Uttar Pradesh J. Zool. 1 : 24–28, 1981

DIURNAL VARIATION IN HYDROBIOLOGY OF A SHALLOW DERELICT POND AT ALIGARH (UTTAR PRADESH)

C.S. SHARMA AND BHARAT B. GUPTA
DEPARTMENT OF ZOOLOGY, DHARMA SAMAJ COLLEGE, ALIGARH 202 001.

Abundance of *Lepocinclis* sp., *Euglena oxyuris*, *Stauroneis* sp., *Closterium sp.*, *Daphnia sp*, *Cyclops sp.*, *Epiphanes* sp, *Brachionus* sp, show a distinct diurnal variation in a shallow derelict pond during late winter. A marked fluctuation in air and water temperatures, dissolved oxygen, pH, free carbon dioxide, carbonates and bicarbonates was also observed.

INTRODUCTION

Diurnal variation is one of the striking phenomena manifested by the plankton (Russel, 1927; Pennak, 1944; Jolly, 1952; Vaas & Sachlan, 1953; Ganapati, 1955; George, 1961; Rao & Rao, 1962; Michael, 1966; Dunn, 1967; Verma, 1967; Khan *et al.*, 1970). But there is paucity of literature about this variation in derelict water especially during winter months when zooplankton are in great abundance. An attempt thus was made to study the diurnal variation of plankton in mid February.

MATERIAL AND METHODS

The present study was made of a shallow, permanent, eutrophic Ravan Tila pond situated in the eastern outskirt of Aligarh about 5000 m^2 in area and 1.25 m in depth (latitude 27° 54′ 30″N, longitude 78° 4′ 26″E and 187.2 m above sea level). The local colony wastes are poured into the pond and its water being used for washing the clothes and bathing of the cattle. The water samples were collected on two consecutive days *i.e.* 15th and 16th February, 1980 at an interval of three hours in glass and plastic bottles for the hydrochemical analysis. Standard methods (Hutchinson, 1957; Anonymous, 1975) were employed for an estimation of various factors (Fig. 1).

The water for hydrobiological analysis was collected from the shore and little below the surface. After identification of the biota, the water was filtered and preserved in 5% formalin. The qualitative and quantitative analysis of plankton were made in a Sedgewick-Rafter Counting Chamber after dilution by Strip Counting and Total Counting methods (Anonymous, 1975) (Table I).

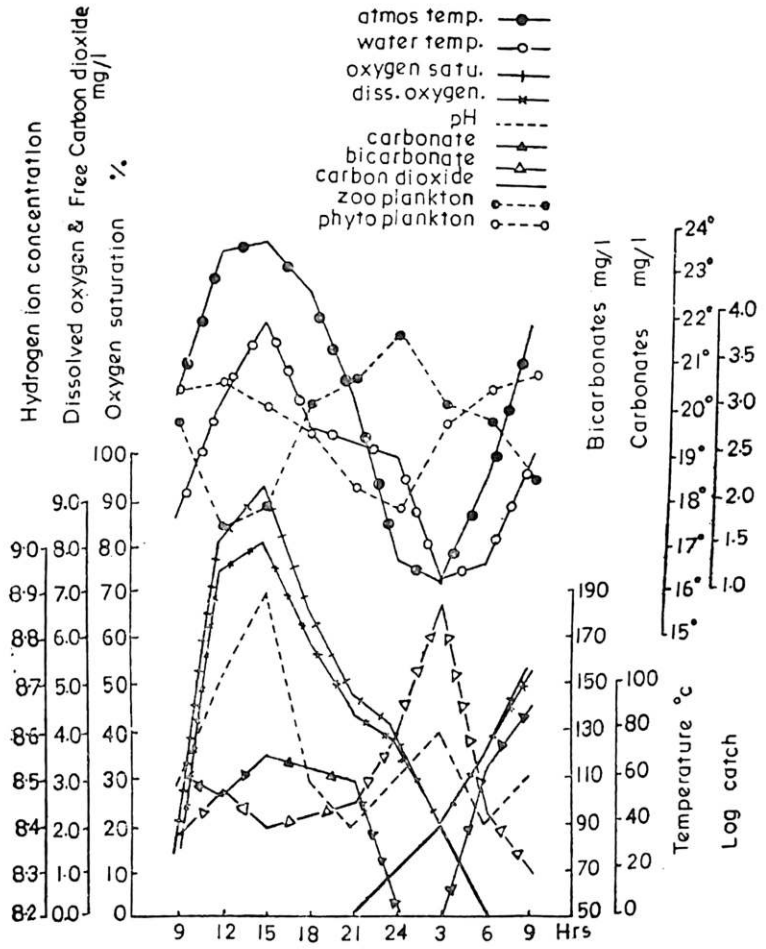

Fig. 1. Activity of zooplankton and phytoplankton in relation to physio-chemical parameters.

