

**ICHTHYOFAUNAL DIVERSITY AND PHYSICO-CHEMICAL
ANALYSIS OF WATER IN THE MIDDLE STRETCH OF VEMBANAD
LAKE, KERALA, INDIA**

ABSTRACT

The status of finfish and shellfish diversity and monthly variation in their distribution and abundance were investigated in the middle stretch of Vembanad Lake at 4 selected sites in Kerala. The study was carried out for a period of 7 months from December 2022 to June 2023. In total 31 species of finfishes and shellfishes belong to 8 orders, 23 families and 29 genera were recorded from the study areas. Calculated values of Biodiversity indices were Shannon Weiner diversity index highest at Vaikom (3.4022), Simpson diversity index highest at Manakunnam (0.9538), Margalef richness index highest at Manakunnam (4.346) and Pielou's evenness index was highest at Thaneermukkom (0.8573). *Etroplus suratensis* and *Villoritacyprinoides* were the most abundant species from all four study sites. Three species are under the category of threatened they are *Oreochromis mossambicus*, *Horobagrus brachysoma* and *Hyporhamphus xanthopterus*. The result of the present study indicates that the Northern part of Thaneermukkom barrage is endowed with rich edible fish fauna. The physicochemical parameters of water were analyzed during the pre-monsoon and monsoon periods. Salinity was higher on the Northern side of the barrage. During the pre-monsoon period temperature, EC, TDS, alkalinity and salinity were high and during the monsoon period hardness, DO, BOD, Phosphate and Nitrate were high when compared with pre-monsoon but all are within the recommended limit.

Keywords: Vembanad Lake; Finfish; Shellfish; Biodiversity indices; Physicochemical analysis.

1. INTRODUCTION

Vembanad Lake is one of the transitional ecotone which is lying parallel to the Arabian Sea and comprises mangroves, mudflats, swamps and marshes (Mogalekar, 2015). As these ecosystems provide a harsh environment, many species of fish may have found them to be an ideal place for spawning, development and growth during their life (Mogalekar, 2015). Fishery resources of the Vembanad wetlands have immense potential because they are one of the readily accessible human food source and it is considered as the basis for the development of an innumerable variety of fishes (Blaber, 1980). The rich biodiversity and ecological value of this wetland made Vembanad Lake to be known as a Ramsar site in November 2002.

The fisheries are classified into four main sections (Harden Jones, 1994; Ravlinsone *et al.*, 1995) subsistence, artisanal, commercial and recreation. The finfishes and shellfish are living components of water bodies and are important food resources and bioindicators of the environmental health and wealth of the waters in which they inhabit. Globally aquatic ecosystems and fish diversity are adversely affected due to an increase in unwise anthropogenic activities (Nansimole, 2014). Therefore knowledge of the status and trends of backwater fisheries is the key to sound policy development, better decision making and responsible fisheries management (Mogalekar, 2015).

Water quality analysis is one of the essential things for using it for any purpose (Ritabrata, 2019). Water quality can be defined as the chemical, physical and biological characteristics of water, usually concerning its suitability for a designated use. Different physicochemical parameters of water such as colour, temperature, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD, and alkalinity used for testing water quality

y

UNDER PEER REVIEW

and it is necessary to have detailed information on it (Patil,2017). Increasing surfacewater pollution causes not only the deterioration of water quality but also threatens human health, the balance of the aquatic ecosystem, economic development and social prosperity (Fakron,2022). The present study was carried out to study the diversity of fishes and physicochemical analysis of water in the selected sites of the middle stretch of Vembanad Lake.

2. MATERIALS AND METHODS

In the present study selected sites from the middle stretch of Vembanad lake is chosen for ichthyofaunal diversity. The selected sites for diversity study and physico-chemical water quality parameters include Kumarakom, Thanneermukkom, Vaikom, and Manakunnam.

Fish samples were located from different selected sites of the middle stretch of Vembanad during the study period of December (2022) – June (2023). It is done with the help of local fishermen using different types of fishing gear i.e., gillnets, cast nets and dragnets. At the time of collection, photographs were taken before preservation since formalin decolorizes the fish colour on long preservation and the collected samples were preserved in 10 % formalin. The fishes were identified by following Talwar and Jhingran (1991) and Jyaram (1999).

The water samples were collected in both pre-monsoon and monsoon seasons to find out the temporal variation. Water quality was checked across parameters

like colour, odour, temperature, electrical conductivity, TDS, PH, hardness, salinity, alkalinity, dissolved oxygen, BOD, phosphates and nitrates. For BOD determination water samples were collected in BOD bottles. For further analysis samples were transported to the laboratory and analyzed other parameters using standard procedures (APHA 2005).

3. RESULTS AND DISCUSSION

In the present ichthyofaunal study total of 31 species were obtained. Among them, 26 finfishes and 5 shellfishes were reported from the four selected sites of the middle stretch of Vembanad Lake (Fig.1 to Fig.31). 26 species of finfish belong to 24 genera and are included under 19 families and 5 species of shellfish belong to 5 different genera and are included under 4 families. The order of Perciformes were dominated in the present study. From the study of Narayanan *et al.*, (2005) a similar report was recorded that order perciformes dominated the study. The systematic positioning of all the fish collected were listed in Table 1.

The abundance of species in percentage was studied from the four sites. The most abundant species from all four sites were observed as *Etroplus suratensis*. The most abundant species of site 1 Kumarakom was *Etroplus suratensis* (8.9%) and the least abundant species is *Macrobrachium rosenbergii* (0.7%). The most abundant species of site 2 Thanneermukkom were observed as *Etroplus suratensis* (9%) and the least abundant one is *Macrobrachium rosenbergii* (0.6%). Some of the species were absent in both sites 1 and 2 like *Leiognathus equulus*, *Nematalosa ausaus*, *Scylla serrata*, and *Penaeus monodon*. The most abundant species of site 3 Vaikom was observed as *Etroplus suratensis* (8.7%) and the least abundant species was *Scylla serrata* and finally the most abundant species of site 4 Manakunnam was found to be *Etroplus suratensis* (8.5%) and the least abundant one is *Scylla serrata* (0.1%).

