

## Research Article

### A Survey on the Species Diversity and Water Quality Parameters of Selected Site in Vembanad Lake

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#### Abstract

The status of fin fish and shell fish diversity were investigated in the Vembanad Lake in the proposed study area includes Chandhi Resort, Chungam, Pallathuruthy, Vattakayal and Aaru Block. A total of 28 species were identified in which the Shannon Wiener diversity index ( $H'$ ) values were found to be on higher side and varied from 0.6548 to 2.311. Simpson Dominance index was shown a maximum of 0.8876 (site 1) and minimum of 0.2466 (site 2). There were signs of decline of the Vembanad fishery resources, evident in the lesser number of species and decline of fishery production. It shows that the difference of 72% was shown in between site 5 and site 2 when compared with others. While the similarity index shows that site 5 and site 2 are much comparable to the extent of difference of 8 %. There is 40% difference were noted between site 4 and with site 3 and 1. The difference of 16% was observed between site 3 and site 1 in the present study. Representation of water quality parameters were also analyzed showed an average salinity during the study period was 11.95 ppt and dissolved oxygen was 4 mg/ml.

Keywords: Phytoplankton; Water Quality Parameters; Fin fish; Shell fish

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## Introduction

The declining biological integrity and fishery production in the aquatic environment lead to biodiversity loss, fish stock reduction and eventually affect the livelihood support of traditional fishers. An ecosystem approach is important in large catchment area for large lakes and river systems [1]. Fluctuations and trends in fish stocks are difficult to assess. So to facilitate fisheries management the stock assessment process in which the collection of fishery production estimation including multispecies and multi gear fishery is important. In an annual survey conducted in the Vembanad Lake revealed a total of 98 species in 2019, compared to 110 species in 2018. A reduction of 12 species reported in the annual survey conducted on the year, the 12th survey in the series conducted every year (June 1, 2019 Daily Hindu report). A post-flood Vembanad fish count conducted in December 2018 to determine the impact of the August deluge on fish diversity and Vembanad Lake had identified the presence of 115 fish species. As many as 43 fish species were identified from Thanneermukkom, Punnamada and Kayippuram and those surveyed the northern side of the lake including Arookutty, High Court and Murinjapuzha recorded 50 species during the survey. The survey also identified five shellfish species in the backwaters. Deficient rains and increased salinity in the waters had facilitated breeding of jellyfish in high numbers. The salinity in the southern side of the lake was slightly higher on account of opening of shutters of the Thanneermukkom bund. The Vembanad-Kol wetland system (09000'-10040'N & 76000'-77030'E) and its 10 associated drainage basins are situated in the humid tropical region on the south west coast of the Indian peninsula. They are characterized by a continuous chain of lagoons or backwaters, 96 km long; one of the largest estuarine systems in Kerala [2]. The wetland system covers an area of 1512 km [2]. And has been designated as a Ramsar Site. The lake is renowned for its live clam resources and subfossil deposits, as a habitat for the threatened Spot-billed Pelican *Pelicanus philippensis*, large bird population especially water fowls, besides a high species diversity of finfish and shellfish [3]. One-hundred-and-fifty species of fish belonging to 100 genera and 56 families are known to occur in Vembanad Lake [4]. The study area covers six areas which include Chandhi Resort, Chungam, Pallathuruthy, Vattakayal, Aaru Block of the Vembanad Lake. Physio-chemical factors and fish species were identified from these locations. The study was conducted with an aim of observing physicochemical characteristics of Vembanad Lake to know the health status in terms of water quality of the lake. Temperature, salinity, dissolved oxygen and pH are the most important variables influencing the abundance of organisms in

the estuarine environment [5]. Knowledge on the status and trends of inland fisheries is the key to sound policy development, better decision-making and responsible fisheries management. It is necessary at the national level for the maintenance of food security and for describing social and economic benefits of fisheries [6].

## Materials and Methods

The present investigation was carried out in the location of Vembanad lake middle area. The riverine sector of the Vembanad Lake include Pallathuruthy spot which was nearer to kuttanad location of the lake. Pallathuruthy (9.4599°N, 76.3695°E) is the meeting point of Vembanad Lake with Pamba River. Water samples were collected in early morning was subjected to analyze temperature, salinity, pH, D.O, alkalinity, transparency, nitrate, phosphate. 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 [7]. Nitrate and phosphate were estimated by using spectrophotometer. Absorbance was measured at 540 nm and 680 nm respectively. And the parameters like Hardness, Calcium, Magnesium, Phosphate, Sulphate and Iron was determined by using the water quality analysis kit made by CPR Environment Education Centre.

