iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** I **Month of publication:** January 2018

DOI: http://doi.org/10.22214/ijraset.2018.1091

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 6 Issue I, January 2018- Available at www.ijraset.com

Study on the Ichthyofaunal Diversity of Kole Wetlands of Puzhakkalkole with Emphasis on Its Water Quality Parameters, Kerala

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Abstract: ***Wetlands are the most productive ecosystems of the earth and they are vital to fish populations because fish depend on certain wetland processes. This study aimed to determine the ichthyofaunal biodiversity in kole wetlands of Puzhakkal, part of Vembanad wetland, designated as Ramsar site. The selected kole wetlands were Adatt, Mullur and Ponnore. The ichthyofauna in relation to water quality was studied on monthly basis from December 2015- to August 2016. The study revealed that physicochemical parameters of three kole wetlands of Puzhakkal were congenial for 35 fish species, belonging to 7 orders and 17 families. The Cypriniformes were dominant and most abundant order with 13 species, followed by Perciformes, Siluriformes and Beloniformes, with 9, 8 and 2 species respectively. The Synbranchiformes, Cyprinodontiformes and Anguilliformes, with one species each. Regarding their conservation status (IUCN), 3 species were of endangered, 5 species were vulnerable and 2 species were near threatened. The current study have been reported a vanishing species the Clariasmacrocephal us from the Ponnorekole wetland. This study reveals the necessity of conservation of Puzhakkalkole ecosystem going under great threat.***
Key words: Ichthyofauna, Kole wetlands, Water quality parameter, Puzhakkal, Ramsar site.

I. INTRODUCTION

Wetlands play a pivotal role in maintaining the natural cycles and supporting a wide range of biological diversity. Wetland ecosystems, including rivers, lakes, marshes, rice fields and coastal areas, provide many services that contribute to human well-being and poverty alleviation. Many wetlands diminish the destructive nature of flooding, and the loss of these wetlands increases the risks of floods occurring. Three wetlands of Kerala, recently included in the Ramsar site are the Vembanad–Kole, Ashtamudiand Sasthamkotta. The 'Kole lands', which is spread into Thrissur and Malappuram districtsis one of the pivotal fresh water wetlands of the Kerala. Fish have been regarded as an effective biological indicator of environmental quality and anthropogenic stress in aquatic ecosystems not only because of its iconic value, but also because of sensitivity to subtle environmental changes and represents a wide range of tolerance at community level (Irigolen, et. al., 2004). Fish is regarded as an indicator of changes in water chemistry due to different anthropogenic activities and environmental factors. The responses of fish to environmental disturbances, including hydro morphological factors are different in time and space. Fish has been identified as suitable for biological assessment due to its easy identification and economic value (Gaston, 2000).

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem and also it is described as ecotones. There are four main kinds of wetlands – marsh, swamp, bog and fen. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil. Wetlands play a number of roles in the environment, principally water purification, flood control, carbon sink and shoreline stability. Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life and by providing a transition between dry land and water bodies.

In India, there are 26 internationally accepted wetlands. But in Kerala a few wetlands of national importance. These include Vembanad – Kole, Ashtamudi and Sasthamcotta lakes which are also designated as Ramasar sites of Kerala. Vembanad-Kole Wetland-The largest brackish, humid tropical wetland ecosystem on the southwest coast of India, is fed by 10 rivers and typical of large estuarine systems on the western coast. Vembanad Kole Wetland was included in the list of wetlands of international importance, as defined by the Ramsar Convention for the conservation and sustainable utilization of wetlands.

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Thrissurkole wetlands is found unique to Kerala. It contributes 40 per cent of the of the Kerala's rice requirement. It takes number of small and large kole systems, it touches near koles by continuously connected water canals. It is highly productive and threatened wetlands in Kerala. Also it provide a natural drainage system for Thrissur. So this study aimed to determine the theichthyofaunal biodiversity in Puzhakkalkole wetlands. Three collection sites were fixed covering the parts of the Puzhakkalkole lands. The selected sites were Adatt, Mullur and Ponnore.

Wetlands are vital to fish populations because fish depend on certain wetland processes. Wetlands serve as a food base, shelter, spawning and nursery areas, and for water filtration.

