GENERAL INTRODUCTION
Aquaculture is a fast growing field in fisheries sector and it is gaining more importance as the fish landings and supply are getting irregular. A consistent supply of fish/shellfish can only be achieved through aquaculture. The success of any culture activity depends on the timely production of seeds of finfishes/shellfishes. The availability of wild seed is seasonal and erratic. So, a dependable source of seed of fishes and shellfishes is possible only through large scale production in hatchery. A successful seed production activity depends on the availability of a variety of suitable live feed organisms in sufficient quantities at the proper time for use in the larval stages. As the live feeds promote high growth rates, easy digestion, assimilation and the quality of not contaminating the culture water when compared to other artificial feeds, make the culture of live feed organisms the principal means of providing food for the larvae of finfishes and shellfishes. Rotifers are considered to be an excellent and indispensable food for larvae of many finfishes and crustaceans. Ito (1960) was the first to culture *Brachionus plicatilis* for feeding marine fish larvae, and now it is being extensively used as live feed in hatcheries all over the world. Rotifers were first studied and described by Leuwenhock in 1703. They are a group of microscopic organisms coming under the Phylum Rotifera which comprises of about 2000 species. Their slow swimming habits, ability to tolerate a wide range of salinities, parthenogenetic mode of reproduction and ability to get enriched easily, make rotifers an ideal live feed organism.

A brief account on the major works carried out on rotifers are given below. A very important work on planktonic rotifers- their biology and taxonomy has been done by Ruttner-Kolisko(1974). In this book, the identification key has been compiled primarily for the general hydrobiologist and not for the specialist. Edmondson(1959) has proposed

Many workers opined that the distribution of rotifers is cosmopolitan. But many opposed this view. According to Pejler (1998) “rotifers tend to be cosmopolitan, some species are restricted to one or a few main biogeographical regions. Some taxa are known only from a smaller part of a main region, e.g. 10 species of Notcholca, exclusively from the Baikal area. The preponderance of the genus Brachionus is located in the
subtropic-tropic areas, while *Notholca, Argonotholca* and *Kellicottia* are found almost exclusively in the arctic-subarctic and temperate regions. Keratella shows the widest latitudinal range. The earlier view that rotifers are entirely cosmopolitan (Hofsten, 1909) has been questioned in recent years (De Ridder, 1981; Dumont, 1983), based on accumulated information on their geographic distribution patterns. Dumont (1980) opined that care should be taken against too rapid generalizations. He adds to our knowledge about rotifers distribution patterns, on a world scale, still presents numerous and enormous gaps. Citing examples from Berzins (1978) work, he adds that caution should be there in making statements about the geographical behaviour of the group as a whole. Peijler (1977) gave an account on the global distribution of the family Brachionidae.

Ruttner-Kolisko (1974) in her beautiful compilation work on “Planktonic rotifers-Biology and taxonomy” states “the distribution of rotifers is potentially cosmopolitan”. She adds “saline waters, including brackish water, must be regarded as extreme biotopes as far as the rotifer fauna is concerned; as the concentration increases the spectrum shows fewer species; at the same time there is the usual spectacular rise in the number of individuals.” In the introduction itself she states “only the open sea is without them; they are at home in fresh water, and it is there that they have developed their variety.” Thane-Fenchel (1968) reports a decrease in species of rotifers with the increase in salinity. Ruttner-Kolisko (1974) mentioned that very little is known about the extend of their variability in one and the same biotope. She also mentioned the possibility of correlation between morphological features and certain factors in the environment. Ruttner-Kolisko state “in addition to variation within a population in one and the same biotope, quite
considerable differences in size and shape, are found when populations of the same species from different waters are compared. To study the relationships between such variations in size and shape with the environmental factors, she(1974) applied the theory of ‘Formenkreise’ as suggested by Rensch, 1929. Polymorphism in the rotifer *Asplanchna sieboldi*: insensitivity of the body wall outgrowth response to temperature, food density, pH and osmolarity differences were studied by Kabay and Gilbert(1978). Marsh *et al.(1978)* described cyclomorphosis of *Keratella cochlearis* while studying the rotifer population in a southeast Texas oxbow lake. Shiel(1979) dealt with the synecology of the Rotifera of the river Murray in South Australia. In a recent article, Rob(2003) comments that the Phylum Rotifera includes about 1800 described species, of which only about 50 are marine or brackish. The remaining species are primarily freshwater. So, the above narrations would give a clear picture of the varying distribution patterns of rotifers and their presence in freshwater, brackishwater and even in higher saline waters.

