ICHTHYOFAUNAL DIVERSITY AND PHYSICO-CHEMICAL ANALYSISOFWATER INTHE MIDDLESTRETCH OFVEMBANAD LAKE,KERALA

ABSTRACT

The status of finfish and shellfish diversity and monthly variation in theirdistribution and abundance were investigated in the middle stretch of Vembanad Lakeat 4 selected sites in Kerala. The study was carried out for a period of 7 months fromDecember2022toJune2023.Intotal31speciesoffinfishesandshellfishesbelongsto8 orders, 23 families and 29 genera were recorded from the study areas. CalculatedvaluesofBiodiversityindiceswereShannonWeinerdiversityindexhighestatVaikom(3.4022),Simpsondiversityindexhighestat Manakunnam(0.9538),Margalef'srichness index highest at Manakunnam (4.346) and Pielou's evenness index highest atThaneermukkom(0.8573).*Etroplussuratensis*and*Villoritacyprinoides*werethemostabundant species from all four study sites. Three species are under the category ofthreatenedtheyare*Oreochromismossambicus*,*Horobagrusbrachysoma*and*Hyporhampusxanthopterus.*

TheresultofthepresentstudyindicatesthattheNorthernpartofThaneermukkombarrageisendowedwithrichediblefishfauna.Thephysicochemicalparametersof water were analyzedduring the pre-monsoonandmonsoon periods. Salinity was higher on the Northern side of the barrage. During thepre-monsoonperiodtemperature,EC,TDS,alkalinityandsalinitywerehighandduringthe monsoon period hardness, DO, BOD, Phosphate and Nitrate were high whencomparedwith pre-monsoon butall arewithintherecommended limit.

Keywords:VembanadLake;Finfish;Shellfish;Biodiversityindices;Physicochemicalanalysis.

1. INTRODUCTION

Vembanad Lake is one of the transitional ecotone which is lying parallel to theArabian Sea and comprises mangroves, mudflats, swamps and marshes (Mogalekar,2015). As these ecosystems provide a harsh environment, many species of fish mayhave found them to be an ideal place for spawning, development and growth duringtheirlife(Mogalekar,2015).FisheryresourcesoftheVembanadwetlandshaveimmense potential because they are one of the readily accessible human food sourceand it is considered as the basis for the development of an innumerable variety offisheries(Blaber,1980).TherichbiodiversityandecologicalvalueofthiswetlandmadeVembanadLaketo be knownas aRamsarsiteinNovember2002.

Thefisheriesareclassifiedintofourmainsections(HardenJones,1994:Ravlinson*et al.*,1995)subsistence,artisanal,commercialandrecreation.Thefinfishesand shellfish are living components of water bodies and are important food resourcesand bioindicators of the environmental health and wealth of the waters in which theyinhabit.Globallyaquaticecosystemsandfishdiversityareadverselyaffectedduetoanincreaseinunwiseanthropogenicactivities(Nansimole,2014).Thereforeknowledgeofthe status and trends of backwater fisheries is the key to sound policy development,betterdecisionmakingandresponsible fisheries management(Mogalekar,2015).

Water quality analysis is one of the essential things for using it for any purpose(Ritabrata,2019).Waterqualitycanbedefinedasthechemical,physicalandbiologicalcharacteristicsofwater,usuallyconcerningitssuitabilityforadesignateduse.Differentphysicochemical parameters of water such as colour, temperature, acidity, hardness,pH,sulphate,chloride,DO,BOD,COD,andalkalinityusedfortestingwaterqualit

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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 threatenshuman health, the balance of the aquatic ecosystem, economic development and socialprosperity (Fakron,2022). The present study was carried out to study the diversity offishes and physicochemical analysis of water in the selected sites of the middle stretchofVembanadLake.

2. MATERIALSANDMETHODS

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

Fish samples were located from different selected sites of the middle stretch ofVembanad during the study period of December (2022) – June (2023). It is done withthe help of local fishermen using different types of fishing gear ie., gillnets, cast netsand dragnets. At the time of collection, photographs were taken before preservationsince formalin decolorizes the fish colour on long preservation and the collectedsamples were preserved in 10 % formalin. The fishes were identified by followingTalwar and Jhingran (1991) and Jyaram (1999).

