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Original Research Paper

Studies on Physicochemical Status of Two Ponds at Patna in Relation To Growth of Fishes

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ABSTRACT

Physicochemical characteristics of two ponds at Patna were studied for a period of one year in 2004-05. The investigation was focused on the determination of water quality parameters such as temperature, pH, DO, alkalinity, nitrite, nitrate and other factors showing that the water quality of these ponds comply with suitability of growth of some fishes.

INTRODUCTION

An ecosystem has two major components, abiotic and biotic which are interdependent. The chief abiotic factors are light, temperature pH, DO and basic inorganic and organic compounds. The biotic factors comprise flora and fauna along with aquatic microbes. Since, both these components mutually influence and interact with each other, a thorough understanding of an ecosystem is not possible without analysing these factors.

In India, several studies have been made to understand the physicochemical properties of lakes, reservoirs and ponds (Jain et al. 1996, Mohanraj et al. 2000, Sah et al. 2000). However, much information is needed especially with reference to specific water bodies of small dimensions. George (1961, 1962) has studied the physicochemical characteristics of shallow ponds at Delhi. Studies of fish ponds at Seoni, Madhya Pradesh, have been made by Verma (1967), whereas Khatri (1985) has investigated Idduki reservoirs, Kerala. In the present investigation an attempt has been made to assess the variation in physico-chemical parameters of two ponds at Patna, Bihar.

MATERIALS AND METHODS

Two ponds, Secretariat pond (Pond-1) and Phulwarisharif pond (Pond-2) were selected in the present study. Both the ponds are perennial having an area of about 0.5 ha (Pond-1) and 2.20 ha (Pond-2), receive rain water and are used for cattle, bathing and cloth washing purposes.

Monthly collections of water samples were made between 9.0 A.M. and 11.0 A.M. during the period from July 2004 to January 2005. Detailed ecological observations were made on these ponds from the time of accumulation of rain water i.e., from July to the period till the fishes were taken out from the ponds. The physicochemical analysis of the water samples was done as per standard procedures given by APHA (1998).

RESULTS AND DISCUSSION

The physicochemical parameters and their monthly fluctuations are presented in Tables 1 and 2.

Temperature alters the rate of metabolic processes. It has a considerable effect on the growth of fishes and is a key factor in controlling planktonic species. In the present study the temperature showed a fluctuation between 18.8°C and 29.9°C (Pond-1) and 24°C and 30°C (Pond-2). Such variation in water temperature has also been reported by Devidas et al. (2006), Ranjan et al. (2007) and others. Collins (1970) has observed that catfish production is poor when water temperature is below 20°C. Khan (1972) showed a positive correlation between temperature and fish growth rate at 5% level. In the present investigation a negative correlation was observed, which was significant in Pond-1 [r = -0.993 at 1% (C), r = -0.994 at 1% (M), r = -0.998 at 1 % (R)].

The oxygen content of the water bodies is one of the important parameters in the assessment of water quality, and its presence is essential in aquatic ecosystems to keep organisms in balance. It also affects the solubility and availability of many nutrients and controls the productivity of ecosystems. In the present investigation, low dissolved oxygen was mostly founded in July, December and January, and there was no significant correlation between dissolved oxygen and growth rate of major carps except Pond-1 [r = 0.731 at 5% (C), r = -0.768 at 5% (R) and r = -0.748 at 5% (M)] which showed a negative correlation. The decrease in DO and its relationship with fish growth may be due to its utilization in the decomposition of organic matter as shown by Doudoroff & Shumway (1970) and Hanan (1979).

The pH is one of the most important factors that serves as an index for pollution. The pH of both the ponds ranged from 6.5 to 8.2 in all the seasons. The change in pH may be due to high phytoplankton productivity as also reported by Gonzalez et al. (2004). Valladolid et al. (1954) observed that among the physico-chemical factors, a pH between 7.3 and 8.4 is suitable for growth of fishes. As per report of Ellis (1937), water pH ranging between 6.5 and 9.0 at daybreak is most suitable for better fish growth. In the present investigation, a positive correlation of water pH with growth rate of fishes was recorded in both the ponds but correlation values were significant in Pond-1 [r = 0.956 at 1% (C), r = 0.657 at 5% (R), r = 0.920 at 1% (M)].

Table 1: Physicochemical analysis of water samples of Pond-1 during 2004-2005.

