1. INTRODUCTION.
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1.1. Scope and purpose of study of the International Indian Ocean Expedition Zooplankton.

Indian Ocean including the Red Sea and Persian Gulf with an area of about 75 million square kilometres covering 14 percent of the earth's surface is the least explored of the world oceans. Our knowledge on the fauna of the Indian Ocean falls far short of that of other oceans. A number of expeditions have collected oceanographic data in the Indian Ocean and incorporated them in their reports. The more important of these expeditions are Novara (1857-1859), Challenger (1873-1874), Gazelle (1874-1876), Elisabeth (1887), Investigator (1887, 1892, 1893, 1925 to 1938), Penguin (1891), Waterwitch (1895), Stork (1897), Valdivia (1898-1899), Gauss (1902-1903), Sealark (1905-1909), Siboga (1906), Planet (1906-1907), Mowe (1912-1913), Marlin (1920), Amiraclio Magnachi (1924), Ormande (1927), W. Snellius (1929), Dana (1928-1930), Mahabiss (1933-1934), Discovery II (1930-1951), John Murray (1933-1934), Albatross (1947-1948), Charcot (1948-1949), William Scoresby (1955, 1956, 1957), Umitaka Maru (1956), Oven (1957, 1958), Atlantis (1959), Vityas (1960) and Guillard (1961).
Of these Mahabiss, Sealark, Investigator and John Murray are the only expeditions which spent considerable amount of time in a detailed investigation of some parts of the Indian Ocean. The reports of these expeditions and the papers published by Sewell (1913, 1929, 1939-43, 1947-48) in the Journal of the Royal Asiatic Society of Bengal, Memoirs of Indian Museum and John Murray Expedition Reports, constituted the early important source of oceanographic data for the Indian Ocean.

In spite of the above works involving about 1300 stations covered in 34 expeditions, vast areas in the Indian Ocean remained unexplored. So the International Council for the Exploration of the Sea recommended a large scale comprehensive study that involved methodically collected samples from a wider area. Based on this, Scientific Committee on Oceanic Research of the ICSU in 1958-1959 initiated a programme which materialized in the International Indian Ocean Expedition (IIOE), held during 1960-1965 involving 75 million rupees and traversing 291,000 kilometres of water. UNESCO through the IOC joined the endeavour by co-sponsoring the expedition and establishing the Indian Ocean Biological Centre (IOBC) at Cochin in 1962 for processing the zooplankton collections made during the IIOE.
As seen above our previous knowledge on the distribution of marine plankton in the Indian Ocean is mainly based on single voyage across the ocean. Therefore the earlier biogeographers found it difficult to state precisely the faunal provinces and relative abundance in each.

Before any work on the biology of animals can be attempted the animals that we wish to study must be described and classified. This is a task going on from the earliest days of marine biology and as regards zooplankton, most of our present knowledge has been built up from the results of the collections of the great oceanographic expeditions. The material collected during the IIIOE is expected to provide necessary knowledge to the final stage. Coincident with the descriptive work, the knowledge on geographical distribution can grow and as the groups have been better known, the distribution of the species among their faunistic regions can become more detailed.

So one of the main objectives of the IIIOE was the study of the qualitative and quantitative distribution (zoogeography) and speciation (diversity) of planktonic organisms. The distributional studies of this sort will also be helpful in (1) evaluating the adaptation
of plankton to physical, chemical and ecological properties of the environment and to know more about their community structure, ecology and behaviour and species diversity, (2) proper determination of the species of various plankton groups that occur in this area of investigation and their ecophenotypic variations in the different water masses if any, (3) to deduce taxonomic features characteristic of particular species, so as to trace phases of phylogenetic significance and to draw evidence from larval taxonomy in confirming classification, (4) to estimate their frequency of occurrence and abundance to some extent in relation to the diurnal, seasonal and annual variations, (5) to elucidate the longitudinal and latitudinal zonation of zooplankton, (6) to explain the pattern of distribution as tracing the faunal provinces (zoogeographical regions) in relation to hydrographical parameters as temperature, salinity, oxygen concentration, nitrate and phosphate concentrations of water masses, (7) to correlate their distribution pattern with the physical factors of the environment as upwelling, eddies, thermocline, light, depth, turbidity, hydrodynamics, seasonal reversal of monsoon circulation and large gyral oceanic storms and to use plankton animals as indicators of water masses as done by Russell (1935 b).
Better information on holo and meroplankton could be available if studies are extended to their life histories and seasonal fluctuations, than the mere numerical data.