RESULTS AND DISCUSSION

Temperature

Air temperature varied between 16.2°C and 23.6°C, and the water temperature between 16.3°C and 21.9°C. The minimum air and water temperatures were recorded at 3 hrs on 16th February while the maximum at 15 hrs on 15th February. George (1961) and Michael (1966) observed the maximum temperature in noon. The average difference between air and water temperature was −2.2 to 3.3°C. On mid night of 15th/16th February, the water temperature was more than the air because of the cold night, and also due to more thermal stability of the water. The maxima observed in air and water temperatures during day hours can be explained by the fact that the rate of cooling and heating of the water depends on atmospheric temperature (Fig. 1).

Table I. Abundance of Plankton in Ravan Tila Pond (Aligarh).

Organism	Time in hrs	15th February 1980					16th February 1980			
		9	12	15	18	21	24	3	6	9
PHYTOPLANKTON/ml										
Lepocinclis sp.		1483	1546	912	447	54	27	573	1335	1845
Euglena oxyuris		34	47	15	11	3	2	23	49	140
Anabaena sp.		3	3	13	8	1	5	4	3	11
Oscillatoria sp.		17	15	12	10	3	2	5	8	14
Stauroneis sp.		36	121	27	17	6	4	17	36	66
Navicula sp.		90	15	22	22	21	9	13	43	77
Ankistrodesmus sp.		14	23	27	28	35	17	15	10	10
Synedra sp.		30	46	27	25	14	9	9	4	10
Closterium sp		6	11	14	8	1	2	3	4	8
ZOOPLANKTON/l										
Daphnia sp.		456	16	34	714	1110	5772	878	574	104
Cyclops sp.		36	9	17	30	38	20	13	18	14
Brachionus sp.		—	2	4	8	11	12	8	4	3
Epiphanes sp.		20	9	14	45	98	180	154	42	22
Nauplius larvae		11	—	—	14	27	38	—	—	--
Eggs		189	16	11	289	837	307	71	115	34

Dissolved Oxygen

The oxygen concentration varied between 1.5 mg/l and 8.2 mg/l. The maximum oxygen was at 15 hrs and minimum at 9 hrs on 15th February. Khan *et al.* (1970) observed the minimum at 18 hrs and maximum at 6 hrs in a fresh water pond at Shahjahanpur. The over saturation of the water with oxygen at peak of the day was due to profuse photosynthesis by the phytoplankton. While in night, the photosynthesis activity stops resulting into the biota to consume the accumulated oxygen and to liberate carbon dioxide, thus supporting to minima of dissolved oxygen in early morning hours (Fig. 1).

Free Carbon dioxide

Due to profuse photosynthesis activity in day and respiration during night, the free carbon dioxide gets accumulated in night (Fig. 1). Possibly the oxygen is utilized by the decomposing matter at the bottom faster in low temperature (night) than during the day. Since the phytoplankton do not produce oxygen in night, carbon dioxide gets maximum and oxygen minimum in the night (Fig. 1).

Hydrogen-ion concentration

The variation of pH between 8.4 and 8.9 is linked with the carbonates and bicarbonates concentration. The maximum value was at 15 hrs while minimum at 21 hrs and 6 hrs. Michael (1966) recorded 0.2 difference in minimum and maximum value of pH but in present investigation this value is 0.5 (Fig. 1).

Carbonates and Bicarbonates

The carbonate concentration was found to vary between 55,0 mg/l and 90.0 mg/l. The maximum carbonate concentration was recorded at 9 hrs on 16th February and minimum at midnight and 3 hrs on 16th February. The maximum bicarbonates were recorded at 3 hrs while minimum at 9 hrs on 16th February. The carbonates and bicarbonates have an inverse relationship. This is due to the fact that the free carbon dioxide liberated during the photosynthesis forms bicarbonates which change into the carbonates and release carbon dioxide. The later is utilized in the photosynthesis.

Plankton

Plankton manifest a remarkable vertical movement in this eutrophic pond (Table I). The green algae included *Lepocinclis* sp., *Euglena oxyuris*, *Ankistrodesmus* sp., and *Closterium* sp. The diatoms include *Stauroneis* sp. *Navicula* sp. and *Synedra* sp. The blue green algae include *Oscillatoria* sp. and *Anabaena* sp. The zooplankton composed of *Daphnia* sp., *Cyclops* sp.; and the rotifers (*Brachionus* sp., *Epiphanes* sp.). Very large numbers and variety of immature stages of animals were present in zooplankton. It has been recorded that the green algae *viz. Euglena* sp., *Closterium* sp. and *Ankistrodesmus* sp. start migrating to surface in early morning hours reaching to climax in late afternoon and then migrate downward at dusk, confirming the findings of Khan *et al.* (1970). The diatoms showed maximum abundance in early morning hours. Their poor quantity at 18 hrs, 21 hrs and 24 hrs suggests their preference to remain at surface during the day time. The blue green algae were encountered maximum at 9 hrs and poor at 24 hrs.