Culture of rotifers and related aspects have been described by many researchers. The rotifer culture in Japan was discussed by Hirata(1979). Again Hirata(1980) described the culture methods of the marine rotifer *Brachionus plicatilis*. Clark and Revera(1980) conducted mass culture of *B.plicatilis* for use as foodstuff in aquaculture. Trotta(1980,1981) described simple and inexpensive systems for continuous mass culture of the rotifer, *B.plicatilis* as well as marine microalgae. The resting egg of rotifer and its application to marine aquaculture was dealt by Lubzens(1981). The production of food organisms with particular emphasis on rotifers was dealt by Watanabe(1982). King *et al.(1983)* dealt with cryopreservation of monogonont rotifers. The production of
zooplankton species contaminating, in the rotifer mass culture tank Su et al.(1997) discussed the collection and culture of live foods for aquaculture in Taiwan. Lubzens et al.(1997) discussed the past achievements and future directions in raising rotifers as food for marine fish larvae in Israel. The interspecific interactions in the marine rotifer microcosm was studied by Jung et al.(1997). Studies on different modes in carrying resting eggs of wild S-strain of the rotifer Brachionus plicatilis were made by Okauchi and Fukusho(1985).

The significance of rotifers as first food for early larvae was indicated by Fujita in 1979 while using the rotifer, Brachionus plicatilis as feed for the larvae of red sea bream, Pagrus major. It is generally accepted that rotifers play a pivotal role in the successful rearing of marine fish larvae(Lubzens et al.,1989). Nandita and Rao(1993) described the patterns of prey selection in rohu and singhi larvae under light and dark conditions. The larval rearing of marine fishes as well as shellfishes using rotifers have been attempted by Lubzens et al.(1989); Fukusho(1989); Theilacker and Mc.Master(1971); Hoff and Snell(1989) etc. Rotifers were successfully employed as live feed in raising important fishes like mullet, Mugil cephalus(Nash et al.,1974; Tamaru et al.,1991), milkfish, Chanos chanos(Liao et al.,1979; Juario et al.,1984), sea bass, Dicentrarchus labrax(Barnabe,1974), grouper,Epinephelus spp.(Salem Al-Thobaity and James,1996), sole, Solea solea(Howell,1973), sea bream, Acanthopagrus shlegelii(Fukusho et al.,1985) turbot, Scophthalmus maximus(Kuhlmann et al., 1981; Olsen and Minck, 1983; Witt et al., 1984) and flounder, Paralichthys olivaceus(Fukusho et al., 1985). Recognising that the rotifers' nutritional quality can not only vary, depending on what they are fed, but that it can be manipulated to ensure a nutritionally
adequate rotifer, was a major breakthrough in the culture of marine fish larvae (Kitajima et al., 1980; Fukusho, 1989; Watanabe et al., 1983). Again, studies on nutritional aspects of rotifers were conducted by Watanabe and Kiron, 1994; Yu et al., 1989; Lavens et al., 1995). Realising the importance of the size of the live feed in relation to mouth size of the larvae to be fed, the use of the super small (SS) strain of the rotifer, Brachionus rotundiformis to the larvae having small mouth opening became popular (Fushimi, 1988; Lim, 1993; Watanabe et al., 1996).

