CHAPTER EIGHT

GENERAL DISCUSSION
The productivity of a lake is dependent on its morphometry as well as the catchment area. The morphology of lake basins is a major consideration in the determination of nutrients dynamics, oxygen regime, heat budget and general productivity levels of lakes (e.g. Cornett and Rigler 1979, Fee 1979). These in turn are affected by the internal hydrological regime which is also determined to a large extent by lake morphology. Ultimately, morphology per se is a major factor of fundamental importance in the determination of productivity. As the main source of nutrients to a lake is through the inflow, the nature and extant of catchment area are important.

The morphological features of Nelligudda reservoir, namely a relatively small surface area and deep basin, have an important effect on its physical structure. Thus, in a year of good inflow, the reservoir would exhibit stable thermal stratification for two extended periods i.e. from around August to November and again from February to May, as observed during 1993 and 1994. Such a thermal stratification has an important bearing on chemical and biological structure of the reservoir.

Nelligudda reservoir with its large drainage area in relation to water spread area, has the advantage of receiving large quantity of allochthonous material rich in organic matter. This is due to the agricultural operations and increased anthropogenic activity in the catchment area (due to its being on the fringes of a bourgeoning metropolis of Bangalore). Thus, heavy inflow in 1993 resulted in allochthonus input on a large scale. Allochthonous material rich in organic matter and having high biological oxygen demand, is corroborated by the anoxic hypolimnion during the period of inflow. In spite of near drought in 1994, algal biomass continued to expand up to the first half of 1995. This was perhaps possible due to the release of nutrients trapped in the sediment (see also Blazka et. al. 1980).
Thermal stratification produced the expected classical changes in the chemical structure of the Nelligudda reservoir such as depletion of oxygen, reduction in pH, increase in the concentration of ammonia and accumulation of hydrogen sulphide in the hypolimnion. Such changes in the physical and chemical structure had their independent as well as combined impact on the biological structure as well. During the period of stable stratification, when the hypolimnion was anoxic, the vertical distribution of zooplankters was restricted only to the oxygenated column of water. Zooplankters were absent in the anoxic deeper layers of water. Partial mixing during stable stratification resulted in charging of nutrients and detritus from the hypolimnion to the euphotic zone. Rotifers and the cyclooids responded to this by increasing their egg production. This was evident from the increase in the clutch size of *T. hyalinus* and increase in the rotifer density.Abrupt mixing in early November 1993 resulted in the steep decline in abundance of *T. hyalinus*, but not in that of rotifers. The period of continuous circulation from June to August 1994, had favourable influence on the rotifer community as reflected by their increased population density. The response of *T. hyalinus* during this period, though positive, was less pronounced. On the whole, the population of *T. hyalinus* was more stable as compared to that of rotifers (which are classified as "opportunists"). The "opportunist species" are known to exploit more quickly any altered condition such as increased availability of food in their favour (see Saunders and Lewis 1988).

Similar to temperate lakes, regular seasonal fluctuations in production and life histories are also characteristic of tropical lakes (Schimdt 1973, Beadle 1974, Leveque 1978, Melack 1979, Lewis 1979). During the present study, clear seasonality could not be established due mainly to the near failure of monsoons in 1994, resulting in poor
inflow. Had the reservoir received the same magnitude of inflow as in 1993, perhaps clear seasonality could have been obtained. Thus, in Nelligudda reservoir, effects of seasonal variation in temperature, wind speed and other meteorological parameters were therefore apparently over-ruled by the factor of inflow through monsoons.

The "cascading trophic interaction hypothesis" suggests that predators exert a strong effect on freshwater plankton community structure and productivity (Carpenter et.al. 1985). Top predators such as piscivores are known to influence the abundance of planktivorous fish, which in turn would determine the abundance, size structure and productivity of zoo- and phytoplankton (Carpenter et.al. 1987). The effects of planktivorous fish on zooplankton are particularly well demonstrated. Planktivorous fish, selectively prey on large-sized zooplankton, and intense zooplanktivory by fish thereby results in a zooplankton community, that comes to be dominated finally by small-sized species (Herbacek 1967, Brooks and Dodson 1965, Zaret 1980).

Similar to some of the tropical lakes like Lake Lanao (Philippines), Lake George (Uganda), Parakrama Samudra (Sri Lanka) and Lake Awassa (Ethiopia), the Nelligudda reservoir lacked any large herbivorous species of zooplankton like Daphnia sp. Strong planktivory by visual predators (mostly zooplanktivorous fish) is suggested as the major factor responsible for the overall small body-size of zooplankters in Lake George (Burgis et.al. 1973) and Lake Awassa (Taylor and Gebre-Marianm 1989).

The small but only pelagic zooplanktivorous minnow, Salmostoma bacaila, is conspicuously abundant in the Nelligudda reservoir. Parameswaran et.al. (1970), Purushothama (1985) and Nijaguna (1989) have recorded a preponderance of zooplankton in the diet of S. bacaila. Predatory fishes (e.g. Channa sp., Mystus sp.) capable of
regulating the numbers of *S. bacaila*, were encountered in negligible numbers in Nelligudda reservoir. Therefore the small body-size of zooplankters in the zooplankton community of the Nelligudda reservoir can, perhaps, be attributed to the predatory pressure of *S. bacaila*. However, future experimental verification of the predatory pressure and its effects on zooplankton community structure in the Nelligudda reservoir, would be necessary to authentically substantiate this hypothesis.

The abundance of predatory fishes being significantly low, the pelagic community of the Nelligudda reservoir corresponds in its trophic structure to other tropical lakes without piscivores (see Hecky 1984) - i.e. restricted only to three trophic levels - 1) the primary producers, 2) the herbivores and 3) the planktivores. Experimental exploration of the role of both herbivorous and carnivorous vertebrate planktivores, in maintaining the plankton community would be a promising step towards understanding the dynamics of such aquatic systems.

8.1 FISHERIES PROSPECTS OF THE RESERVOIR

In the recent past, the Nelligudda reservoir has not been brought under scientific fish culture. Hence, the fishery is dominated by not so economical, undersized *Oreochromis mossambicus*. The average returns to the fisherman from tilapia is only about Rs. 5 to 8/kg unlike major carps which fetch Rs. 25 to 30/kg. Fast growing Indian major carps (*catla*, *rohu*, *mrigal* and *calbasu*) as well as peninsular carps (*Cirrhinus cirrhosa*, *C. reba*, *Labeo fimbriatus* and *Puntius carnaticus*) should be stocked to exploit the abundant phyto-and zooplankton as well as detritus resources. Stocking of the seed of freshwater prawns (*Macrobrachium malcolmsonii* and *M. rosenbergii*) is also suggested to harness the detritus.
8.2 FUTURE MANAGEMENT OF THE RESERVOIR

The drainage area, being on the fringes of the fast expanding metropolis of Bangalore, is attracting increased anthropogenic activity. The time is not far off when the drainage area is enveloped by urban settlement. This is bound to increase the organic load into the reservoir. In a few years to come, it will not be surprising if an abrupt mixing similar to the one that occurred in early November 1993 results in massive fish mortality. To prevent Nelligudda reservoir in heading towards eutrophication and reaching the same fate as many other lakes in and around Bangalore (e.g. Madiwala tank, Hebbal tank, Bellundur tank), it is necessary for the urban planning authority to take proper measures immediately to divert (and thus prevent the entry) or treat the sewage and other effluents originating in and around the watershed.