The collected species were categorized according to IUCN status. 45% of species were demarcated as Not Evaluated, followed by 42% as Least Concern, 7% as Vulnerable, and 3% as Data Deficient, and 3% as Near Threatened. *Oreochromis mossambicus* belongs to order Perciformes and the family Cichlidae is under the

NearThreatenedcategoryofIUCN.*Horabagrusbrachysoma*ofSiluriformesorderand

UNDER PEER REVIEW

Bagridae family is under the Vulnerable status of IUCN. *Hyporhamphus xanthopterus* of order Belontiiformes and family Hemiramphidae family is also under the category of Vulnerable that is in short three species were identified as threatened. It is clear that three of the species of fishes reported in the present study is threatened and it was shown in the checklist of Bijikumar *et al.*, (2015). A similar report was given by Ansar *et al.*, (2017) showing the list of threatened species of fishes in Vembanad Lake.

The statistical analysis of the collected data was done and various diversity indices were used (Table 2). The Shannon-Weiner diversity index of species collected from four different sites was found in the present study. Here site 3 Vaikom has the highest Shannon diversity index i.e., 3.4022 and the low Shannon diversity index in Kumarakom i.e., 3.131 but they are within the range of 1.5 to 3.5. The next index used in the study is Simpson's Diversity Index of four sites in which Manakunnam site 4 is with high value that is 0.9538 followed by Vaikom site 3 (0.09535), Thanneermukkom site 2 (0.9514) and Kumarakom site 1 (0.9508). To measure species richness Margalef's Diversity Index is used in the present study. The range of Margalef's diversity index varies from 0 to 8 and here Site 4 Manakunnam has high species richness among the four sites selected with a value of 4.346, followed by Site 3 Vaikom (4.292), Site 1 Kumarakom (3.816) and Site 2 Thanneermukkom (3.777). To measure the evenness of species from the four sites Pielou's evenness index was used and usually Pielou's Index ranges from 0 to 1. In the present study, Thanneermukkom site 2 is with high value of evenness that is 0.8573 followed by Kumarakom site 1 (0.8522), Manakunnam site 4 (0.8051), and Vaikom site 1 (0.8031).

With the construction of Thanneermukkom bund, the salinity barraged divided the lake into two distinct ecosystems, freshwater on the south and brackish water on the north and there were some changes in the physicochemical condition of water and

species diversity. The southern part of the bundie., Kumarakom (Site 1) and Thaneermukkom South (Site 2) has less number of species when compared to the Northern partie., Vaikom (Site 3) and Manakunnam (Site 4). The most abundant species are *Etroplus suratensis* and *Villoritacyprinoides* from all study sites. Two species of shellfish *Scyllaserrata* and *Penaeus monodon* were completely absent on the Southern side of Thaneermukkom bund

The physicochemical analysis of water from selected sites was done using standard procedures (APHA 2005) and depicted in Fig. 32 to Fig. 42. Water quality analysis was done during both Pre-monsoon and Monsoon seasons. The correlation between water quality parameters is done using Pearson's Correlation Coefficient. Correlations were cross-checked with species abundance and water quality parameters. It is clear that mean species abundance is positively correlated with some of the water quality parameters like Temperature ($r = 0.75422$), EC ($r = 0.85703$), Alkalinity ($r = 0.96895$), Hardness ($r = 0.74110$), Salinity ($r = 0.97750$) and BOD ($r = 0.25275$) and negatively correlated with TDS ($r = -0.97528$), PH ($r = -0.42240$), DO ($r = -0.98974$), Phosphate ($r = -0.23601$) and Nitrate ($r = -0.83535$).

Table1.List offinfishes andshellfishes collectedfromthestudy area

Order	Family	Study Site	Scientific Name	Common Name	Local Name	Commercial status
Perciformes	Ambassidae	KMR TMK VKM MKM	<i>Parambassis homassi</i>	Western ghatsglassy perchlet	Arinjil	Ornamental /foodfish
Perciformes	Anabantidae	KMR TMK VKM MKM	<i>Anabastes tudineus</i>	Climbing perch	Andikalli	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	<i>Etroplus suratensis</i>	Bandedpearlspot	Karimeen	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	<i>Pseudetroplus maculatus</i>	Orangechromide	Pallathi	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	<i>Oreochromis mossambicus</i>	Tilapia	Silopia	Foodfish
Perciformes	Centropomidae	KMR TMK VKM MKM	<i>Latescalcarifer</i>	Barramundi	Narimeen	Foodfish

Perciformes	Gobidae	KMR TMK VKM MKM	<i>Stenogobius gymnopomus</i>	Malabar goby	Poolan	Ornamental/fo od fish
Perciformes	Leignathidae	VKM MKM	<i>Leiognathus equulus</i>	Common ponyfish	kurichil	Ornamental/fo od fish
Perciformes	Lutjanidae	KMR TMK VKM MKM	<i>Lutjanusargen timaculatus</i>	Mangrover edsnapper	Chemballi	Ornamental/fo od fish
Perciformes	Scatophagida e	KMR TMK VKM MKM	<i>Scatophagus argus</i>	Spotted scat	Nachara	Ornamental/ foodfish
Perciformes	Sciaenidae	KMR TMK VKM MKM	<i>Daysciaena albida</i>	Bengal arvina	Pallikora	Foodfish
Perciformes	Sillaginidae	KMR TMK VKM MKM	<i>Sillago sihamo</i>	Silver sillago	Kathiran	Foodfish
Perciformes	Sphyraenidae	KMR TMK VKM MKM	<i>Sphyraena jello</i>	Bandedb arracuda	Seelavu	Foodfish
Cypriniform es	Cyprinidae	KMR TMK VKM MKM	<i>Amblypharyn godonmeletti nus</i>	Molac arplet	Vayambu	Ornamental/ foodfish

