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DIEL Variations of Physico-Chemical Factors and Planktonpopulation in a Swamp Of Harda, Purnia, Bihar (India)

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Abstract- Diel variations of physic- chemical factors and plankton population were investigated in the swamps of Purnia district, Bihar on a seasonal basis, Air and water temperature, pH, DO2 and bicarbonate alkalinity were found to increase during day time which decreased during night hours. The amount of free CO2 was also observed higher during the night period. Water temperature showed a positive correlation with air temperature, pH, DO2 bicarbonate alkalinity and a negative one with free CO2 in most cases. Phytoplankton also showed increased number during day time. Not a very clear-cut pattern of diel variation was observed and this fluctuation was mostly due to photosynthetic activity of producers, respiratory activity of biota and fluctuation in water temperature. A complex interaction of various environmental factors e g., seasons, climate, nutrients, pollution, light hours etc. also play an important role to decide the fate of diel variation of abiotic factors and biotic population.

Index Terms- Diel variations, Swamps, Physico-chemical factors, plankton population, Purnia

I. INTRODUCTION

Considerable investigations have been made on the diel variation in physico-chemical of various freshwater ecosystems, i.e., lakes, ponds, streams, reservoirs and rivers (Ganpati, 1955; George, 1961, Michael, 1970; Verma, 1967; Nasar and Datta Munshi; 1975; Saha and Bose, 1986; Saha and Pandit, 1986 b; Choudhary, et al., (1991). Saha (1981) even worked out the diel cycle of abiotic factors of the thermal stream of Bhimbandh, Munger. No such work has so far been done on any swamps in Purnia district (Bihar)).The present work was undertaken to study the diurnal changes of some abiotic factors and their relations with plankton population.

II. TERRAIN

The study site is located at a distance of 7 km. from Purnia district headquarters in the southward direction by NH 31 near Harda, a local halt. It is situated on 25º41' North Latitude and 87º28' East longitude and at an altitude of 35 m. above sea level. It is a wide water body spread on either side of Saura river

III. MATERIALS AND METHODS

For the study of diel variations, the spot was selected keeping in mind its accessible position at night. For the investigation of fluctuation in physico-chemical parameters and plankton population, water samples were collected at 4 hour internal for a period of 24 hours and most of the analyses were made on the spot. Investigations were made on different dates to observe the results in different seasons i.e., on 20th March (Spring), 15th June (Summer), 21st September (Monsoon) and 18th December (Winter) during 2006. pH Temperature was measured by mercury –filled Celsius thermometer while p recovered with the help of a portable pH meter. Other chemical parameters e.g., dissolved oxygen (DO2), free CO2, bicarbonate ($HCO3^{-}$) alkalinity and chloride were analysed at the spot adopting the standard methods (APHA, 1989, Trivedy and Goel,1984). Each sample of plankton was collected by filtering of water from different places, through a plankton net (made of bolting silk no. 21 having 77 meshes/cm2). The concentrated planktons were then preserved in 4% formalin for subsequent qualitative and quantitative determination (Lackey, 1938; Ward and Whipple, 1959; Desikachary, 1959; Fritsch, 1959). Counts were expressed in organisms per litre. Correlation coefficient among the physico-chemical parameters and biological parameters were statistically calculated and analysed whether they follow any diel seasonal variations or not.

IV. RESULTS AND DISCUSSION

The diel cycle of abiotic factors and plankton population in different seasons has been presented in Table-1. The atmospheric temperature varied between 10.5ºC and 37.4ºC, maximum in summer and minimum in winter. Generally air temperature was observed lower in the morning hour and higher in noon periods. Temperature of water varied between 15.2ºC and 31.0ºC and observed to follow the same diel fluctuation pattern in all seasons. Similar results were observed by Michael (1970) and Datta *et al*. (1983). A significant positive correlation between the water temperature and atmospheric temperature was observed (Table-2) in almost all seasons while during winter, it was found insignificant. The lowest range of atmospheric temperature

probably could not invade and affect the temperature provided by the bottom.

