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Distribution and Abundance of Planktonic Amphipods in the Indian Ocean

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This report is to our knowledge the first to describe the quantitative and qualitative distribution of amphipods in the Indian Ocean, with special emphasis on the dominance of various families within the sub-order. Detailed studies at the species level are in progress.

I. Material and Methods

The data presented here arise from the basic sorting and subsorting of the IIOE samples carried out at the Indian Ocean Biological Centre (IOBC). Out of 1927 samples processed (IOBC Handbook 1, 1969), only 1548 standard samples have been taken into account in preparing the figures.

The year is divided into 2 periods: April 16–October 15 SW monsoon and October

Table 1. Composition of pelagic amphipods in the IIOE collections, total number of specimens, percentage and number of stations

Suborder <i>Hyperiidea</i>	No. of specimens	Percentage	No. of stations
Family			
Hyperiidæ	56 426	45.18	1 589
Anchylomeridæ	19 897	15.93	1 306
Pronoidæ and Lycaeidæ	13 514	10.89	1 227
Platyscelidæ and Parascelidæ	9 640	7.71	1 083
Phronimidæ	8 593	6.88	880
Vibiliidæ	3 920	3.14	598
Oxycephalidæ	2 853	2.28	555
Lycaeopsidæ	2 762	2.21	485
Scinidæ	2 101	1.69	541
Paraphronimidæ	1 012	0.81	194
Lanceolidæ	36	0.03	15
Mimonectidæ	28	0.02	14
Dairellidæ	2	0.002	2
Suborder Gammaroidea	4 116	3.30	514

16–April 15 NE monsoon. In the preparation of the figures, the data from each Marsden 5° square have been averaged. Blank squares indicate that no samples were collected from that area. A table shows the percentage composition of the catches (Table 1) and the figures give latitudinal and longitudinal variations (Figs. 6–9), both standard and nonstandard collections being taken into consideration.

II. Results

Amphipods were few in the southern central Indian Ocean and central Arabian Sea (Fig. 5). Fair numbers were noted in the east and west of the southern Indian Ocean, which can be compared with the equatorial area. The Somali and Arabian coasts showed average to good density, comparable to that of the Bay of Bengal where a high concentration was noted towards the northern part of the Bay. The highest concentration was recorded in the northern part of the Arabian Sea.

In order to study the seasonal fluctuation and vertical migration of these animals, we made a seasonal analysis of the data.

1. April 16 to October 15

Day collections (Fig. 1) show a general north-to-south decrease in abundance. Low values were noted in the southern central Indian Ocean and central Arabian Sea. Relatively few amphipods were found at the eastern and western sides of the Indian Ocean, with

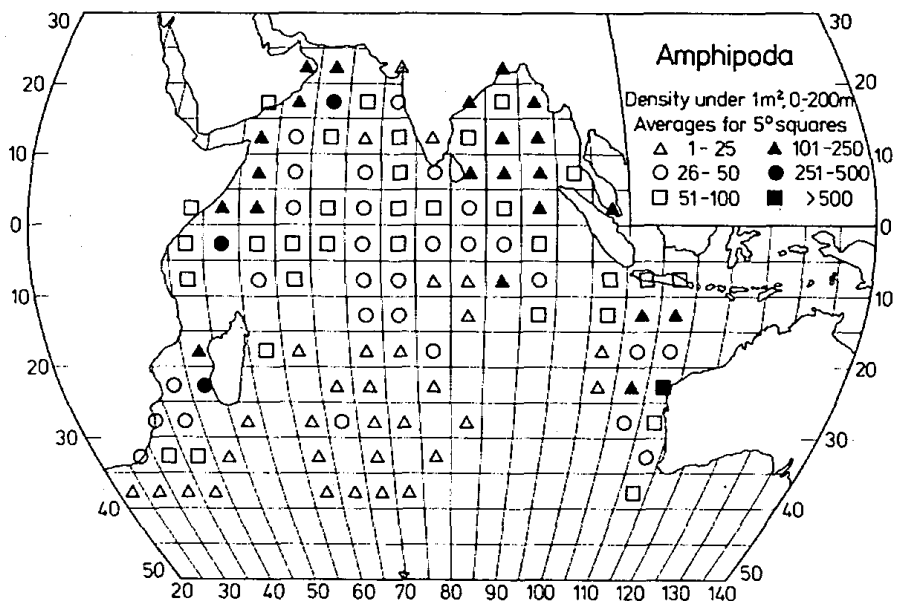


Fig. 1. Distribution of pelagic amphipods in the Indian Ocean during the period from April 16 to October 15 (day collections)

