CHAPTER 11

PHYSICO-CHEMICAL PROPERTIES OF WATER

3.1 Introduction

The functioning of an aquatic ecosystem and its stability to support life forms depend, to a great extent, on the physico-chemical characteristics of its water. The key feature of an ecosystem is the interaction among the biotic and abiotic components. The external controls and internal interactions combine to produce a certain ecosystem structure and the species develop certain pattern of abundance, seasonality, biomass and stratification. Any change in the abiotic components will be reflected in the biotic life.

Consideration of water quality is important in wetland habitat evaluation because a host of interacting physical and chemical factors can influence the levels of the primary productivity and thus influence trophic structure and total biomass throughout the aquatic food web (Wetzel, 1975).

A study on various physico-chemical properties of water in natural habitat (NH) and fragile ecosystem habitat (F) were carried out during the present study. The following parameters were analysed:

1. Dissolved oxygen (mg/l)
2. Water temperature (°C)
3. Hydrogen ion concentration (pH)
4. Water depth (cm)

Unit of measurements are indicated in parentheses. The above parameters were monitored regularly in the natural habitat and fragile ecosystem habitat separately.
3.2 Methodology

Standard analytical methods (Welch, 1948; Trivedi and Goel, 1984 and Greenberg, 1992) were followed in the analysis of water samples.

Water samples were collected fortnightly from 18 different locations (three from each study plot) in the study area for analysis. The samples collected were chemically fixed in the field itself for measuring dissolved oxygen and analysed on the same day in the laboratory.

All the parameters were monitored in the morning hours. Water temperature was measured at the time of water sample collection using an ordinary thermometer.

pH was recorded using a water analyser kit during the first five months. Due to improper functioning of the kit, pH meter as well as pH indicator papers were used to measure the pH.

Water level fluctuations was measured from sluice top in each study plot.

3.3 Results

3.3.1 Dissolved Oxygen (mg/l)

In the natural habitat the maximum level of average dissolved oxygen was noticed in December 2001 (10.33 mg/l) and the minimum in March 2001 (3.84 mg/l). The highest value in the fragile ecosystem habitat was in September 2001 (12.41 mg/l) and the lowest value in April 2001 (4 mg/l) during 2000-2002 (July-June). (Fig. 4)
Dissolved oxygen was comparatively low in the fragile ecosystem (F) in January, February, March and April during 2000-2001 (July-June).

3.3.2 Water Temperature

The water temperature recorded from natural habitat (NH) and fragile ecosystem habitat (F) showed only slight variations. Average water temperature of NH varied from 26.5°C to 31.8°C during 2000-2001 (July-June) and during 2001-2002 (July-June), a minimum of 28.8°C and a maximum of 32.2°C were recorded. In the fragile ecosystem (F) water temperature varied between 27.9°C and 32°C during 2000-2001 (July-June) and between 28.5°C and 32°C during 2001-2002 (Table 4).
Table 4: Average water temperature in degree celsius

<table>
<thead>
<tr>
<th>Month</th>
<th>2000-2001</th>
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<td>Dry</td>
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3.3.3 Hydrogen Ion Concentration (pH)

The pH was almost similar in both the natural habitat (NH) and fragile ecosystem habitat (F) during both the years. In the natural habitat a lowest pH of 5.5 and a highest of 7.2 were recorded whereas the fragile ecosystem recorded a lowest of 5.9 and highest of 7.8 (Fig. 5). During 2001-2002 (July to June), the pH remained close to 7 and the values fluctuated between 6.5 and 7.6 in both natural habitat and fragile ecosystem.
3.3.4 Water Depth

Water level was measured from the sluice top above which mixing of water occur between the natural habitat and fragile ecosystem habitat and the overflowing sluice level is the Full Reservoir Level (FRL). Water level was recorded in NH and F separately from either side of the sluice. The water depth corresponding to the point of measurement from the sluice top in NH, NH2 and NH3 are 160 cm, 124 cm and 172 cm respectively and in F1, F2 and F3 are 160 cm, 100 cm and 175 cm respectively. In the graph zero indicate the sluice top level (FRL) and the values in the graph indicates the distance between sluice top and water level. July 2000 and July to October 2001 were the dry periods in NH, the values corresponding to these months in the graph denotes the ground level.
Fig. 6

Water level fluctuations from sluice

Fig. 7

Water level fluctuations from sluice
3.4 Discussion

Oxygen is one of the most important factors in any living ecosystem. The main source of dissolved oxygen are atmosphere and photosynthetic process of producer organisms. The amount of dissolved oxygen in water depends on surface area exposed, temperature etc. Dissolved oxygen is an important factor in assessing water quality. Monitoring oxygen concentration also helps to know the "health" of a water body and its one convenient way of "feeling the pulse" of an aquatic ecosystem (Odum, 1971). So it is always good to monitor the physico-chemical parameters of aquatic ecosystems whenever such ecosystems are studied.