They contain large volumes of food that attract many animal species. Plants and other organic matter provide food for small aquatic insects, fish, and shellfish. In turn, the smaller insects and fish become food for larger predatory fish, reptiles, amphibians, birds, and mammals. Wetlands not only provide food for aquatic and non-aquatic animal and fish species, they also provide vegetated areas where fish can reproduce, hide from predators, and take refuge from inclement weather or other changes in the physical environment. Wetlands also filter out sediments and pollutants, providing the clean water that fish need. Thus, a network of abundant and healthy wetlands is vital to the survival of most fish species. Wetland loss and declining fish populations affect not only natural ecosystem functions, but commercial and recreational fishing as well.

The present work investigates the diversity, status of fish fauna in three kole wetlands of Puzhakkalkole. The physico-chemical characteristics of water have an important role in supporting fish diversity freshwater ecosystems. The main water quality parameters tested were Temperature, pH, Salinity, Dissolved oxygen and Dissolved carbondioxide. The pH is considered as an indicator of overall productivity that causes habitat diversity.

In particular, fish populations are highly dependent upon the variations of physicochemical characteristics of their aquatic habitat which supports their biological functions(Mushahida-Al-Noor *et.al,* 2013). Among the physicochemical factors, temperature, Dissolved Oxygen, pH, turbidity, water transparency and current among others, and their regular or irregular fluctuations, have been identified as determinants in riverine fish ecology (Boyd,*et.al,* 1998). Fishes are driven by their physicochemical surroundings to areas that are physiologically optimal (Beadle, 1981).

The interactions of both the physical and chemical properties of water play a significant role in composition, distribution, abundance, movements and diversity of aquatic organisms (Mustapha,2006). The physico-chemical characteristics are interrelated to each other and exert influence on the biological communities and production in water bodies and thus, it is essential to understand this interrelationship. The analysis of biological parameters along with chemical factors of water forms a valid method of water quality assessment. Chemical analyses of water provide a good indication of the quality of the aquatic systems which can directly correlates with the fish fauna.

The kole wetland systems are faced the pollution threats also like the other wetlands. The major pollution include the deposition of industrial waste, over fertilization in paddy fields, etc. Over fertilization cause excessive nutrient in wetlands koles, and leads the eutrophication. Finally the algal bloom cause the closure of wetland surfaces, results in less oxygen content in water and high amount of organic matter,enhance water pollution. Also eutrophication results the unsuitable aquatic life for many vertebrates like fishes. So pollution is directly proportional to the fish diversity. Then ichthyofaunal biodiversity in relation with the water quality parameters is best way to study the status of a ecosystem.

It needs proper management and utilization of this fish wealth and sustainable steps to monitor and conserve this fish health. Fish assemblages have widely been used as ecological indicators to assess and evaluate the level of degradation and health of kole wetlands.

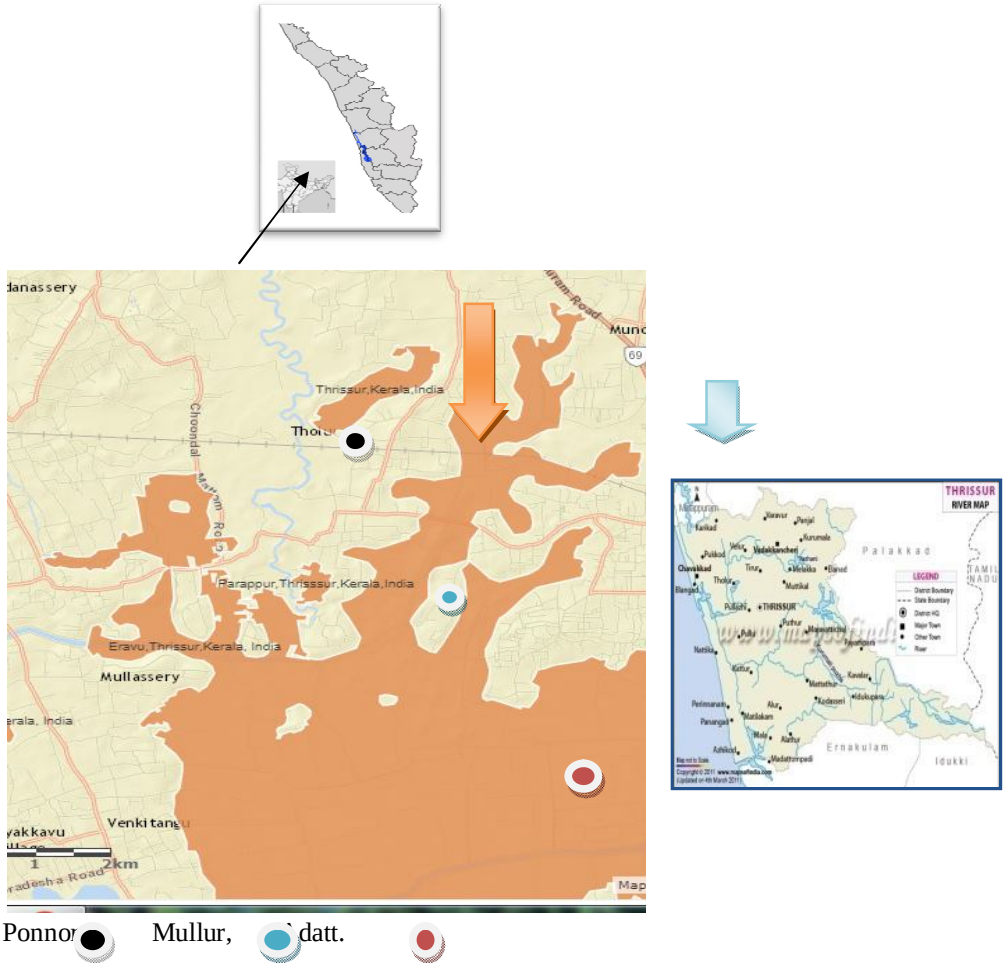
There are many advantages of using fish assemblage as biological indicator. Many fish species have become highly endangered, particularly in rivers and kole wetlands where heavy demand is placed on freshwater. So the present study has good scope for further references, future studies and research.

