nair, 1980) of this species from Indian Ocean. The zoogeographical range of *C. acuminata* was more extensive in the present study than shown by IIOE data. *O. bispinosa* and *C. daphnoides* were obtained from stations located south of the Equator. *C. kyrtophora* was occasionally represented in the collections.

Species assemblage

Distribution of planktonic organisms in the Indian Ocean is to a great extent influenced by differences in various environmental parameters (Rao, 1979). The present study on the distribution of chaetognaths and ostracods in the western Indian Ocean indicates latitudinal variation in the abundance of some species and in the Indian Ocean such variations seem to be influenced by the physico-chemical differences in the tropical/subtropical realms. Species assemblages do occur in a defined environment. Considering this aspect of zooplankton distribution the present data and previous literature on chaetognaths and ostracods of the Indian Ocean were utilised to make general comments on their zoogeography.

Earlier reports on chaetognaths of the Indian Ocean are based mainly on the IIOE data and a few subsequent studies in the western Bay of Bengal and Andaman Sea (Nair *et al.*, 1981; Nair *et al.*, 1981a). A total of 27 species of chaetognaths occur in the Indian Ocean.

Information on the ostracods of the Indian Ocean obtained from the Valdivia, John Murray and Dana Expeditions were compiled by Poulsen (1962, 1969, 1973). Ecological studies on ostracods from the IIOE data are limited to a single report confined to the northern Indian Ocean (George & Nair, 1980). Other studies include an account of their distribution along the South West Coast of India (George *et al.*, 1975) and reports from the Bay of Bengal (Nair *et al.*, 1981) and the Andaman Sea (Madrupratap *et al.*, 1981). Compared to chaetognaths the information available on which to assess zoogeographical ranges and assemblages of the Indian Ocean ostracods is scant. Angel & Fasham (1975) reported 96 species of ostracods from the Atlantic, Deevey (1968) recorded 43 species from the Sargasso Sea, but only 32 species have so far been obtained from the Indian Ocean, probably because of the lack of information from deep water samples from the region. Fasham & Angel (1975) found latitudinal variations in the vertical distribution of ostracod species in the Atlantic. However, no clear indicator species of water masses or faunal boundaries were observed; instead it was the structure of the communities that changed across hydrographic boundaries. Very few data exist on the vertical distribution or deep water ostracods of the Indian Ocean.

The recorded species of chaetognaths and ostracods can be categorised into seven main zoogeographical groups.

1. Neritic species and species extending from oceanic to neritic region. *S. hombayensis* is a typical neritic species endemic to the Indian coastal waters. *S. oecania* is another species extending into the neritic, creek areas (Nair *et al.*, 1981b) and backwaters (Nair, 1974). The species *S. bedoti*, *S. neglecta* and *S. pulchra* are characteristic of the Indo-Pacific warm waters, advancing in the Indian Ocean into coastal areas and extending south to 10°S. *Euconchoecia aculeata* and *Cypridina dentata* commonly occur in the neritic waters of India. *E. chierchiaie*, the only halocyprid ostracod abundant in the neritic waters of Atlantic (Angel, 1979) does not occur along the Indian Coast but has been reported from the Gulf of Aden, Somali Coast and Andaman sea in the Indian Ocean.
2. Oceanic and epiplanktonic species restricted to the Indo-Pacific region. *S. pacifica* and *S. regu-*

laris are very common in the Indian Ocean particularly north of 20°S. Distributional range of these species extends to 42°S. *S. ferox* densely populated the tropical equatorial waters but its distribution extends up to 42°S. *S. robusta* is a related species to *S. ferox* more common in the northern Indian Ocean and extends to 34°S.

Paraconchoecia decipiens and *Orthoconchoecia striola* are the two ostracod species typical of tropical Indo-Pacific.

3. Oceanic and epiplanktonic species of Atlantic, Pacific and Indian Oceans. *S. enflata*, *P. draco*, *S. bipunctata*, *S. minima*, *S. hexaptera* and *K. subtilis* are cosmopolitan species of the warm and temperate region. Most of them were widely distributed in the Indian Ocean and geographical limit of the species is around 42°S. *K. pacifica*, a tropical species is common north of 10°S, even though the distribution extends to 28°S.