Water temperature showed a direct relationship with DO_2 and inverse relationship with free CO_2 in spring and monsoon seasons. The increase in temperature increases DO_2 by enhancing photosynthesis rate of phytoplanktons and macrophytes during day time. On the other hand, free CO_2 in water decreased during day time and increased during night hours, as CO_2 was utilized in the light periods while the amount of free CO_2 increased in dark period due to biotic respiration and ceasing of photosynthesis. The number of phytoplanktons was also observed higher during day hours in almost all seasons. Similar observations were found by Itazawa(1957), Srivastava and Desai(1980), Saha (1981), Bhattacharya *et al*., (1988), Pandey *et al*., (1989), and Choudhary *et al*.,(1991).

Inverse result was found in summer season during which water temperature showed a negative correction with dissolved oxygen and positive correction with free CO_2. The high water temperature during summer season accelerated the decomposition of submerged vegetation causing increased value of free CO_2 and decreased amount of dissolved O_2. Pandey *et al*, (1989) also observed the hypoxic and hypercarbion condition of water due to decomposition of accumulated organic matters in the bottom sediments of the ponds. During the monsoon season, the amount of DO_2 in the day hours was not found well due to the clouded weather decreasing the photosynthesis activity of the aquatic flora.

Almost a significant negative correlationship was observed between DO_2 and free CO_2. Such inverse relationship is typical of a pond which is photo synthetically controlled (Goldman and Horne, 1983). The diel variations of free CO_2 was noted between 9.2 mgl^{-1} (16 hr of winter) and 40.4 mgl^{-1}(16 hr. of summer) while the value of HCO_3^- was recorded maximum (148 mgl^{-1}) during 16 hr of spring and minimum (96 mgl^{-1}) during 16 hr of summer. A positive and mostly significant correlation between HCO_3^- and pH was observed during almost all seasons while a negative correlation existed between free CO_2 and pH. Automatically free CO_2 and HCO_3^- were inversely correlated. The pH value was observed below 7 in summer while it was found almost above 7 in other seasons particularly during day hours. The low value of pH was due to high amount of free CO_2 in water resulted from the decomposition of submerged vegetation. The graded decrease in pH value was observed from day to night hour (clearly) observed in spring and winter seasons) Such nocturnal decrease in pH was probably due to high level of free CO_2, accumulated as a result of community respiration and absence of photosynthesis at night. According to Zafar (1966) the pH of water is controlled by the relative quantity of bicarbonate and CO_2. Higher value of HCO_3^- and lower value of free CO_2 cause the higher value of pH. The changes in pH during day and night may be due to the conversion of carbon dioxide into carbonate and vice versa (Srivastava and Desai, 1980). The buffer system of most natural water involves the reversible transformation of carbon dioxide to bicarbonate to carbonate. Carbon dioxide recorded was in half bound state (HCO_3^-) and free- state (CO_2). As free CO_2 and CO_3 (Carbonate) cannot coexist, since they would neutralize each other to form bicarbonate (HCO_3^-). The surplus CO_2 was channelized into alkalinity system and retained in the form of HCO_3^- (Verma, 1981).

Thus it may be concluded that some physico-chemical factors of the swamps water, under investigation, such as temperature, pH, DO_2, free CO_2, bicarbonate alkalinity exhibit diel pattern of fluctuation to some extent which are controlled by complex interaction of various environmental factors operating in the system e.g., light hour, photosynthetic activity, community respiration of biota, seasons, climate, and nutrients present in water. All these physico-chemical factors also control each other and all these factors in turn influence the diel pattern of plankton.

Table1 -Diel variations of some physico-chemical parameters and plankton population in swamps of Purnia