II. STUDY AREA

Puzhakkalkolewetlands ,a part of Thrissurkole is located km at 10.35.35.3868" N, 76.8.8.9016 E from Thrissur town. Adattkole (site-1) is locatedat 10.485587 , 76.129288 covering an area of 9,522.35hector kole wetland. Mullurkole (site-2) wetland is located at 10.489587, 76.229378 covering an area of 9,522 hector kole wetlands. Ponnorekole(site-3) wetlands covers an area of 93.53 hector of paddy cultivating fields, located at 10.582806, 76.124572. This isthe kole land is in Edakkalathur village and Kaiparambuvillage in Thrissur. These are the parts of Puzhakkalkole wetland, designated as Vembanadkole wetland, Ramsar site.

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A. Map:Showing the kole wetlands of Puzhakkal, Thrissur.



Ponnor Mullur, datt.

III. METHODOLOGY

Fish specimens were collected from kole wetlands of Puzhakkal for a period of months (December 2015 - August 2016). Fishes and water samples were collected twice (first and third week) in each month). The specimens collection was performed in 100 m reach of the sampling site during the study period. Fish were collected with the help of local fishermen using different types of nets namely gill nets and cast nets. Fishes brought to the Laboratory were fixed in 10% formalin solution in separate jars according to the area of collection. Photographs were taken in the field prior to preservation. The specimens were identified by referring the book of Day.F. (1865) and also with the help of taxonomists. Classification based on IUCN categorization was also done. From preselected station of the wetland, water samples were collected using a clean 1L- Polyethylene bottle for analysis of water quality parameters in the laboratory. Sampling and measurements were done early the morning. Water temperature and pH was recorded from the field itself and the result is recorded in the field book. Water samples are collected and transported to the laboratory immediately for further analysis. Dissolved oxygen, dissolved carbon dioxide, salinity was analyzed in the laboratory by titration. Temperature was measured by using mercury thermometer, pH measures with pH meter. Oxygen by Winkler`s method, Carbon dioxide and salinity were measured by titration method.

IV. RESULTS

A total of 35 species belonging to seven orders were recorded during the sampling period (December 2015- August 2016). The detailed list of species was represented in Table 1. The water quality parameters recorded during the sampling period have been presented in table 2.