Cypriniformes	Cyprinidae	KMR TMK VKM MKM	<i>Labeoduss umieri</i>	Malabar labeo	pullan	Foodfish
Cypriniformes	Cyprinidae	KMR TMK VKM MKM	<i>Systomus serana</i>	Olivebarb	Paral	Ornamental/ foodfish
Siluriformes	Ariidae	KMR TMK VKM MKM	<i>Ariussubros tratus</i>	Shovel nose catfish	Vazha koo ri	Ornamental/ foodfish
Siluriformes	Bagridae	KMR TMK VKM MKM	<i>Mystuso culatus</i>	Malabar mystus	Chilan koo ri	Ornamental/ foodfish
Siluriformes	Bagridae	KMR TMK VKM MKM	<i>Horabagrus bracysoma</i>	Gunter's catfish	Manjakoo ri	Ornamental/ foodfish
Clupeiformes	Clupeidae	VKM MKM	<i>Nematalosa nausa</i>	Bloch's gizzard shad	Manga meen	Foodfish
Clupeiformes	Engraulidae	KMR TMK VKM MKM	<i>Stolephorus ommersonnii</i>	Commer son's sanchov y	Netholi	Ornamental/ foodfish
Clupeiformes	Engraulidae	KMR TMK VKM MKM	<i>Stolephorus indicus</i>	Indiana nchovy	Kozhuva	Foodfish

Beloniformes	Hemiramphidae	KMR TMK VKM MKM	<i>Hyporhamphus xanthopterus</i>	Vembanad halfbeak	Kola	Ornamental/foodfish
Beloniformes	Hemiramphidae	KMR TMK VKM MKM	<i>Hyporhamphus limbatus</i>	Halfbeak	Kola	Ornamental/foodfish
Pleuronectiformes	Soleidae	KMR TMK VKM MKM	<i>Brachirus orientalis</i>	Oriental sole	Nanku	Ornamental/foodfish
Pleuronectiformes	Cynoglossidae	KMR TMK VKM MKM	<i>Cynoglossus cynoglossus</i>	Bengaltong uesole	Manthal	Ornamental/foodfish
Venerida	Cyrenidae	KMR TMK VKM MKM	<i>Villoritacy prinoides</i>	Blackclam	Kakka	Food
Decapoda	Portunidae	VKM MKM	<i>Scyllaserrata</i>	Mangrove crab	Njand	Food
Decapoda	Penaeidae	VKM MKM	<i>Penaeus monodon</i>	Gianttiger prawn	Kara	Food
Decapoda	Palaemonidae	KMR TMK VKM MKM	<i>Macrobrachium mresenbergii</i>	Giantfresh waterprawn	Aattu Konch	Food
Decapoda	Penaeidae	KMR TMK VKM MKM	<i>Metapenaeus dobsoni</i>	Kadals hrimp	Thelly	Food

KMR:Kumarakom

TMK

:ThanneermukkomVKM:

Vaikom

MKM:Manakunnam

Table2.Diversityindicesoffoursitesstudied

Sl.No	Sites	Shannon diversity Index	Simpson's DiversityI ndex	Margalef's diversityIn dex	Pielou'sevenne ssIndex
1	Kumarakom	3.131	0.9508	3.816	0.8522
2	Thanneer- mukkom	3.2195	0.9514	3.777	0.8573
3	Vaikom	3.4022	0.9535	4.292	0.8031
4	Manakunnam	3.19321	0.9538	4.346	0.8051

Table3.Physico-chemicalparametersofwater

parameters	Site 1(K)		Site2(T)		Site3(V)		Site4(M)	
	PM	M	PM	M	PM	M	PM	M
Temp.	30.8 ^o C	26.8 ^o C	30 ^o C	27 ^o C	31 ^o C	27 ^o C	31 ^o C	27 ^o C
EC	0.058mS/cm	0	0.058mS/cm	0	0.4mS/cm	0.188mS/cm	0.412mS/cm	0.195mS/cm
TDS	0.142g/l	0.002g/l	0.138g/l	0	0.069g/l	0.003g/l	0.071g/l	0.003g/l
PH	6.6	6.9	6.5	6.8	6.5	6.7	6.6	6.8
Alkalinity	75mg/l	45mg/l	77mg/l	50mg/l	125mg/l	50mg/l	120mg/l	55mg/l
Hardness	40mg/l	68mg/l	41mg/l	65mg/l	48mg/l	78mg/l	45mg/l	70mg/l
Salinity	0.033ppt	0.002ppt	0.033ppt	0.002ppt	0.193ppt	0.092ppt	0.199ppt	0.095ppt
DO	7.2mg/l	9mg/l	7mg/l	9mg/l	6.9mg/l	7.5mg/l	6.5mg/l	7mg/l
BOD	2mg/l	3mg/l	2mg/l	2.2mg/l	2.5mg/l	3mg/l	2mg/l	2.6mg/l
Phosphate	0.0086mg/l	0.012mg/l	0.007mg/l	0.01mg/l	0.0079mg/l	0.0108mg/l	0.0078mg/l	0.0107mg/l
Nitrate	0.0049mg/l	0.016mg/l	0.0047mg/l	0.014mg/l	0.005mg/l	0.013mg/l	0.006mg/l	0.012mg/l

