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The physico-chemical characteristics of vembanad backwaters at Eramalloor region, Alappuzha district, Kerala, India

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Abstract
The present investigation was carried out on Vembanad lake in the Eramalloor region of Ernakulam district, Alappuzha, Kerala. The study was carried out for a period of 11 months from September 2015 to July 2016. During the study, the average temperature was 29.0ºC, average salinity was 19.02% highest salinity was observed in the month of April, the average transparency was 71.60 cm and the lowest dissolved oxygen was observed during the month of March 3.8 mg/l, pH was observed maximum in the month of May (8.1) and minimum (6.2) in the month of October. The average alkalinity was 90.98 mg/l, Nitrate ranged between 16.3µg/l and 4.7µg/l and average of 9.56µg/l. Phosphate ranged between 1.01µg/l to 5.8µg/l. Premonsoon season showed peak salinity whereas, mesohaline nature was found throughout study period.

Keywords: Vembanad, Temperature, Salinity, pH, Alkalinity, Nitrate, Phosphate

Introduction
Water is the most important life supporting factor on the Earth. India is having very rich source of inland water in the form of lakes, rivers and reservoirs [1]. Physico-chemical factors are perfect from the point of view of makeup of the structure of reservoir ecosystems. Many studies have been done to understand the relationship between various physico-chemical properties and pollution, exploitation and seasonal variation in different aquatic environments like reservoirs, lakes, and rivers [2]. Vembanad lake is the second largest brackish water lake in India. Vembanad lake is the among the most productive life supporting coastal wetland in Kerala, spread over three districts, *viz.,* Ernkulam, Kottayam and Allaphuzha having length of 96 km and surface area of 1512 km^2. The brackish water bodies are highly productive and support good fisheries as they are indispensible habitat to a variety of biologically and economically important resident and migratory aquatic fauna [3-4].
The biological components of water body depend solely on physico-chemical conditions which indicate that the quality of life is linked with quality of environment and the variations in the physico-chemical parameters of the lakes [5]. The seasonal change in hydrography play an important role in regulating the fauna of back waters [6]. Due to various anthropogenic activities the natural aquatic resources have been polluted and leading to depletion of water quality and aquatic biota [7]. Untreated discharge of pollutants into a river from domestic sewage, Storm water discharges, industrial waste waters, agricultural runoff and other sources can have short term and long term effects on the water quality. Temperature, salinity, dissolved oxygen and pH are the most important variables influencing the abundance of organisms in the estuarine environment [8]. Processing industries release processing waste and untreated sewage in Vembanad lake have created an alarming situation in this area. Various physical factors of water, such as temperature, TDS, Transparency, conductivity play important role in various chemical and metabolic activities of various organisms in the water bodies while chemical characteristics such as pH, dissolved gases, alkalinity etc. largely govern the productivity [9]. The study was conducted with an aim of observing physico-chemical characteristics of Vembanad lake to know the health status in terms of water quality of the lake.

Materials and methods

The present investigation was carried out to undertake the temporal variation in physico-chemical parameters at vemband lake in Eramalloor region for the period of 11 months from September 2015 to July 2016. Eramalloor region is located at northern region of Vemband lake and is extremely brackish water area in Ernakulam district of Kerala. Water samples were collected fortnightly were subjected to analyse temporal variations in temperature, salinity, pH, D.O, alkalinity, transparency, nitrate, phosphate [10]. Water temperature was measured by mercury thermometer and transparency was measured by secchi disk. pH was estimated by the universal indicator. Alkalinity and dissolved oxygen were estimated by titration method. Salinity was determined by Mohr-Knudson titration method [11]. Nitrate and phosphate were estimated by using spectrophotometer. Absorbance was measured at 540 nm and 680 nm respectively. Physico-chemical parameters monthly average data were employing Pearson's correlation coefficient (r) to find out the relationship among different water quality parameters at 1% (**) and 5% (*) level of significance by using (SPSS 20v).

Results and Discussion

Hydrographical parameters

Water temperature

The average temperature observed during study period was 29.0^{0}C. The maximum temperature was observed during the month of May (30.8^{0}C) and the minimum temperature was observed during the month of July (26.2^{0}C). Temperature showed a positive correlation with salinity (r = 0.929**), transparency (r = 0.603**), pH (r = 0.820**), Alkalinity (r = 0.909**), showed negative correlation with Dissolved oxygen (r = -0.800**), nitrate (r = -0.700**) and phosphate (r = -0.478*) [12]. have reported low temperature during the month of July (25ºC). May was peak summer, where high and low temperature was due to monsoon influx in July (Fig. 1) and (Table 1).

