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PHYSICO-CHEMICAL STATUS OF POLACHIRA WETLAND ECOSYSTEM IN SOUTHERN KERALA

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ABSTRACT

Polachira wetland in Southern Kerala is a famousdestination of itinerant birds.Thebird aggregation in wetlands is always correlated to the abiotic and biotic factors of the ecosystem. The present investigation reveals the hydrology of the Polachirawetland during February to July 2014. The air and water temperature agreed with the climatic factors prevailed. The pH showed slight acidity and alkalinity. The total solids fluctuation was renderedby the Total Suspended Solid and Total Dissolved Solid which was indicated by organic discharge, high chloride content and salinity in water. Salinity in water was elevated due to the incursion of saline water from Paravur estuary to Polachira wetland through a canal. The free carbondioxide concentration did not show much variation but dissolved oxygen showed variation. The total hardness which was related to the calcium and magnesium hardness in water was determined.Alkalinity was balance in the ecosystem. Nutrients such as nitrite, nitrate, phosphate and silicate were in equilibrium concentration.Correlations of physicochemical parameters among six months were statistically significant.

Keywords: Polachirawetland, hydrology, nutrients.

1. INTRODUCTION

Wetlands are unique landscape which abode a great biodiversity. These ecotonesare saturated with countless forms of species of great ecological importance. This sensitive system preserves both aquatic and terrestrial ecosystems.In wetland the species richness is always enveloped around the hydrological regime of the environment. Nowadays anthropogenic input is elevating beyond a certain threshold level which has a profound impact on the water quality of the aquatic environment.India sustains assorted types of wetlands strewn across various eco- geographical regimes that comprises of wetlands in high altitude Himalayas to Deccan plateau.Kerala is bestowed with the most productive wetlands. Wetlands in Kerala are facing dwindling of ecological and economical valuesdue to high populace.The present investigation has been taken up the variations in the hydrology of Polachira wetland in Southern Kerala.

2. MATERIALS AND METHODS

The present study was carried out on the physico-chemical parameters of Polachira Wetland (8°50′26.89″N and 76°42′0.3″E) located in the Southern part of Kollam district in Kerala.The sprawling wetland spread over 600 hectares is on theem bankment of estuaries of the Ithikkara River and Paravur backwaters.It is an oval shape wetland at a depth of 1m below ground level and is encircled by small creeks and is densely vegetated. The samples were collected from five stations in the second week of every month during a period from February 2014 to July 2014. Physical parameters like Temperature and pH, were performed on the field. The physicochemical parameters like Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Dissolved O_2, Free carbon dioxide, Total alkalinity, Total hardness, Calcium hardness, Magnesium hardness, Chloride, Salinity, Phosphate, Sulphate, Nitrite and Nitrate were analyzed as per the methods of APHA (1998) and Trivedy and Goel (1986). Data collected were subjected to proper statistical analysis. One-way analysis of variance (ANOVA) and Pearsoncorrelation coefficient was calculated to test the degree of relationship of water quality parameters between six months.

3. RESULTS AND DISCUSSION

The monthly variation (average value of different stations) of physicochemical parameters is given in Table 1. The temperature of both air and water is a remarkable regulatory factor governing the biogeochemical reactions of aquatic ecosystem. Monthly variation of atmospheric temperature in Polachira wetland ecosystem ranged between 30.1˚C and 36.6˚C during the month of June and March respectively.The present investigation revealed well marked variations in the atmospheric temperature. This may be due to the climatic conditions. Water temperature ranged from 29.6˚C (July) to 33.4˚C (March). The maximum and minimum temperatures may be due to the hot and cold climatic conditions.

Table 1. Monthly variation of physico-chemical parameters of Polachira wetland ecosystem during February to July, 2014.

