

STUDIES ON CIRCADIAN VARIATION IN A FRESHWATER POND IN RANCHI, BIHAR. 1. ABIOTIC FACTORS.

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ABSTRACT

The study revealed a wide range of fluctuations in air and water temperatures, 13.2° C and 9.9° C respectively. When the intensity of sunlight was most, temperature was highest and transparency reading also exhibited an upward trend. Oxygen increased in day time owing to photosynthetic activity of producers while free carbondioxide increased at night hours due to respiration of biota. The pH values showed a diurnal increase and total alkalinity concentrations revealed very little fluctuation.

INTRODUCTION

For effective and successful development of inland fisheries it is a pre-requisite to find out the diurnal and seasonal variations of environment parameters. Studies on diurnal Variation in physico-chemical factors are not very extensive both in tropical and sub-tropical waters (vasisht and Sharma 1980). In India, work on similar aspects have been done by many others. Some of them are George (1961), Michael (1964,1966), Verma (1967), Khan and Siddiqui (1970), Saxena and Adoni (1973) and Bohra et al (1978). However, there is no such published account on the aquatic biotopes of Chhotanagpur region. The present communication records for the first time the trend of diurnal variation in some physico-chemical factors in a freshwater pond in Ranchi town located between 83° 20C Long. and 25° 15C Lat.

MATERIALS AND METHODS

A series of three hourly collections were made from 7th to 8th October 1978. Air and water temperatures were recorded at the time of each collection and transparency of water was taken during diel cycle by Secchi disc. pH was determined by electronic pH meter. The chemical characteristics of the pond water collected each time were analysed by standard methods (A.P.H.A., 1971).

RESULTS AND DISCUSSION

The data recorded revealing circadian variation and physico- chemical factors of water has been presented in Table-1, with some statistical analysis viz. Mean, Standard deviation, Coefficient of variation and variance.

Temperature

The maximum and minimum air temperatures were 32.4° C at 12.00 hours and 06.00 hours respectively. Maximum and minimum temperatures of water were 30.1° C and 20.2° C at 15.00 hours and 03.00 hours respectively. Thus, there was a difference of 13.2° C in air temperature and 9.9° C in water temperature.

Transparency

The Secchi disc readings showed an upward trend till 12.00 hours and then is gradually followed a downward trend, being maximum of 56.5 cms. at 12.00 hours and minimum of 47 cms. at 18.00 hours.

Dissolved Oxygen

TABLE - 1

Diurnal variation in physico - chemical factors. Data are the mean of three observations and per litre.

Parameters	Time in hrs.								Analysis			
	09.00	12.00	15.00	18.00	21.00	24.00	03.00	06.00	N	SD	CV	V
Air temperature °C	24.8	32.4	32.0	28.6	26.2	22.2	20.1	19.4	25.712	4.708	18.311	22.168
Water temperature °C	23.1	28.9	30.1	25.3	22.2	20.2	20.6	20.8	23.900	3.590	16.058	12.888
pH	6.1	6.2	6.4	6.2	6.1	6.1	6.1	5.9	6.137	0.131	2.245	0.017
Transparency (cm)	49.2	56.2	50.1	47.6	-	-	-	-	50.770	3.257	6.415	10.608
Dissolved O ₂ (ppm)	7.2	7.7	9.8	8.0	7.4	6.1	5.2	3.2	6.800	1.863	29.279	3.470
Free CO ₂ (ppm)	2.3	-	-	-	1.2	3.1	6.3	8.0	4.180	2.556	61.114	6.533
Total Alkalinity (ppm)	32.6	31.6	32.4	30.4	29.6	30.4	27.2	26.1	30.037	2.196	7.310	4.824

M = Mean SD = Standard Deviation, CV = Coefficient of VARIance, V = variance.

The peak of DO₂ was recorded to be 9.8 ppm at 15.00 hours and the minimum of 3.2 ppm at 06.00 hours.