areas of comparative abundance along the Somali coast, off and around the Andamans. Patchy areas of high concentration were recorded along the SW coast of Madagascar, towards the west of the equatorial area, and off Saudi Arabia. Maximum abundance was towards the northern part of the west coast of Australia.

Night collections (Fig. 2) show greater abundance in most of the samples than day collections. This may be due to vertical migration, which is quite common among hyperiid amphipods. Fairly high values are noted from the Somali coast, the northern part of the Bay of Bengal, south of the Andamans and off the south coast of Java.

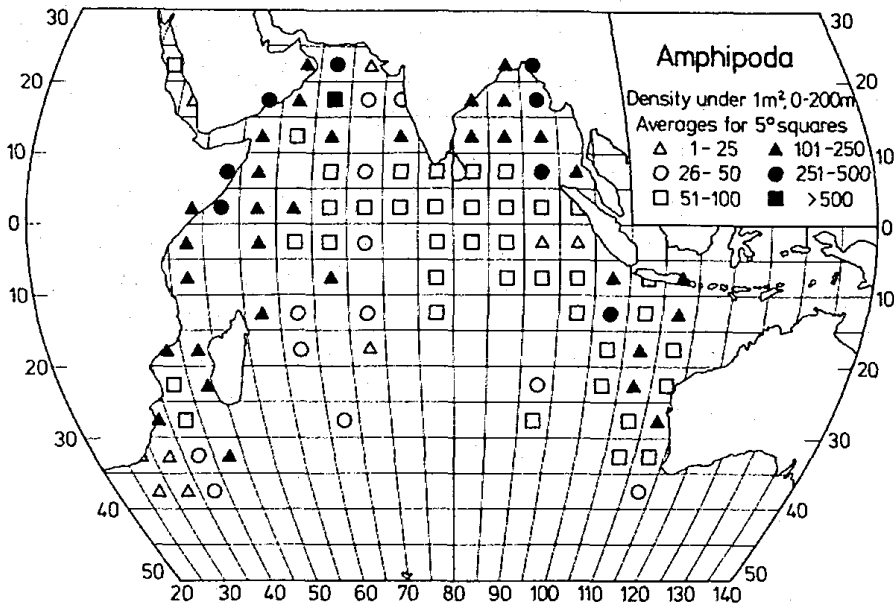


Fig. 2. Distribution of pelagic amphipods in the Indian Ocean during the period from April 16 to October 15 (night collections)

2. October 16 to April 15

Day samples (Fig. 3) show in general that in the south central Indian Ocean, central Arabian Sea and southern Bay of Bengal values are minimal, as in the SW monsoon period. Average to good density values were seen to the east and west of the southern Indian