The water samples were collected in both pre-monsoon and monsoon seasonsto find out the temporal variation. Water quality was checked across parameters likecolour,odour,temperature,electricalconductivity,TDS,PH,hardness,salinity,alkalinity, dissolved oxygen, BOD, phosphates and nitrates. For BOD determinationwater samples were collected inBOD bottles.For further analysis samples weretransported to the laboratory and analyzed other parameters using standard procedures(APHA2005).

3. RESULTSANDDISCUSSION

In the present ichthyofaunal study total of 31 species were obtained. Amongthem, 26 finfishes and 5 shellfishes were reported from the four selected sites of themiddle stretch of Vembanad Lake (Fig.1 to Fig.31). 26 species of finfish belong to 24generaandareincludedunder19familiesand5speciesofshellfishbelongto5differentgenera and are included under 4 families. The order of Perciformes were dominated inthe present study. From the study of Narayanan *et al.,* (2005) a similar report wasrecorded that order perciformes dominated the study. The systematic positioning of allthefish collected werelisted in Table1.

The abundance of species in percentage was studied from the four sites. Themost abundant species from all four sites were observed as *Etroplus suratensis*. Themost abundant species of site 1 Kumarakom was *Etroplus suratensis* (8.9%) and theleast abundant species is *Macrobranchium rosenbergii* (0.7%). The most abundantspecies of site 2 Thanneermukkom were observed as *Etroplus suratensis* (9%) and theleast abundant one is *Macrobrachium rosenbergii* (0.6%). Some of the species wereabsent in both sites 1 and 2 like*Leiognathus equulus*, *Nematalosa nausus*, *Scyllaserrata*, and *Penaeus monodon.* The most abundant species of site 3 Vaikom wasobserved as *Etroplus suratensis*(8.7%) and the least abundant species was *Scyllaserrata* and finally the most abundant species of site 4 Manakunnam was found to be*Etroplussuratensis*(8.5%)andthe least abundantone is*Scyllaserrate*(0.1%).

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

NearThreatenedcategoryofIUCN.*Horabagrusbrachysoma*ofSiluriformesorderand

Bagridae family is under the Vulnerable status of IUCN. *Hyporhampus xanthopterus*of order Beloniformes and family Hemiramphidae family is also under the category ofVulnerable that is in short three species were identified as threatened. It is clear thatthreeofthespeciesoffishesreportedinthepresentstudyisthreatenedanditwasshownin the checklist of Bijikumar *et al.,* (2015). A similar report was given by Ansar *et al.*,(2017)showingthe listof threatened speciesof fishes inVembanadLake.

The statistical analysis of the collected data was done and various diversityindiceswereused(Table 2).TheShannon-Weinerdiversityindexofspeciescollectedfrom four different sites was found in the present study. Here site 3 Vaikom has thehighest Shannon diversity index ie., 3.4022 and the low Shannon diversity index inKumarakom ie., 3.131 but they are within the range of 1.5 to 3.5. The next index usedin the study is Simpson's Diversity Index of four sites in which Manakunnam site 4 iswithhighvaluethatis0.9538followedbyVaikomsite3(0.09535),Thanneermukkomsite2 (0.9514)andKumarakomsite1(0.9508).TomeasurespeciesrichnessMargalef'sDiversity Index is used in the present study. The range of Margalef's diversity indexvaries from 0 to 8 and here Site 4 Manakunnam has high species richness among thefour sites selected with a value of 4.346, followed by Site 3 Vaikom (4.292), Site 1Kumarakom(3.816) and Site 2 Thanneermukkom (3.777). To measure the evenness ofspeciesfromthefoursitesPielou'sevennessindexwasusedandusuallyPielou'sIndexrang es from 0 to 1. In the present study, Thanneermukkom site 2 is with high value ofevenness that is 0.8573 followed by Kumarakom site 1 (0.8522), Manakunnam site 4(0.8051),and Vaikom site1 (0.8031).