OBSERVED ICHTHYOFAUNA DURING THE STUDY PERIOD

^{0C}
FINEISHES OF VEMBANAD LAKE

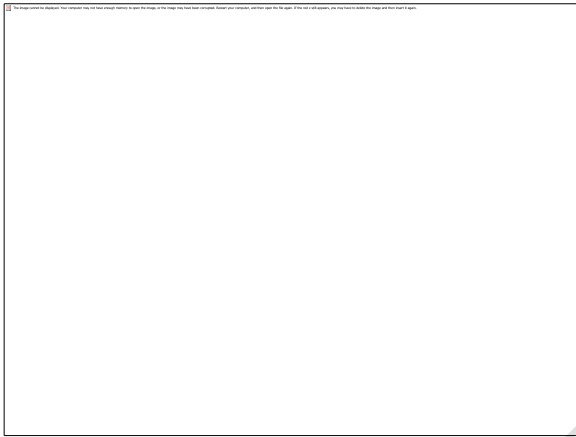


Fig.1. *Parambassithomassi*



Fig.2. *Anabastestudineus*

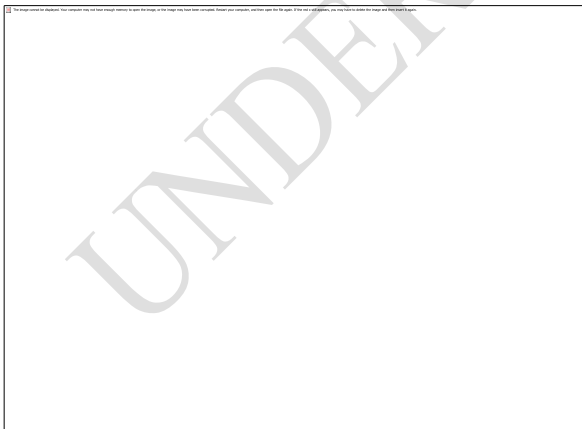


Fig.3. *Etroplus suratensis*

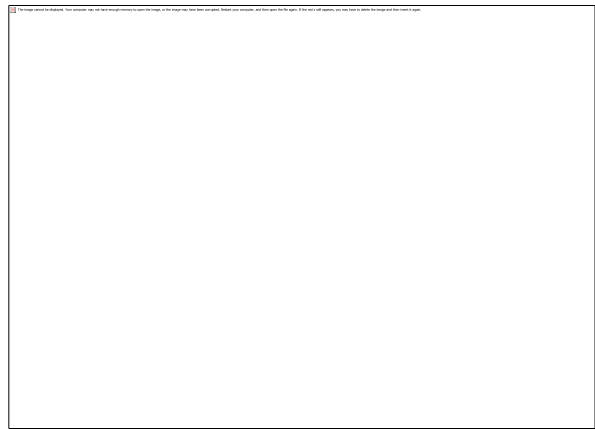


Fig.4. *Pseudotroplus maculatus*



Fig. 5. *Oreochromis mossambicus*



Fig.6. *Latescalcarifer*



Fig.7. *Stenogobius gymnopomus*

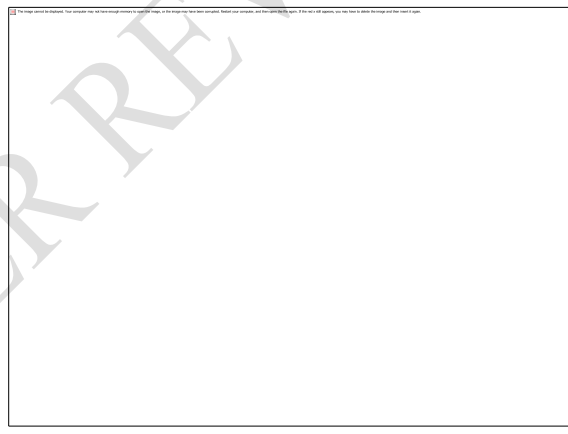


Fig.8. *Leiognathus equulus*



Fig.9. *Lutjanus argentimaculatus*

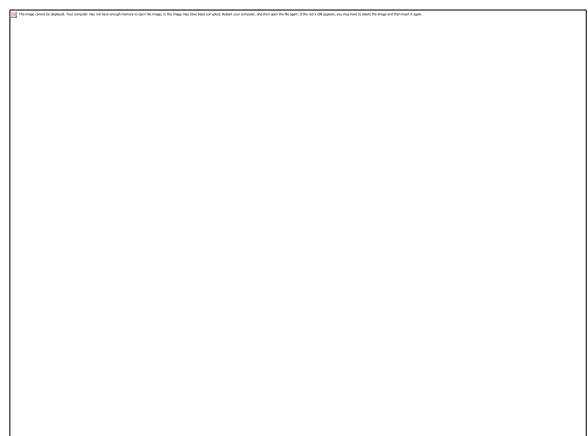


Fig.10. *Scatophagus argus*



Fig.11.*Daysciaenaalbida*



Fig.12.*Sillagosihamo*



Fig.13.*Sphyraenajello*



Fig.14.*Amblypharyngodonmelettinus*

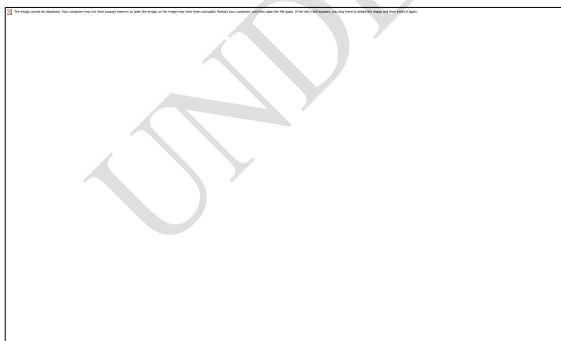


Fig.15.*Labeodussumieri*

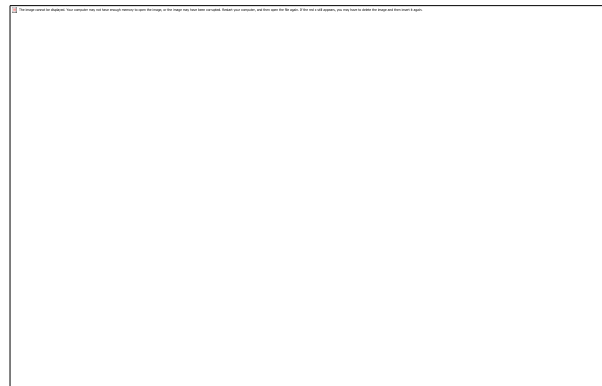


Fig.16.*Systemusserana*



Fig.17.*Arius subrostratus*



Fig.18.*Mystus oculatus*

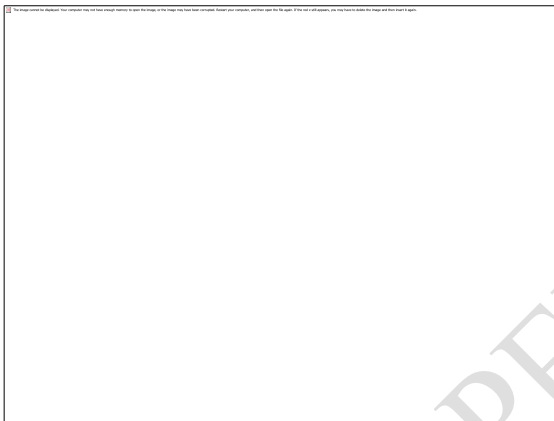


Fig.19.*Horabagrus brachysoma*

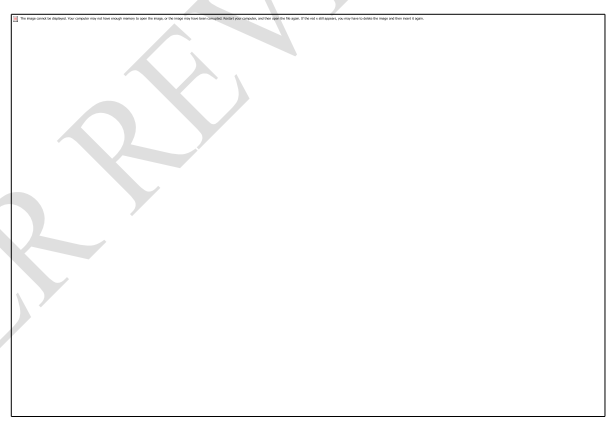


Fig.20.*Nematalosanausa*



Fig.21.*Stolephorus commersoni*

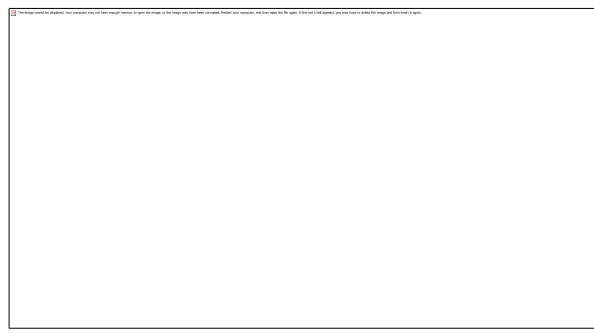


Fig.22.*Stolephorus indica*