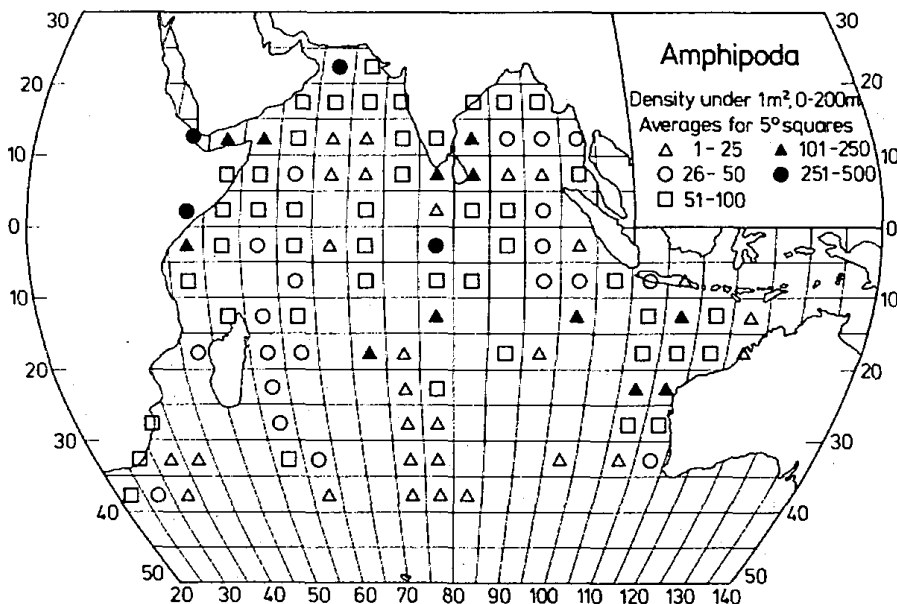


Fig. 3. Distribution of pelagic amphipods in the Indian Ocean during the period from October 16 to April 15 (day collections)

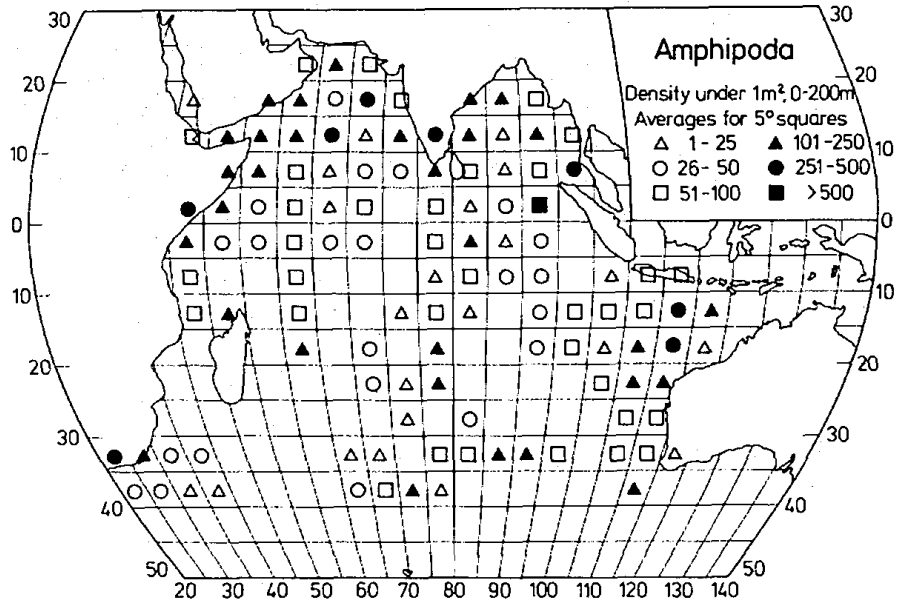


Fig. 4. Distribution of pelagic amphipods in the Indian Ocean during the period from October 16 to April 15 (night collections)

Ocean, Somali coast, and the west and east coasts of India. Patchy areas of high concentration were noted in the central part of the equatorial area, south of the Somali coast, in the Gulf of Aden and the north Arabian Sea.

Values for night samples (Fig. 4) were higher than for day samples. Areas of high concentration were recorded in the Andaman Sea, Arabian Sea, off the Somali coast, Agulhas Bank and to the south of Java. The maximum abundance was found off the west coast of Sumatra.