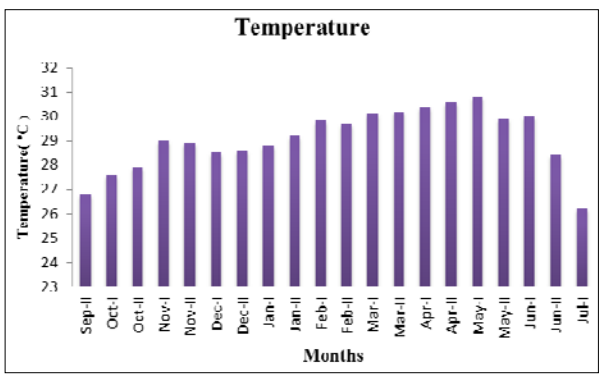

Fig 1: Monthly variation in temperature (ºC)

Salinity

The average salinity observed during study period was 19.02 %. The highest salinity was observed during the month of April (22.9%) and the lowest salinity were observed during the month of July (12.8%). The salinity showed significant positive correlation with water surface temperature (r = 0.929**), transparency (r = 0.570**), pH (r = 0.722**) Alkalinity (r = 0.866**), and negative correlation with dissolved oxygen (r = -0.732**), nitrate (r = -0.614**) and phosphate(r = -0.474*) [13]. reported the maximum salinity during pre monsoon months in Cochin back waters. Similar results were obtained by [14]. High evaporation was found in the month of April that may be the reason for increase in salinity (Fig. 2) and (Table 1).

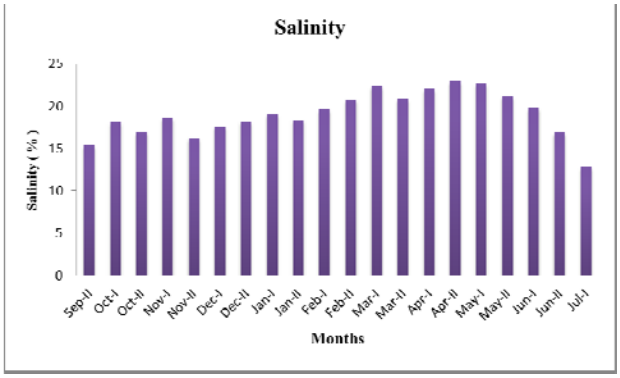

Fig 2: Monthly variation in Salinity (%)

Transparency

The average transparency observed during study period was 71.60 cm and maximum transparency was observed during the month of June (110 cm) and minimum transparency was observed during the month of September (40.6 cm). Transparency showed significant positive correlation with temperature (r = 0.603**), salinity (r = 0.570**), pH (r = 0.616**) and alkalinity (r = 0.759**). Negative correlation with dissolved oxygen (r = -0.685**) and nitrate (r = -0.670**) [14]. reported transparency range between 39.30cm and 97.40 with an average of 65.70 cm which is comparable with the present study. High transparency may be due to transition zone between high temperature and lesser temperature from May to June. Minimum transparency was found due to stabilization of phytoplankton and zooplankton in the environment (Fig. 3) and (Table 1).

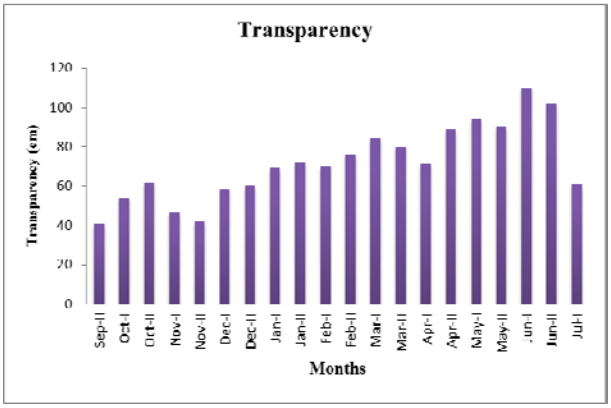

Fig 3: Monthly variation in Taransparency (cm).

Dissolved oxygen

The average dissolved oxygen observed during study period was 5.15 mg/l. The maximum dissolved oxygen was observed during the month of October (7.3 mg/l) and minimum dissolved oxygen was observed during the month of March (3.8 mg/l). The dissolved oxygen showed a significant positive correlation with nitrate (r = 0.610**) and negative correlation with temperature (r = -0.800**), salinity (r = -0.732**), transparency (r = -0.685**), pH (r = -0.857**) and alkalinity (r = 0.848**) [15]. reported that high values of dissolved oxygen in the month of June to November in Vembanad back water system [16]. recorded a diurnal changes

in dissolved oxygen values ranging from 0.5 to 8.9 ml/l and from 0.1 to 7.08 mg/l in two prawn filtration ponds in Vallarpadam Island, Cochin. High dissolved oxygen was found due to suitable phytoplankton in water and minimum was found due to evaporation and salinity increase (Fig. 4) and (Table 1).