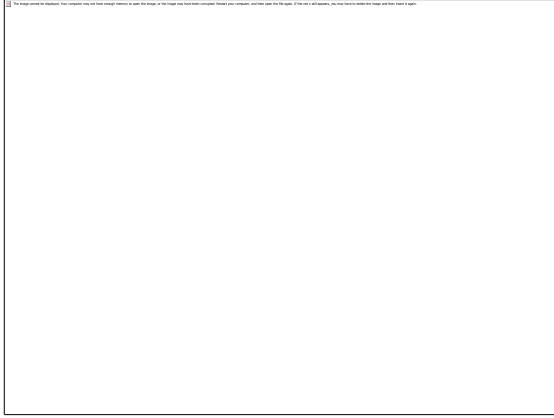


Fig.23.*Hyporhamphusxanthopterus*



Fig.24.*Hyporhamphuslimbatus*



Fig.25.*Brachirusorientalis*



Fig.26.*Cynoglossuscynoglossus*

UNDER PEER REVIEW

SHELLEISHES OF VEMBANAD LAKE



Fig.27.*Penaeus monodon*



Fig.28.*Macrobrachium rosenbergii*



Fig.29.*Metapenaeus dobsoni*



Fig.30.*Scylla serrata*

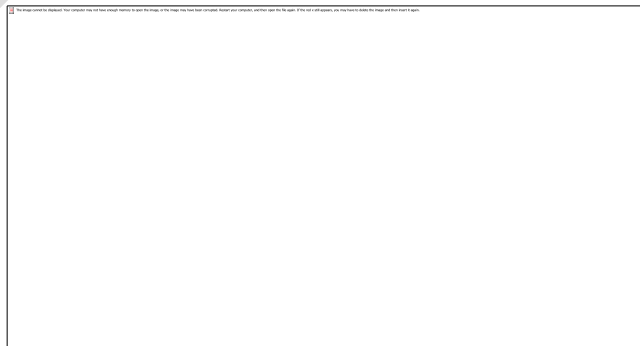


Fig.31.*Villoritacyprinoides*

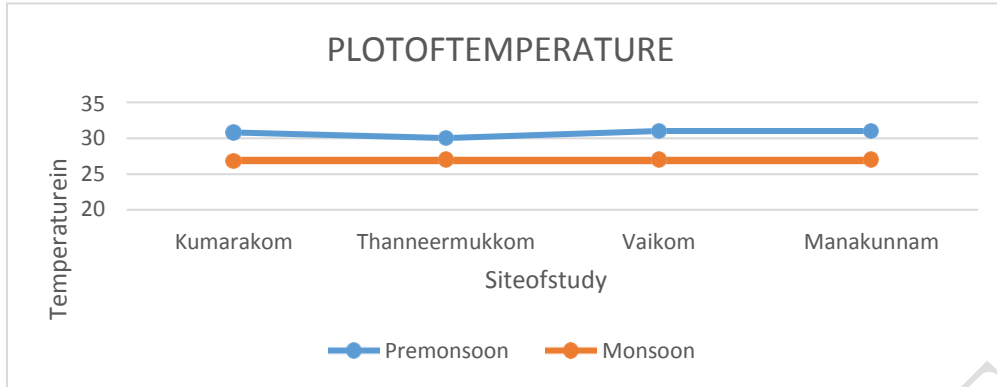


Fig32. The distribution plots of evaluated Temperature

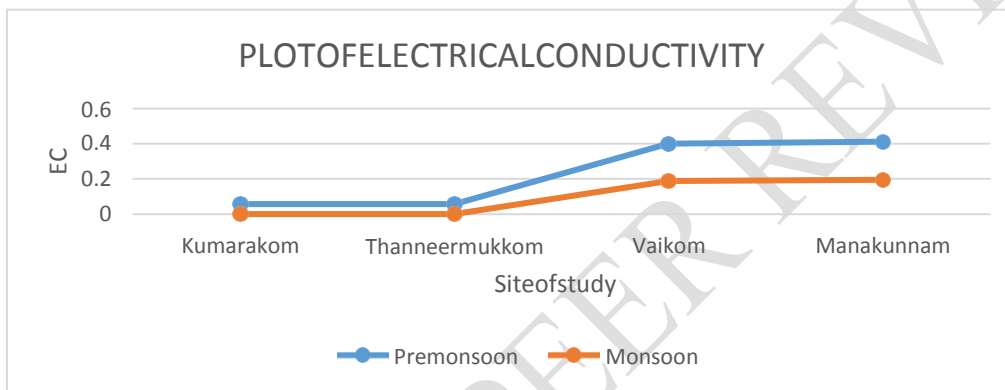


Fig33. The distribution plots of evaluated EC

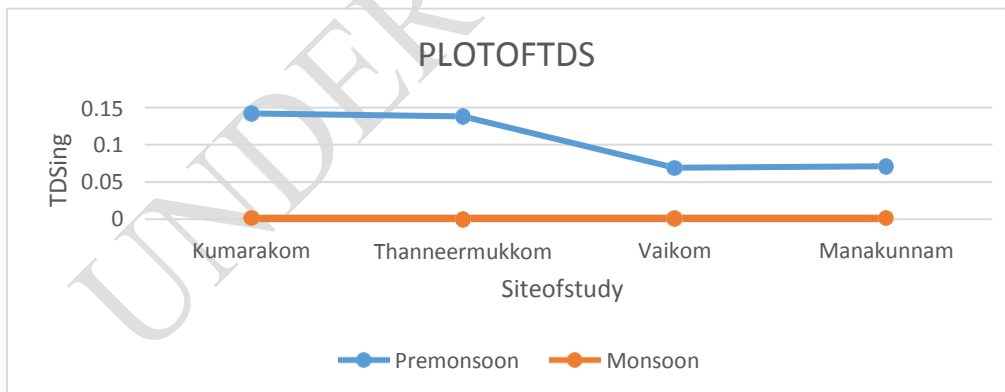


Fig34. The distribution plots of evaluated TDS

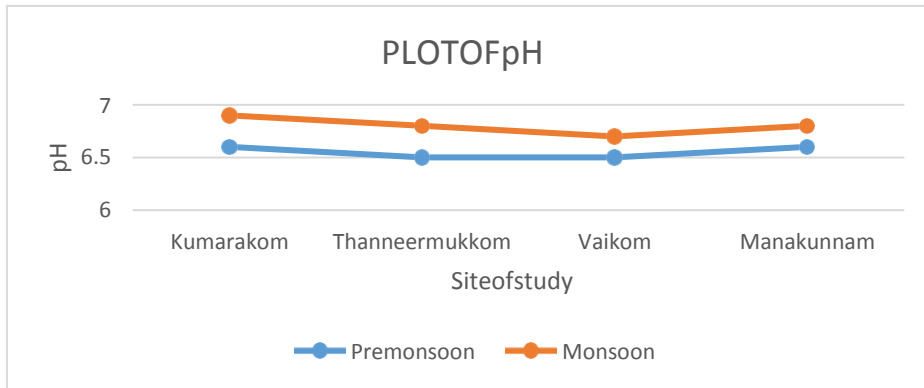


Fig35. The distribution plots of evaluated PH

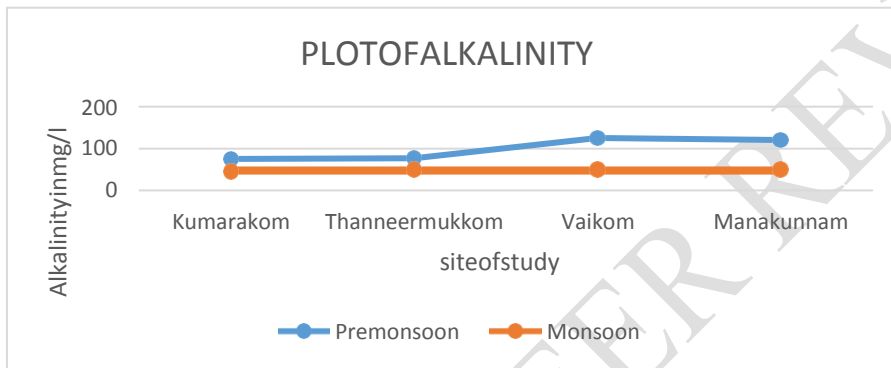


Fig36. The distribution plots of evaluated Alkalinity

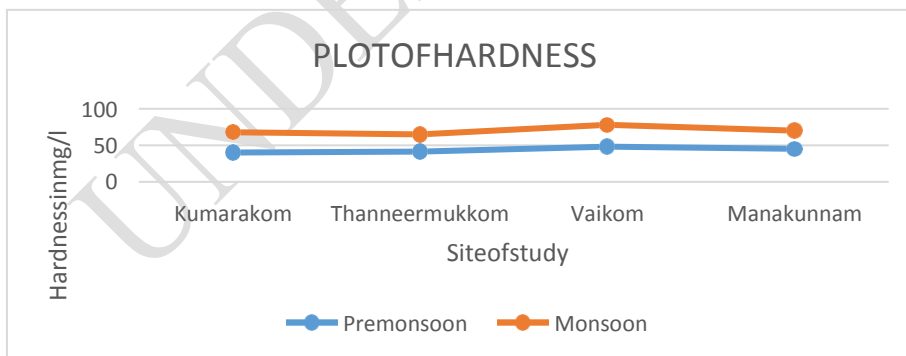


Fig37. The distribution plots for evaluated Hardness

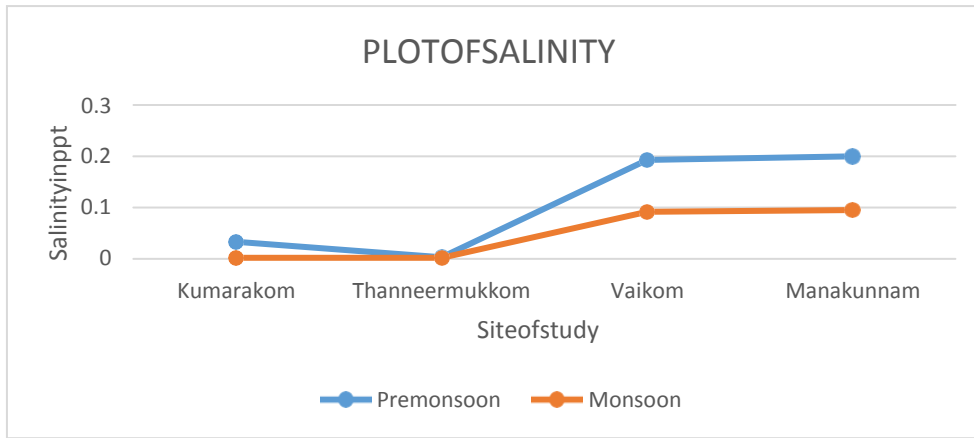


Fig 38. The distribution plots for evaluated Salinity

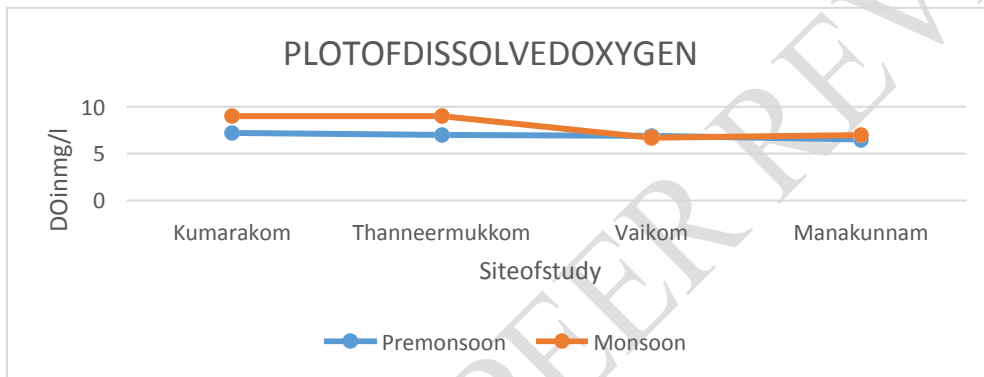


Fig 39. The distribution plots for evaluated DO

