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LIMNOLOGICAL STUDIES OF THE PERENNIAL WATERBODY, ATTIGRE TANK, KOLHAPUR DIST., MAHARASHTRA

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ABSTRACT

This paper describes the physico-chemical profile of perennial tank of Attigre, Maharashtra, where limnological studies were conducted during May 1999 to April 2001. Variables analysed from surface water of the tank were temperature, transparency, pH, electrical conductivity, dissolved oxygen, alkalinity, hardness, chlorides, nitrates and phosphate. The seasonal variations of these factors were studied and interrelationships existing between them are discussed. The pH of water was alkaline. Transparency, EC, hardness and alkalinity were tend to increase during summer and decrease in winter. Dissolved oxygen was maximum during winter and minimum during summer. Dissolved oxygen showed inverse relationship with temperature and EC. Nitrate and phosphate were higher in monsoon and postmonsoon, fluctuated directly with dissolved oxygen.

INTRODUCTION

India has vast freshwater resources in the form of both lentic and lotic ecosystems. The lentic ecosystems include ponds, lakes, tanks and reservoirs. The perennial tanks play an important role as a valuable water resource for domestic, agriculture and aquaculture. The lentic ecosystems have long attracted the attention of ecologists, both for their importance as the source of drinking water and in the development of fisheries. To employ scientific methods for aquaculture, understanding of environmental conditions prevailing in the water body is essential. Increased attention is, therefore, be given to the physico-chemical factors, since they directly or indirectly affect fishes and other aquatic inhabitants.

The freshwater tank of Attigre is located in Kolhapur district (17°17' to 15°43'N latitudes and 73°40' and 70°42' E longitudes) of southwestern Maharashtra. The climate of the district is tropical monsoon. An year can be broadly divided into three seasons; summer season from March to May, rainy season from June to October and winter from November to February. Attigre tank has maximum length and width of about 820 and 430m respectively. The tank water was formerly used for irrigation purpose, but after arrival of lift irrigation schemes from river Panchaganga, the water use pattern changed from irrigation to washing, bathing and pisciculture activities. The tank store rainwater received from adjoining catchment area and is much influenced by anthropogenic activities.

Several limnological studies have been carried out in past few decades on lakes and tanks of this region, notable among those are of Kamat (1965), Goel et al. (1988) and Bhosale et al. (1994). Most of the studies were carried out in water bodies situated in urban areas. The reports on water bodies from rural areas are meagre. Thus there is lack of baseline data on limnological characteristics of Attigre tank, which is being used for pisciculture activities. There fore the present study was undertaken.

MATERIALS AND METHODS

The samples of surface water were collected fortnightly from four sampling sites of the tank. A few tests particularly for dissolved oxygen and alkalinity were performed at the site. The water temperature was measured using mercury thermometer. The transparency of water was measured by using Secchi disc. The pH was determined by using pH meter. The water samples were transferred to the laboratory for further chemical analysis. Standard methods as described by APHA-AWWA-WPCF (1985) and Trivedy et al. *(*1998) were followed for various physico-chemical parameters. Statistical analysis was done to find out the interrelationship among physico-chemical factors.

RESULTS AND DISCUSSION

The average minimum and maximum values of each parameter recorded in Attigre tank during May 1999 to April 2001 are given in Table 1. The values of correlation coefficient between physico-chemical factors are given in Table 2. The monthly variations of these variables are depicted in Figs. 1 to 10.

The surface water temperature ranged between 22 and 31.6°C. It was recorded minimum during winter and maximum in summer (Fig. 1). The monthly variations showed that the water temperature followed the seasonal pattern and fluctuated according to the prevailing atmospheric temperature.

The pH of the tank water was always alkaline and ranged from 7.6 to 8.8. The variation in pH was not very wide. The waters having pH range of 6.5 to 9.0 are most suitable for aquaculture (Jhingran 1982). The pH in Attigre tank was found suitable for pisciculture. Maximum pH was recorded during summer and minimum in monsoon (Fig. 2). The high pH in summer possibly results from increased photosynthesis; photosynthetic assimilation of dissolved inorganic carbon can increase pH (King 1970). The pH showed direct relationship with total alkalinity (Table 2). Such a relationship was also reported by Bharadwaj & Sharma (1999).