The concentration of dissolved oxygen is usually related to water current, temperature or substrate conditions. The biota of running water is in several ways highly dependent upon the ready availability of oxygen (Hynes, 1970). Biju et al. (2000) studied the chemical and physical conditions of Chalakudy river system and
reported that dissolved oxygen level was higher in high altitudes of the river than in lower reaches due to movement of water and the values ranged from 5.3 to 8.5 mg/l.

Seshavatharam et al. (1990) reported that in Kondakaria freshwater lake the dissolved oxygen concentration varied between 1.60 and 16.29 mg/l. Seshavatharam (1990) studied the dissolved oxygen content of Kolleru Lake, the largest freshwater wetland in Andhra Pradesh and reported that the concentration ranged between 3.0 and 12.28 mg/l.

In the present study slight variations were noticed between the average dissolved oxygen content of natural habitat and fragile ecosystem habitat in both the years. The low dissolved oxygen recorded during January, February, March and April in the fragile ecosystem (F) is due to the uptake of oxygen for decomposition of macrophytes. The floating and submerged aquatic macrophytes which get established as it completes its growth, starts decaying which adds to a decrease in the dissolved oxygen level. The highest amount of dissolved oxygen (12.41 mg/l) was recorded in September 2001 from the fragile ecosystem (F). The accumulation of the submerged aquatic macrophytes like Hydrilla, Limnophila, Chara etc. and the movement of water and mixing up of atmospheric oxygen with water while diverting the natural stream to maintain the water level in the fragile habitat played a role in this. A minimum of 3.84 mg/l of dissolved oxygen was noticed in March 2001 in the natural habitat. This is due to the decrease in aquatic macrophytes especially the submerged vegetation in the area.

Parker et al. (1992) measured the influence of water acidity on the presence of fish and aquatic invertebrates to understand how these variables influence the distribution of waterfowl in fresh water wetlands. They observed that piscivores were abundant in wetlands with pH 5.5, whereas insectivores / omnivores showed no selection for wetlands with specific acidity. In the present study pH was almost similar in both the habitats studied and the values remained closed to 7. So here pH
does not act as a limiting factor in the distribution of aquatic macroinvertebrates, fishes and aquatic birds.

Vijayan (1991) studied on the physico-chemical properties of water in the Keoladeo National Park, Bharatpur. The water was acidic during the first year of study (1982) and remained basic in the remaining study period from 1983 to 1988. The dissolved oxygen showed a decreasing trend from 1982 to 1985 followed by a slight increasing trend up to 1988. Seshavatharam et al. (1990) and Seshavatharam (1990) reported that the pH of Konackaria lake and Kolleru lake varied between 7.2 to 8.4. Both the natural habitat and fragile ecosystem maintained a pH value close to 7 in the present study.

Temperature is an important factor and all life processes are accelerated or slowed down by temperature changes in the environment. It influences the solubility of gases and salts in water. Volume as well as density of water depends upon temperature. Temperature of running water usually varies seasonally and daily and among locations due to climate, elevation, extent of streamside vegetation and the relative importance of ground water inputs. Hydrobiological features of Kawar lake, Bihar was studied by Ahmad and Singh (1990). Various physico-chemical characteristics of water were recorded. Water temperature varied from 18.3°C to 33.1°C, pH 7.9 to 8.6 and dissolved oxygen 7.6 to 11.2 mg/l. During the present study it was noted that the water temperature fluctuated between 26.5°C and 32°C and was higher during summer months when atmospheric temperature also remained high.

Abbasi (1997) conducted studies in Pookot Lake, a rare high altitude lake in Wayanad district, Kerala. He reported the seasonal variations in pH and dissolved oxygen content of the lake. The pH varied between 0.8 and 8.6 while dissolved oxygen level ranged from 5 to 8.8 mg/l.

Abbasi (1997) also reported the seasonal variations in pH and dissolved oxygen content of water in Punnurpuzha river near Kozhikode, Kerala. Water was
slightly acidic throughout the study and fluctuated between 6.2 and 6.8. The dissolved oxygen level varied between 4.8 and 7.7 mg/l.

Water depth showed variations during different months. The natural habitat was dry during July 2000 and July 2001-October 2001 due to the annual drainage of water from Bhoothathankettu Dam and the water level in this area is mainly dependent on the Dam reservoir level. Water depth in NH showed a positive correlation with dissolved Oxygen and pH ($r = 0.724$, $p < .05$ and $r = 0.93$, $p < .01$).

The fragile ecosystem could maintain its water level throughout the year by the sluice and canal system. In order to provide necessary facilities for the bridge construction going across river Periyar at Thattakad the water level remained high in the Dam reservoir for few months. Hence during March, April, May and June (2001) the water level was above Full Reservoir Level in all the study habitats.

In the present study it is clear that the physico-chemical properties of water in the fragile ecosystem habitat (F) is similar to the natural habitat (NH) indicating that both the habitats have conditions suitable to support a biotic community.