Free Carbon dioxide

The concentration was maximum (8.0 ppm) at 6.00 hours and was found to be absent from 12.00 hours to 18.00 hours.

Hydrogen-ion-concentration

In the present study the water was found to be acidic throughout the period. The maximum value of pH was recorded to be 6.4 at 15.00 hours and minimum of 5.9 at 06.00 hours, there being a difference of 0.5 unit only.

Total alkalinity

Total alkalinity values varied from 38.4 ppm to 29.6 ppm.

The phenomena behind the changes in the physico-chemical factors during the 24 hours period, as observed, is due to the geophysical cycle. In the natural habitat daily rhythms are strictly 24 hours in length and are 'locked' or 'entrained' to this frequency mainly by light-dark cycles generated by the rotation of the earth on its axis. The key-factor causing fluctuations in physico-chemical factors in the present study is light (solar radiation) and ultimately temperature. A definite pattern of increase and decrease of temperature in day and night respectively was observed which is in accordance with the observations made by Michael (1964), Bohra (1978), Kumar et al (1978) and Vasisht and Sharma (1980).

This action can be understood by taking warm-cold for 'light-dark', cool temperature for 'darkness' warm temperature for 'light', temperature cycle for 'light-dark cycle' and constant temperature for 'constant light'. a range of variation in water temperature by 4.8° C-5.0° C (Sreenivasan, 1964a), 5.4° C (Srionivasan, 1964b), 5.2° C (George, 1966), 4.6° C (Kumar et al, 1978), 3.3° C (Bohra, 1978) has been reported while a wide range of temperature variation by 9.9° C was observed during the present study, probably due to prevailing climatic and

geographical condition of the area.

Michael (1964) reported that the transparency reading mostly showed a downward trend from morning towards afternoon. But in the present study the transparency reading exhibited an upward trend. This can be justified due to intense sunlight in this part of the country and also because of the shallowness of the pond under investigation.

During the day hours, solar radiations lead to profuse accumulation of more oxygen which got consumed at night due to respiration of the biota. In the night hours, as no renewal was possible in the absence of sunlight and photosynthesis, the concentration of dissolved oxygen dropped to minimum level at 06.00 hours. Thus, a direct relationship was found between dissolved oxygen and water temperature. The present findings also confirm the observations of Vass and Sachlan (1953), Itazawa (1957), George (1961), Michael (1966), Khan and Siddiqui (1970) and Saksena and Adoni (1973).

The distribution of free CO₂ repeated the usual pattern i.e. increase during night hours and decrease and even absence during day time can be attributed to respiration of biota and photosynthetic activity of producers respectively. No correlation could be established between concentration of dissolved oxygen and free carbon-dioxide as has been reported by Vasist and Sharma (1980). The pH of the water showed a gradual rise from morning towards afternoon and, therefore, decreased during night. This is in accordance with the findings of Verduin (1959), Michael (1966), and Vasisht and Sharma (1980), who demonstrated that nocturnal decrease in pH values was usually equal to the diurnal increase. In the present study, a variation of 0.5 units in pH was recorded. Very little fluctuation in total alkalinity values (8.8 ppm) was observed which is in accordance with Vasisht and Sharma (1980) and was not marked as compared to 36.0 ppm recorded by George (1961), 20.6 ppm recorded by Michael (1966), 54.0 ppm recorded by Kumar et al (1978) and 27.0 ppm recorded by Bohra et al (1978). However, Michael (1966) attributed wider variations in bicarbonate alkalinity to higher summer temperature but no such fact was noticed in the present observation.

On the basis of foregoing discussion following conclusion can be drawn:-

1. Daily variation of physico-chemical factors is governed by light and temperature resulting from geophysical cycle.
2. The fluctuation in oxygen and carbon-dioxide i.e. diurnal increase of oxygen and nocturnal increase of carbon-dioxide, is due to the photosynthetic activity of the producers and respiratory activity of the biota present in the system.

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