Water Quality Assessment of Polachira Wetland Ecosystem in Kerala

Suvi .S[1], S. Shibu[2], J. Sreeja[3]

PG & Research Department of Zoology, Sree Narayana College, Kollam-691 001, India

Abstract: ***The present study is aimed at assessing the water quality status of the Polachira wetland. Polachira is one of the important fresh water wetlands of Kerala coast, located in the Southern part of Kollam district. The study was carried out for a period of two years from October 2012 to September 2014. The parameters estimated were temperature, depth, pH, alkalinity, Salinity, DO, dissolved CO_2, Hardness, TS, TDS, TSS and the nutrients (nitrate, nitrite, phosphate, silicate and sulphate). Accepted standard methods were followed for the estimations. The observations were statistically interpreted. The detailed investigation of the parameters which are well within the desirable limit indicates that the Polachira wetland is a fairly unpolluted, except for high alkalinity and hardness, which can be attributed to natural causes and agricultural runoff.***

Keywords: Water quality, Polachira wetland

1. Introduction

Polachira is one of the important wetlands of Kerala coast, located in the Southern part of Kollam district. It is located in the Chirakkara Grama Panchayath and is about 5 Km South of Chathannoor town and 6 Km north east of Paravur town. Polachira lies between $8^0$50'0''N to $8^0$51'0''N Latitudes and $76^0$41'0''E to $76^0$42'30''E Longitudes. It is spread over 650 hectares of sprawling land and at a depth of 5 m above sea level. The wetland formed in the estuaries of the Ithikkara river and Paravur backwaters is encircled by small rivulets and is thickly vegetated. Polachira is also a natural habitat of birds.

Polachira wetland is a partially water logged marshy basin. It is a unique eco-geo-system. It is believed that the name of Polachira originated from the word 'Pola' referring a water plant and 'Chira' locally means a marshy lake. Hence the name "Polachira". Pola has air filled leaf stalks which can float on the stagnant body of muddy water, with intermesh root system, grow luxuriously forming a blanket of extensive root matting. The slowly settling suspended sediments get trapped within the root matting, and develop into a floating root mesh-supported clay slab, whose upper surface is in level with the water surface. The "root matting and sediment accretion process" can take place twice annually during the two monsoon flood seasons. Over a long period of time, the root matted clay layer had evolved into a 2-2.5m thick. During the months of extreme desiccation the surface water is completely drained, exposing the clay slab to insolation, and mud-cracking. However, the deep body of water beneath effectively supports the clay slab. When the next flood comes mud is deposited within the mud cracks and root mesh above it. This accounts for the annual increase in thickness of the floating clay slab. Local farmers cultivate paddy upon these black floating clay slab during the month of January to April. Sometimes rice transplantation is done by placing indigenously developed bamboo-rafts floating over it. There had been several reports of fragmentation and drifting away of these cultivated slabs laterally, due to sudden rise in water level.

Literature survey revealed that available literature about the Polachira wetland is only its sedimental characteristics and avian fauna. The present investigation was therefore, taken up with a view to understanding and assessing the water quality of Polachira wetland.

2. Materials and Methods

Water samples were collected at monthly intervals for a period of two years from October 2012 to September 2014. Five stations were selected randomly for the collection of samples. The sampling was done in the morning hours. The major parameters used to judge the health of the water body are temperature, depth, pH, alkalinity, salinity, DO, CO_2, total hardness, Ca hardness, Mg hardness, TDS, TSS, TS, NO_3, NO_2, PO_4, SO_4, SiO_3. Water samples were carried out as per the methods of Trivedy and Goel (1986) and APHA (2005). The observations were statistically interpreted and presented based on correlation analysis and ANOVA. The statistical analyses of data were made by using the software, SPSS 17.01.

3. Results and Discussion

Results of the hydrographical variables and the nutrient variables of the five stations of the Polachira wetland ecosystem are presented in the Table 1-2.