The zooplankton showed the most clear diurnal migration (Table I). The cladocerans, copepods and rotifers showed maxima at 21 hrs and 24 hrs and minima at mid day. They evidently start their upward movement in afternoon or with the sunset and attain maximum density in surface water at night while again move downward in early morning hours, and remain there till mid day. Vaas & Sachlan (1953) also observed maximum rotifer population at night whereas George (1961) observed the same in a few Delhi ponds during the day hours. As observed by Michael (1966) and Verma (1967), the immature stages show downward movement in day hours and distribute themselves abundantly at surface in night.

The diurnal migration of phytoplankton does not show any direct correlation with water temperature as the maximum concentration of these were noticed, irregularly at different time of the day while zooplankton showed more clear pattern, remaining poor in mid day. This indicates that the zooplankton avoid bright light and high temperature of surface water. This view is also in confirmity to Russel (1927).

It seems that the diurnal movement of plankton is a simple phenomenon affected solely by phototropism. However, it is not so simple to predict that only one factor is responsible to explain this movement. The pond is a small microcosm where several factors operate simultaneously and affect the distribution of plankton and other physico-chemical factors discussed in the present study. Pennak (1944) and Jolly (1952) considered light, temperature, gravity, food factors as possible causes for distribution of plankton.

Though the physico-chemical variables were found constant from day to day, but no doubt affect the diurnal movement of the plankton. The decomposed or chemically oxidised organic matter from human excretment perhaps evolved certain gases which have altered the physico-chemical property of the pond water. This may, therefore, be assigned to one of the probable causes of diurnal plankton movement in a derelict pond.

ACKNOWLEDGEMENTS

Thanks are due to the authorities of Dharma Samaj College, Aligarh for providing facilities; and to C.S.I.R., New Delhi for financial assistance.

REFERENCES

ANONYMOUS, 1975. Standard methods for the Examination of water, sewage and industrial waste *Amer. Publ. Health Asso. AWWA, WPCF,* Washington, pp. 1193.

DUNN, I.G. 1967. Diurnal fluctuation of physico-chemical condition in a shallow tropical pond. *Limnol. Oceonogr.* **12** : 151-153.

GANAPATI, S.V. 1955. Diurnal variation in dissolved gases,, hydrogen ion concentration and some of the important dissolved substances of biological significance in three temporary Rock pool in stream bed at Mettur-Dam. *Hydrobiologia* **7** : 285-303.

GEORGE, M.G. 1961. Diurnal variation in two shallow pond in Delhi, India. *Ibid.* **18** : 265-273.

HUTCHINSON, G.E. 1957. A Treatise in Limnology I. Geography, Physics and Chemistry. John Wiley & Sons, New York.

JOLLY, V.H. 1952. Diurnal surface concentration of zooplankton in lake Tempo, Newzealand. *Hydrobiologia* **25** : 466-472.

KHAN, A.A., SIDDIQUI, A. Q. & NAZIR, M. 1970. Diurnal variation in a shallow tropical fresh water fish pond in Shahjahanpur U.P. (India). *Ibid.* **35** : 297-304.

MICHAEL, R.G. 1966. Diurnal variation in physico-chemical factors and zooplankton in the surface layer of three fresh water fish ponds. *Indian J. Fish* **13** : 48-82.

PENNAK, R.W. 1944. Diurnal movement of zooplankton organism in some Colorado mountain lakes. *Ecology* **25** : 387-403.

RAO, T.S.S. & RAO, V.C. 1962. Studies on diurnal variation in hydrobiological conditions of Waltair coast. *J. Mar. Biol. Asso. India* **4** : 23-43.

RUSSEL, F.S. 1927. The vertical distribution of Plankton in sea. *Biol. Rev. Biol. Proc. Cambridge Phil. Soc.* **2** : 213-262.

VAAS, K.F. & SACHLAN, M. 1953. Limnological studies on diurnal fluctuation in shallow ponds in Indonesia. *Verh. Int. Ver. Limnol.* **12** : 309-319.

VERMA, M.N. 1967. Diurnal variation in a fish pond in Seoni, India. *Hydrobiologia* **30** : 129-137.

WELCH. P.S. 1948. Limnological Methods. McGraw Hill, New York.