Sl No	Parameters	FEB	MAR	APR	MAY	JUN	JULY
1	Atmospheric Temp.(˚C)	31.4	36.6	32.2	35.3	30.1	33.8
2	Water Temp. (˚C)	31.8	33.4	31.6	32.8	30.4	29.6
3	pH	6.63	7.23	5.88	8.28	6.34	5.97
4	Total Solid (mg/L)	1420	960	2160	900	740	560
5	Total Suspended Solid(mg/L)	460	320	500	360	280	220
6	Total Dissolved Solid (mg/L)	780	640	1680	540	460	340
7	Dissolved O_2 (mg/L)	4	3.4	4.08	3.6	6.3	3.9
8	Free CO_2 (mg/L)	15.14	15.1	17.03	14.64	15.36	14.12
9	Total Alkalinity (mg/l)	101	76	74	71	101	72
10	Hardness (mg/L $CaCO_3$)	364	380	300	292	276	160
11	Ca Hardness (mg/L $CaCO_3$)	41.022	96.162	85.762	60.9	68.932	46.49
12	Mg Hardness (mg/L $CaCO_3$)	50.692	34.136	20.476	21.442	25.342	10.712
13	Chloride (mg/L)	360.78	202.74	1177.8	760.38	864.76	536.76
14	Salinity (ppt)	0.6636	0.3870	2.1038	1.369	1.5548	0.9751
15	Nitrite (ppm)	0.0538	0.0057	0.0148	0.08368	0.0678	0.0516
16	Nitrate (ppm)	0.0536	0.0465	0.1399	0.7863	0.1899	0.1306
17	Phosphate (ppm)	0.0213	0.0177	0.0889	0.0174	0.0294	0.0296
18	Silicate (ppm)	16.013	12.787	12.1688	14.513	14.361	14.076

Table 2. Analysis of Variance of physico-chemical characteristics of Polachira wetland ecosystem during February – July, 2014.

One factor ANOVA

Mean	*n*	*Std. Dev*	
204.626	18	372.7767	FEB
156.556	18	265.3550	MAR
339.075	18	649.0492	APR
173.173	18	283.5576	MAY
162.263	18	266.3045	JUN
113.812	18	182.8021	JULY
191.584	108	366.9605	Total

ANOVA table

Source	*SS*	*df*	*MS*	*F*	*p-value*
Treatment	547,158.8997	5	109,431.77993	0.81	.5485
Error	13,861,463.1610	102	135,896.69766		
Total	14,408,622.0606	107			

Table 3. Correlation matrix of physico-chemical characteristics of Polachira wetland ecosystem during February – July, 2014.

Correlation Matrix

	FEB	*MAR*	*APR*	*MAY*	*JUN*	*JULY*
FEB	1.000					
MAR	.987	1.000				
APR	.950	.930	1.000			
MAY	.902	.873	.950	1.000		
JUN	.812	.778	.898	.983	1.000	
JULY	.869	.834	.936	.996	.993	1.000

18 sample size

± .468 critical value .05 (two-tail)

± .590 critical value .01 (two-tail)

pH showed a minimum and maximum value of 5.88 and 8.28 during the month of April and May. It is found that a slight acidic as well as basic in water may be induced by the improper use of fertilizers from agriculture field and garbage disposal.

The Total solids (TS) are a measure of both, the dissolved as well as suspended solids in watercomprising dissolved salts, suspended particles, soil particles, discharged effluents and decomposed organic matter (Patil *et al.,* 2011). In the present study the total solid varied between 560 mg/L (July) and 2160 mg/L (April). The total suspended solid was measured between 220 mg/L (July) and 500 mg/L (April). The total solid and total suspended solid may be resulted from the run-off water, which carries dissolved solids and also organic wastes from garbage dumping, agricultural land, waste water discharges and algal growth. A similar observation was reported by Chennakrishnan *et al.* (2008). A minimum total dissolved solid of 340 mg/L was observed in July and a maximum of 1680 mg/L was during the month of April.Presence of high TDS may be due to the high chloride and salinity contributed by the intrusion of saline water from Paravur estuary to Polachira wetland through a canal.