WiththeconstructionofThaneermukkombund,thesalinitybarragedividedthelake into two distinct ecosystems, freshwater on the south and brackishwater on

thenorthandthereweresomechangesinthephysicochemicalconditionofwaterand

speciesdiversity.Thesouthernpartofthebundie.,Kumarakom(Site1)andThaneermukkom South (Site 2) has less number of species when compared to theNorthernpartie.,Vaikom(Site3)andManakunnam(Site4).Themostabundantspeciesar e *Etroplus suratensis* and *Villorita cyprinoides* from all study sites. Two species ofshellfish*Scyllaserrata*and*Penaeusmonodon*werecompletelyabsentontheSouthernside ofThaneermukkonbund

The physicochemical analysis of water from selected sites was done usingstandard procedures (APHA 2005) and depicted in Fig. 32 to Fig.42. Water qualityanalysis was done during both Pre-monsoon and Monsoon seasons. The correlationbetween water quality parameters is done using Pearson's Correlation Coefficient.Correlationswerecross-checkedwithspeciesabundanceandwaterqualityparameters.It is clear that mean species abundance is positively correlated with some of the waterquality 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) andnegatively 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	*Parambassist homassi*	Western ghatsgla ssy perchlet	Arinjil	Ornamental /foodfish
Perciformes	Anabantidae	KMR TMK VKM MKM	*Anabastes tudineus*	Climbing perch	Andikalli	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	*Etroplussu rantensis*	Bandedp earlspot	Karimeen	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	*Pseudetroplus maculatus*	Orangec hromide	Pallathi	Ornamental /foodfish
Perciformes	Cichlidae	KMR TMK VKM MKM	*Oreochromis mossambicus*	Tilapia	Silopia	Foodfish
Perciformes	Centropomid ae	KMR TMK VKM MKM	*Latescalc arifer*	Barramundi	Narimeen	Foodfish

Perciformes	Gobidae	KMR TMK VKM MKM	*Stenogobius gymnopomus*	Malabar goby	Poolan	Ornamental/food fish
Perciformes	Leignathidae	VKM MKM	*Leiognathus equulus*	Common ponyfish	kurichil	Ornamental/food fish
Perciformes	Lutjanidae	KMR TMK VKM MKM	*Lutjanusargentimaculatus*	Mangrover edsnapper	Chemballi	Ornamental/food fish
Perciformes	Scatophagidae	KMR TMK VKM MKM	*Scatophagus argus*	Spotted scat	Nachara	Ornamental/ foodfish
Perciformes	Sciaenidae	KMR TMK VKM MKM	*Daysciaena albida*	Bengal arvina	Pallikora	Foodfish
Perciformes	Sillaginidae	KMR TMK VKM MKM	*Sillago sihamo*	Silver sillago	Kathiran	Foodfish
Perciformes	Sphyraenidae	KMR TMK VKM MKM	*Sphyraena jello*	Bandedb arracuda	Seelavu	Foodfish
Cypriniformes	Cyprinidae	KMR TMK VKM MKM	*Amblypharyngodonmelettinus*	Molac arplet	Vayambu	Ornamental/ foodfish

Cypriniformes	Cyprinidae	KMR TMK VKM MKM	*Labeoduss umieri*	Malabar labeo	pullan	Foodfish
Cypriniformes	Cyprinidae	KMR TMK VKM MKM	*Systomus serana*	Olivebarb	Paral	Ornamental/ foodfish
Siluriformes	Ariidae	KMR TMK VKM MKM	*Ariussubros tratus*	Shoveln oseseac atfish	Vazha koori	Ornamental/ foodfish
Siluriformes	Bagridae	KMR TMK VKM MKM	*Mystuso culatus*	Malabar mystus	Chilan koori	Ornamental/ foodfish
Siluriformes	Bagridae	KMR TMK VKM MKM	*Horabagrus bracysoma*	Gunter's catfish	Manjakoor i	Ornamental/ foodfish
Clupeiformes	Clupeidae	VKM MKM	*Nematalosa nausa*	Bloch's gizzard shad	Manga meen	Foodfish
Clupeiformes	Engraulidae	KMR TMK VKM MKM	*Stolephoruscommersonnii*	Commerson'sanchovy	Netholi	Ornamental/ foodfish
Clupeiformes	Engraulidae	KMR TMK VKM MKM	*Stolephorus indicus*	Indiana nchovy	Kozhuva	Foodfish