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Table 1

SL.NO	Scientific name	Conservation status (IUCN)	Potential value
Order : Perciformes			
a.Family : Channidae			
1.	Channastriatus (Bloch, 1793)	LC	FF*
2.	Channagachua(Hamilton 1822)	LC	OT*
3.	Channamarulius(Hamilton, 1822)	LC	FF
b.Family : Cichlidae			
4.	Etroplusmaculatus(Bloch, 1795)	LC	FA*
5.	Etroplussuratensis	LC	FF
c. Family : Abassidae			
6.	Parambassisthomassi(Day, 1870)	LC	FF
7.	Parambassis day(Bleeker, 1874)	VU	FA*
d. Family: Anabandidae			
8.	Anabas testudineus(Bloch,1792)	EN	FA*
e. Family : Nandidae			
9.	Nandusnandus(Hamilton-buchanan, 1822)	LC	FF
Order : Cypriniformes			
f. Family: Cyprinidae			
10.	Esomusbarbatus(Halmilton, 1844)	LC	OT*
11.	Puntiusparrah(Day, 1865)	VU	FA*
12.	Puntiusdorsalis(Jerdon, 1849)	LC	FA*
13.	Puntiusfilamentosus(Valenciennes, 1844)	LC	FA*
14.	Puntiusmahecola(Valenciennes, 1844)	EN	FA*
15.	Pethiavittatus(Day , 1865)	VU	OT
16.	Rasboradandia(Hamilton – buchanan,1822)	LC	OR*
17.	Amplypharyngodonmelettinus(Valenciennes, 1844)	LC	OR
18.	Barbodessudnasutus (Valenciennes, 1842)	LC	OT
19.	Catlacatla(Hamilton, 1822)	LC	FF
20.	Labeorohita(Hamilton, 1822)	LC	FF
21.	Daniomalabaricus(Jerdon, 1849)	LC	FA
g. Family : Cobitidae			
22.	Lepidocephalichthysthermalis(Valenciennes, 1846)	LC	OR*
Order : Cyprinodontiformes			
h. Family: Aplocheilidae			
23.	Aplocheiluslineatus(Arnold,1911)	LC	OR*
Order : Siluriformes			
i. Family : Bagridae			
24.	Mystusarmatus(Day , 1865)	LC	FA
25.	Mystusoculatus(Valenciennes, 1840)	LC	FA
26.	Mystusmontanus (Jerdon, 1849)	VU	FA
j. Family: Horabagridae			
27.	Horabagrusbranchysoma(Gunther, 1864)	EN	OR
k. Family : Siluridae			
28.	Wallagoattu(Schnider, 1801)	LC	FF

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29.	Ompakbimaculatus(Bloch, 1794)	LC	FA
l. Family:Clariidae			
30.	Clariasmacrocephalus(Gunther, 1864)	NT	FF
m. Family: Heteropneustidae			
31.	Heteropneustesfossilis(Bloch ,1794)	VU	FA
Order: Beloniformes			
n. Family : Hemiramphidae			
32.	Hyporamphuslimbatus(Valenciennes, 1847)	LC	FA
o. Family : Belonidae			
33.	Xenendodoncancila(Hamilton, 1822)	LC	FA
Order: Anguilliformes			
p. Family : Anguillidae			
34.	Anguilla bengalensis(Grey and Hardwicke, 1844)	NT	FF
Order: Synbrachiformes			
q. Family: Mastacembelidae			
35.	Mastacembelusarmatus(Lacepede, 1800)	LC	FF

LC-Least concern, VU-Vulnerable, NT-Near threatened, EN-Endangered.
FF- Food fish, *FA*-Food and ornamental, *OR*-Ornamental, *OT*-Others
*Larvicidal

Table2: Seasonal variation of water quality parameters of the water in three kole wetlands of Puzhakkal, December 2015-August 2016.

Parameters (units)	Winter season (December-February)	Summer season (March–June)	Rainy season (July–August)
Ponnore(site-1)			
Water temperature (°C)	23.5-26.6	23.8-28.7	22.4-29.5
D.O_2(mg/L)	5.21-6.23	5.71-6.02	5.4-5.6
D.CO_2 (mg/L)	8.22–9.12	7.88–8.94	7.5-8.5
Salinity (ppt)	0.016-0.019	0.012-0.014	0.011-0.013
pH	6.3-6.6	6.0-6.8	6.2-6.5
Mullur(site-2)			
Water temperature(°C)	22.9-25.6	27.8-28.9	25.5-29.3
D.O_2(mg/L)	6.32-6.43	5.81-6.21	5.6-5.9
D.CO_2 (mg/L)	8.22–9.12	7.88–8.94	7.5-8.5
Salinity (ppt)	0.016-0.019	0.012-0.014	0.011-0.013
pH	6.3-6.6	6.0-6.8	6.2-6.5
Mullur(site-2)			
Water temperature (°C)	22.9-25.6	27.8-28.9	25.5-29.3
D.O_2(mg/L)	6.32-6.43	5.81-6.21	5.6-5.9