The Indian scenario of rotifer research is still in its infancy. Anderson (1889) initiated the taxonomic studies on Indian rotifers while Nayar and Nair (1969) initiated the taxonomic works on rotifers from Kerala. Vasisht and Battish (1971, 1972) studied the rotifer fauna of north India – Brachionus, Keratella, Platias, Lecane, Monostyla, Lepadella, Colurella, Filinia, Testudinella, Philodina, Rotaria, Asplanchna, and Polyarthra. A synopsis of taxonomic studies on Indian Rotatoria was prepared by Sharma and Michael (1980). Sharma (1987) remarks “the genus Brachionus is of Gondwanian origin and has invaded Eurasia and North America secondarily by dispersal from Africa and India (Dumont, 1983)”. He adds, it is missing in the arctics but predominates in the tropics and subtropics. Sharma (1987) also gives a short description related to the distribution of Brachionids of India. Sarma (1988) in the introductory remark on his contribution to the new records of freshwater rotifers from Indian waters quotes “records of rotifer taxa in different countries are helpful in making generalizations on their geographical distribution”. Rao and Mohan (1984) studied ecology of rotifers in Visakhapatnam harbour and commented that very little work has been done on the systematics and ecology of Rotifera in the marine and brackishwater environments in
India. In their work on the distribution and quantitative abundance of benthic rotifers in the north western arm of the Visakhapatnam harbour, they point out that *Encentrum marinum* which they report for the first time from India has a wide distribution ranging from freshwater to salinity conditions. They add that population density of rotifers was considerably high in freshwater conditions whereas it was less where typical marine conditions prevails. They further add as suggested by Remane(1950) that rotifers can mainly be considered as a limnetic element in marine fauna. Laal(1984) dealt with the ecology of planktonic rotifers in a freshwater pond in Bihar. Michael(1985) discussed the use of rotifers as potential bioindicators of Indian freshwater ecosystem. Sharma(1986) made an attempt to study the indicators of pollution in Indian rotifers.


Research on rotifers on culture experiments, mass culture techniques, and nutritional enrichment have been carried out in plenty. However the technology of larval rearing is not yet fully perfected with respect to many marine fishes. This may because of the inadequate supply of suitable live feed, including rotifers at the proper
time, and this in turn may be due to problems associated with rotifer cultures. To solve such problems, a proper understanding about the optimum environmental conditions for the growth of rotifers is required. To achieve this objective it is essential to know the natural habitats of rotifers and their relationships with different ecological parameters in which they grow in nature. Information on the interrelationships of rotifers with other planktonic organisms would also help us in better understanding of their position in the natural food web. Information as to what species are better adapted to varying environmental conditions will also help us in utilizing the appropriate species needed for a specific group of larvae. From the review of literature, it can be seen that in brackishwater habitats, studies on rotifers are scanty not only in India but in other countries also. Although some studies have been carried out on taxonomy, distribution, ecology and culture aspects on rotifers in India, only very little information is available on these aspects from the brackishwater environments of Kerala. It is also necessary to isolate new species of rotifers because non-conventional live feeds are being given more importance. Hence, the topic “Studies on taxonomy, distribution, ecology and reproductive potential of rotifers from selected centres in Cochin backwater system, Kerala” was selected for the present study.

The studies were conducted in nine stations with varying ecological characteristics along Cochin backwaters and adjoining canals. The present account is divided into three chapters. In the first chapter, the species/genera of rotifers available in the selected stations are described with their systematic position.
The second chapter deals with the rotifer species diversity, numerical abundance in space and time, its composition in zooplankton assemblages and the interrelationships between rotifers and various physico-chemical parameters in the study area.

The third chapter discusses the influence of salinity, feed type and feed concentration on the reproductive potential of the locally isolated rotifer, *Brachionus rotundiformis* in cultures. This information will be useful in successfully maintaining mass cultures of rotifers, thereby helping in enhanced fish production by aquaculture.