Oxygen content is a major parameter needed by aquatic life forms. The dissolved O_2 measured a lowest concentration of 3.4 mg/L in the month of March and the highest concentration of 6.3 mg/L observed during the month of June.Low oxygen concentrations are generally associated with heavy contamination of organic matter. In such conditions oxygen, sometimes, totally disappears from the water (Trivedy and Goel, 1986). Monthly variation of free CO_2 concentration ranged between 14.12 mg/L (July) and 17.03 mg/L (April).The wetland received more organic matter through surface run off and drainage and its decomposition might have resulted in the liberation of more amounts of CO_2 in the water column. The free CO_2 concentration change may be due to the micro bacterial activities, increase in temperature and biochemical reactions.

Alkalinity is a measure of acid present in water and of the cations balanced against them (Yogesh Shastri and Pendse, 2001). The presence of total alkalinity during the investigation period showed a fluctuation between 71 mg/L in May and 101 mg/L during the month of February and June respectively. The increase in total alkalinity was found to be associated with the rainfall and the subsequent surface run off and leaching.

The level of hardness was estimated between 160 mg/L $CaCO_3$ and 380 mg/L $CaCO_3$ during the month of July and March. High values of hardness are probably due to regular addition of large quantities of sewage and detergent into wetland from the nearby residential localities. Trivedi and Goel (1986) and Singh and Mahajen (1987) are of the view that the high hardness is suggestive of pollution due to domestic waste and industrial effluents.The calcium hardness value was recorded between a minimum of 41.022 mg/L $CaCO_3$ (February) and a maximum of 96.162 mg/L $CaCO_3$ (March). The amount of calcium increase may be due to rapid oxidation/decomposition of organic matter.

Monthly variation of magnesium hardness recorded between 10.712 mg/L $CaCO_3$ (July) and 50.692 mg/L $CaCO_3$ (February). Magnesium also occurs in all kinds of natural waters with calcium, but its concentration remains generally lower than the calcium (Trivedy and Goel, 1986).

Chloride is one of the factor governing the biota of aquatic system. The chloride content recorded lowest value of 202.74 mg/L (March) and maximum rate of 1177.8 mg/L (April). High and low chloride concentration was coincided with the salinity. The salinity ratewas measured between 0.3870 ppt (March) and 2.1038 ppt (April). Higher salinity content was due to the connection of Polachira wetland with Paravurestuary through a canal.

The nitrite content showed a variation between 0.0057 ppm and 0.0836 ppm. Presence of even a small quantity of nitrite will indicate the organic pollution and the availability of partially oxidized nitrogenous matter (Trivedy and Goel, 1986). The average nitrate concentration was measured between 0.0465 ppm (March) and 0.7863 ppm (May). The low rate of nitrite and nitrate concentration may be due to the utilization by the phytoplankton which was abundant during March. The increase in nitrate concentration may be due to the decaying of organic materials, discharge of sewage, natural runoff and agricultural wastes.

Phosphate is the nutrient considered to be the critical limiting nutrient causing eutrophication offresh water systems (Rabalais, 2002). The variation of phosphate concentration was between 0.0174 ppm (May) and 0.0296 ppm (July). The presence of phosphate in the wetland may be due to surface runoff during rainy season receiving huge quantity of domestic sewage, cattle dung and detergents from the surrounding catchment area. Monthly variation of silicate concentration showed a minimum of 12.168 ppm (April) and maximum of 16.013 ppm (February). High silicate content may be due to the soil erosion from catchment area.Analysis of variance of physico-chemical parameters during February to July 2014 showed that there is no significant difference in the mean value among months (Table 2). All correlations among six months were statistically significant (Table 3).

4. CONCLUSION

The monthly variations in physicochemical characteristics of Polachira wetland are providing a vivid knowledgeregarding the ecological status of wetland. This wetland is a preferred safe haven for resident and migratory birds. A frequent and continuous evaluation of this ecosystem is necessary to avoid dwindling of the resources.

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