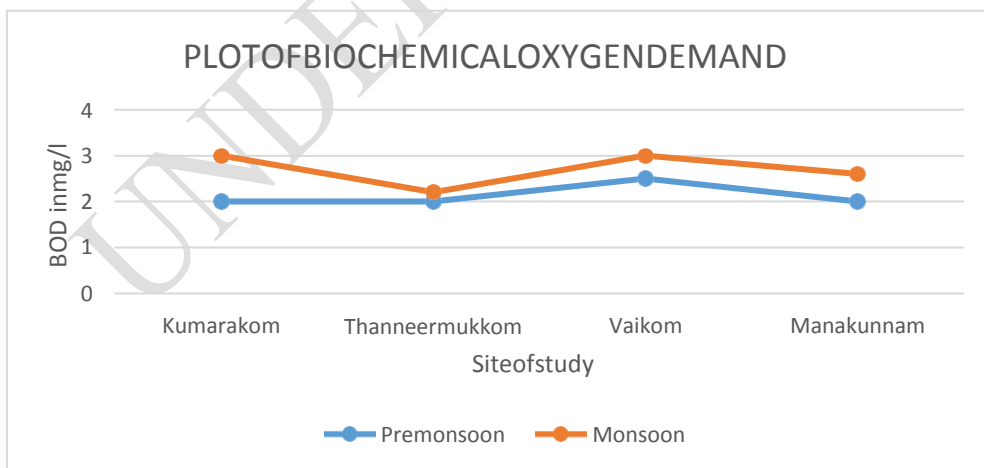


Fig 40. The distribution plots for evaluated BOD

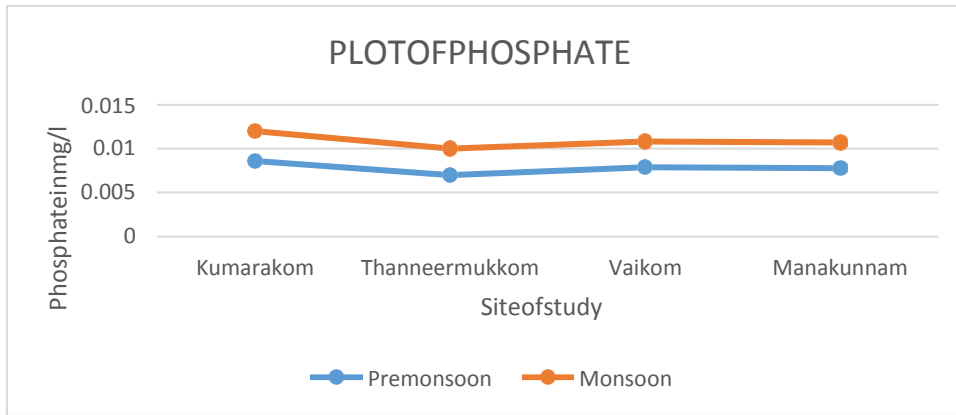


Fig41. The distribution plots for evaluated Phosphate

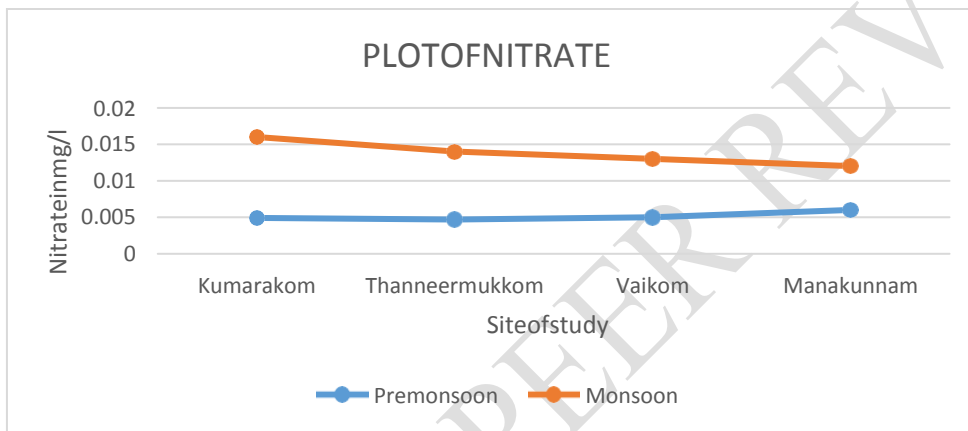


Fig42. The distribution plots for evaluated Nitrate

UNDER PEER REVIEW

CONCLUSION

The study reflects on the fin fish and shellfish diversity of selected sites of Vembanad Lake along with the analysis of physico-chemical parameters of water. The most abundant species are *Etroplus suratensis* and *Villoritacyprinoides* from all study sites. Two species of shellfish *Scylla serrata* and *Penaeus monodon* were completely absent on the Southern side of Thaneermukkon bund. Under the IUCN categorization, there were two Vulnerable species and one Near Threatened species i.e., *Horabagrus brachysoma* and *Hyporhamphus xanthopterus* were considered as vulnerable and *Oreochromis mossambicus* as Near Threatened. All the physicochemical parameters are within the limited range during both pre-monsoon and monsoon periods. Salinity was higher on the Northern side of the barrage. During the Pre-monsoon period Temperature, EC, TDS, Alkalinity, and salinity are high