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A Study on the Ichthyofauna diversity of Meenachil River, Thazhathangady Region, Kottayam, Kerala

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Abstract

The study was conducted to understand the Ichthyofauna diversity of Meenachil River – Thazhathangady region. The Meenachil river, originating from Western Ghats is a degrading riverine ecosystem in Central Kerala of India, may be the only river in Kerala which is characterized by the presence of human settlement right from the source of the river till it confluences at Vembanad lake, India's second largest wetland ecosystem. Thazhathangady region is a place with a rich indigenous fishery resource with great biodiversity. The present investigation has been conducted to identify the fishes in the Thazhathangady region which is a part of the Meenachil River for a period of 6 months (July 2019 to December 2019) at an interval of 15 days.
A total of 44 freshwater species was found during our survey; out of this 20 species are selected for our study. It includes cultivable fishes and food fishes.

Keywords: Ichthyofauna , Meenachil River, Thazhathangady Region ,Vembanadlake .

1. Introduction

Knowledge of species inhabiting natural freshwater ecosystems is a fundamental requirement for the management of any Riverine ecosystem. Many of the Indian rivers experiencing serious gaps in the biodiversity composition due to the lack of robust documentation efforts as reflected in the minor contributions to the international literature on conservation and freshwater biology. Declines in the biodiversity are far greater in fresh water other than the most affected terrestrial ecosystems. (Sala et al., 2000). Over 10,000 fish species live in fresh water (Lundberg et al., 2000); approximately 40% of global fish biodiversity and one quarter of global vertebrate biodiversity. The unreliability of estimates of species richness in individual rivers make it virtually certain that regional national inventories, museum collections and taxonomic knowledge in many parts of the tropics are inadequate to document extinctions and thus widespread undetected extinctions of inconspicuous species have already taken place (Harrison and Stiassny 2000).

Meenachil River is situated in Kottayam District. This river is formed by the streams from the Western Ghats. Some of the places through which this river flows are Poonjar, Teekoy, Erattupetta, Palai, Ettumanoor and Kottayam. This river which has a length of 78kms ends at the Vembanad Lake in Kumarakom. The water from this river is used for drinking purposes and irrigational uses. Meenachil

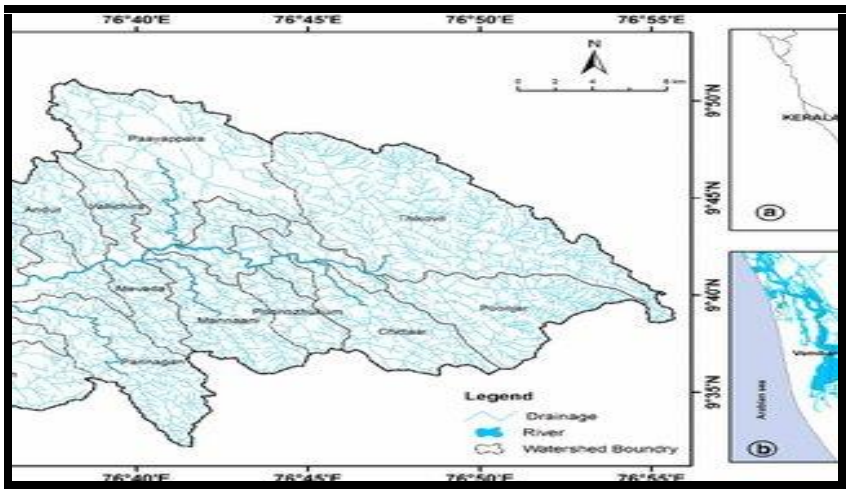
river water enters the Vembanad Lake before reaching the sea and has a major share in shaping the water bodies in and around Kottayam towards western coast and the backwaters. During monsoon the river can be full or flooding the nearby low lying areas on many occasions. People who live near the river and its tributaries indeed are deeply concerned about the decline of the river's water retention capacity due to loss of tree cover, top soil loss and excessive legal and illegal sand mining and also the serious water pollution issues due to garbage disposal to the river all though the banks of the river. There is now acute shortage of water in summer. The mighty rain-fed river turns almost completely dry in summer.

It is clear that Meenachil River end at Vembanad Lake in Kumarakom. Vembanad Lake is a transitional ecotone lying parallel to the Arabian Sea and encompassing mangroves, mudflats, swamps and marshes. As these ecosystems provide a harsh environment, many species of fish have found them to be an ideal place for spawning, development and growth during their early life. Fishes are living components of water bodies and are important food resource and bio indicators of the environmental health and wealth of the waters in which they inhabit. Globally aquatic ecosystems and fish diversity are adversely affected due to increase in unwise anthropogenic activities. Decline in estuarine diversity as a result of overfishing, insufficient management practices and habitat degradation, which reduces the chances of its sustainability. Therefore, knowledge on the status and trends of backwater fisheries is the key to sound policy development, better decision making and responsible fisheries management. A study on the distribution and abundance of fish diversity was lacking in Illikkal region of Meenachil River. Henceforth, in present investigation attempt has been made to identify finfishes.

A survey of fish varieties in Meenachil River conducted by a group of environmental experts indicated a slight decrease in the number of species in comparison to the previous year. The fish count conducted in earlier years had indicated a decline in different kinds of fish in the river. 2017 fish count was the 10th in the series of annual fish counts organized by the ATREE. The fish count conducted 2016 indicated a gradual reduction in species of fish in the lake. It noted a steady decline in carnivorous fishes and an increase in omnivorous fishes.Over exploitation, wrong practices as well as pollution have been cited as the major reasons for the decline in fish population.