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D.CO_2 (mg/L)	7.42–8.16	6.98–7.33	6.9-7.45
Salinity (ppt)	0.014-0.018	0.015-0.016	0.011-0.019
pH	6.6-7.1	7.2-7.1	6.8-6.9
Adatt(site.3)			
Water temperature (˚C)	20.6-23.9	27.3-27.1	24.5-28.7
D.O(mg/L)	5.88-6.93	5.01-6.82	5.4-5.90
D.CO_2 (mg/L)	8.42–9.52	8.48–8.91	6.9-7.8.9
Salinity (ppt)	0.017-0.019	0.014-0.016	0.015-0.019
pH	6.7-7.4	6.6-7.8	6.8-7.7

Table 3: Order wise composition of the fish community of kole wetlands of Puzhakkal.

Sl. Number	Taxa	Number of species	Percentage (%)
1	Order: Cypriniformes	13	37.14
2	Order: Perciformes	9	25.73
3	Order: Siluriformes	8	22.85
4	Order: Beloniformes	2	5.71
5	Order: Cyprinodontiformes	1	2.82
6	Order: Synbranchiformes	1	2.85
7	Order: Anguilliformes	1	2.85
Total		35	

Table 4: Composition of the fish community by family.

Sl. number	Taxa/families	Number of Species	Percentage (%)
1	Family: Cyprinidae	12	34
2	Family: Ambassidae	2	6
3	Family: Cichlidae	2	6
4	Family: Hemiramphidae	1	3
5	Family: Anabantidae	1	3
6	Family: Belonidae	1	3
7	Family: Siluridae	2	6
8	Family: Clariidae	1	3
9	Family: Heteropneustidae	1	3
10	Family: Bagridae	3	9
11	Family: Cobitidae	1	3
12	Family: Channidae	3	9
13	Family: Nandidae	1	3

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14	Family: Mastacembelidae	1	3
15	Family: Anguillidae	1	3
16	Family: Aplocheilidae	1	3
17	Family: Horabagridae	1	3
Total		35	

Diagram 1, Showing Order wise species percentage of kole wetlands of Puzhakkal.

