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SEASONAL CHANGES IN PHYSICO-CHEMISTRY AND PLANKTONIC LIFE OF A COMMERCIAL FISH FARM

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The physico-chemistry and planktonic life of a commercial fish farm near Faisalabad was studied from October, 1985 to September 1986. Air temperature varied from 17-40°C; water temperature 13-33°C; light penetration from 15-27 cm; pH 7.45-8.50; electrical conductivity 6.00-6.09 mmoh/cm; dissolved oxygen 2.8-13.2 mg/l; total alkalinity 500-820 mg/l; carbonates 80-250 mg/l; bicarbonates 340-560 mg/l; total hardness 660-896 mg/l; calcium 230.35-380.56 mg/l; magnesium 5.11-47.96 mg/l; chlorides 600-790 mg/l; sodium 1029.6-1302.0 mg/l; potassium 39-53 mg/l; nitrates 3.10-17.25 mg/l; phosphates 0.011-0.059 mg/l; total solids 2994-5440 mg/l; total dissolved solids 2600-4588 mg/l. Productivity based on the dried weight of biomass ranged from 32-1126 mg/l. Fourteen animal genera and eleven genera of algae were recorded.

INRTODUCTION

Pond fish culture provides an efficient way of turning low value proteins into high quality fish proteins. The availability of suitable food and ecological conditions for the fish in the pond are the basic needs for securing high fish production and protein quality. The availability of suitable food for fish in the pond depends upon its richness with planktonic life which in turn depends upon the physico-chemical environments of the pond. This paper describes the seasonal variations in physico-chemical factors and planktonic life in a commercial fish farm near Faisalabad.

MATERIALS AND METHODS

For the purpose of the present study Ajmal Fish Farm was selected. It is located in Bismillahpur Village, 19 km from Faisalabad on Samundri Road. The pond is rectangular in shape (144m x 38m) and its depth varies from 1 to 2.5 m.

Three sides of the pond are surrounded by small trees and it is exclusively served with tube-well water. Major carps viz. *Cirrhina mirrgala*, *Catla catla*, and *Labeo rohita* cultured with a total density of 3000 fishes.

The samples were collected fortnightly from October, 1985 through September, 1986. Water samples were collected in plastic bottles. Air and water temperature was recorded with the help of an alcohol thermometer. Secchi's disc was used for determining light penetration, while pH and conductivity of water samples were determined in the laboratory. Dissolved oxygen, total alkalinity, carbonates, bicarbonates, total hardness, calcium, magnesium, nitrates, phosphates, total solids and total dissolved solibs and dry weight of planktonic biomass were estimated according to Boyd (1981). Sodium and potassium concentrations were estimated by flame photometer. For quantitative and qualitative analysis of planktonic life water samples collected through the planktonic net (mesh size 56μ) were later on identified under microscope upto generic level following Wards and Whipple (1959).

RESULTS AND DISCUSSION

Air and water temperature of this lentic water body varied between 17-40°C & 13-36°C respectively due to season. The air temperature was the lowest in December and highest in June. The water temperature showed a trend similar to that of atmospheric temperature. Such a direct relationship between atmospheric and water temperature was also recorded by Nazneen (1980). There was a minimum difference between air and water temperatures during the months of October and November; this was due to increase in humidity which greatly decreased the loss of heat through evaporation. The transparency values as interpreted from Secchi's disc ranged from 16 to 27 cm. The low transparency was due to turbidity of suspended matter. The pH varied between 7.45-8.60. The changes in pH are usually associated with the rate of photosynthesis (Hutchinson, 1967). The electrical conductivity values ranged between 6.00-6.09 mmoh/cm and were high due to the persence of high salt contents. The decrease in conductivity in December-February was apparently related to dilution following heavy rains.

Dissolved oxygen varied irregularly, the range being 2.8-13.2 mg/l. As pointed out by Nazneen (1980), high values of oxygen during July-September might have been due to the effect of rain, physical aeration and high blooms of phytoplonkton. Low oxygen content during December-January and in the beginning of June might have been the result of combined effect of high salinity of water and decreased photosynthetic activity. Absence of free carbon dioxide throughout the period of this study might have been due to persistently higher value of pH.

In the present study the pattern of seasonal variations in total alkalinity corrensponded to total hardness. Total alkalinity ranged from 500 to 820 mg/l and total hardness from 660 to 896 mg/l. Calcium and magnesium were the dominant cations and bicarbonate and carbonate were the dominant anions. A strong correlation existed between the decline and increase of these cations and anions. Chlorides varied from 606 to 790 mg/l. The maximum concentration being in August when the water level decreased greatly and the minimum concentration was in January when the pond was flooded causing dilution of salts. Sodium content varied from 1029.6 to 1302.0 mg/l and potassium from 39 to 53 mg/l. Sodium and potassium followed the pattern exhibited by chlorides.

