

## Distribution of Copepoda in the Indian Ocean

L. R. KASTURIRANGAN, M. SARASWATHY, and T. C. GOPALAKRISHNAN

The present paper deals with the distribution of the group *Copepoda* in the Indian Ocean. This group includes mostly species of planktonic habits, besides demersal species which are excluded from this account. The group is treated as a whole, without reference to the constituent species or families. The paper is based on numerical data derived from the zooplankton samples collected during the International Indian Ocean Expedition (IIOE) and processed at the Indian Ocean Biological Centre (HANSEN, 1966; IOBC, 1969).

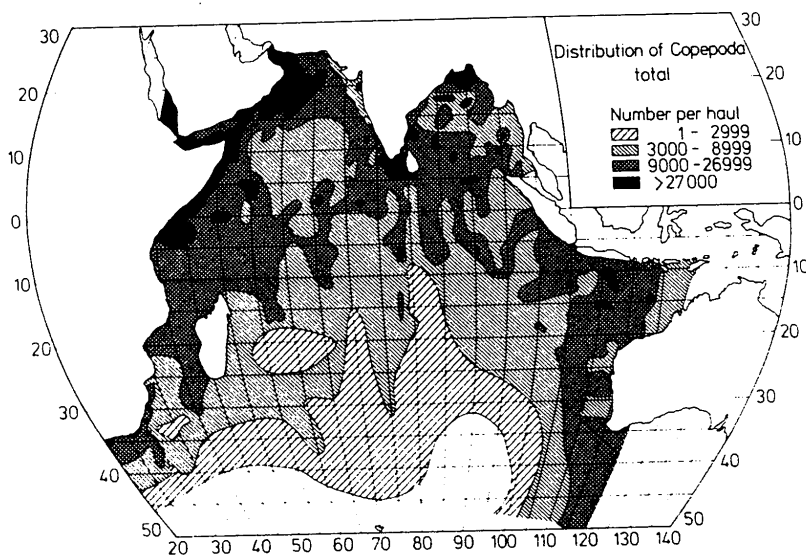


Fig. 1. Distribution of *Copepoda* (total) in the Indian Ocean from 1548 standard samples. (After IOBC, 1970a)

Fig. 1 to 3 are reproduced, with some simplification, from the original maps which were published in the IIOE Plankton Atlas, Volume II, fascicle 1 (IOBC, 1970a). These maps must be regarded as visual aids, giving only a general picture of the geographical pattern of the distribution of numerical abundance. Areas of high copepod populations correspond in general with areas of high zooplankton standing stock. In Fig. 1 the total distribution of copepods is given. The areas of highest population density (27 000 and above) are mostly close to the land masses. The areas of high density which occur in mid-ocean are smaller and fewer. In general, they are greater in extent in the northern

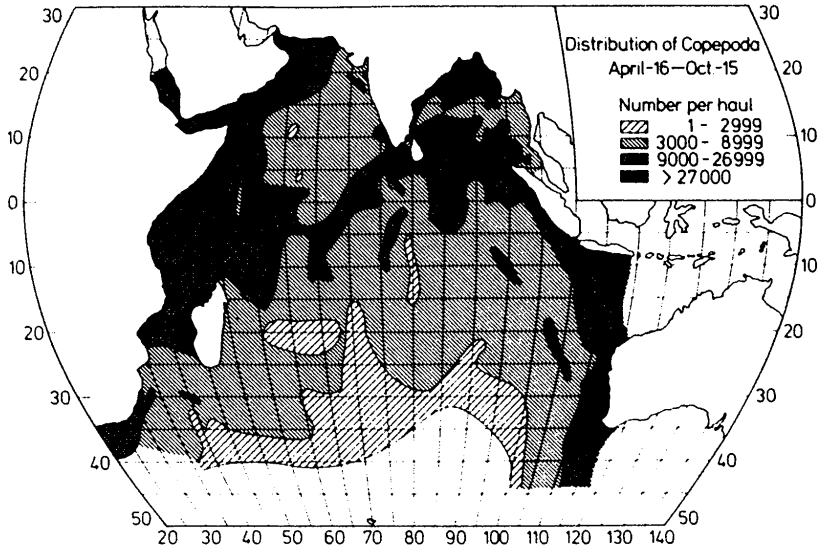


Fig. 2. Distribution of *Copepoda* (16 April to 15 October) in the Indian Ocean from 836 standart samples. (After IOBC, 1970 a)

