Distribution of *Pleuromamma* spp (Copepoda-Calanoida) in
the northern Arabian Sea

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Distribution of common marine copepods of genus *Pleuromamma* Giesbrecht was studied. Two species, *Pleuromamma indica* Wolfenden and *P. gracilis* (Claus) were present in surface and vertical samples (0-500 m). The former was dominant (98.17%) and *P. gracilis* evinced restricted distribution with northern limit till lat. 18°N. Copepodite stages (C IV and C V) of both species were distributed mostly in the euphotic zone. The adults occurred at deeper depths. The males were recorded at shallower depths compared to the females.

Calanoid copepods of genus *Pleuromamma* constitute an important component of marine zooplankton in the world oceans. These calanoids are known for marked diel changes in vertical distribution and form the principal food items of fishes, shrimps, other decapods and euphausiids. Distribution of *Pleuromamma* spp in the Indian Ocean has been described. Information is scanty on their ecology, size variations and sexual segregation among the co-existing species. Present paper deals with these aspects in two species of *Pleuromamma*.

Zooplankton samples were collected during FORV Sagar Sampa 94 (12-23 September 1991, Fig. 1) from 4 depths—0 to 1 m (44 samples), 0 to 200 m (15 samples), 0 to 250 m (11 samples) and 0 to 500 m (6 samples) using Bongo net fitted with a calibrated flowmeter. The net was towed at 2 knots for 10 min. and samples were preserved in 5% formaldehyde. Copepodite stages and adult specimens were sorted from 6.25 to 100% of the sample depending on their abundance and number raised to the total. Environmental parameters were determined using standard procedures. For study of diel variability of species, zooplankton samples collected from 0600 to 1800 and 1800 to 0600 hrs were considered arbitrarily as day and night samples respectively.

*Pleuromamma* spp were present in all oblique zooplankton samples from different depths but their occurrence was relatively poor in surface samples (0-1 m) (Fig. 2). They occurred mostly in samples collected at night except at st. 41 where late copepodite stages (C IV and C V) were recorded during day. Surface zooplankton samples collected at night contained adults indicating that both the species are confirmed vertical migrants as reported from southeast Arabian Sea. Of the 2 species recorded in the present study, *P. indica* was abundant (98.71%). This is common in the shelf and slope waters of Pakistan during postmonsoon and premonsoon periods. Presently it was collected from lat. 15° to 22°N with higher abundance at stations located between lat. 20° and 22°N. *P. gracilis* which formed only a small fraction (1.29%) of the total *Pleuromamma* population was recorded up to lat. 18°N with maximum number (568 individuals. 100 m⁻³) at st. 5 (lat. 17°04'N, long. 71°10'1'E) showing its extended distribution beyond lat. 15°N recorded earlier. Nocturnal abundance was observed for both species. Day and night variations in percentage occurrence of *P. indica* and *P. gracilis* were 35.21 and 64.79, 20.57 and 79.43 respectively.

Numerical abundance of both the species was poor

![Fig. 1—Station positions in the north Arabian Sea](image-url)
in surface layer forming 0.34% of the total population. Their number increased exponentially from surface up to 500 m. Sarawathy\textsuperscript{1} reported that \textit{P. indica} was evolved in the Indian Ocean and the present results showed that it is almost endemic to the area. In the present study, \textit{P. indica} population comprised mainly adults both in the day and night samples. The copepodite stages were negligible. On the other hand, copepodite stages (C IV and C V) of \textit{P. gracilis} were present in the surface samples of the day along with adults while they were absent at night. The adults occurred both in day and night samples up to 250 m. The species was absent in collections from 0-500 m (Fig. 2). The species was reported to occur mainly between 250 and 100 m by day and migrate towards the surface between 100 and 0 m by night\textsuperscript{5}. The absence of the species at 500 m depth in the present study might be due to occurrence of oxygen minimum layer.

Present study shows preponderance of females (98.31%) in populations irrespective of the sampling depth. The adult females were segregated vertically at day but there was considerable overlapping at night. The males of both the species were seen at relatively shallower depths compared to the females. However, they were never recorded in the surface layer. Vertical migration and consequent mixing of \textit{Pleuromamma} population might be compensating for the low male counts. In \textit{P. indica}, males were confined to collections from 0-250 m while in \textit{P. gracilis} a few of them were recorded in collections from 0-200 m during day. Sexual segregation among co-occurring \textit{Pleuromamma} species is poorly known from the Indian Ocean. Occurrence of males of \textit{Pleuromamma} species (\textit{P. borealis}, \textit{P. gracilis} and \textit{P. piseki}) at shallower depths compared to the females in the Pacific Ocean was reported\textsuperscript{6}.

The individuals of \textit{Pleuromamma} were slightly smaller in size in areas which sustained the maximum density compared to those with sparse population. Size of \textit{P. indica} ranged from 1.5 to 2.1 mm. The smaller forms were usually present at stations located between lat.20° and 21°N sustaining the maximum population density. The size of \textit{P. gracilis} was between 1.2 and 2 mm. The intra-specific size variations were assigned to the availability of food in any ecosystem\textsuperscript{4}. Both the species of \textit{Pleuromamma} have pigment knob (ocellus) in both sexes. In males, its position varied in relation to the position of geniculate antennule. When the geniculation was on the right side, the pigment knob was located on the left side of the body and vice versa. It was either on right or left side in females of \textit{P. indica}, but in those of \textit{P. gracilis}, it was always on the right side. Our knowledge with regard to the origin and maintenance of this asymmetry is incomplete. It may be controlled genetically or by exo- or endogenous factors modifying the expression of phenotype\textsuperscript{8}.

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\textbf{References}

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\textsuperscript{8} Ferrari F D, in \textit{Smithsonian Contributions to Zoology}, No. 420 (1985) pp. 55.