The water under study had variable levels of nitrates which could be attributed to fluctuations in the biological activity and the degree of contamination due to ogrganic pollutants. The period of maximum concentration of nitrates in July coincided the blooming period of phytoplankton, especially *Microcystis*. This showed with that inspite of continuous consumption of nitrates by algae, these were still in excess in water. This may be due to regeneration of nitrate in water by bacterial species and by nitrogen fixing cyanophyta. The concentration of inorganic phosphates fluctuated between 0.011 to 0.069 mg/l. The level varied from time to time and these fluctuations did not affect the distribution of phytoplankton species, particularly *Microcystis*. However, when the phosphates fell below the minimum required for phytoplankton production, growth was seriously limited. The maximum abundance of *Spirogyra* was associated with low concentration of phosphates. Preponderance of phosphates in October, July and August might be related to the decomposition of zooplankton, heavier monsoon rains in June/July or to a combined effect of these factors.

The patterns of seasonal variations in the concentrations of total solids (TS) and total dissolved solids (TDS) were similar. A steady decrease in the concentration of TS and TDS from December to February was possibly due to less deposition of suspended matter and high water level. The maximum amount of TS in November was due to liming of pond done in October. The concentration of TS and TDS was correlated with electrical conductivity and agreed to that reported by Prather *et al.* (1982). The higher values of TS and TDS were indicative of the fact that this lentic water body was considerably more saline than normal fish ponds. Productivity of the pond was measured by the dry weight of biomass. The biomass varied between 32-1126 mg/l. Biomass peak recorded in October, November was due to *Microcystis*, *Oscillatrois*, *Synedra*, *Daphnia*, *Moina*, *Cyclops* and *Rotifers*. The minimum value of 32 mg/l of biomass was observed in June immediately after a spell of heavy rain. Perhaps the rains disturbed the fauna and flora and water chemistry of the pond.

The biota of the pond varied both qualitatively as well as quantitatively throughout the year. This was due to fluctuations in physico-chemical factors. Total plankton abundance showed relatively high densities during spring and fall and low during summer and winter. Among the Zooplankton, *Crustaceans* and *Rotifers* were totally dominant. Six genera of *Crustaceans* and four of *Rotifers* were recorded throughout the period of study. Among the *Crustaceans*, *Cyclops* was the most prevalent genus which was present almost throughout the year. The maximum density of *Cyclops* was recorded in March-May when other parameters approximated the optimum. With rise in temperature, *Cyclops* numbers began to decline and disappeared by mid June. It reappeared in August that is towards the end of the summer season and showed a significant increase in its population. Among other *Crustaceans*, *Daphnia* and *Moina* (Cladocerans) were important. *Daphnia* and *Moina* were predominant and showed similar abundance trends.

The abundance peaks of *Microcystis*, a phytoplankton, coincided with those of *Daphnia* and Moina. Nanzato and Yasuno (1985) reported similar trends of production in Cladoceran. The synchronization of *Daphnia*, *Moina* and *Microcystis* populations hinted to their producer and consumer relationship (Ahmad, 1976). *Scapholebaris* and *Diaptomus* were recorded for a relatively shorter period of time. It is interesting to note that *Scapholebaris* appeared at the time when *Synedra* was abundant and *Euglenoids* had declined. Among the Rotifers, *Branchionus*, *Asplanchna* and *Platylas* were most abundant and they exhibited irregular pattern of distribution throughout the duration of this study. No single reason could be assigned to such differential distribution.

Among the aquatic insects, *Corixa* was commonly found at high level of chlorinity and alkalinity. Demsal fly and May fly nymphs also appeared irregularly. The *Culex* and *Chironomus* larvae as an indication of pollution was recorded during February-April (Ali *et al.*, 1975).

Eleven genera of phytoplankton were recorded in this study. Of which *Microcystis*, *Spirogyra*, *Euglena* and *Synedra* were in abundance. The density of phytoplankton was irregular, maximum growth occurring in October, February, March, August and September, agreeing thereby with the observation of Campos *et al.* (1983). *Microcystis* was the only phytoplankton which increased in density with increase in temperature, the maximum being during July-September. *Anabaena* and *Nostic* were recorded only in June and July respectively. *Oscillatoria* also occurred irregularly attaining maximum density in August. *Oedogonium*, *Volvox*, *Navicula* and *Saturoneis* were recorded irregularly. The abundance of the phytoplankton was higher during the months of milder temperature.

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