Beloniformes	Hemiramphidae	KMR TMK VKM MKM	*Hyporamphus xanthopterus*	Vembanad halfbeak	Kola	Ornamental/ foodfish
Beloniformes	Hemiramphidae	KMR TMK VKM MKM	*Hyporamphus limbatus*	Halfbeak	Kola	Ornamental/ foodfish
Pleuronectiformes	Soleidae	KMR TMK VKM MKM	*Brachirus orientalis*	Oriental sole	Nanku	Ornamental/ foodfish
Pleuronectiformes	Cynoglossidae	KMR TMK VKM MKM	*Cynoglossus cynoglossus*	Bengaltonguesole	Manthal	Ornamental/ foodfish
Venerida	Cyrenidae	KMR TMK VKM MKM	*Villoritacy prinoides*	Blackclam	Kakka	Food
Decapoda	Portunidae	VKM MKM	*Scyllaserrata*	Mangrove crab	Njand	Food
Decapoda	Penaeidae	VKM MKM	*Penaeus monodon*	Gianttiger prawn	Kara	Food
Decapoda	Palaemonidae	KMR TMK VKM MKM	*Macrobrachium resenbergii*	Giantfresh waterprawn	Aattu Konch	Food
Decapoda	Penaeidae	KMR TMK VKM MKM	*Metapenaeus dobsoni*	Kadalshrimp	Thelly	Food

KMR:Kumarakom

TMK :

ThanneermukkomVKM:

Vaikom

MKM:Manakunnam

Table2.Diversityindicesoffoursitesstudied

Sl.No	Sites	Shannon diversity Index	Simpson's DiversityIndex	Margalef's diversityIndex	Pielou'sevennessIndex
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^{0}C	26.8^{0}C	30^{0}C	27^{0}C	31^{0}C	27^{0}C	31^{0}C	27^{0}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