## Results and Discussion

Representation of water quality parameters are shown in Table 1. The average salinity during the study period was 11.95 ppt. The highest salinity was observed in the first two stations. High salinity may be due to high rate of evaporation in this region [7]. There is no correlation with salinity and other parameters in the study area. The average dissolved oxygen was 4 mg/ml and a low value of 3 mg/ml was observed in station [1] and highest was observed in station [3]. A DO content of greater than 5 mg/l in water is required for sustaining aquatic Fauna. Dissolved oxygen had got significant correlation between total hardness, sulphate and magnesium ( $P < 0.05$ ) and significant correlation between calcium ( $P < 0.01$ ). High dissolved oxygen was found due to suitable phytoplankton in water and minimum was found due to evaporation and salinity increase [8]. Dissolved oxygen (DO) is the relative amount of oxygen dissolved in water. Oxygen enters the water by diffusion from the atmosphere or through plant photosynthesis. Actual solubility is directly proportional to the partial pressure in the gas phase, to salt concentration and temperature [8]. The dissolved oxygen level in water is constantly changing and represents a balance between respiration and decomposition that deplete oxygen and photosynthetic activity that increases it [8]. Presence of organic waste in water may overload a natural system causing serious depletion of the oxygen supply that

in turn leads to fish kills. The average pH of the study area was found to be 5.75 and the slight acidity was found of in water which may be due to addition of chemical pollutants from agriculture waste [9]. pH has got significant correlation ( $p < 0.05$ ) with that of nitrite. The average nitrate was about 0.55 ppm during the study period. Nitrogen, phosphorous and potassium are the results of chemical fertilizers application in the agriculture fields [10]. The average total hardness was shown as 1530 in the study area. Total hardness has got significant correlation ( $P < 0.01$ ) between sulphate and magnesium and also with calcium and dissolved oxygen with a significant correlation ( $P < 0.05$ ). The Iron content present in the water sample has got no significant correlation between other parameters, the higher value was showed in site 3 and lower value was shown in site 5, the values are 0.26 and 0.93, respectively. Sulphate content has got an average value of 1268, which has got significant correlation ( $P < 0.01$ ) between total hardness, calcium and magnesium. Dissolved oxygen has also got significant correlation ( $P < 0.05$ ) between sulphate. Nitrate and nitrite content showed a value between a higher concentration of 0.35 and 0.83 and 0.009 and 0.01, for nitrate and nitrite, respectively. Nitrite has got significant correlation ( $P < 0.05$ ) between pH content of the water. The permissible limit of nitrate is 50 mg/l. Levels exceeding 0.55 mg/l (ppm) nitrite-nitrogen can cause 'brown-blood' disease in finfish [10]. Site 4 contains a higher level of nitrite. Calcium, magnesium and phosphate are important parameter which influences the species richness. Algal blooms are encouraged by levels of phosphate greater than 25 micrograms/L. The phosphate level above 0.1 mg/l is regarded as unhealthy. In all sites the phosphate level was very less and in site 2 and site

5 the level was below detectable. Nitrate ( $\text{NO}_3$ ) and nitrite ( $\text{NO}_2$ ) are produced as a result of biological breakdown of organic wastes containing ammonia such as, animal feces or fertilizers containing these chemicals. Although not particularly toxic to aquatic organisms, excess nitrates and nitrites in the water is often used as an indicator of poor water quality. Anaerobic conditions may result in the formation and persistence of nitrite. The presence of large quantities of nitrites in Vembanad Lake is indicative of water pollution due to possible agricultural runoff from the adjoining paddy field in Kuttanad [10]. The possible reason for increase of nitrogenous compounds is mainly due to the use of nitrogen based fertilizers in the paddy field adjacent to site 4. High phosphate concentration in surface waters also indicates fertilizer runoff, domestic waste discharge, or the presence of industrial effluents or detergents [11]. If high phosphate levels persist, algae and other aquatic life will flourish, eventually decreasing the level of dissolved oxygen due to the accelerated decay of organic matter [11]. The increased concentration of sulphate is due to the flushing off water from the agricultural lands. This can result in the eutrophication a state in which the nutrient content of the system reaches the peak and which results in algal bloom and adversely affect the ecosystem and organisms. There is significant correlation between total hardness with calcium ( $P < 0.05$ ) and magnesium ( $P < 0.01$ ). These two parameters have found significant correlation ( $P < 0.01$ ) between sulphate. Calcium has got significant correlation ( $P < 0.05$ ) with magnesium. There is also significant correlation between dissolved oxygen with these two parameters with  $P < 0.01$  to calcium and  $P < 0.05$  with magnesium.

**Table 1:** Represents water quality parameters in the study area.

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5
pH	5.76	5.75	5.73	5.77	5.76
Total Hardness	1850	1550	1450	1400	1400
Iron	0.76	0.60	0.93	0.34	0.26
Sulphate	1557.4	1266	1212.8	1153.2	1155.3
Nitrate	0.47	0.55	0.49	0.83	0.35
Nitrite	0.01	0.009	0.05	0.005	0.004
Phosphate	0.01	BDL	0.02	0.03	BDL
Calcium	120.2	100.2	100.2	100.2	100.2
Magnesium	378.2	317.2	292.8	280.6	280.6
Dissolved Oxygen	3	4	4.1	4.0	4.0
Salinity	12.0	12.0	11.9	11.9	11.9