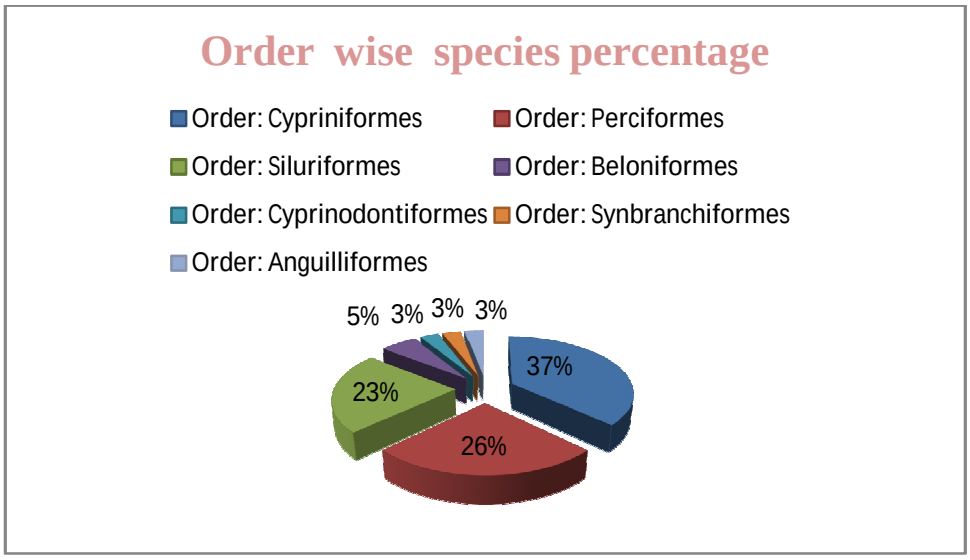
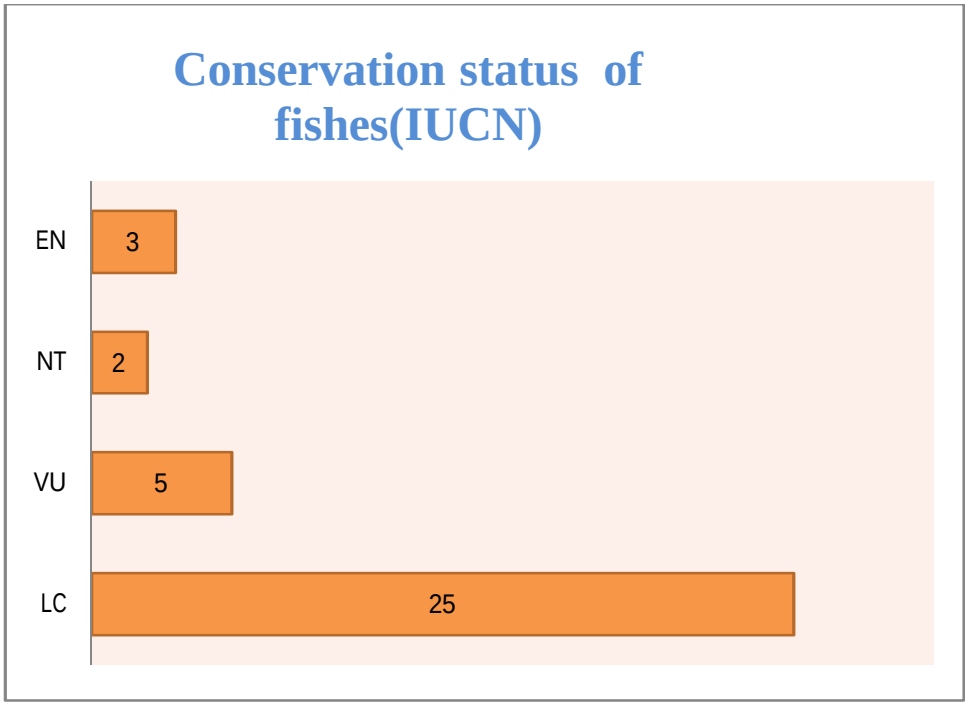
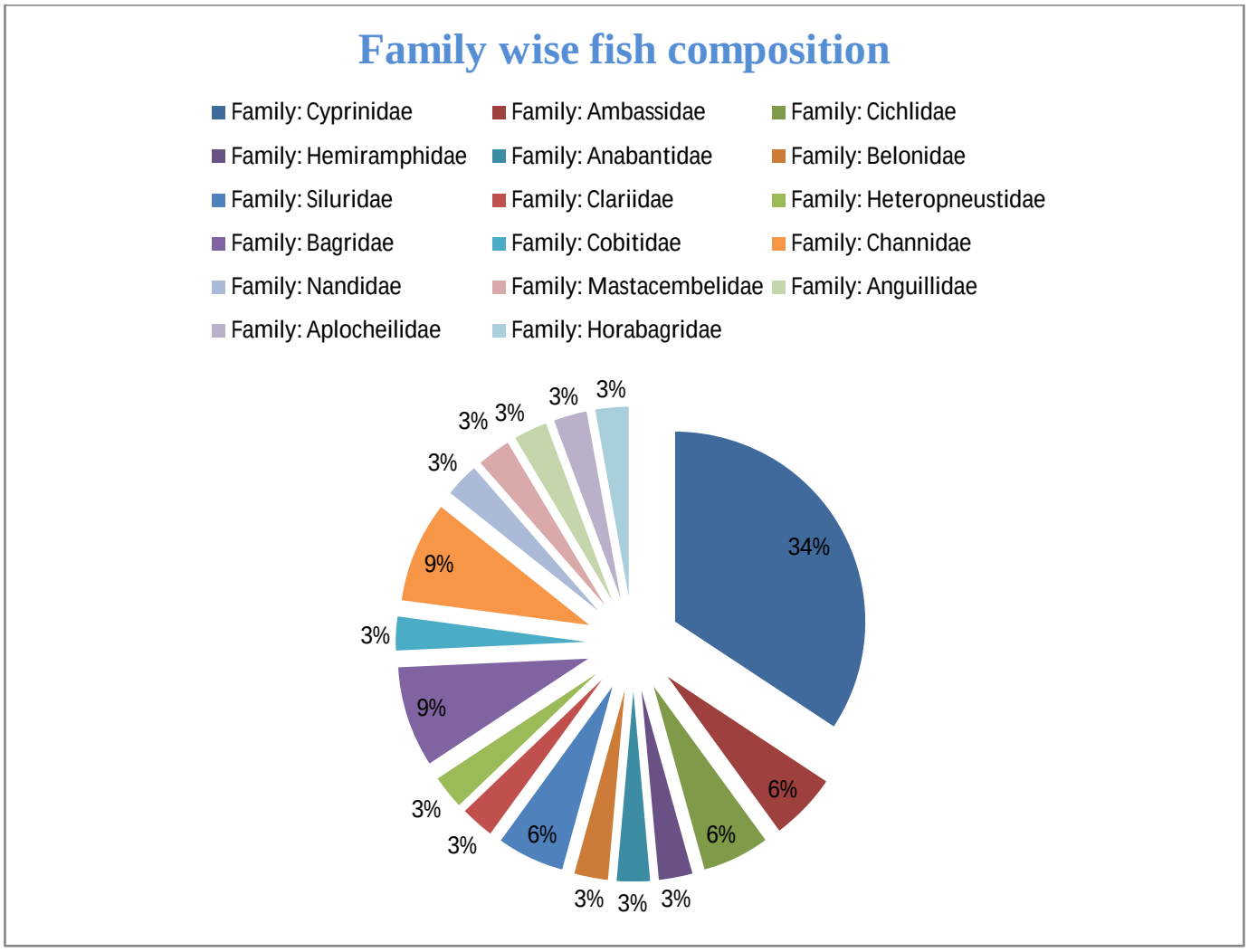