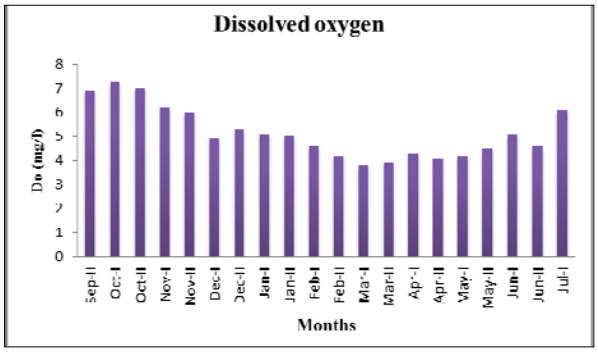

Fig 4: Monthly variation in Dissolved oxygen (mg/l).

pH

The average pH observed during study period was 7.31 and maximum pH was observed during the month of May (8.1) and minimum pH was observed during the month of October (6.2). pH showed a significant positive correlation with temperature(r = 0.820**) salinity (r = 0.722**) transparency (r = 0.616**) alkalinity (r = 0.858**) and significant negative correlation with dissolved oxygen (r = -0.857**) and nitrate (r = -0.586**) [17]. observed the pH of Chilika Lake water varied from 6.65 to 8.57 with the average value of 7.93. Slight acidicity as well as basicity was found of in water which may be due to addition of chemical pollutants from agriculture waste [16]. studied that pH in both the prawn culture fields around Cochin area and reported that the pH values ranges between 7 and 8. High pH is related to the season and day light. In the month of May summer is on its peak whereas, in the month of October the day light is less which may be the reason for the high and low pH (Fig. 5) and (Table 1).

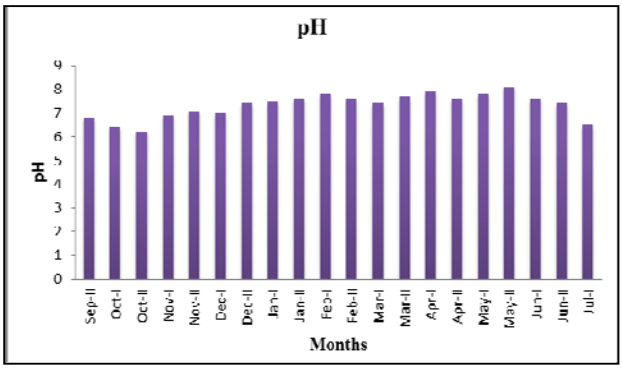

Fig 5 Monthly variation in pH.

Alkalinity

The average alkalinity observed during study period was 90.98 ppm and maximum alkalinity was observed during the month of May (116.8 ppm) and minimum alkalinity was observed during the month of July (46.6 ppm). Alkalinity showed a significant positive correlation with temperature(r = 0.909**) salinity (r = 0.866**) transparency (r = 0.759**) pH (r = 0.858**) and negative correlation with dissolved oxygen (r = -0.848**) nitrate (r = -0.801**) and phosphate (r = -0.501*). During the premonsoon months, variation in alkalinity in Cochin back water was less [18, 19]. observed that the alkalinity in culture fields of the traditional prawn culture system around Cochin was between 14 ppm and 150 ppm. Alkalinity (optimal) is 70 to 200ppm which is in the limits (Fig. 6) and (Table 1).

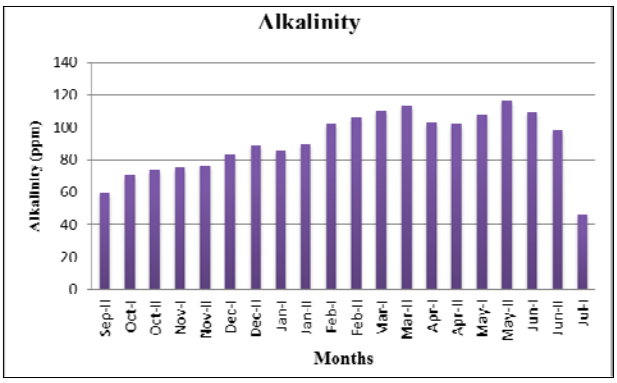

Fig 6: Monthly Variation in Alkalinity (ppm).