OBSERVEDICHTHYOFAUNADURINGTHESTUDYPERIOD

FINFISHES OFVEMBANADLAKE

Fig.1.*Parambassisthomassi*

Fig.2.*Anabastestudineus*

Fig.3.*Etroplussuratensis*

Fig.4.*Pseudetroplusmaculatus*

Fig. 5. ***Oreochromismossambicus***

Fig.6.*Latescalcarifer*

Fig.7.*Stenogobius gymnopomus*

Fig.8.*Leiognathusequulus*

Fig.9.*Lutjanusargentimaculatus*

Fig.10.*Scatophagusargus*

Fig.11.*Daysciaenaalbida*

Fig.12.*Sillagosihamo*

Fig.13.*Sphyraenajello*

Fig.14.*Amblypharyngodonmelettinus*

Fig.15.*Labeodussumieri*

Fig.16.*Systomusserana*

Fig.17.*Ariussubrostratus*

Fig.18.*Mystusoculatus*

Fig.19.*Horabagrusbrachysoma*

Fig.20.*Nematalosanausa*

Fig.21.*Stolephoruscommersoni*

Fig.22.*Stolephorusindica*

Fig.23.*Hyporhamphusxanthopterus*

Fig.24.*Hyporhamphus limbatus*

Fig.*25.*Brachirusorientalis

Fig.*26.*Cynoglossuscynoglossus

SHELLFISHES OFVEMBANADLAKE

Fig.27.*Penaeusmonodon*

Fig.28.*Macrobrachiumrosenbergii*

Fig.29.*Metapenaeusdobsoni*

Fig.30.*Scyllaserrata*

Fig.31.*Villorita cyprinoides*

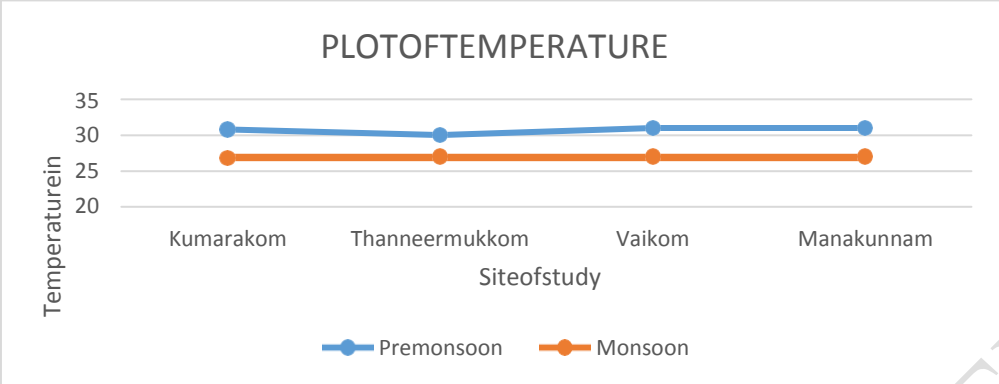

Fig32.Thedistribution plotsofevaluatedTemperature

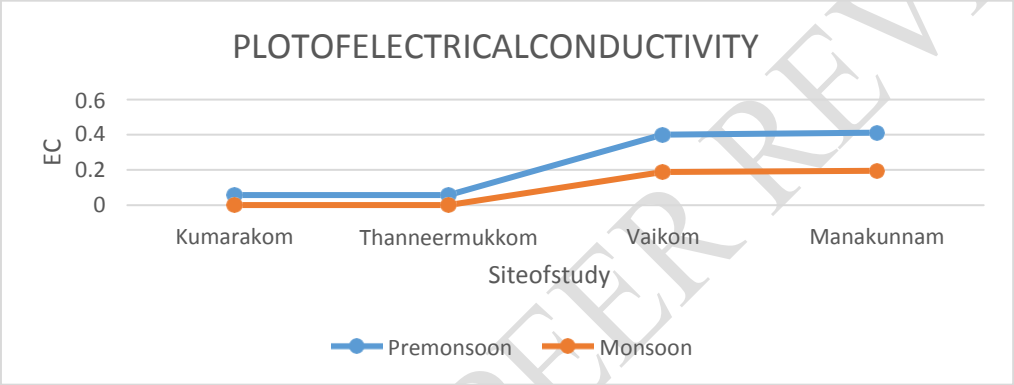

Fig33.ThedistributionplotsofevaluatedEC