The transparency ranged from 25.2 cm to 67.45 cm. Maximum transparency was recorded in summer, and lowest during monsoon and postmonsoon (Fig. 3). The rainwater brought in a lot of dissolved and undissolved inorganic and organic materials that made the water turbid and caused lowest transparency in rainy months. These observations are in agreement with the findings of Timms & Midgley (1970).

The EC values ranged from 290.5 to 427.2 µmhos/cm, being maximum in summer and minimum in winter (Fig. 4). The EC showed direct relationship with water temperature, hardness and chlorides (Table 2). The relation of EC with temperature could be explained on the basis of the fact that

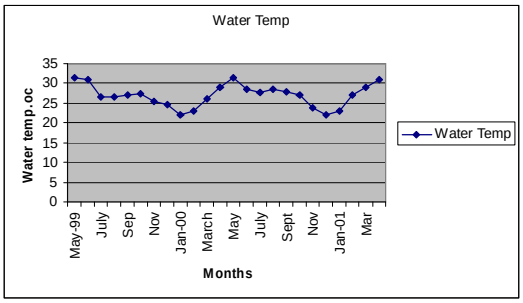

Fig. 1: Monthly variation in water temperature.

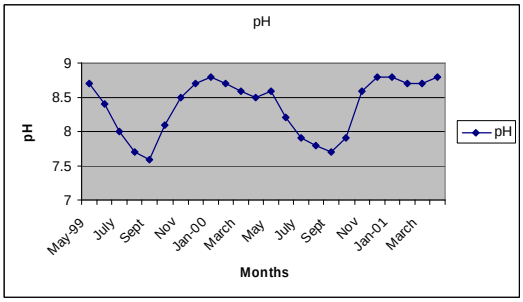

Fig. 2: Monthly variation in pH.

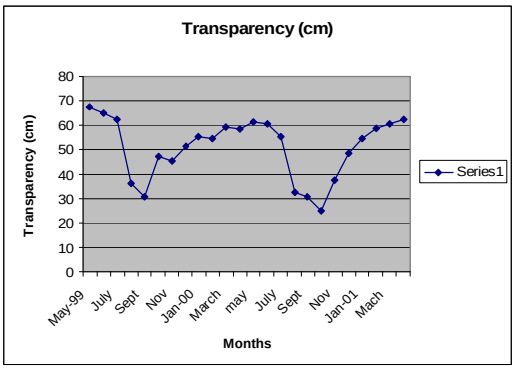

Fig. 3: Monthly variation in Transparency (cm)

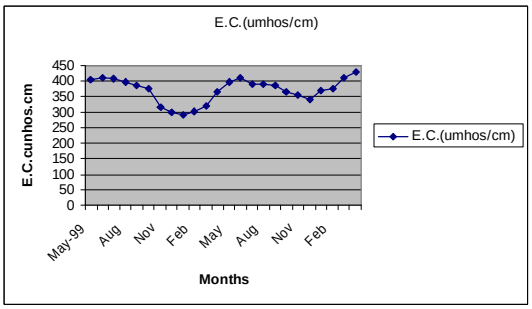

Fig. 4: Monthly variation in E.C. (µmhos/cm).

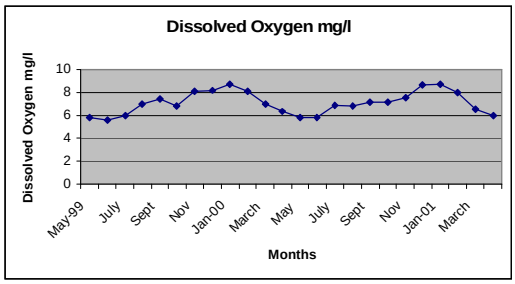

Fig. 5: Monthly variation in dissolved oxygen (mg/L).