Our knowledge on the taxonomy and distribution of scolecithricid calanoids from the Indian Ocean is mainly based on some of the earlier expeditions in this area. In the present study 27 species belonging to 7 genera were identified of which 2 were new records from the Indian Ocean and one was described as a new species. No attempt has hitherto been made for such a comprehensive study involving methodically collected samples covering the entire Indian Ocean. Since Scolecithricidae also formed an important link in the food chain, this study has become particularly important. In addition to the general treatment of the taxonomy, zoogeography and species diversity in relation to various environmental parameters are also attempted. The main purpose of the study is to outline the main distributional features of the species of the calanoid copepod family Scolecithricidae in the Indian Ocean Expedition collections and to distinguish and describe their niches.
1.2. Taxonomic history of Calanoida.

Eventhough the earlier works on copepod taxonomy are numerous, those of Zenker (1854), Thorell (1859), Claus (1857-1895) as cited by Saraswathy (1961) and Canu (1892) are worth mentioning. Claus divided Copepoda into two divisions namely Gnathostomata and Siphonostomata, grouping all the free living copepods under Gnathostomata and parasitic copepods under Siphonostomata. Thorell (1859) created a third division known as Poecilostomata for the semiparasitic forms. But the presence of transitional forms made the above system of classification incomplete. Canu (1892) grouped Copepoda under Monoporodelphia with single genital opening in females and Diporodelphia with a pair of genital openings in females. Later, specimens with single and paired genital openings were discovered within the same family. Also this classification could not be applied to males. As a result this system also became unnatural.

In view of the above inconsistencies that existed in the earlier works, the system of classification by Giesbrecht (1892) was followed for subsequent studies. He divided the subclass Copepoda into two orders;
Branchiura comprising a single family Argulidae in which most of the species were parasitic and Eucopepoda include all the rest. Order Eucopepoda was divided into two suborders namely Gynnoplea in which the last thoracic somite was firmly united with the preceding somite and movably articulated with the first abdominal somite and Podoplea in which the last thoracic somite was movably articulated with the preceding somite and firmly united with the first abdominal somite. Suborder Gynnoplea was divided into two tribes; Amphaskandria with male antennules not geniculate and Heterarthrandria with one of the male antennules geniculate. The former included the family Calanidae and the latter included the families Centropagidae, Pseudocyclopidae, Candaciidae and Pontellidae. Suborder Podoplea was divided into two tribes namely Isokerandria with male antennules not geniculate and Amphanthrandria with both male antennules geniculate. However his system of classification also was not satisfactory on the following grounds: The delimitations of the families under Podoplea, especially the parasitic ones, were left unidentified. So his treatment of Podoplea was incomplete when compared to Gynnoplea.

The first natural and most comprehensive classification of copepoda is that of Sars (1905) who revised
the above classification dividing the order Eucopoda into 7 suborders namely Calanoida, Cyclopoida, Harpacticoida, Notodelphoida, Monstrilloida, Caligoida and Lernaeoida. Among these, the first three suborders were usually found in plankton, Calanoida being the most dominant. Suborder Calanoida was equivalent to Gynonea of Giesbrecht. Sars (1905) divided Calanoida into three divisions: Amphaskandria and Heterartrhrandria as proposed by Giesbrecht (1892) for Gynonea and a third division Isokerandria for forms with antennules identical in both sexes. The latter name was suggested by Giesbrecht for a division of Podoplea. Instead of a single family Calanidae under Amphaskandria suggested by Giesbrecht, Sars included 8 families under it namely Calanidae, Eucalanidae, Paracalanidae, Pseudocalanidae, Aetideidae, Buchastidae, Phasminidae and Scolecithricidae. Though the literature on Copepoda has increased considerably, the classification introduced by Sars (1905) remains almost unchanged since it offered a place for every valid genus. 27 species belonging to 7 genera of the family Scolecithricidae were identified in this study.
1.3. **Studies on planktonic Copepods from the Indian Ocean.**