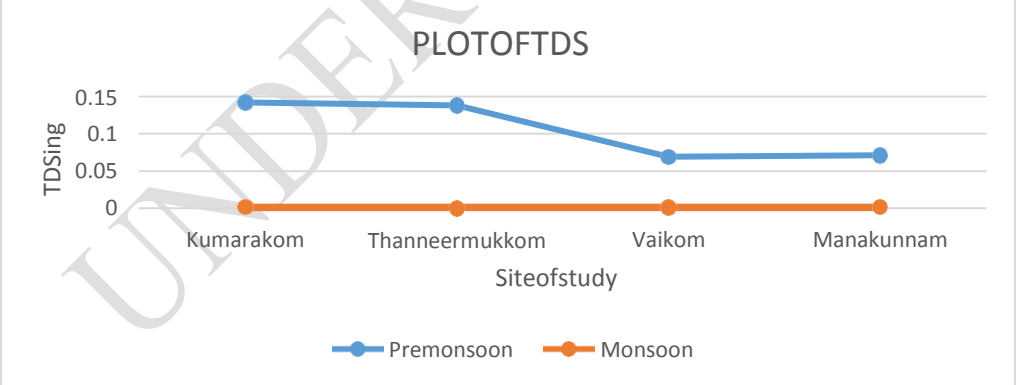

Fig34.ThedistributionplotsofevaluatedTDS

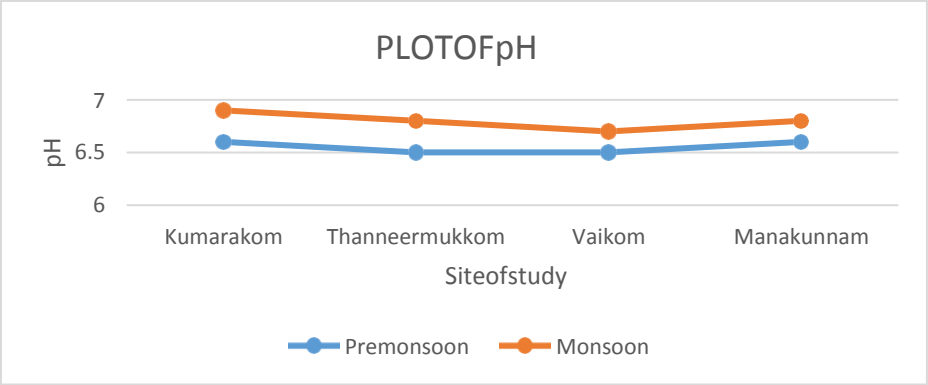

Fig35.Thedistributionplotsof evaluatedPH

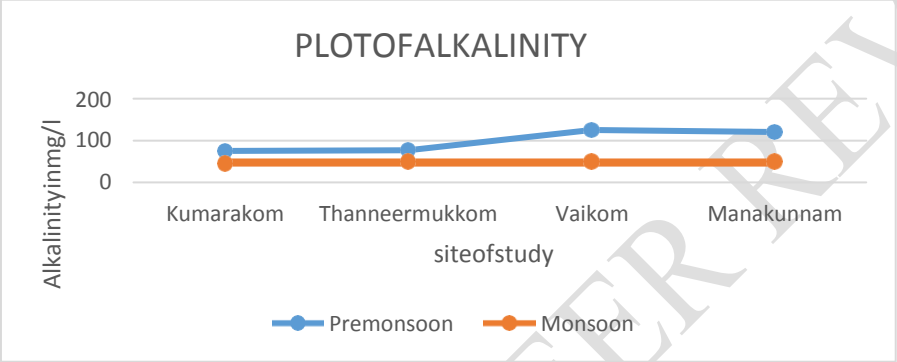

Fig36.Thedistributionplotsof evaluatedAlkalinity

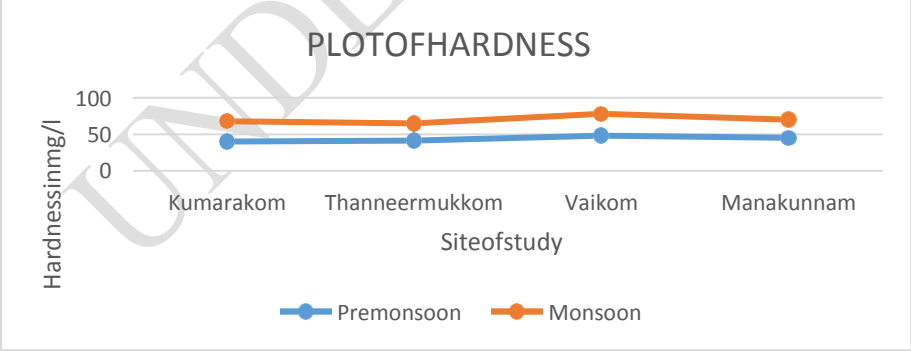

Fig37.ThedistributionplotsforevaluatedHardness

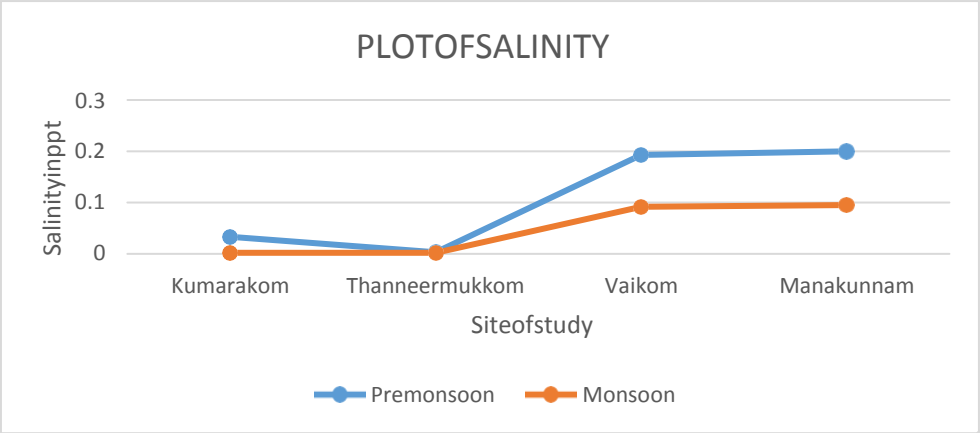

Fig38.Thedistribution plotsforevaluatedSalinity

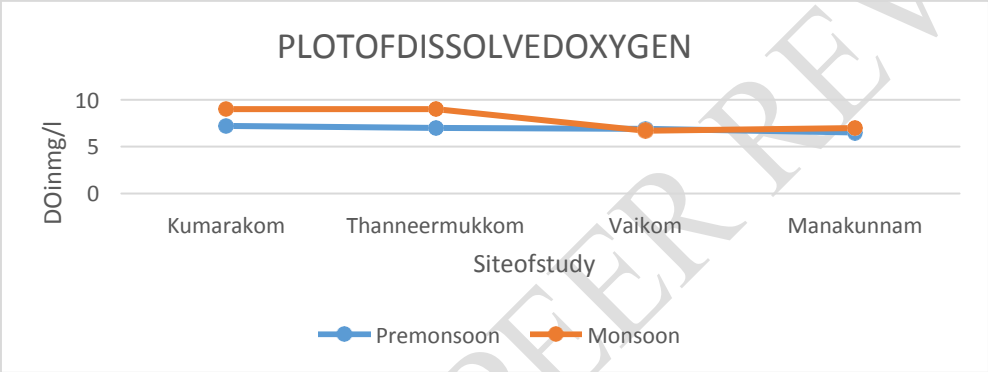

Fig39.ThedistributionplotsforevaluatedDO

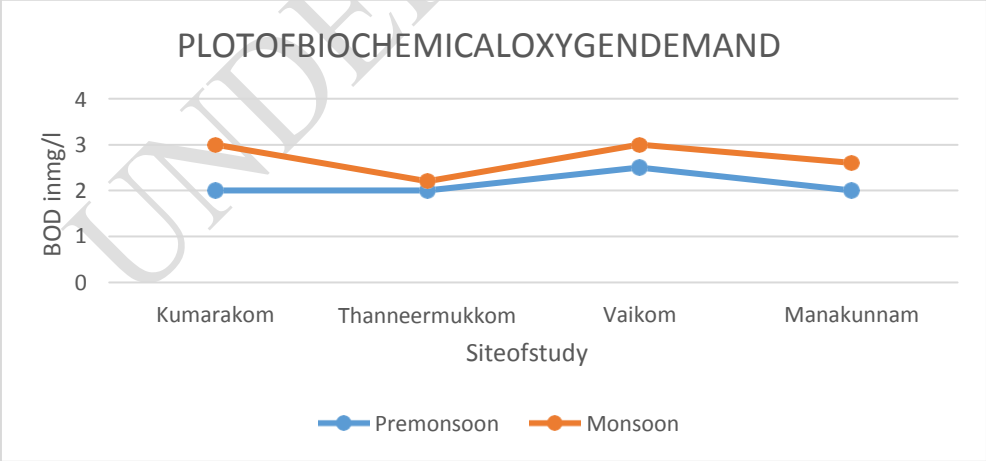

Fig40.Thedistributionplots forevaluatedBOD

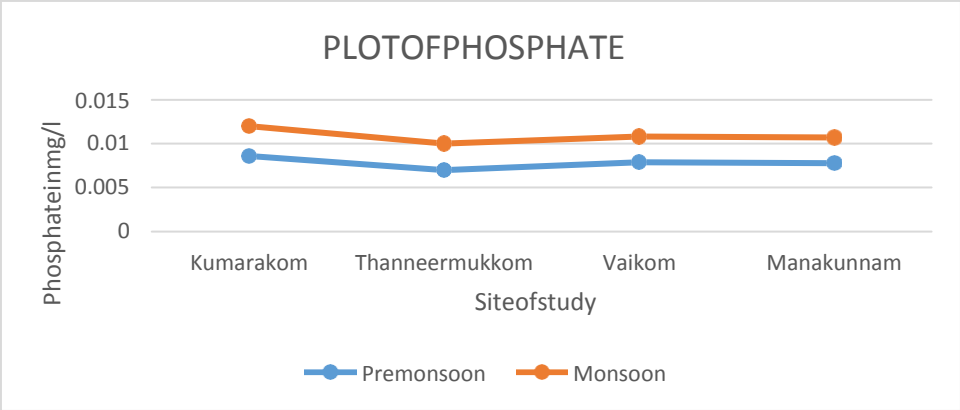

Fig41.ThedistributionplotsforevaluatedPhosphate

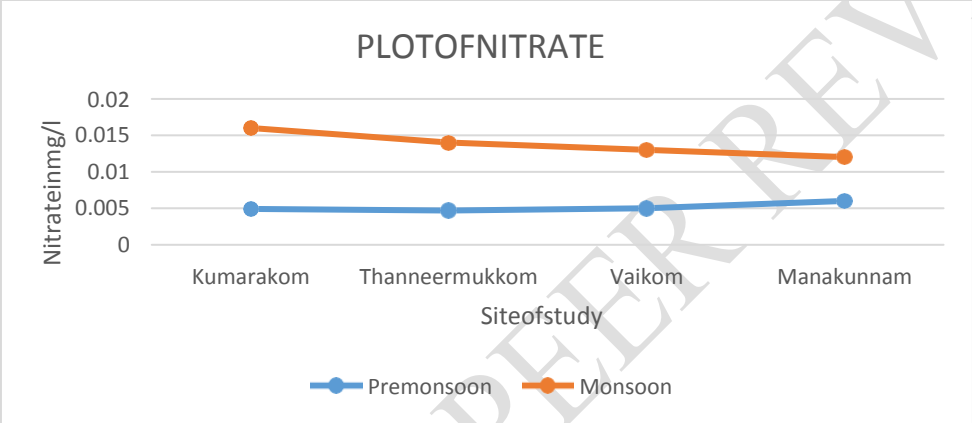

Fig42.ThedistributionplotsforevaluatedNitrate

CONCLUSION

The study reflects on the fin fish and shellfish diversity of selected sites ofVembanad Lake along with the analysis of physico-chemical parameters of water. Themost abundant species are *Etroplus suratensis* and *Villorita cyprinoides* from all studysites. Two species of shellfish *Scylla serrata* and *Penaeus monodon* were completelyabsent on the Southern