CHAPTER II. REVIEW OF LITERATURE

The Zooplankton community play an important intermediate link in the pelagic food web by the transfer of energy derived from the phytoplankton to the highest trophic level in the aquatic food web. Being passive drifters, zooplankton are bound to be influenced by environmental factors and depending on the prevailing tide and currents, organisms may be carried towards the shore or away from the shore. Zooplankton are said to be the ecological indicators of water bodies and distribution of these organisms in polluted and non-polluted waters can provide useful information on the productivity and pollution of an area where they are found (Gajbhiye and Desai, 1981). Among the marine and estuarine habitats, the zooplankton community comprises the species of principle phyla namely, Protozoa, Coelenterata, Ctenophora, Chaetognatha, Annelida, Mollusca (Pteropoda), Echinodermata, Arthropoda (Crustacea) and sub phylum Urochordata. Apart from these groups, zooplankton also comprises the vast assemblage of larval forms of pelagic and demersal species. Generally, the Ctenophores, Coelenterates, Chaetognaths and Annelids are exclusively carnivores and vary in their size from a few millimeters to several meters of Jelly fishes. Among the zooplankton the largest group is the Crustacea (Arthropoda) and these are either
herbivorous, omnivorous or carnivorous and are varying in their size ranging from the smallest nauplius measuring several micrometer to larger pelagic euphausids of several centimeters in length.

Zooplankton living their entire life cycle in the pelagic environment (Holoplankton) tend to dominate in the open water but in coastal regions there are large number of organisms which spend only part of their life cycle as plankton (Meroplankton) and these will include the larvae of benthic invertebrates as well as the larvae of some benthic and pelagic fishes.

Distribution and abundance of zooplankton in the west coast of India are reported by earlier workers, like Clove (1901), Vinogradov and Voronina (1961 & '62); Voronina (1962); Kasturirangan (1963); Timonin (1971); Wyotki (1974); Fleminger and Hulsemann (1973); Tanaka (1973); Zeitzschel (1973); Pillai (1976); Lawson (1977); Sakthivel (1977); Madhupratap et al., (1977, '79 and '81); Tranter (1977); Rao et al.,(1975); Saraladevi et al., (1979); Haridas et al., (1980); Stephen (1980); Gajbhiye et al., (1982); Goswami (1982); Reddy and Radhakrishna (1982); Smith (1982) Madhupratap (1983) and Ramaiah and Nair (1993), Nandan and Azis, (1994), Goswami and Padmavati (1996) Padmavati and Goswami (1996) respectively.
Zooplankton distribution and dynamics in a North Pacific eddy of coastal region was studied by Mackas and Galbraith (2002). Similarly a good amount of zooplankton studies were carried out in foreign waters also, of which most important ones are Barber et al., 2002; Bollens et al., 2002; Bucklin et al., (2003); Kolbasov et al., (2003) Gallienne et al., (2004) and Conway et al., (2003).

Zooplankton keep drifting at the mercy of water currents and hence they cannot avoid the impact of periodic variations in different hydrological parameters. Thus, observations on the impact of these factors on various zooplanktonic groups has gained importance. Muthu (1953) observed the impact of unusual lowering of salinity on planktons in the Madras coastal area, while Grindley (1964) studied the effect of low salinity water in the vertical migration of estuarine plankton. Zooplankton distribution in the west coast of India before and after the monsoon period was reported by Nair and Tranter (1966). Plankton distribution in Hooghly estuary with special reference to salinity and temperature was studied by Saha et al., (1967). Distribution of Chaetognaths along the salinity gradient in the Cochin backwaters was studied by Nair (1971). Plankton in relation to hydrography of Mandovi and Zuari estuaries of Goa, by Goswami and Singbal, (1972) and influence of nutrients on plankton in the inshore waters of Mangalore by Prabhu and Reddy, (1987) are of importance.
Haridas et al., (1973) discussed the variations in salinity, temperature and dissolved oxygen and zooplankton biomass in the backwaters of Cochin to Alleppey with reference to conditions prevailing in premonsoon and post monsoon periods. Zooplankton distribution along salinity gradient in the Cochin backwater before and after the monsoon was studied by Chandrashekaran and Tranter (1971). Tidal influence on the diel variations of zooplankton with special reference to copepods in the Cochin backwater was studied by Pillai and Pillai (1973) while occurrence of Siphonophores in the Cochin backwater was reported by Rangarajan (1974). Naik et al., (1989) have discussed the hydrographic impact on the population of plankton of Karwar waters and have also observed the variations in plankton and fisheries in relation to the nutrient budget of the Karwar bay. Zingade and Singbal (1983) have studied the characteristics of near shore waters in Binaga bay, Karwar while the hydrographic features of Karwar area were studied by many workers in the recent past (Ramamurthy, 1965; Annigeri, 1968 & 72; Ramamirtham, 1965; Noble, 1968; Sudarshana et al., 1984; Naik, 1986; and Naik et al., 1989). These are some of the important works carried on these lines in central west coast of India.

