Relationship Between Physico-Chemical and Meteorological Conditions of a Fishpond at Rajshahi, Bangladesh

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Abstract: Studies on the limnology of a fishpond of Rajshahi University campus were made over a period of 12 months between January-December 2002. Fluctuations of some physico-chemical parameters were noted. This pond was found to be of eutrophic in nature with slightly acidic to alkaline pH, with high bicarbonate content. Diurnal change of water temperature was also observed. Like other stagnant water bodies the thermal stratification occurs in this pond.

Key words: Fluctuation, physico-chemical and meteorological conditions, pond

INTRODUCTION

Different environmental factors, which determine the characters of water, have great importance upon the growth, maturity, reproduction and development of fish. Growth and abundance of zooplankton varies from month to month and also in various depth ranges and depends upon meteorological and water properties (Ali *et al.*, 1989). The relationship between the fish and their biotic and abiotic environments is not an isolated phenomenon. Changes of one may reflect and affect on other. Fishes are more dependent on water temperature, pH dissolved oxygen, free CO_2, alkalinity and some salts for growth and development (Nikolsky, 1963). Water quality of a pond is influenced by the meteorological condition and soil condition of that area. The pond is in Rajshahi where the weather is sometimes very rough (dry or humid). The maximum temperature being in the neighbourhood of 42-43°C and minimum is 7°C. The air is generally dry. In summer a remarkable diurnal variation of air temperature usually occurs.

MATERIALS AND METHODS

Morphology of the pond: The study was conducted over a period of 12 months between January to December 2002 in a pond of Rajshahi University campus. The pond is rectangular in shape and has an area of 2800 m^2. The study pond is still (lentic) water body with heavy mud and clay, debris, detritus, unicellular algae, filamentous algae, aquatic weeds and aquatic plants. Rainfall is the water source of the pond. The pond has an outlet for passing away of excess water from the pond. The pond receives direct sunlight throughout the year.

Sample collection: Water samples were collected at weekly interval from below the surface, middle and bottom layer at 6, 12 and 18 h of the day. Some physical and chemical factors like turbidity, pH and dissolved oxygen were determined immediately by water quality checker (Model No. WQC 20A, TOA electronics Ltd., Japan). Chemical factors such as free CO_2, CO_3 and HCO_3 alkalinity were estimated according to the procedure given by Welch (1948).

Weather records of Rajshahi were collected from Bangladesh Rice Research Institute Regional station, Shyampur, Rajshahi in 2002.

RESULTS AND DISCUSSION

Both physical and chemical parameters of water were recorded during the study period. The results are shown in Table 1. Thermal stratification of water was observed during the study period. The highest water temperatures were recorded during winter months. Similar investigations were made by Islam *et al.* (1974) and Patra and Azadi (1987). The lowest turbidity was recorded in November and highest in June (Table 1). Highest and lowest pH value was observed in the month of May and August, respectively (Table 1). Carbonate alkalinity was found to be almost nil in several months (Table 1). But Begum *et al.* (1994) found carbonate alkalinity in a semi intensively managed fishpond in the month of May, July and August in 1986.

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Table 1: Monthly mean variation of physico-chemical parameters of the study pond in 2002

Month	Water temperature	Turbidity (ppm)	pH	DO mg L^{-1}	Free CO_2 mg L^{-1}	CO_3 alkalinity mg L^{-1}	HCO_3 Alkalinity mg L^{-1}
January	20.29	135.00	7.67	5.49	3.21	0.00	64.92
February	22.26	139.11	7.80	5.82	3.18	0.00	69.11
March	27.64	150.81	7.48	3.91	0.00	3.19	68.56
April	29.94	166.64	7.78	3.04	1.68	2.20	70.44
May	31.88	190.66	8.14	3.21	1.75	2.94	75.42
June	32.47	194.53	7.62	2.98	3.88	1.47	57.56
July	32.77	169.39	8.04	2.86	9.42	0.00	41.36
August	31.76	175.25	7.07	2.80	9.44	0.00	37.03
September	30.25	170.03	8.09	4.63	4.37	0.00	41.19
October	28.61	147.97	8.06	5.44	7.55	0.00	48.36
November	25.54	127.97	7.79	5.13	4.03	0.31	58.14
December	21.00	132.19	7.79	5.36	3.93	0.00	55.75