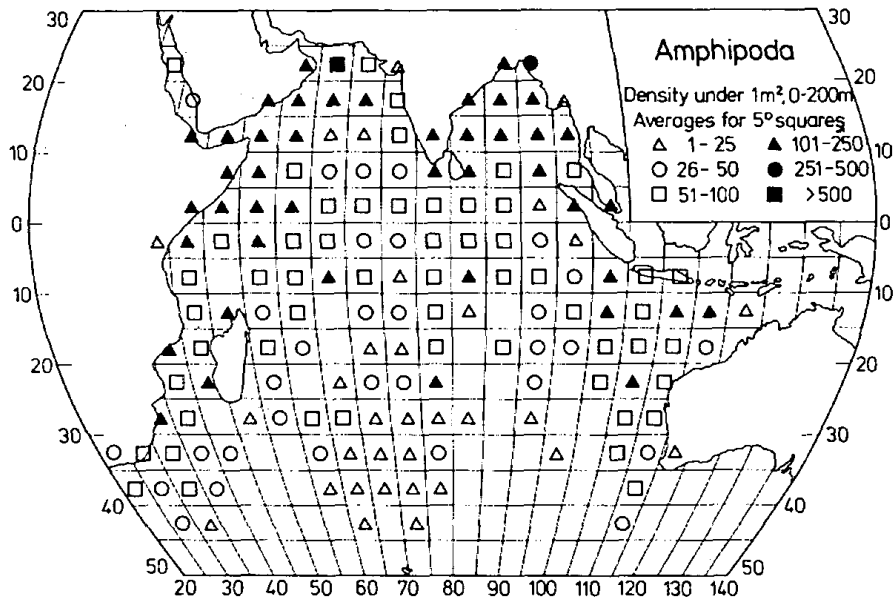


Fig. 5. Total distribution of pelagic amphipods in the Indian Ocean

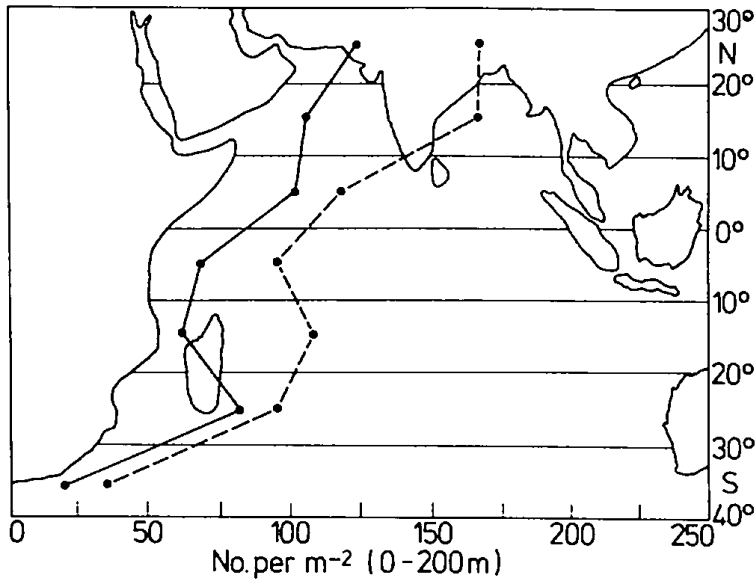


Fig. 6. Day and night variations in the distribution of pelagic amphipods under 1 m^2 (200–0 m) in each 10° zone of latitude for the period April 16–October 15 (solid line: day, dotted line: night)

In general, the numerical abundance of amphipods is higher in areas of upwelling, off South Africa (pronounced, especially during the southern summer), the Somali coast, South Arabia, the west coast of India, the head of the Bay of Bengal, the Andaman coast, and the east coast of India (maximum during the SW monsoon). In the equatorial zone there are moderately high peaks in patches of abundance throughout the year. Low-density areas were noted round the year in the south central Indian Ocean, in the central Arabian Sea and in scattered areas.