side of Thaneermukkon bund. Under the IUCN categorization,there were two Vulnerable species and one Near Threatened species ie., *HorabagrusbrachysomaandHyporhampusxanthopterus*wereconsideredasvulnerablean d*Oreochromis mossambicus* as Near Threatened. All the physicochemical parametersare within the limited range during both pre-monsoon and monsoon periods. Salinitywas higheron the Northern side of the barrage.Duringthe Pre-monsoon periodTemperature, EC, TDS, Alkalinity, and salinity are high and during Monsoon seasonhardness, DO, BOD, Phosphate, and Nitrate were high when compared with Pre-monsoonbutallwerewithinthelimit.WaterqualityparameterslikeTemperature,EC,Alkali nity,Hardness,SalinityandBODwerepositivelycorrelatedwithspeciesabundance.

REFERENCES

AnsarCP,Mogalekar HS, SudhanDL, Hauhan A, Golandaj H, Canciyal J. FinfishandShellfishdiversityofVembanadLakeintheKumarakomregionofKottaya m,Kerala,India.JournalofEntomologyand ZoologyStudies.2017;5(2):351-357.

APHA. Standard methods for examination of water and waste water, American PublicHealth Association,Washington,DC,APHA-AWWA-WEF,2005,167.

BijukumarA,RaghavanR.AchecklistoffishesofKerala,India.JournalofThreatenedTaxa.2 015,7(13),8036.