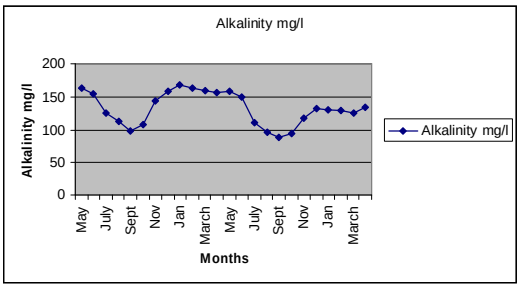

Fig. 6: Monthly variation in alkalinity (mg/L).

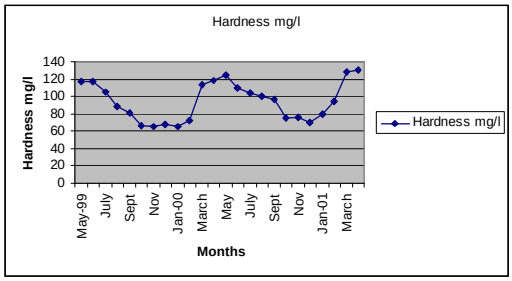

Fig. 7: Monthly in variation in hardness (mg/L).

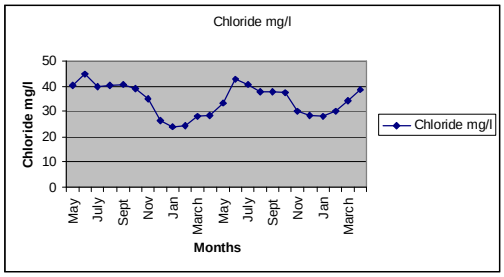

Fig. 8: Monthly variation in chlorides (mg/L).

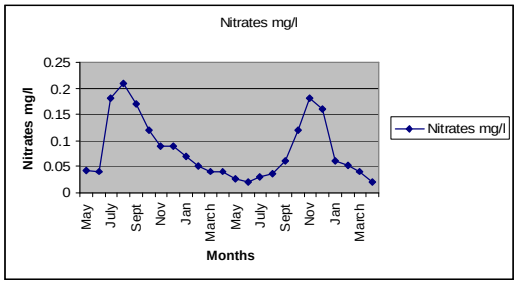

Fig . 9: Monthly variation in nitrates (mg/L).

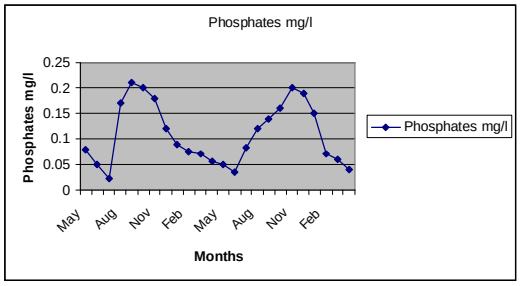

Fig. 10: Monthly variation in phosphates (mg/L).

Table 1: Average values and (ranges in parantheses) of physical and chemical parameters recorded at Attigre tank during May 1999 to April 2001.

	May 1999 - April 2000	May 2000 - April 2001
Temperature (°C)	26.7 (22-31.5)	27.2 (22-31.6)
Transparency, cm	52.7 (30.5-67.45)	49.0 (25.2-62.3)
pH	8.35 (7.6-8.8)	8.37 (7.7-8.8)
Electrical conductivity, µmhos/cm	356.7 (290.5-412)	(385.0) (340-427.2)
Dissolved oxygen, mg/L	7.0 (5.6-8.7)	7.0 (5.8 – 8.7)
Hardness, mg/L	89.73 (65.0-117.7)	99.0 (70-130.0)
Total alkalinity, mg/L	142.0 (98.27-166.9)	121.9 (96.7-158.5)
Chlorides, mg/L	34.23 (24-44.7)	34.94 (28.6-42.6)
Nitrate (NO_3-N), mg/L	0.09 (0.04-0.21)	0.07 (0.02-0.18)
Phosphate (PO_4-P), mg/L	0.1 (0.02-0.21)	0.11 (0.036-0.2)

Table 2: Correlation matrix of physico-chemical characteristics of Attigre tank.