Parameters*	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Atmospheric temperature, °C	31.2	30.0	31.42	29.2	25.75	24.2	20.0
Water temperature, °C	29.65	29.9	30.3	28.4	24.6	22.8	18.8
Transparency, cm	16.62	21.3	18.3	13.83	12.25	19.96	21.5
pH units	8.03	7.67	7.7	8.25	7.7	7.81	7.6
Dissolved oxygen	3.0	7.63	6.8	7.86	6.6	3.73	4.0
% Saturation of DO	39.12	99.6	90.75	102.12	82.43	44.72	44.20
FreeCO_2	9.1	8.0	-	-	-	-	9.6
Carbonate	-	-	2.2	6.66	8.0	2.0	-
Bicarbonate	126.5	142.16	127.76	164.66	125.0	152.66	220.0
Total alkalinity	126.5	142.16	129.78	171.33	133.0	156.0	225.0
Chloride	22.5	28.41	36.88	53.35	40.25	31.66	40.0
Specific conductivity, µmhos/cm	150.0	158.63	400.0	506.66	415.0	356.66	470.0
Nitrite	-	0.031	0.019	0.022	0.042	0.032	0.12
Nitrate	0.56	0.14	0.131	0.633	0.312	0.066	-
Phosphate	-	0.117	-	0.4	0.175	0.66	0.1
Calcium	38.2	32.26	27.6	25.06	32.8	34.8	42.4
Silicate	12.0	12.33	7.5	15.33	11.0	11.33	7.0

* All the parameters are in the mg/L except temperature, transparency, pH and specific conductivity.

Table 2: Physicochemical analysis of water of Pond-2 during 2004-2005.

Parameters*	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Atmospheric temperature, °C	27.5	30.0	32.0	28.0	27.0	28.0
Water temperature, °C	26.0	27.5	30.0	27.0	25.0	24.0
Transparency, cm	5.3	6.6	5.5	3.7	4.3	6.5
pH units	7.4	6.8	7.8	7.6	8.1	7.3
Dissolved oxygen	7.0	12.0	8.6	6.5	5.0	6.2
% Saturation of DO	87.6	153.64	110.96	81.35	63.61	75.15
FreeCO_2	7.0	1.0	3.0	5.0	4.0	4.5
Carbonate	-	-	-	-	-	-
Bicarbonate	20.0	60.0	58.0	64.0	85.0	35.0
Total alkalinity	22.0	58.0	56.0	62.0	82.0	32.0
Chloride	6.0	9.0	7.5	9.8	12.5	6.8
Specific conductivity, µmhos/cm	100.0	104.0	118.0	120.0	180.0	155.0
Nitrite	-	0.003	0.0013	0.05	0.061	0.009
Nitrate	0.105	0.25	0.2	0.375	0.275	0.10
Phosphate	Traces	0.475	0.205	0.275	0.65	0.25
Calcium	17.5	16.0	16.5	16.8	16.0	18.5
Silicate	6.5	8.0	6.0	6.7	10.4	6.8

* All the parameters are in the mg/L except temperature, transparency, pH and Specific conductivity.

In the present study, free CO_2 concentration at many occasions was recorded high (above 9.0 mg/L). Chow (1958) opined that free CO_2 ranging from 3.0 to 4.0 mg/L affects the fish breath with difficulty and the fishes die if exposed to 30.0 mg/L. Similar views have also been given by Devi (1993), Kumar et al. (1996) and Mishra et al. (1999).

Total alkalinity of waters affects the growth of fishes and other organisms profoundly. In the present study, total alkalinity was recorded as 125.0-320.0 mg/L in Pond-1 and 105.0-225.0 mg/L in Pond-2, which affects fish growth positively. A positive correlation was found between total alkalinity and growth of the major carps, but it was significant only with some species in Pond-2; r = 0.823 at 1% (C), r = 0.779 at 5% (R), r = 0.720 at 5% (M); Pond-1; r = 0.699 at 5% (C), r = 0.701 at 5% (R). Such reports have also been given by Michael (1969) and Khan (1972).

Phosphate is one of the major nutrients responsible for biological productivity. In the present study, in all the ponds the phosphate content was quite high, ranging from traces to 0.65 mg/L (Pond-2) and from 0.02-0.4 mg/L (Pond-1), which shows a good production and fish growth.

Like phosphate, nitrite is also important nutrient in aquatic ecosystem. A positive correlation was recorded, which was significant in Pond-2 [r = 0.997 at 0.01% (C), r = 0.874 at 1% (R), r = 0.873 at 1% (M)] and in Pond-1 [r = 0.863 at 1% (R), r = 0.788 at 5% (M)]. On the other hand no significant correlation was found between nitrate content of the water and fish growth.

CONCLUSION

- A negative correlation was found between temperature and fish growth.
- No significant correlation was found between DO and fish growth.
- There was a positive correlation between pH and fish growth.
- No significant correlation was found between free CO_2 and fish growth.
- Specific conductivity was found to be positively correlated with fish growth in both the ponds.
- A positive correlation was found between total alkalinity and fish growth.

- In both the ponds high phosphate contents were observed showing a high production of fish.
- A positive correlation was found between nitrite nitrogen and high fish growth.
- Calcium was found to be positively related with fish growth.

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