	Some interval Parameters	**4.00**	**8.00**	**12.00**	**16.00**	**20.00**	**24.00**
Spring	**Atm.temp.(ºC)**	19.5	22.2	26.0	29.2	24.0	22.5
	Wat.temp.(ºC)	18.0	19.3	22.2	25.5	22.1	21.0
	pH	7.3	7.2	7.4	7.4	7.1	7.1
	$DO_2(mgl^{-1})$	7.0	7.	8.0	8.2	6.9	6.8
	Free $CO_2(mgl^{-1})$	18.4	20.4	15.2	16.6	22.4	20.4
	$HCO_3^-(mgl^{-1})$	135	125	140	148	130	130
	$Cl^-(mgl^{-1})$	20	19	22	22	20	22
	Phytoplank.(no/l)	11076	10030	11275	12817	7192	8225
	Zooplank.(no/l)	483	1025	795	924	371	324
Summer	**Atm.temp.(ºC)**	26	28.2	36.6	37.4	31.5	30.0
	Wat.temp.(ºC)	24.6	26.0	30.2	31.0	28.1	26.5
	pH	6.8	6.7	6.2	6.0	6.4	6.8
	$DO_2(mgl^{-1})$	5.8	6.0	5.6	5.8	6.0	5.8
	Free $CO_2(mgl^{-1})$	28.2	30.6	38.2	40.4	32.2	26.0
	$HCO_3^-(mgl^{-1})$	122	110	102	96	115	120
	$Cl^-(mgl^{-1})$	18	20	24	26	20	18
	Phytoplank(no/l)	6694	10112	8126	9845	7112	8814
	Zooplank(no/l)	70	62	96	106	92	68

Monsoon	**Atm.temp.(ºC)**	24.7	26.2	34.5	32.4	28.0	26.2
	Wat.temp.(ºC)	18.5	20.6	27.2	26.0	20.8	20.0
	pH	7.2	7.1	7.0	7.0	7.2	7.3
	$DO_2(mgl^{-1})$	5.4	6.0	5.8	6.0	5.6	5.8
	Free $CO_2(mgl^{-1})$	28.2	20.6	18.4	20.2	22.2	26.0
	$HCO_3^-(mgl^{-1})$	144	140	130	135	140	142
	$Cl^-(mgl^{-1})$	22	24	26	28	20	20
	Phytoplank(no/l)	2815	3008	3440	3612	3140	3208
	Zooplank(no/l)	322	255	338	294	235	208
Winter	**Atm.temp.(ºC)**	11.5	12.2	15.6	14.4	13.5	10.0
	Wat.temp.(ºC)	17.2	15.6	18.0	16.0	15.2	16.5
	pH	6.9	7.0	7.3	7.4	7.0	6.9
	$DO_2(mgl^{-1})$	6.0	6.5	7.8	8.0	6.8	6.7
	Free $CO_2(mgl^{-1})$	16.2	12.8	10.2	9.2	12.0	14.4
	$HCO_3^-(mgl^{-1})$	128	130	140	144	138	130
	$Cl^-(mgl^{-1})$	16	18	20	20	18	17
	Phytoplank(no/l)	12018	16522	14872	15522	12216	10143
	Zooplank(no/l)	33	45	61	50	36	45

Table2 - Coefficient of Correlation (r) computed among various physico-chemical factors during their diel cycle in different seasons, of the swamps of Purnia

Relationship	**Spring**		**Summer**		**Monsoon**		**Winter**	
	r	Prob.	R	Prob	r	Prob.	r	Prob.
Water temp.vs. pH	0.342	Ins.	-0.96	P>0.001	-0.538	Ins.	0.025	Ins.
DO_2	0.759	P<0.1	-0.414	Ins.	0.525	Ins.	0.141	Ins.
Free CO_2	-0.372	Ins.	0.801	P>0.05	-0.822	P<0.05	0.062	Ins.
HCO^-_3	0.404	Ins.	-0.889	P<0.02	-0.975	P<0.01	0.038	Ins.
HCO^-_3 vs. pH	0.264	Ins.	0.903	P>0.01	0.427	Ins.	0.898	P<0.02
Free CO_2 vs. pH	-0.956	P<0.005	-0.97	P>0.001	0.778	P<0.1	-0.915	P>0.01
DO_2	-0.947	P<0.005	0.084	Ins.	-0.684	Ins.	-0.776	P<0.1
HCO_3^-	-0.796	P>0.05	-0.952	P<0.005	0.864	P>0.02	-0.935	P>0.005
AT vs. WT.	0.892	P<0.05	-0.996	P<0.001	0.986	P<0.001	0.232	Ins.

AT = Atmospheric temperature
WT = Water temperature

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