and during Monsoon season hardness, DO, BOD, Phosphate, and Nitrate were high when compared with Pre-monsoon but all were within the limit. Water quality parameters like Temperature, EC, Alkalinity, Hardness, Salinity and BOD were positively correlated with species abundance.

REFERENCES

- Ansar CP, Mogalekar HS, Sudhan DL, Hauhan A, Gollandaj H, Canciyal J. Finfish and Shellfish diversity of Vembanad Lake in the Kumarakom region of Kottayam, Kerala, India. *Journal of Entomology and Zoology Studies*. 2017;5(2):351-357.
- APHA. Standard methods for examination of water and waste water, American Public Health Association, Washington, DC, APHA-AWWA-WEF, 2005, 167.
- Bijukumar A, Raghavan R. A checklist of fishes of Kerala, India. *Journal of Threatened Taxa*. 2015;7(13), 8036.

Blaber SJ, Fish of Trinity Inlet system of north Queensland with notes on the ecology of fish faunas of tropical Indo-Pacific estuaries. *Marine and Freshwater Research*. 1980;31:137-146.

Fakron Malik MA. Surface Water Pollution & Restoration (December 7, 2022).

Harden Jones FR. Fisheries Ecologically Sustainable Development:

Terms and

Concepts. IASOS, University of Tasmania, Hobart, Australia. 205 pp. (1994):