Blaber SJ, Fish of Trinity Inlet system of north Queensland with notes on the ecologyoffishfaunasoftropicalIndo-Pacificestuaries.Marineand FreshwaterResearch.1980;31:137-146.

FakronMalik MA. SurfaceWater Pollution&Restoration(December 7,2022).

HardenJonesFR.FisheriesEcologicallySustainableDevelopment: Termsandc oncepts.IASOS,UniversityofTasmania,Hobart,Australia.205pp.(1994):

Jayaram.,K.C.,TheFreshWaterFishesoftheIndianRegions.NarendraPublishingHouse,Delhi,1999,pp:1-551.

Jhingran,VG.Fishand FisheriesofIndiaEdn3rdHindustanPublishingCorporation,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.PollutionResearch.2015,34.345-349.

Narayanan, S. P., Thapanjith, T., & Thomas, A. P. (2005). A study on the icthyofaunaof 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 resourcesfromfourestuariesinTrivandrumdistrict,Kerala,India.InternationalJournalofScientific Research.2014;3(12):129-131.

Patil,RG,GujaP,MoreSM..Physicochemicalparametersand ichthyofaunaldiversityinKudaliRiver,districtSatara,Maharashtra(India).InternationalJournalofBiologicalScieces,2017,5:12-23.

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