CHAPTER SIX

OVERVIEW
6.0 OVERVIEW

The results on the physico-chemical characteristics of water and zooplankton dynamics in the four fish ponds suggests that, despite they being adjacently located, variations in few physicochemical factors and zooplankton diversity and density were evident. Rainfall and consequent fluctuations in water level have been observed to influence strongly the regulation of physicochemical features of water and zooplankton density in tropics (Carter, 1960). Since the water level in these fish ponds was low (1.25m) and never fluctuated, rainfall and water level did not have a significant bearing on the physico-chemical features of water and plankton density.

Although the thermal structure of water in the four ponds was influenced by associated changes in air temperature, the pattern of variation in the four ponds remained similar. From Table 58, it is apparent that in one annual cycle, the minimum and maximum temperature of surface water in fish ponds was higher than those recorded for the surface water of perennial tanks. This could probably be due to lower surface area (volume of water) and small depth of the fish ponds than that of the tanks. The lower and upper lethal temperature of cyprinids have been reported to be 16.7°C and 39-41°C respectively (Das, 1945, Jhingran, 1982). Since the water temperature never exceeded 35°C, the ponds are able to support the survival of carps.
Table 50

Thermal features of some freshwater tanks and fish ponds of Bangalore district. *for comparison fish pond from Barrackpore, W.Bengal also given.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Maximum depth (m)</th>
<th>Surface Water Temperature (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hebbal tank 1</td>
<td>-</td>
<td>19.0</td>
<td></td>
<td>26.0</td>
</tr>
<tr>
<td>Hulimau tank 2</td>
<td>4.80</td>
<td>18.2</td>
<td></td>
<td>25.2</td>
</tr>
<tr>
<td>Bhimanakuppe tank 3</td>
<td>6.95</td>
<td>22.0</td>
<td></td>
<td>30.5</td>
</tr>
<tr>
<td>Sankey tank 4</td>
<td>6.00</td>
<td>21.0</td>
<td></td>
<td>28.5</td>
</tr>
<tr>
<td>Madiwala tank 5</td>
<td>4.27</td>
<td>21.5</td>
<td></td>
<td>29.0</td>
</tr>
<tr>
<td>Fish ponds (present work)</td>
<td>1.25</td>
<td>22.8</td>
<td></td>
<td>34.5</td>
</tr>
<tr>
<td>Fish ponds Barrackpore* (West Bengal)</td>
<td>2.50</td>
<td>13.5</td>
<td></td>
<td>36.0</td>
</tr>
</tbody>
</table>

1. Nagendran (1980)
* Michael (1969)
Suspended particulate matter provide vast surface area for the growth of fungi and bacteria (Cairns, 1967) and hence bring about disease in aquaculture systems (Stickney, 1979). Although no information is available on the turbidity tolerance of cultivable species of fishes, the low turbidity in the four fish ponds implies that the presence of suspended particulate inorganic matter is at the minimum.

It has been suggested by Sreenivasan, (1967) that conductivity values higher than 400 μ mho cm$^{-1}$ did not limit productivity while, Rodhe (1951) and Radwan et al (1973) have opined that productive waters exhibit higher conductance values. In the four fish ponds the high conductance of water could be attributed to the regular addition of fertilizers like cow dung, super phosphate, groundnut oil cake, rice bran and fish meal.

In tropics, high temperature and greater intensity of sunlight bring about significant quantities of oxygen production (Sreenivasan 1970a). In the four fish ponds, at any given time, the oxygen level never formed a limiting factor. The values appear to depend on the biological activities occurring in the pond.

In aquaculture systems, alkalinity of water is found to generally range from 30-200 mg CaCO$_3$ l$^{-1}$ (Stickney, 1979). The water in the four ponds remained alkaline throughout the period of study and the values fall within this range and are comparable to the values reported for a fish pond in Barrackpore, West Bengal (Michael, 1969).
In lakes, phosphorus is of great biological significance (Wetzel, 1973) and low phosphorus may limit production of phytoplankton (Mir and Kachroo, 1982). Published accounts of phosphorus in tanks and reservoirs of Bangalore district suggest that this nutrient is available in considerable quantities and has never been a limiting factor. Similarly, a concentration of sediment phosphorus between 0.05 to 2 ppm is indicative of medium productivity (Banerjea, 1967). In the four fish ponds, despite low levels of phosphorus in the water, its level in the sediment was considerable and hence, this nutrient did not limit the production of zooplankton.

Several workers have emphasized that zooplankton abundance is dependent upon phytoplankton abundance while others opined that the zooplankton abundance is based on the abundance of mannoplankton including bacteria (Mathew, 1977). In the present study, the standing crop of zooplankton varied in the different ponds. Addition of fertilizers such as rice bran, super-phosphate, groundnut oil cake and cow dung to fish ponds appear to enhance the zooplankton production (Shirgur 1971). Presently, due to lack of data on the rate of application of these fertilizers into the fish ponds and stocking rate of fishes, much discussion on this aspect has not been attempted. However, as the phytoplankton density in these ponds remained low, it could be surmised that the pattern of abundance of zooplankton was influenced more by the nutrients (fertilizers) than by the phytoplankters in the ponds.
Rotifers in fish ponds are known to occur in maximum density during summer months (Michael, 1969). On the contrary, the loricate forms had their maximum occurrence not only during summer (March-April) but also during cool-dry months (December-January). High water temperature (range: 22.8-29.5°C) during the cool-dry months and the availability of nutrients (fertilizers) must have resulted in higher production of rotifers during these months.