Nitrate

The average nitrate observed during study period was 9.56 µg/l and maximum nitrate was observed during the month of July (16.3µg/l) and minimum nitrate was observed during the month of June (4.7 µg/l). Nitrate showed a significant positive correlation with dissolved oxygen (r = 0.610**) and phosphate (r = 0.825**) and negative correlation with temperature (r = -0.700**), salinity (r = -0.614**), transparency (r = -0.670**), pH (r = -0.586**), alkalinity (r = -0.801**) [20]. reported nitrate concentration of 10.09 to 14.53µmol/l. at Nettoor mangrove area (Fig. 7) and (Table 1).

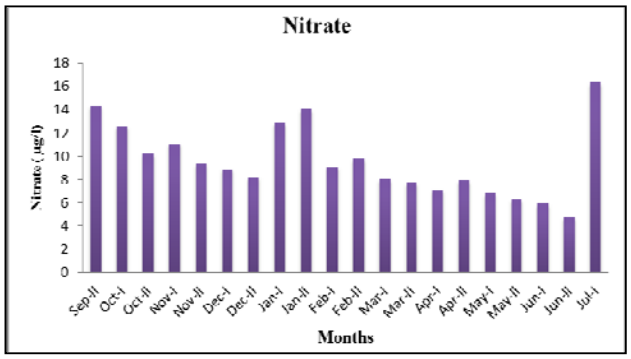

Fig 7: Monthly variation in Nitrate (µg/l).

Phosphate

The average phosphate observed during study period was 2.24 µg/l and maximum phosphate was observed during the month of July (5.8 µg/l) and minimum phosphate was observed during the month of April (1.01µg/l). Phosphate showed a significant positive correlation with a nitrate (r = 0.825**) and negative correlation with temperature (r = -0.478*), salinity (r = -0.474*), alkalinity (r = -0.501*) [21]. reported that phosphate concentration ranged between 0 and 32 µg/l in Vembanad Lake. The phosphate values estimated in the present study agrees with the study made by [14]. Nitrogen, phosphorous and potassium are the results of chemical fertilizers application in the agriculture fields. They might have drained from there to the lakes during monsoon and NPK might have increased in July (Fig. 8) and (Table 1).

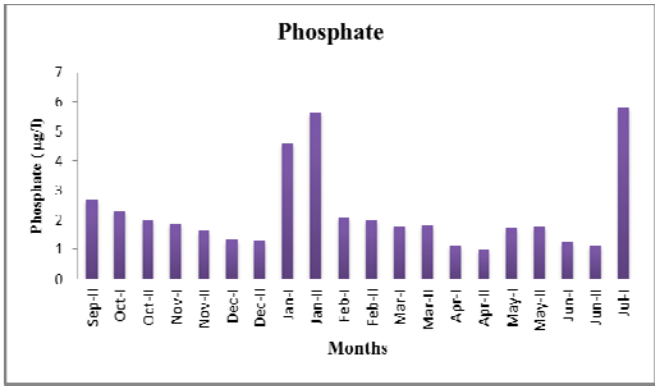

Fig 8: Monthly variation in Phosphate (µg/l).

Table 1: Correlation between Physico-chemical parameters at Vembanad backwaters at Eramalloor region.

Correlations								
	Water Temperature	**Salinity**	**Transparency**	**Dissolved Oxygen**	**p^{H}**	**Alkalinity**	**Nitrate**	**Phosphate**
Water Temperature	1	0.929**	0.603**	-0.800**	0.820**	0.909**	-0.700**	-0.478*
Salinity		1	0.570**	-0.732**	0.722**	0.866**	-0.614**	-0.474*
Transparency			1	-0.685**	0.616**	0.759**	-0.670**	-0.248
Dissolved Oxygen				1	-0.857**	-0.848**	0.610**	0.260
pH					1	0.858**	-0.586**	-0.239
Alkalinity						1	-0.801**	-0.501*
Nitrate							1	0.825**
Phosphate								1
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

Conclusion

The present investigation about the Physico- Chemical Characteristics of Cochin backwaters at Eramalloor region of Vembanad lake, indicates all the water quality parameters are within the limits and salinity showed peaks during Premonsoon season (March –May) and salinity was mesohaline nature. Water hyacinth is occupying large area in all most all seasons and these area slightly polluted because of domestic sewage and processing of industrial waste. Normally Monsoon season is great influence on hydrobiologiacal parameters at study region.

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