From the analysis of 881 publications cited by Prasad (1964) in the bibliography of plankton of the Indian Ocean, it would appear that considerable amount of work has been done on the planktonic copepods of the Indian waters. The most important of those studies are given below. Giesbrecht* (1896) - collections from the Red Sea, Thompson (1900) - collections from (a) east coast of Africa to Ceylon and the head of Bay of Bengal and (b) Durban to Suez Canal through the Red Sea, Cleve* (1901) - along the route from Aden to Java, in the Malay Archipelago and across the Indian Ocean 45°S, 22°E to 30°S, 91°E and thence to 2°N, 94°E, A. Scott* (1902) - from Suez to Colombo, Thompson* and A. Scott (1903) - from Port Said to Colombo and round the Pearl Banks of Ceylon, Cleve* (1904) - from the Red Sea through the Gulf of Aden and across the Arabian Sea, Cleve* (1904a) - from the east coast of Africa and Agulhas Current, Wolfenden* (1906) - from the Maldives Archipelago, A. Scott* (1909) - from Malay Archipelago, Brady (1910) and Wolfenden* (1911) - collections of Gauss from the southern part of Indian Ocean, Farren (1911 & 1913) - collections from the Christmas Island in the Indian Ocean, Sewell* (1912) - from the coastal region of the Bay of
Bengal, T. Scott* (1912) - from the Bay of Bengal and central Indian Ocean, Pesta (1912) - from the neighbourhood of Muscat and Bushire in the Persian Gulf, Pesta (1913) - from the Arabian Sea, Sewell* (1913) - from the coastal region of the Bay of Bengal and the mid water region of the bay, Brady* (1914-1915) - from Durban Bay, Sewell* (1914) - from the Ceylon Pearl Banks, Sewell (1919-1924) - from the Chilka Lake, Sewell* (1929-1932) - coastal region of South Burma including the Mergui Archipelago, the Andaman and Nicobar Islands; the west coast of India and the Malay Archipelago, Menon (1931) - Madras coast, Sewell* (1940, 1947, 1948) - John Murray Expedition collections, Menon (1948) - Trivandrum coast, Bal and Pradhan (1945), Jacob and Menon (1947), Chacko (1950), George (1953) - copepods of Indian waters, Krishnaswamy (1953, 1953a, 1953b, 1954) - copepods of Madras coast, Prasad (1954, 1956) - Bimodal distribution of copepods around Mandapam, Prasad and Kartha (1959) - copepod breeding in relation to the diatom cycle in the Gulf of Mannar, Ganapati and Santhakumari (1962) - planktonic copepods of the Lawson Bay, Kasturirangan* (1963) - key for the more common copepods from Cochin, Calicut, Madras and Mandapam, Saraswathy* (1967) - pelagic copepods from the inshore waters off Trivandrum

Sewell (1948) gave an account of the distribution along with latitudinal variations and endemic nature of planktonic copepoda of the Indian Ocean collected during the John Murray Expedition. On comparing species distribution in different oceans, he showed the distinct nature of Indo-Pacific copepod fauna from that of the Atlantic.

Among the planktonic Copepoda, eventhough the Calanoida ranks highest in species diversity and numerical abundance, detailed studies of only a few calanoid genera from the Indian Ocean based on the IIIOE material have been published.

The results of the IIIOE have been published by UNESCO in the form of IIIOE collected reprints volumes 1 to 8 during 1965-1972. Besides, Indian Ocean Biological Centre, Cochin has brought out Atlases volumes I to V (1968-1973) showing zones of occurrence and abundance of zooplankton. Also the Centre has issued a series of Handbooks - volumes I to V (1969-1973) based on the
International zooplankton collections. Many papers were also read by individuals at the following four symposia. (1) NISI/INCOR Symposium on "Indian Ocean" held in 1967 at New Delhi, (2) the International Symposium on "Indian Ocean and Adjacent Seas, their origin, science and resources" conducted at Cochin (1971), (3) "The Biology of the Indian Ocean" held at Kiel, West Germany (1971) and (4) on "Warm Water Zooplankton" held at Goa (1976). Most important of these papers are: Frost and Fleminger (1968), Tanaka (1973), Lawson (1973a, b, 1976, 1977), Gopalakrishnan* (1973, 1974), Saraswathy (1973), Rosanna Stephen and Saraladevi (1973), Saraladevi (1977), Grice and Hulsemann* (1967), Fleminger and Hulsemann (1974), Vinogradov and Voronina (1961) and Jones (1966a, b).

1.4. Studies on zoogeography and diversity of zooplankton.


* includes studies on Scolecithricidae.