INTRODUCTION

Man is interested in fishes for diverse reasons. They afford sport for the angler, provide food for millions all over the world, and have other commercial uses as animal food and raw materials (Bond, 1979). The total number of fish species listed in India is 2200, out of more than 20,000 species recorded worldwide. India is bestowed with plentiful of fish species inhabiting diversified ecosystem comprising of cold water (4.53%), fresh water (30.43%), estuarine water (9.12%), and marine waters (55.92 %) (Das and John, 1991). There is a wide inland water resource in India comprising length of rivers and canals to 171334 km, area of reservoirs to 2.02 m ha, area under tanks & ponds to 2.855 m ha, oxbow lakes & derelict waters to 0.788 m ha and brackish water to 1.422 m ha (Anonymous, 1996).

Parasitism is one of the most common lifestyles among eukaryotes (Poulin & Morand, 2004). Parasites are an essential part of each aquatic community. Their presence becomes evident after a massive development, causing disease and sometimes even leading to the mass mortality of infested hosts. Such events are often combined with biotic or abiotic changes in the environment (Moller, 1987). Parasites belong to many different phylogenetically distinct taxa, and as such, display a variety of life histories and body forms. Virtually every species of free-living organism has parasites. Indeed, there may be more species of parasitic organisms than of free-living ones (Price, 1980). Thus, parasites contribute significantly to biodiversity simply in terms of the number and variety of species in existence.

On the basis of site of occurrence two types may be recognized: Ectoparasites that live on the external surface of the host such as skin or gills and Endoparasites sequestered in internal organs or cavities of a host. Internal parasitic worms of one kind or another often occur in most marine and fresh water fishes, and include Trematodes, Tapeworms, Round or Thread worms, and Thorn headed worms. Parasites can be divided into microparasites and macroparasites on the basis of size. The Microparasites include viruses, bacteria, fungi, protozoans, and myxozoans. Surveys for microparasites generally include only Protozoa and Myxozoa. The Macroparasites are larger multicellular organisms mainly comprising of the helminthes and arthropods. Helminths include Monogenea, Trematoda, Cestoda, Nematoda and Acanthocephala. Arthropod parasites of vertebrates in freshwater are represented mainly by the Copepoda (Marcogliese, 2004).
Fishes have great resistance to disease or parasites but under certain circumstances like bad treatment, unsuitable food, lack of oxygen, too high or too low temperature, or other adverse influences, they become susceptible to helminth parasites (Pande, et. al. 2007). Fishes serve as the intermediate or reservoir hosts for larval stages of some nematode species and as definitive hosts for others. Although the latter group is by far the more numerous of the two in terms of number of species, the former group may actually be more abundant in terms of number of individuals (Margolis, 1970). Nearly all fishes are infested to a greater or lesser extent by animal parasites of various kinds, some of them cause serious discomfort or injury, and others are apparently harmless. One negative aspect of man's relationship with fish that is important in some geographical areas is the ability of various species to harbor parasites that can affect man directly. The parasites are usually of concern only in areas where freshwater fishes are eaten raw or without sufficient processing, although there are some parasites that can be transmitted to man by marine fishes (Bond, 1979).

Parasites are a subject of choice in evolutionary biology because their environment (i.e. host) is definable in space and time more easily than the external environment. Parasites are often described as an ideal biological model for ecological study (De Meeus, et. al. 1998). Their ecological niches are easier to define than those of free living animals. It is also possible to study the evolution of their environment in time, through a host phylogeny (Des devises, et. al. 2001).

Helminth infection of fishes causes deterioration in food value and may result in heavy mortality. The importance of fish parasites as a factor contributing to fish mortality should not be underestimated especially in fish farming and culture, where sometimes the whole population of the pond is killed, resulting in the loss of potential food and financial loss to the culturist. Nematodes and cestodes are of prime importance in fish hatcheries (Herman, 1970). Parasitic infestation tends to affect the growth rate, resulting in stunting of the fish.

Roundworms, threadworms or nematodes form the phylum Nematoda. Nematodes remain the major gastrointestinal parasites of livestock animals, responsible for decreased productivities resulting in heavy economic losses in animal-based industries (Stear, et. al. 2007). Nematode life cycles vary from very simple to complex (Anderson, 2000). Monogeneans (flukes) are a group of parasites best described as flatworms. The name “monogenea” means born once, and refers to the simple life cycle. In heavy infections they can kill captive fishes and occasionally wild ones (Schell, 1970). They are
obligate parasites of aquatic and semi-aquatic organisms because they are unable to withstand desiccation (Bychowsky, 1957). Fish forms the main host for the majority of the known monogeneans (Euzet and Combes, 1998; Lim, 1998).