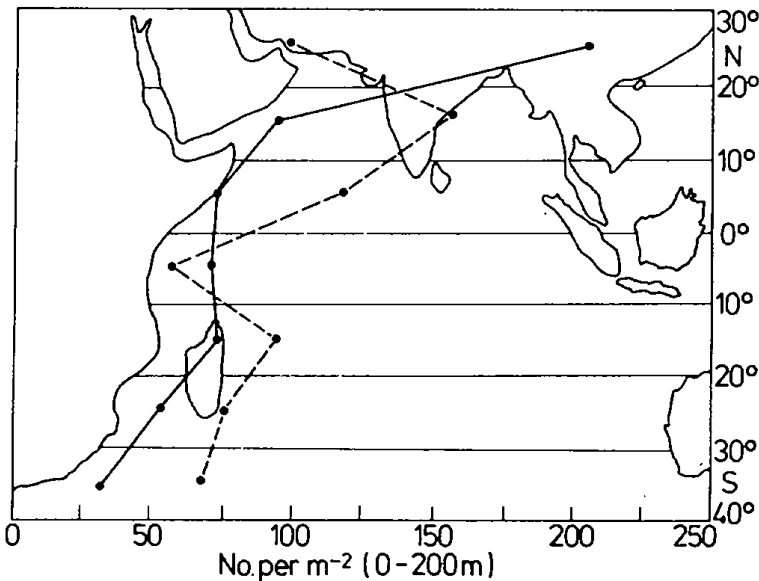


Fig. 7. Day and night variations in the distribution of pelagic amphipods under 1 m^2 (200–0 m) in each 10° zone of latitude for the period October 16–April 15 (solid line: day, dotted line: night)

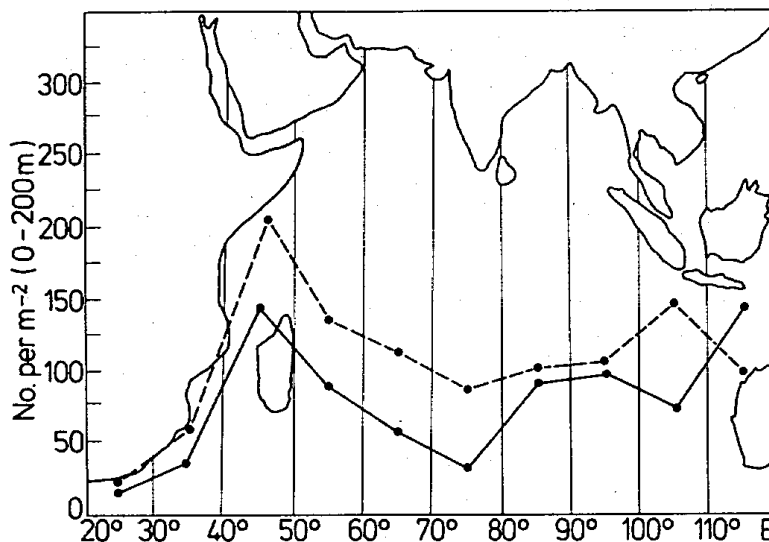


Fig. 8. Day and night variations in the distribution of pelagic amphipods under 1 m^2 (200–0 m) in each 10° zone of longitude for the period April 16–October 15 (solid line: day, dotted line: night)

Latitudinal variation (Figs. 6 and 7) shows a general decrease in numbers of amphipods from north to south in both seasons reaching a minimum in the belt from 30° to 40° S. Likewise, the number of families and species also decreases from north to south. The highest peaks for both seasons occur along the belt between 20° and 30° N, due to the high values found in the northern part of the Arabian Sea and the Bay of Bengal. In general, night values were much higher compared to day except in areas within $20\text{--}30^\circ$ N and $0\text{--}10^\circ$ S (Fig. 7). The high day values for the former area were

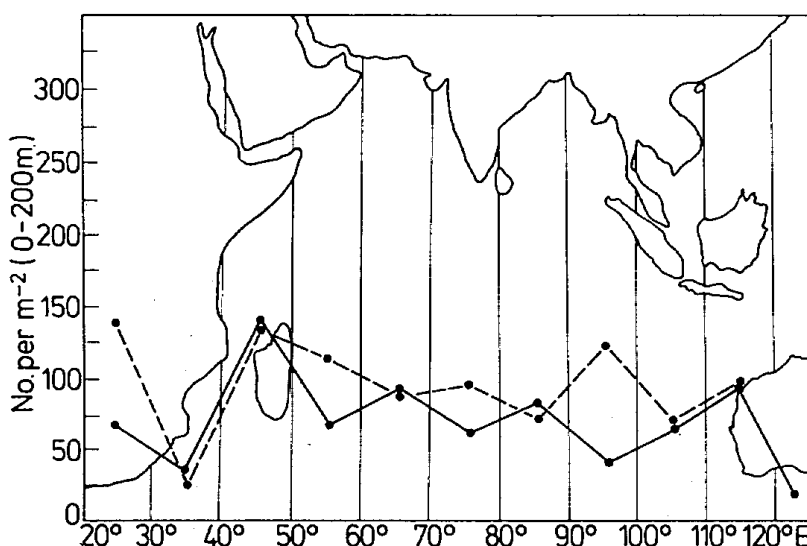


Fig. 9. Day and night variations in the distribution of pelagic amphipods under 1 m^2 (200–0 m) in each 10° zone of longitude for the period October 16–April 15 (solid line: day, dotted line: night)