Jayaram., K.C., The Fresh Water Fishes of the Indian Regions. Narendra Publishing House, Delhi, 1999, pp: 1-551.

Jhingran, V.G. Fish and

Fisheries of India Edn 3rd Hindustan Publishing Corporation, India, 954, 1991.

Mogalekar, HS, Ansar CP, Raman NN, Jayachandran KV, Dinesh K, Kolhe Suraj. Fish diversity of Vembanad lake in the Panangad- Kumbalam region of Kochi, Kerala, India. *Pollution Research*. 2015, 34: 345-349.

Narayanan, S. P., Thapanjith, T., & Thomas, A. P. (2005). A study on the ichthyofauna of Aymanam Panchayath, in Vembanad wetland, Kerala. *Zoos' Print Journal*, 20(9), 1980–1982.

Nansimole A, Sruthi S, Devi GV, Radhakrishnan T. First report on fishery resources from four estuaries in Trivandrum district, Kerala, India. *International Journal of Scientific Research*. 2014;3(12):129-131.

Patil, RG, Guja P, More SM. Physicochemical parameters and

ichthyofaunal diversity in Kudali River, district Satara, Maharashtra (India). *International Journal of Biological Sciences*, 2017, 5: 12-23.

Roy R. An Introduction to water quality analysis. *International Journal of Rehabilitation and Conservation*. 2019, 9(1): 94—100.

UNDER PEER REVIEW