Water temperature has been shown to be the controlling factor in the seasonal variations of copepods (Mathew 1977). However, in the four fish ponds no definite correlation between water temperature and copepod density was evident. An inverse relationship between the abundance of rotifers and cladocerans has been reported for a tropical lake (Mathew, 1975). Interestingly such a relationship was also significantly evident in the fish ponds.

The littoral zone is the most productive area in many lakes and rapid changes in community structure may occur over short time intervals (Walls et al., 1990). The data presented on the diel variations of physico-chemical features and zooplankton dynamics in the littoral region of Madiwala tank suggests that these variations differ during the different seasons. The noteworthy observation is that in the man-made tank (Madiwala) the species diversity of zooplankton in the littoral zone is much higher than that found in the fish ponds. On the whole, it is seen that, the different seasons did not have a clear influence on the diel
migrations of zooplankton in the littoral region of Madiwala tank.

With the development of modern technology of aquaculture to increase fish production, mass culture of live food and formulation of artificial feed has gained much importance to increase the required stocking material. The studies on the mass production of zooplankters suggests that the growth rate of the plankter was dependent on the type of fertilizer (nutrient) used. Groundnut oil cake and cow dung in the ratio of 1:3 provides the best yield (4125 l⁻¹) of the Cladoceran Scapholeberis kingi. Irrespective of the nature and proportions of fertilizer used, it is seen that the population after reaching a peak exhibited a slump. In cladocerans, the period of low production has been described as a depression by Berg (1934). The cause of the depression has been attributed to the appearance of rotifers and protozoans in the culture (Bhanot and Vass, 1976).

Many species of rotifers have become an essential live food organisms for the larval culture of fish and prawns, According to Pourriot (1986), the rate at which planktonic rotifers multiply during the parthenogenetic phase is dependent on the availability of sufficient food and water temperature. Bottrell et al. (1976) draw attention to the fact that the relationship between these demographic variables and temperature follows general laws.

Presently, all the diets provided growth rates for Brachionus calyciflorus, B. angularis and Monostyla sp. yielding
densities over 7000 ind. l\(^{-1}\), which were typical of batch cultures (Nagata and Whyte, 1992). However, distinct differences in growth rates were observed as a function of diet. Groundnut oil cake, cow dung and Baker’s yeast in combination provided the maximum yield of *B. calyciflorus* (33165 ind l\(^{-1}\)) and *B. angularis* (78,670 ind l\(^{-1}\)). Since the temperature of culture media in these two species did not vary significantly, it could be surmised that, these nutrients are better utilized by *B. angularis* than by *B. calyciflorus*. Addition of Baker’s yeast into the culture medium has been found to enhance the production of *B. plicatilis* (James *et al.*, 1987). The fecundity of *B. calyciflorus* has been found to be influenced by the quality and quantity of food (Awaiss and Kestemont, 1992). The high rate of growth of the population of *B. calyciflorus* and *B. angularis* as observed presently suggests that the groundnut oil cake, cow dung and Baker’s yeast may promote higher fecundity in these individuals and thus result in an increased production.

Interestingly, Baker’s yeast has also promoted high production of the copepod *Mesocyclops leuckarti*. A combination of groundnut oil cake, cow dung and Baker’s yeast gives a production rate of 10,147 ind l\(^{-1}\) at 26.5\(^{\circ}\)C. The harvest period in the tested diets ranged from 23 to 30 days. Copepods are generally found to feed on phytoplankton (Sehgal, 1977) and their production increases with increase in protein content of the diet (Gopalan, 1977). Since, Baker’s yeast is a good substitute for microalgae, its use in copepod culture may enhance the daily production rate.
The results on the physiological energetics of feeding in carps throws light on the usefulness of zooplankton for survival and growth of carp fry. While an exclusive food *M. leuckarti* does not support the survival of *Catla catla* fry, zooplankton in combination with supplementary feed such as rice bran promotes survival and growth. Although, there has been considerable progress in the field of hybridization in fishes, very little information is available on the food requirement of these hybrids, particularly during their early life history. In nature the hybrid *Catla catla* x *Labeo rohita* has been found to be detritivore (Natarajan *et al.*, 1976). While the chief food *Catla catla* has been indicated to be zooplankton, the hybrids are found to shift towards detritous and phytoplankton. Hence, an exclusive diet of zooplankton as provided presently may not support the growth of the hybrid fry. Among all the tested cyprinids, *Labeo rohita* appears to utilize the zooplankton (*Scapholeberis kingii*) more efficiently than *Oreochromis mossambicus*. Hence, more attention could be given to the mass production of the cladoceran. Further work on the physiological aspects of the digestive tract of these fish fry and biochemical constituents of zooplankton would pave way for the better utilization of zooplankton for larval/fry survival and growth.