Water temperature was slightly higher than the atmospheric temperature. This may be due to the property of water of slow release of heat that it has absorbed, when compared to that of air. The water level of the wetland was rarely stable; it varied from station to station and with seasons. The maximum depth of the wetland was 168 cm. The fluctuation in water level is mainly due to climatic factors e.g., evaporation of water due to increased atmospheric temperature during the day time, wind velocity, rainfall and humidity (Welch, 1952). Throughout the period of study water pH remain slightly acidic to alkaline in nature. Average value of water pH in the Polachira wetland oscillated between 7.3 to 7.6 falling well within the desired limit of IS:10500:2004. Total alkalinity in the Polachira wetland was greater than 100 mg l^{-1} which is an indication of the highly productive nature of the system. Total alkalinity values in the Polachira wetland fall well within the desirable limit of drinking water (200 mg l^{-1}) as per IS:10500: 2004. Very low salinity was recorded in all stations throughout the period of study. Average value of dissolved oxygen ranged from 5.1 mg l^{-1} to 7.4 mg l^{-1}. The concentrations of dissolved oxygen in unpolluted waters are usually about 8-10 mg l^{-1} (Joseph and Jacob, 2010). Compared to other fresh water wetlands, the average amount of DO in the Polachira wetland indicates the healthy nature of the water body. Average value of dissolved CO_2 content was quite low and it did not show wide fluctuations.

Based on the hardness, Sawyer and McCarty (1966) have classified water into four classes such as soft (<75 ppm), moderately hard (75-150 ppm), hard (150-300 ppm) and very hard (>300 ppm). The Polachira wetland belongs to the third category on this scale. Based on the calcium content in natural waters the German limnologist, Ohale (1938) classified water into three classes such as poor (< 10 mg l^{-1}), medium (10 mg l^{-1} to 25 mg l^{-1}), and rich (>25 mg l^{-1}). According to this classification, the Polachira wetland falls under rich category. An average value of Mg hardness in the present study varied from 10.3 mg l^{-1} to 43.7 mg l^{-1}. Average value of Mg hardness in the study region fall within the permissible limit of 100 mg l^{-1} (IS: 10500-2004).

An average value of total solids in the study region ranged between 483.3 mg l^{-1} to 1783 mg l^{-1}. TS content in the Polachira wetland was slightly higher upper limit. The greater concentration of total solids in the present study is related to high evaporation rate due to warm weather. It was found that the average value of TDS in the study region fell within the permissible limit of 2000 mg l^{-1} (IS: 10500-2004). Average value of TSS in the study region varied from 300 mg l^{-1} to 800 mg l^{-1}. High value observed in the present study might be due to low water level and abundance of phytoplankton density.

An average value of nitrate-nitrogen in the study region ranged from 1.2 µg l^{-1} to 1.5 µg l^{-1}. In the present study the concentration of nitrate content of the wetland found to be less than that of the desirable limit of 45 mg l^{-1} (IS: 10500-1991). An average value of nitrate-nitrogen in the study region ranged from 0.5 µg l^{-1} to 0.8 µg l^{-1}. The standard permissible limit of nitrite is 0.2 mg l^{-1} for drinking water quality (WHO, 2008) and 0.5 to 1.0 mg l^{-1} for surface water quality. (USEPA, 2001). In the present investigation nitrite content of the wetland was within the standard acceptable limits of the above mentioned standard. An average value of Phosphate-Phosphorus concentration in the study region ranged from 11.7 µg l^{-1} to 14.8 µg l^{-1}. Concentration of phosphate-phosphorus analyzed was within the standard limit of inland surface water quality (IS: 10500-1991). An average value of Silicate-Silicon in the study region ranging from 75 µg l^{-1} to 104.6 µg l^{-1}. High value of silicate content in the study might be due to high density of diatom population and also be related to the soil characteristics of the wetland basin. The desirable limit of sulphate prescribed for drinking water as per IS: 10500-2004 is 200 mg l^{-1}. Comparatively very low values of sulphate observed in the Polachira wetland indicated the unpolluted status of the wetland.

4. Conclusion

In Polachira, a typical tropical climate was prevalent during the entire period. The detailed investigation of the parameters which are well within the desirable limit indicates that the Polachira wetland is fairly unpolluted, except for high alkalinity and hardness, which can be attributed to natural causes and the agricultural runoff. Very low salinity of the wetland influenced greatly the distribution of biota. The shallowness of the system promotes a short nutrient turnover resulting high productivity. The present investigation has generated some baseline data on the current status of this wetland and it would be helpful for further surveys and intensive studies for the conservation of this wetland.