contributed by 2 collections which sampled through a dense patch of amphipods, while for the latter area night samples were generally lower.

Longitudinal variations show their highest peak between 40° – 50° E for both seasons (Figs. 8 and 9). Other peaks occur between 90° – 100° E (Fig. 9) and 110° – 120° E (Fig. 8) and are due to the areas of upwelling off the Somali coast, and rich areas in the Bay of Bengal and off south of Java. During the southern summer, minimum values are noted between 20° and 30° E for both day and night, while the same area shows fairly high values during the southern winter (Fig. 9), the low-density areas being shifted to 30° – 40° E. These 2 areas are under the dominance of the Agulhas Current and the changes may be related to seasonal displacement of the areas of upwelling in this area. Night values were slightly lower than day values (Fig. 9) between 30° – 40° E, 40° – 50° E, 60° – 70° E and 80° – 90° E; this may be due to chance.

Table 1 shows the percentage composition by families represented in the catches and the number of stations from which they were collected. The family *Hyperiidæ* contributed the most individuals and *Dairellidæ* the least, being recorded from only 2 stations at $17^{\circ} 30' N$, $68^{\circ} 00' E$ (central Arabia Sea) and $06^{\circ} 51' N$, $75^{\circ} 02' E$ (to the southwest of Cape Comorin). The family comprises only one genus of 2 species and of these only *Dairella latissima* had been recorded from the Indian Ocean (BARNARD, 1937).

III. Discussion

The total data, irrespective of seasons and times of collection, show a higher concentration of pelagic amphipods towards the northern part of the Indian Ocean, especially in areas enriched by upwelling and land drainage, or regions adjacent to them. Pelagic amphipods were thought to be more abundant in high latitudes (BOWMAN, 1960) but our data indicate high concentrations towards the tropical and sub-tropical regions as well, associated with highly productive waters.

The overall picture of distribution and abundance of pelagic amphipods (Fig. 5) on the scale of the IOBC maps (1970 a, b) closely resembles that of copepods and fish larvae with minor variations here and there. Amphipods are abundant (> 501) in the northern part of the Arabian Sea, whereas the copepod maxima extend south to the Gulf of Aden and along the Somali coast. The high values of copepods over a wide area may be due to their varied feeding habits. Fairly high concentrations of amphipods noted towards the northern part of the Bay of Bengal also coincide with the great abundance of copepods and decapod larvae. Areas of minimum concentration of copepods also show low values of amphipods.

A comparison of amphipod distribution in relation to zooplankton biomass distribution (IOBC, 1968 a, b), in the Indian Ocean for the whole year reveals that the peaks of both are located towards the northern part of the Arabian Sea and head of the Bay of Bengal. However, at the station level no clear correlation was found between the areas of high primary production and the areas of abundance of amphipods (see maps on the inside of the front and back cover).

Studies of the gut content of members of the family *Phronimidæ* show that they are omnivorous (SHIH, 1969). This is probably true for other hyperiid amphipods as well. Young hyperiids generally occur towards the surface, probably due to the abundance of food in the surface layers. Vertical migrations are known in hyperiid amphipods (SHIH,

1969). The greater abundance of amphipods in night hauls in the upper 200 m layer may well be due to diurnal vertical migration.

Formation of swarms is also noted among pelagic amphipods. During an oceanographic cruise of "Blue Fin" (April, 1970) a swarm of hyperiid amphipods mostly constituted by a single genus, *Hyperia* (family *Hyperiididae*) was observed extending for more than 20 miles along the coast of Kerala; flying fishes in large numbers were seen feeding on them.