Diagram 2, Showing the status of fish species of kole wetlands of Puzhakkal.



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Diagram 3, Showing family wise fish composition of kole wetlands of Puzhakkal.



V. DISCUSSION

Fish assemblage are indicators of status of ecosystem, they are appropriate indicators of trends in aquatic biodiversity as their enormous variety reflects a wide range of environmental conditions with a major impact on the distribution and abundance of other organisms in waters they inhabit.The present study results indicated that the fish diversity of kole wetlands of Puzhakkal is diverse and some rare and endangered species have been recorded as well. This can be attributed to the presence of favourable habitat found in the area.

In the present study, 35 species of fishes belonging to 7 orders and 17 families were recorded from three kole wetlands (Ponnore, Mullur and Adatt) of Puzhakkalduring the period, December 2015 to August 2016. The most dominant order was group Cypriniformes. This order was represented by 2 families consisting of 12 species followed by order Perciformes with 9 species contributed with 5 families and Siluriformes consisting of 8 species with 5 families. Also recorded the order Beloniformes (2 species) with 2 families and orders Anguilliformes, Cyprinodontiformes and Synbranchiformes represented by single species. Unexpectedly we have recorded a very rarely present and vanishing species Clariasmacrocephalus from the Ponnorekole. Catfishes have been reported as vanishing from the waters of Kerala. Out of 35 species reported, 25 species are found to be Least concerned category (IUCN). Some species such as Anabas testudineus, Horabagrusbranchysoma and Puntiusmahecolawere found to be endangered and 5 species of vulnerable were recorded. The Pethiavittatus, Puntiusparrah, Parambassis day, Heteropneustesfossilis and Mystusmontanus are the vulnerable species got recorded. The Anguilla bengalensis and Clariasmacrocephalus are the Near Threatened species reported in this study. The status of some species contributing the fish diversity of the study area indicated that they faced a very high risk of extinction, but the area inhabited by such species, is the essential conservation part of a ecosystem

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which imparts the survival of threatened species as well. Nowadays Puzhakkalkolewetlands highly faces the habitat modifications and other anthropogenic activities.

The water quality parameters have observed in the three kole wetlands of Puzhakkalis found to be suitable for fish diversity. The temperature of kole wetlands increase with December to April and decreases from June. The pH ofkole wetlands vary slightly and found slight acidic in nature. Dissolved oxygen reduced in the winter due to receding water level with increase in water planktons and weeds of the kole wetlands. High value of dissolved carbon-dioxide was reported in the monsoon due to higher decomposition of organic matter and de-oxigenation. Based on the potential value of collected fishes, 11 species have recorded ascommom "Food fish", 15 species are "Food and ornamental" valued and 5 species include in "Ornamental" valued, remaining 4 species contribute to "Others" category. Also some species were reported with its larvicidalactivity (13 species) together with their potential value. The reoccurrence of the fish by the natural replenishment of stock after two decades epidemic of whose severe victims were the bottom living fish Channids, Heteropneustids and Clarids. Heteropneustesfossilis was also reported as absent in the watershed of the river according to Thomas (2004) but the recent presence of the fish from the various sites supports the proposition.

VI. CONCLUSION

The present short time investigation reveals that kole wetlands of Puzhakkal harbours the 35 species of fishes caught from the three sites is rich and diverse. A vanishing species Clariasmacrocephalus obtained from this study supports the necessity of the conservation of this particular kole wetland ecosystem. Today kole wetlands of Puzhakkal ceases by the civilisation and various modification. Puzhakkal is also famous for urbanisation and development of buildings, malls, etc. This anthrapogenic activitieson kole wetlands of Puzhakkalleads to the massive destruction of the highly productive, diversity rich treasures of Kerala.