Flukes, digeneans (formerly digenetic trematodes) form another class of flatworms. Flukes reproduce as adults and again as larvae, hence the name “di-genetic” or two births. They cause serious and fatal diseases in many animals including humans. (Schell, 1970).

Tapeworms or cestodes form a large class of the flatworms or platyhelminths. The common name comes from the long series of body segments which resemble a tape measure. They are always of interest because they can reduce growth and affect reproductive success of fishes, and some that could harm humans occur as immature stages in fishes (Williams & Williams, 1994).

Acanthocephala or thorny-headed worms form a small phylum in the animal kingdom. The name “acanthocephala” means thorny headed. Acanthocephalans are all permanent parasites in the intestine of most vertebrates, including Humans. (Williams & Williams, 1994). Acanthocephalans are obligate endoparasites. The adults live in the intestine of gnathostome definitive hosts. The body of adult acanthocephalans is anchored at the intestinal wall of definitive hosts by the presoma (Taraschewski, 1989 a,b, 2000; Taraschewski, et. al. 1989). Additionally, in some species the trunk serves as an organ of attachment (Aznar, et. al. 1999). Acanthocephalans are less important in public health, although they may be very pathogenic (Neafie & Marty, 2000) and even able to regulate their definitive host populations (Mowlavi, et. al., 2006). A free-living egg stage is present which is voided with the faeces of the definitive host, which must be eaten by an intermediate arthropod host (insect, crustacean, myriapod) that is dependent on climatic conditions (Schmidt, 1985).

Studies of parasitology of fishes consist primarily of new species descriptions, parasite life history studies, and occasional listing of pleuronectid parasites as part of more general marine fish parasite surveys. There are few investigations conducted by Gibson (1972) and Wickins and Mac Farlane (1973) that include ecological aspects of host parasite relationships. In fish populations, intensity of infection by metazoan parasites increases with the age or size of fish hosts (Dogiel, 1958). The increase sometimes stops beyond a certain host age or size, but the positive relationship generally holds when several size classes are pooled. Older fish have had longer period to accumulate parasites than younger ones. Being larger, they provide more internal and external space for parasite
establishment and incur higher infection rates because they eat more parasitized prey and offer a larger contact area for skin attaching parasites (des Clers, 1991).

The relationships between species richness and ecosystem function have been the subject of many ecological studies, especially those with implications for conservation ecology (Tilman, 1996). Fish parasite communities may provide important information on ecosystem conditions due to their intimate contact with both the host and aquatic environments. Thus, they are frequently used as bio-indicators of environmental stress, especially with respect to pollution (Koskivaara, et. al. 1992; Bagge and Valtonen, 1996; Marcogliese and Cone, 1996; Gelnar, et. al. 1997; Valtonen, et. al. 1997). Under natural conditions, parasite presence or abundance is influenced by both host and environmental factors (Rohde, 1982; Esch, et. al. 1990). Moreover, the effect of season on parasite population dynamics in continental climates has been the subject of many studies (Hanek and Fernando, 1978; Koskivaara, et. al. 1991; Simkova, et. al. 2001). Among host factors, host size was identified as the main factor influencing parasite community structure, especially for temperate and tropical ectoparasite species (Buchmann, 1989; Hayward, et. al. 1998; Lo, et. al. 1998). There are also comparative studies showing that ectoparasite species richness increases with host body size (Morand, 2000).

In general, and according to the life-cycle pattern of each helminth species, climate variables are able to affect the prevalence, intensity and geographical distribution of helminths by directly influencing free-living larval stages as well as indirectly influencing mainly the invertebrate, but also the vertebrate, hosts (Coma, et. al. 2008). Trematodes follow a heterogenous life cycle in which the first intermediate host is a specific mollusc (Erasmus, 1972; Galaktionov & Dovrovolskij, 2003). Cestodes follow life cycles that are less influenced by climatic conditions (Arme & Pappas, 1983; Joyeux & Baer, 1961).