In total 28 species of finfish and shell fish were identified in the study area as shown in Table 2. *Etroplus suratensis*, *Dwakensia filamentosa*, *Barbus mahicola*, *Pseudoetroplus maculates* are the dominant species reported in the study. Calculated biodiversity indices are presented in Annexure 3. The Shannon Wiener diversity index (H') values were found to be on higher side and varied from 0.6548 to 2.311. The maximum value of Margalef richness index (d) was 3.899 and minimum was 1.51. According to Mehnick richness index the value as between 1.51 to 3.899. Diversity showed maximum in site 2 and minimum in site 1 and the species richness was high in site 2 and minimum in site 3. Simpson Dominance index was shown a maximum of 0.8876 (site 1) and minimum of 0.2466 (site 2). There were signs of decline of the Vembanad fishery resources, evident in the lesser number of species and decline of fishery production. There is previous report show that 37 fish species belonging to 18 families and 9 orders from Aymanam panchayath, in Vembanad wetland [12,13]. Another study recorded 39 species of finfishes belonging to 27 families, 11 orders and 31 genera from Panangad-Kumbalam Region of Vembanad Lake in Kochi. The present study area covered a very small area resulted in a recovery level of fish species. The distance between similarity and difference were plotted in Annexure 4. It shows that the difference of 72% was shown in between site 5 and site 2 when compared with others. While the similarity index shows that site 5 and site 2 are much comparable to the extent of difference of 8%. There is 40% difference were noted between site 4 and with site 3 and 1. The difference of 16% was observed between site 3 and site 1 in the present study.

**Table 2:** Represents species number present in each site of the study area.

Species name	Site 1	Site 2	Site 3	Site 4	Site 5
<i>Parambassis dyee</i>	1		1		
<i>Etroplus suratensis</i>	5				
<i>Macrobrachium rosenbergii</i>	1				1
<i>Barbus mahicola</i>	84		83	54	
<i>Puntius dyeee</i>	1	1			
<i>Amplipharyngodon melitus</i>	1	1	1		
<i>Glossogobius giuris</i>	1				
<i>Dayella malabarica</i>	1		1		
<i>Dawkinsia filamentosa</i>		3	14	8	
<i>Mystus gulio</i>		1		1	1
<i>Parambassis thomassi</i>		1			
<i>Pseudoetroplus maculates</i>		1		20	
<i>Puntius vittatus</i>		1			
<i>Caridean shrimp</i>		1			

<i>Freshwater puffer</i>	1	1	1		
<i>Labeo dussumeiri</i>		1	1		
<i>Hyporamphorus dussumeiri</i>			1		
<i>Mystus oculatus</i>					1
<i>Puntius stomacerana</i>					1
<i>Heterandria Formosa</i>					1
<i>Aplocylus panchacus</i>					1
<i>Devario aequipinnatus</i>	1				
<i>Aplocheilus lineatus</i>	1				
<i>Clarius Batrachus</i>		1			
<i>Gobiodon okinawae</i>		1			
<i>Pyloodicus olivaris</i>			1		
<i>Sperata aor</i>					1
<i>Rasbora daniconius</i>					1

## Conclusion

The study was conducted with an aim of observing physicochemical characteristics of Vembanad Lake to know the health status in terms of water quality of the lake. Temperature, salinity, dissolved oxygen and pH are the most important variables influencing the abundance of organisms in the estuarine environment. To facilitate the fishery management the resources could be surveyed for implementing issue related surveillance programme. Species diversity may address the issue of environmental impacts approach based research. Water quality parameters were highly influenced by the runoff water bodies to the lake system. An evaluation of these were indexed in the present study.

## Ethics Approval and Consent to Participate

The study was approved by Institutional Ethical committee (Vembanad Fish Count) of St. Albert's College (Autonomous), Ernakulam.

## Consent for Publication

Our contribution is in collecting the data and interpreting with statistical tools about the status of the lake. We are in team which involved in the data collection and interpretation

- Availability of data and material
- Duplicate sampling and statistical analysis was done
- Competing interests

Vembanad fish count is an annual survey programme done by an NGO for knowing the species diversity of the lake. Many students are participating in this cruise with an intention to know the status of physio chemical and biological parameters of the lake along with the idea of species composition. Satisfy with only giving the present scenario of the lake to project a large group who are reading the article.

## Funding

This is a self- motivated programme in which no funding for participants are allowed. A group of students and a guide faculty will be travel through different parts of the lake and formulate data interpretation with the obtained idea. There is no conflict of interest for any payment or liability in this study

## Authors' Contributions

- Yadhu Krishnan: Collection of DO samples, Sampling of Water parameters and check DO
- Namitha Paul: Fish Diversity recorded, Sampling and collection of fish species
- June Mary Josy: Analysis of Methods, Identification of species
- Shiya Biju: Statistical analysis, Analysis of water quality parameters
- Jithu Paul Jacob: Headed the team and literature writing, Compiling the data, statistical analysis and paper writing

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