	Temp-rature	Transpa-rency	pH	EC	DO	Alkalinity	Hardness	Chlorides	Nitrate	Phos-phate
Temperature	1									
Transparency	0.27	1								
pH	-0.14	0.65**	1							
EC	0.76*	0.13	-0.37	1						
DO	-0.93*	-0.36	0.26	-0.80*	1					
Alkalinity	-0.03	0.76*	0.48**	0.35	-0.05	1				
Hardness	0.80*	0.54**	0.05	0.69*	-0.91*	0.18	1			
Chlorides	0.66*	-0.14	-0.66*	0.79*	-0.72*	-0.44**	0.40	1		
Nitrates	-0.44**	-0.52**	-0.35	-0.09	0.58**	-0.35	-0.56**	0.06	1	
Phosphates	-0.46**	-0.72*	-0.29	0.29	0.58**	-0.45**	-0.74*	-0.01	0.64 *	1

* = P < 0.01; ** = P < 0.05

solubility of minerals and other inorganic matter increases with increase in water temperature. Kataria et al. (1995) have reported similar seasonal trend of EC, which supports our findings.

According to APHA (1985) the lowest dissolved oxygen for maintaining fish in healthy condition is 5.0 mg/L and the critical value is 3.0 mg/L. In the Attigre tank average DO value recorded was 7 mg/L, indicating favourable condition for fish growth. Dissolved oxygen varied from 5.6 to 8.7 mg/L being minimum in summer and maximum in winter (Fig. 5). DO showed significant inverse relationship with water temperature. This might be attributed to two reasons, i.e., in summer at high temperature the rate of oxidation of organic matter increases and oxygen is consumed and secondly at high temperature oxygen holding capacity of water decreases (Welch 1952, Nair 1999).

The total alkalinity ranged from 96.7 to 166.9 mg/L. It was recorded maximum in summer during both the years of the study, and minimum during monsoon and winter during first and second year respectively. According to Jackson (1961), alkalinity below 50 mg/L indicated low photosynthetic rate. The alkalinity in Attigre tank remained always high indicating high photosynthesis rate. Kaur et al. (1997) observed higher alkalinity during summer and lower during monsoon. The high values of alkalinity in present study imply large reserve of total CO_2 which provide supply of inorganic carbon for the support of algal population as Sinada & Abdel Karim (1984) have observed.

Hardness of Attigre tank varied from 65 to 130 mg/L. Kannan (1991) has classified water with hardness values ranging from 60-180 mg/L as moderately hard to hard. By these criteria the water of Attigre tank can be termed as moderately hard. The hardness showed seasonal variation, being maximum in summer and minimum in winter (Fig. 7). Rao & Mahmood (1995) have also recorded higher hardness in summer and lower in winter, which support our findings. Hardness showed direct relationship with temperature, EC and transparency (Table 2). Similar relationship was reported by Jhingran (1982) and Kaur et al. (2000). Chloride values ranged between 24.0 and 44.7 mg/L. Slightly higher values of chloride were recorded during monsoon (Fig. 8).

Freshwater contains 8.3 mg of chlorides per litre, in general, (Swarnalatha & Rao 1998) but in present investigation the chloride concentration was observed higher indicating polluted nature of the tank. Munawar (1970) suggested that higher concentration of chloride in water is an index of pollution of animal origin. Higher chloride values during monsoon might be attributed to run off from the catchment area, which added dung and other agricultural wastes in the tank water. Chloride showed direct relationship with water temperature and EC.

Nitrates (NO_3-N) were reported in lower concentration which might be due to biological destruction. The nitrate ranged from 0.02 to 0.21 mg/L. Though nitrate content of the tank water was lower, higher values were reported in monsoon than in winter and summer (Fig. 9). Highest values of nitrates in rainy season may be due to addition of nitrogen in the form of run off water. The nitrate showed direct correlation with DO, and such a direct relationship was also observed by Swarnalatha & Rao (1998).

Phosphate (PO_4-P) content of tank water varied from 0.02 to 0.21 mg/L being higher in monsoon and postmonsoon and lower in summer (Fig. 10). Nair (2000) has observed similar seasonal trend in phosphate concentration. Phosphate showed direct relationship with DO and nitrate, and negative correlation with water temperature, transparency, hardness and alkalinity (Table 2). Singh (1986) also reported such a relationship of phosphate with other parameters.

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