References

[1] APHA 2005 *Standard Methods for the Examination of Water and Wastewater*. 21st ed., Am. Public Hlth. Ass., Washington, DC, USA.
[2] Joseph, P. V. & C. Jacob 2010 Physico chemical characteristics of Pennar river, A fresh water wetland in Kerala, India. *E-J. Chem*., **7**: 1266-1273
[3] Ohale, W. 1938 Die Bedeutung der Anstanschvorgange Zwischew Schalamn und wasser fur den Stoffkereislauf der Gewasser, “Vom Wasser”.
[4] Sawyer, C.H. & McCarty 1996 Chemistry for Sanitary Engineers. 2nd ed. McGraw Hill, New York, 518 pp.
[5] Trivedy, R. K. & P.K. Goel 1986 *Chemical and Biological Methods for Water Pollution Studies*. Environmental Publications, Karad (India), 320.
[6] USEPA 2001 *Parameters of Water Quality: Interpretation and Standards*, Published by EPA, Ireland. 132pp.
[7] Welch, T.S. 1952 *Limnology*. 2nd ed. McGraw Hill Book Co., New York, 538.
[8] WHO 2008 *Guidelines for drinking water quality*. Vol. I. *Reccomendations*. 3rd ed. World Health Organization, Geneva, 494 pp.

Table 1: Results of ANOVA comparing hydrological variables between the five stations of the Polachira wetland during 2012-2014

	Station 1	Station 2	Station 3	Station 4	Station 5
Atmosphere Temperature	29.8 ± 0.9	30.9 ± 1	31.1 ± 0.8	31.6 ± 0.9	32.3 ± 1.1
Water Temperature	30.2 ± 1.1	31.2 ± 1	31.5 ± 1	31.8 ± 1.1	32.7 ± 1.3
Depth	58.9 ± 14.6	106 ± 46.7	103.5 ± 40.7	101.8 ± 40.1	83.8 ± 36.6
Transparency	30.8 ± 9.8	41.7 ± 22.5	40.7 ± 20.7	41.1 ± 18	36.2 ± 12.7
pH	7.4 ± 0.7	7.4 ± 0.5	7.3 ± 0.6	7.3 ± 0.6	7.6 ± 0.5
Alkalinity	65.8 ± 18.9	54.6 ± 21.2	51.7 ± 19.5	47.9 ± 15.5	44.6 ± 11.4

Salinity	3.1 ± 5.4	1 ± 1.6	0.6 ± 1.3	0.1 ± 0.3	0 ± 0
DO	5.1 ± 2.3	5.7 ± 2.6	5.5 ± 2.9	6.6 ± 2.8	6.9 ± 2.4
CO2	3.7 ± 2.7	4 ± 3.1	3.7 ± 2.4	4.1 ± 2.9	3.8 ± 2.6
Total Hardness	247.7 ± 261.1	258.3 ± 307.7	183.9 ± 234.6	120.7 ± 124.5	59.8 ± 63.8
Calcium Hardness	48.7 ± 66.5	36.2 ± 44.2	26.9 ± 33.7	17.6 ± 19.7	7 ± 4.8
Magnesium Hardness	30.8 ± 38.4	43.7 ± 53.5	31.2 ± 43.3	18.7 ± 22.1	10.3 ± 13.2
Total Solids	1783.3 ± 1737.5	1283.3 ± 1458.9	1183.3 ± 1158.6	800 ± 727.1	483.3 ± 612.7
Total Dissolved Solids	983.3 ± 1365.3	783.3 ± 1245.4	583.3 ± 736.4	383.3 ± 692.6	183.3 ± 311.6
Total Suspended Solids	800 ± 808.6	500 ± 592.7	600 ± 646.1	416.7 ± 343.5	300 ± 429.4

Table 2: Variations in the nutrient concentrations of the five stations of the Polachira wetland during 2012-2014

	Station 1	Station 2	Station 3	Station 4	Station 5
Nitrate	1.2 ± 0.6	1.3 ± 0.7	1.3 ± 0.6	1.5 ± 0.6	1.4 ± 0.6
Nitrite	0.6 ± 0.3	0.6 ± 0.3	0.6 ± 0.3	0.7 ± 0.3	0.7 ± 0.3
Phosphate	12.8 ± 2.2	13.2 ± 2.3	13.5 ± 2.3	13.2 ± 2.2	12.4 ± 2
Silicate	85.5 ± 23.2	89.6 ± 21.6	95.6 ± 18.1	93 ± 24.2	83 ± 18.1
Sulphate	2.8 ± 2	2.5 ± 1.7	1.8 ± 1.7	2 ± 2	1.6 ± 2.1