These zooplankton form secondary production in the marine food chain and they serve as food for the secondary consumers. Thus
the fishery of an area depends upon the quality of zooplankton to considerable extent. Under these circumstances, the plankton study becomes an inseparable part of any fishery investigation and its stock assessment. One of such pioneering works in Indian waters, is the correlation of fisheries with plankton of Malbar and South Kanara, west coast of India (Menon, 1945). Bhimachar and George (1950) come across an abrupt setback in fisheries of the Malabar and Kanara coast and related this to plankton dynamics. Mukundan (1967) found a relationship between the plankton of Calicut inshore waters and coastal pelagic fisheries. Nair (1980), estimated the production and association of zooplankton in estuarine and near shore waters off Goa and also quantified the organic carbon content of tropical zooplankton. Production and association of zooplankton in estuarine and nearshore waters of Goa was studied by Nair (1980) whereas Plankton studies in the estuarine and near shore regions of Mandovi and Zuari was studied by Rajgopal (1981). Zooplankton composition in a bar-built estuary, southwest coast of India was studied by Vareethiah (1999). Estuarine copepod abundance and diversity in relation to environmental variables, southwest coast of India was dealt in detail by Eswari and Ramanibai (2004). Distribution of nutrients in the coastal and estuarine waters of Goa was reported by Verlencar (1987). Zooplankton from shelf waters off west coast of India was reported by
Nair and Peter (1980) where as the zooplankton and *Trichodesmium* phenomena was studied by Devassy and Qasim (1980). Swarming of *Creseis acicula* in the coastal waters of Goa has been reported by Goswami (1983). An Elaborate investigation on environmental characteristics (Qasim and Sengupta, 1981) and zooplankton ecology (Padmavati and Goswami, 1996) in the Mandovi-Zuari estuarine system of Goa, west coast of India are important landmarks. Gajbhiye *et al.*, (1984) have observed the distribution and swarming of mysids in the nearshore waters of Bombay. Pant *et al.*, (1984) made an observation on the biomass relations between phyto and zooplankton in the Goa waters. Distribution of calanoid copepods in the Arabian sea and Bay of Bengal were reported by Rosamma (1984). Naik *et al.*, (1989) have found a relationship between plankton and pelagic fisheries (Mackerel and oil Sardine) off Karwar.

Diel variation in the distribution of zooplankton in relation to changing physico-chemical conditions of Godavari estuary was studied by Chandramohan and Rao (1972). Similarly Vijaylakshmi and Venugopalan (1973) from Vellar estuary. Singbal (1973), Bhargava and Dwivedi (1974) and Goswami *et al.*, (1979) have studied diurnal variation in physico-chemical parameters and phytoplankton pigments and zooplankton populations respectively from the Zuari estuary, Goa.
Seasonal variation of zooplankton of the Ashtamudi lake, southwest coast of India was extensively studied by Divakaran et al., (1982).

Zooplankton abundance and diversity can be considered as an index to the health of an aquatic environment and are good indicators of pelagic and demersal fishery. An extensive work was carried out on biological productivity of the Indian ocean during IIOE expeditions (Qasim, 1977). While diel and tidal variations in zooplanktonic populations in the Zuari estuary, Goa was by Goswami et al., (1979). A survey of environmental features in a section of the Vellar-Coleroon estuarine system, south India was carried out by Krishnamurthy and Sunderaraj, (1973). Plankton production associated with cold water incursion into the estuarine environment was studied by Devassy (1983). Studies on ecology of the Ashtamudi estuary, southwest coast of India was carried out by Nair and Azis, (1987). George (1951) and Ravindran et al., (1971) observed the zooplankton of Cochin backwaters, where as Rao et al., (1975) studied the distribution of zooplankton in tropical estuary. Nair (1980) estimated the production of zooplankton in estuarine and near shore waters of Goa.

Larval retention within the estuary or exchange between an estuary and its adjacent coastal areas depend upon characteristic
circulation. Bhat et al., (1989) have reported the distribution of zooplankton in Karwar waters with special reference to the abundance of pelagic larvae.

Literature on specific studies on the settling behaviour of larvae are also available (Kurian and Mahadevan, 1954; Deniel, 1955, & '57; Kalyanasundram and Ganapati, 1974 and Ravindran et al., 1977). The details of fresh settlement of meroplankton in a tropical estuary was observed by Bhat and Gupta (1982).

Studies on zooplankton of Karwar waters are limited to a few reports. Ramamurthy (1965) pioneered studies on zooplankton off Karwar, followed by Konnur (1981), Nair and Paulinose (1980); and Kather Batcha (1983). Sudarshana et al., (1984) have evaluated the role of plankton in the trophic chain of Karwar bay. Naik (1986) has carried out comprehensive study on the plankton and productivity of inshore and estuarine waters of Karwar. Changes in the hydrological parameters of the Kali estuary in relation to tides during monsoon period was studied by Gunaga and Neelakantan (1987) while Bhosale (1988) studied the zooplankton distribution with special reference to pelagic larvae of Karwar area. Naik et al., (1989) have studied the plankton and its relationship to various hydrographic factors of near
shore waters of Karwar and correlated plankton population to the pelagic fishery of this area.

In the present investigation, an attempt has been made to compare the zooplankton abundance and distribution of two biotopes, mainly near shore waters and Kali estuary, Karwar. The impact of environmental (hydrographic) factors on zooplankton of these biotopes are worked out. In addition to this, the food and feeding habit of a marine fish, \textit{Rastrelliger kanargurta} and the estuarine/coastal fish \textit{Mugil cephalus} were investigated and results presented.