Table 2: Monthly fluctuations of weather elements at Rajshahi in 2002

Month	Air temperature (°C)			Rainfall (mm)	No. of rainy day	Average sun shine hour	Solar radiation (rad.)	Evaporation (mm)	Relative humidity at 12 noon
	Average max temp. (°C)	Average min. temp. (°C)	Average air temp. (°C)						
January	32.8	9.0	16.40	16.0	2	7.97	308	2.03	56
February	26.3	12.3	19.30	34.0	3	7.97	358	2.78	63
March	32.1	15.7	23.90	7.0	2	8.09	418	4.40	45
April	37.7	21.8	29.75	6.0	1	9.20	474	7.00	40
May	37.5	25.2	31.35	87.4	8	6.60	403	6.40	62
June	33.3	25.2	29.35	232.2	16	6.00	384	4.40	75
July	31.8	24.9	28.35	301.4	23	3.60	300	3.60	81
August	32.2	25.3	28.75	29.8	16	2.40	298	3.70	81
September	32.0	25.0	28.50	338.7	17	3.30	259	3.60	81
October	32.0	23.0	27.60	34.0	3	8.40	385	3.80	68
November	38.3	17.3	22.80	44.2	4	6.40	381	2.70	63
December	25.8	11.3	18.55	3.2	3	7.70	389	2.2	55
				1363.9	98	6.47±2.23	4157		64.17±13.78

The monthly fluctuations of weather elements i.e., average air temperature, rainfall, rainy days, average sunshine hour, solar radiation, evaporation and relative humidity are shown in Table 2.

The air and water temperature showed strong positive relationship (r = 0.96), but sometimes exceptions may occur when water temperature may be slightly higher than air temperature. The direct relationship between air and water temperature was also reported by Islam *et al.* (1974), Miah *et al.* (1981) and Begum *et al.* (1989). The rainfall and water temperature viaried directly (r = 0.67). This was also observed by Miah *et al.* (1981).

Heavy rainfall occurs in monsoon. In rainy season surface run off, organic decomposition occurs. Surface run off brings clay and other soil particles, which is the reason of high turbidity in summer months. After monsoon clay and other soil particles settle down so the turbidity began to decrease. After that in winter evaporation of water decrease water level. So, the rabidity began to increase. During the month of spring and especially in the month of summer when the air and water temperature is very high, the water level decreases which is responsible for gradual increase of turbidity. Turbidity shows positive correlation with evaporation (r = 0.68), water temperature (r = 0.87), solar radiation

(r = 0.31), rainy day (r = 0.64), rainfall (r = 0.63) and negative correlation with sunshine hour (r = -0.46).

The pH value of study pond water showed to be alkaline in nature with small variation. pH is not influenced by rainfall (r = 0.01). Dissolved oxygen decreases suddenly after February due to high temperature. The occurrence of dissolved oxygen decreases reversely with the water temperature (r = 0.85) and rainfall (r = -0.51). The same result was noticed by Islam and Mendes (1976). Ali *et al.* (1989) found high value of Dissolved Oxygen (DO) during winter and low value in summer. The high free CO_2 content during summer months were possibly due to the high temperature (r = 0.33) and heavy rainfall (r = 0.58) with heavy land drainage which speeded up the decomposition of organic matters; low photosynthetic activity; low precipitation of free CO_2 as carbonates. The free CO_2 content varied together with water temperature and rainfall, which is supported by Verma (1969).

CO_3 alkalinity showed inverse relationship with rainfall (r = -0.28). The HCO_3 alkalinity above 40 mg L^{-1} is considered to be hard water characteristics (Moyle, 1947; Mathew, 1975), which helps to maintain the pH value in alkaline condition. Welch (1952) observed the alkalinity of as aquatic habitat partly depends on the amount of water present in it. Turbulence of water during the rainy months

may derive free CO_2 to escape to nature, consequently, causing a fluctuation in the bicarbonate alkalinity values. These conditions were noticed during the period of study in the pond. The high bicarbonate alkalinity during spring was possibly due to the low free CO_2, low rainfall and evaporation of water, which cause a low volume of water causing as increase in alkalinity. The low bicarbonate alkalinity during late summer months was possibly due to the heavy rainfall, which diluted the alkalinity ($r = 0.72$), further more production of free CO_2 exchanged by highest temperature agreed with Verma (1969). The alkalinity showed a negative relationship with water temperature ($r = -0.34$) and rainfall ($r = -0.72$) and positive correlation with evaporation ($r = 0.37$).

CONCLUSION

From the above observation, it is found that productivity of the pond is medium to high. It was found that water temperature is highly correlated ($r = 0.96$) with air temperature. Rainfall influences water temperature, water turbidity and CO_2 positively; DO and HCO_3 alkalinity negatively. O_2 (negative) and CO_2 (positively) are affected by rainy days but CO_3 and HCO_3 alkalinity is not affected by rainy days. Humidity does not affect DO. Turbidity also, fluctuates with evaporation, water temperature and rainy days. Sunshine hour influences DO positively whereas and CO_2 negatively.

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