Parasites differ markedly in their degree of host specificity and the extent to which this reflects relationships between hosts (Holmes and Price, 1980). In addition, other factors such as host age, diet, habitat, and migratory behaviour may also influence the relationship between parasite and host (Zubchenko, 1985; Houston and Haedrich, 1986; Stock & Holmes, 1986). Conversely related host species with different food preferences may exhibit large differences in their parasite faunas (Polyanski, 1961). The diversity of parasite may also be linked to the availability of their host. The parasite richness is therefore correlated with the diversity of the free-living fauna in a certain area.
Heterogeneity in habitat, and dietary preferences among hosts seem to be important determinants of helminth community structure in teleosts (Holmes, 1987, 1990). This has been addressed previously at a broad level by comparison of different host species (Bell & Burt, 1991; Morand, et. al. 2000; Simkova, et. al. 2001). Intraspecific comparisons using different ecotype of a host species occurring in the same water source, however, should give more precise information about impacts of the trophic niche on the helminth community structure. (Knudsen, et. al. 2003)

Species richness may be the single most important feature of a community (Poulin and Rohde, 1997), however, it does not include all aspects of diversity (Luque, et. al. 2004) and other features of parasitism, such as parasite abundance, measured either as number or biomass of parasites per host (George-Nascimento, et. al. 2004; Mouillot, et. al. 2005; Poulin and George-Nascimento, 2007) as well as the use of average taxonomic distance between parasite species in an assemblage (Luque, et. al. 2004) have been thus considered as an alternative measurement of diversity in parasite communities.

The scale of observation in parasitology is also important. A parasite population in an individual host is an, infrapopulation whereas that in a host population is a component population. All the parasites of a given species in an ecosystem compose the suprapopulation. Within an individual host, all the parasites found compose an infracommunity and within a host population, a component community. All the parasites found in an ecosystem form the compound community (Esch, et. al. 1990). Diversity studies are a helpful tool for the analysis of ecosystem. It is not simply the sum of all species that are present in a community, but it also regards the respective abundance of these species. To get knowledge about the balance of species within a community or an assemblage, several indices can be calculated. The equability and dominance levels of species are gained as result to judge about important patterns of the community: it's general structure (controlled either by dominance or competition), the level of succession, the influence of extreme factors, or the density of populations (Connell, 1978; Huston, 1979). According to Leong and Holmes (1981), the richness and diversity of fish parasite communities depend on the number of related hosts in the respective habitat, on the sizes of host specimen and of host populations. The diversity of parasites is dependent on the specific feeding behaviour of hosts, the availability of intermediate and final hosts, depth distribution and host migrations (Rhode, 1984; Kennedy, et. al. 1986; Poulin, 1995). The diversity of parasite may also be linked to the availability of their host. The parasite richness is therefore correlated with the diversity of the free-living fauna in a certain area (Poulin, 1995).
Host specificity is defined as the number of host species used by a given parasite species; it is the same as host range (Lymbery, 1989). It should be remembered that specificity is inversely related to host range, so that it decreases while host range increases. These concepts are relative (Kitahara & Fuji, 1994), parasite species inhabiting either a single genus or an entire family may be termed specialists (Ludwig, 1982). The host specificity of many parasites is not absolute, and may be influenced by morphological, physiological and ecological factors (Pavlovski, 1946 a, b; Dogiel, 1958; Shulman, 1958; Williams, 1970; Baer, 1971).

In fisheries biology, parasitological studies have increasing importance, because parasites may serve as natural markers for the identification of fish stocks (Mac Kenzie, 1983; Williams, et. al. 1992). Parasitology has always been a discipline in which purely academic studies of the evolution of parasites and their life cycles have progressed as a necessary complement to the study of the pathology and control of the major tropical diseases of humans and their livestock. Indeed, the most striking feature of parasitology is the diversity of parasites in the warm tropical regions of the world and the frightening levels of debilitation and misery they cause (Anderson and May, 1979; May and Anderson, 1979). Moreover, parasites can help to analyze the diet of fish species, serving as biological indicators of the prey species and their origin (Campbell, et. al. 1980; Palm, et. al. 1998). Whereas stomach analyses may provide detailed information on the immediate trophic relationship at the time of sampling, parasitological studies make it possible to infer previous trophic interactions, thus integrating short-term variability in the food web to make wider relationships more apparent. Helminths are particularly useful for such studies, because the different stages in their life cycle are passed through the marine food web until they reach their definitive host (Campbell, et. al. 1980).

However, one cannot overemphasize the interdisciplinary role of parasitology. As is the case in increasingly more of the branches of the biological sciences, parasitologists are examining the nature of their interests, that is, parasites and parasitism, at all levels of organization, ranging from populational and macrological to micrological and biochemical levels (Cheng, 1973).