VII. ACKNOWLEDGEMENT

The authors are thankful to the Principal and Head Department of Zoology, Vimala College, Thrissur for giving permission to conduct the basic survey work and using the laboratory. Also my sincere thanks to Mr. Ashokankunnathully andDr.Shaji.C.P for giving valuable help during this study.

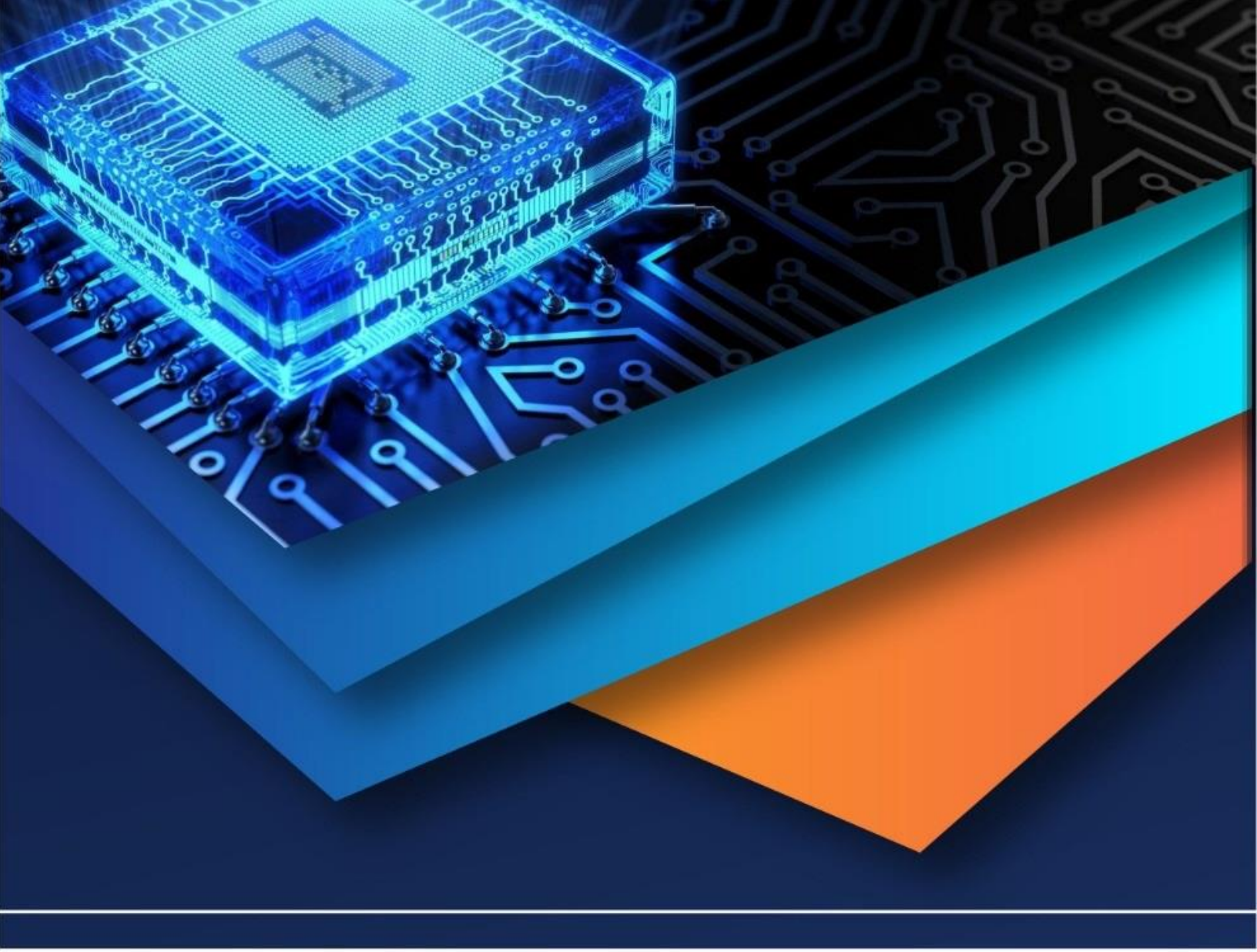
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