All but four species of ostracods recorded from the Indian Ocean enjoy a cosmopolitan distribution. *Metaconchoecia rotundata*, *Conchoecetta giesbrechti*, *Paraconchoecia elegans*, *Euconchoecia aculeata* and *Spinoecia porrecta* were the most common species in the present study. These and other species like *Paraconchoecia procera*, *Microconchoecia curta* and *Spinoecia parthenoda* are widely distributed in the Indian Ocean. *Paraconchoecia oblonga*, *P. echinata* and *Conchoecilla daphnoides* were previously reported to be more common along the equatorial belt of the Indian Ocean, but in this study *P. oblonga* was confined to the southern latitudes. *Pseudoconchoecia concentrica* and *Alacia alata* were limited mainly to the Arabian Sea. Species like *Conchoecia magna*, *C. kyrtophora* and *Archiconchoecia striata* have a patchy distribution. *Orthoconchoecia bispinosa*, *Conchoecissa imbricata*, *Archiconchoecia ventricosa*, *Paraconchoecia discophora* and *Cypridina acuminata* are rare in the Indian Ocean. *Halocypria globosa* and *Halocypris inflata* are characteristic of the tropical parts of all Oceans. *Orthoconchoecia atlantica*, *Conchoecetta acuminata* and *Euconchoecia chierchiaie* are the other cosmopolitan species recorded from the Indian Ocean.

4. Epiplanktonic cold water species. *S. serratodentata* is typical of temperate and warm Atlantic waters and this Atlantic population seems to be

carried eastward with the West Wind Drift (Alvariño, 1974) and reach the south Indian Ocean. *S. tasmanica* is typical of Subantarctic waters and southern most part of the Indo-Pacific.

5. Mesoplanktonic species. *S. decipiens* and *S. macrocephala* are the most common mesoplanktonic species in the Indian Ocean. *S. maxima*, *S. zetesios*, *S. gazellae* and *S. planktonis* are the lesser abundant mesoplanktonic species and are limited mostly to the southern region of the Indian Ocean.
6. Bathyplanktonic species. *Eukrohnia fowleri* is the dominant bathyplanktonic species in the Indian Ocean north of 20°S. *E. hamata* dominate the area south of 20°S and the distributional range of the species extends to Antarctic convergence. *S. bathypelagica* is a truly cosmopolitan species inhabiting the deep waters of the Arctic, Antarctic, Atlantic, Pacific and Indian Oceans.
7. Species whose distributional range not known. A few of the ostracods species recorded from the Indian Ocean come under this category. *Platyoconchoecia prosadena* has a patchy distribution in the Indian Ocean. This species reported by Poulsen (1973) from the Atlantic Ocean was not observed in subsequent studies (Angel & Fasham, 1975; Angel, 1979). *Bathyconchoecia deevyae* and *B. angeli* are two other ostracods recorded from Indian Ocean. While the former has been reported from the Pacific Ocean their general distribution in the three oceans is yet to be ascertained. Probably the two *Bathyconchoecia* species are benthopelagic and will be sampled in nets fished to within 50 m of the sea bed usually in deep waters.

Summary and conclusions

Findings on the distribution of two groups of zooplankton viz. Chaetognatha and Ostracoda based on a set of collections between 9°N and 20°S from the Indian Ocean are presented.

Discussing spatial organisation of pelagic organisms, especially plankton, poses intrinsic problems. Plankton more than often have a patchy distribution and it is virtually impossible to arrive at conclusions from a single sampling programme. The problem of spatial heterogeneity is compounded by seasonal variations which preclude categoric

assignment of ecotones. Nevertheless, available information on the zoogeography of the species of these two groups from the Indian Ocean is reviewed to highlight species assemblages over space.

Twenty-seven species of chaetognaths and 32 species of ostracods occur in the Indian Ocean. The major biogeographical boundary for the chaetognaths appears to be the hydrochemical front and the subtropical convergence. The majority of the ostracod species in the Indian Ocean are oceanic and cosmopolitan in distribution. This perhaps suggests the high adaptability of these species to the oceanic realm.

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