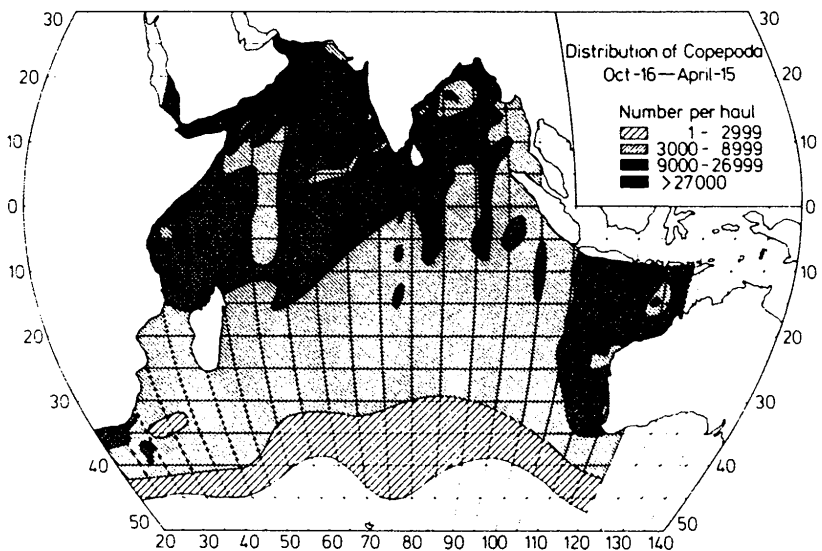


Fig. 3. Distribution of *Copepoda* (16 October to 15 April) in the Indian Ocean from 712 standard samples. (After IOBC, 1970 a)

Indian Ocean as compared to the southern, and more extensive in the Arabian Sea than in the Bay of Bengal. The largest of the areas of high population density is located in the northwestern border of the Arabian Sea. It is shown in the northern winter map (Fig. 3) as well as in the northern summer map (Fig. 2), but it is broken into 2 sections in Fig. 3 and the bigger section is located a little further north as compared to Fig. 2.

In Fig. 2 the comparatively low-density area in the Arabian Sea (3 000 to 8 999) is

quite large; it is, in the main, centrally located but it abuts over the greater part of the west coast of India. In contrast to this, the northern winter map (Fig. 3) shows the low-density area (3 000 to 8 999) to be smaller in extent and located more to the south and to the west.

The lowest population density (1 to 2 999) extends over greater areas in the southern Indian Ocean as compared to the northern. It is more noticeable over the central oceanic areas, not extending to the western borders close to Africa or the eastern borders close to Australia.

Copepods from day and night samples show a remarkable difference in their abundance. In the following description of day night distribution patterns we refer to Figs. 4 and 5 of the IIOE Plankton Atlas (IOBC, 1970 a). In Fig. 4 of the Atlas, depicting day stations, the lowest density of 1 to 2 999 is fairly extensive over the southern and central parts of the ocean but in Fig. 5 (IIOE Atlas), depicting night station, this density is reduced to a few small patches; there is a compensating increase in the area covered by the next higher density of 3 000 to 8 999. In comparison to Fig. 4, Fig. 5 (night stations) shows that the area covered by the highest density (27 000 and above), is nearly doubled and the area covered by the density, 9 000 to 26 999, is also distinctly greater. From this, the conclusion is drawn that the night samples of the IIOE, by and large, contain more copepods than the day samples.

The copepods form the dominant element of the zooplankton. By *Copepoda*, in this context, is meant the *Calanoida*, which are extremely numerous; the *Harpacticoida* and the *Cyclopoida* also occur in the IIOE plankton but they are quite subordinate to the *Calanoida* in number and bulk.

The lowest population density (1 to 2 999) extends over great areas of the southern Indian Ocean (Figs. 1 to 3) and corresponds to the centre of the anticlockwise gyre with the predominance of conditions of convergence. It may be pointed out that in all the 5 figures in the Atlas, a gradual increase in numerical abundance of copepods is evident as we proceed northward from lat. 40° S. This has also been remarked upon in relation to biomass by PRASAD (1969). Comparing Fig. 4 (day stations) with Fig. 5 (night stations) of the IIOE Plankton Atlas, we assume that the replacement of numerical density 1 to 2 999 by the next higher values of 3 000 to 8 999 in the night stations is related to vertical migration in several species of copepods (CLARKE, 1933). The movement of the copepods either upward or downward within the upper 200 m of the ocean would not alter the population figures calculated for the standard hauls, but if the species that stay below 200 m during the daytime migrate upwards during the night hours, there would be an augmentation of the population density in the upper 200 m stratum. The genus *Pleuromamma* is an example. It is represented by at least 6 species in the IIOE collections. It has been observed during subsorting of the *Copepoda* that individuals of *Pleuromamma* species are abundant in the night samples only, whereas in the day samples they are very sparse and include mostly juvenile stages.

The areas of greater density of copepod populations are the same as areas of rich overall zooplankton production. The southern borders of the Indian Ocean are poor in copepods but a gradual northward increase in population is observed, and the extensive border areas of the northwestern Indian Ocean are rich in copepods. The fact that in some areas night stations show higher numbers of copepods than day stations, is thought to be due to circadian rhythms which cause the copepods to migrate to the upper 200 m of the sea at night.