Meenachil River, one of the major rivers of Kerala, originates from Araikunnumudi at an elevation of 1097 m. above MSL. Its watershed extend from 90 25’ to 90 55’ N latitudes and 760 20’ to 760 55’ E longitudes (Fig. 1). The river has a length of 78 km. Meenachil River Basin has an area of 1272 km2, falling within 57 panchayats and 3 municipal towns in Kottayam as well as in Vaikom, Kanjirappally, Meenachil and Changanacherry Taluks. The entire river basin falls within the district of Kottayam. The main municipalities such as Kottayam and Pala and Panchayats like Erattupetta, Bharananaganam, Kidangoor, Ayarkunnam, Kumaranallor, Aymanam, Thiruvarppu, Vijayapuram, Ettumannor, Thidanadu, Thalappalam, Meenachil and Mutholy are situated near the bank of the river. The river splits up into numerous inter-connecting water courses and finally joins the Vembanadlake through a series of criss-crossing channels.

Fig.1 Map showing Meenachil river, Kottayam



2. Review of literature

Kerala is a land of rivers which harbour a rich and diversified fish fauna characterized by many rare and endemic species. The Western Ghats are recognized as one of the 21 biodiversity hotspots of the world. Several workers have contributed to the knowledge about the fishes in Kerala. Dr.Francis day has done the pioneering studies about the fresh water fishes of Kerala in 1865; He published “fishes of Malabar”. Sunder lalhora an eminent zoogeographer and ichphyologist made extensive surveys in different parts of India and named many f.ws pecies. Ajith et.al in 2001 studied f.w fish fauna and its distribution in kerala.Kurup B M, Radhakrishnan K V and Manojkumar T G published a study report on status of fishes inhabiting rivers of Kerala with special reference to endemism, threads and conservation measures.

We have et. al (2002) studied the bottom feeder carps and common carps their inter relationship and effect on polyculture. Pawar et.al (2002) studied ecthyo fauna of shiror reservoir And yadav (2004) studied fish diversity in Panch national park. Sarkar and pathak (2006) reported richness of seasonal fish species, diversity and habitat etc. In Ganga river proostiet. Al (2007) gave some new addition to fish fauna to kavala dew national park, a world heritage site in India. Sindey (2009), Biby et.al (2009); Rai (2009) and Jagpath (2009) studied the fish diversity of Ravra river. In India, the workers who made important contribution in the assessment of fish biodiversity in various water bodies like fish fauna of chalakudy River (Raghavan et.al, 2008)

Fish species identification is traditionally based on external morphological features. Yet in some cases morphological features are of limited value for identification and differentiation purposes even with whole specimen because they can show either considerable intraspecific variation or small differences between species. Furthermore; identification of early life stages (eggs and larvae) is even more complicated than adult individuals (Strauss and Bond, 1990). DNA based micro genomic identification methods offer an analytically powerful addition or even an alternative. Among the largest ongoing efforts to catalogue biodiversity are those predicated on DNA bar-coding (Ratnasingham and Hebert, 2007), which relies on sequencing and comparison of a standardized portion of the genome- most often cytochrome c oxidase subunit 1 (COI) region of mtDNA (Hebert et al. 2003a)- for species delineation and identification. Mitochondrial genes such as Cyt b and 16S rRNA are common fish species identification markers that have been widely utilized in sea food control (Quinteiro et al. 1998; Sotelo et al. 2001 Santa Clara, 2006), and species delineation (Kochzius et al., 2003; Lemer et al., 2007).Molecular methods also reveal cryptic species indistinguishable by morphological characters (Semina and Polyakova, 2007). However such a molecular database is totally lacking in Indian rivers. The aim of this project is to increase our understanding of the biodiversity and processes generating it on one hand, and to produce information useful for delimiting management and conservation units, including possible identification of yet unknown (i.e. cryptic) species found in Meenachil river, on the other.

We lack robust data on the population status on the vast majority of rare or economically important fresh water species. For example even landing statistics for wild- caught river fish in Asia are in extremely short supply (FAO, 1999). It follows, therefore that we need additional surveys. There are no published works on the fish diversity of many rivers of Kerala. (Bijukumar et al., 2010) Notable studies on the freshwater fish fauna of Kerala was reviewed by Kurup et al., (2004). They confirmed the presence of 175 freshwater fishes from 41 west flowing and 3 east flowing river systems of Kerala (Kurup et al., 2004). These can be grouped under 106 ornamental and 67 food fishes. The biodiversity status of these fishes was assessed according to IUCN criteria. The results showed that populations of the majority of fish species showed drastic reduction over the past five decades. Thirty-three fish species were found to be endemic to the rivers of Kerala. The distributions of the species were found to vary within and between the river systems and some of the species exhibited a high degree of habitat specificity.

The diversity and abundance of the species generally showed an inverse relationship with altitude. The serious threats faced by the freshwater fishes of Kerala are mostly in the form of human interventions and habitat alterations. Conservation plans have to be immediately implemented for the protection and preservation of the unique and rare fish biodiversity of Kerala. However, new species are still being described from this region (Abraham, 2011; Baby et al. 2011; Plamoottil et al., 2013, 2014a, b). Apart from new descriptions, several taxonomic changes have taken place including both synonymization of species, as

well as resurrection from synonymy (Dahanukar and Raghavan, 2013). A data base on fish biodiversity is essential as a decision making tool for conservation and management of fish germplasm, declaration of part of the rivers as aquatic sanctuaries, protection and preservation of endangered species and mitigation of anthropogenic activities so as to fulfil India's obligations under conventions on biological diversity with special reference to Articles 6 and 8 of UNEP (1992). Even though some notable surveys were conducted on the major rivers of Kerala, like Pamba, Manimala and Achancovil (Thomas and George, 2010), only a very few attempts were made to document the fish diversity of dying rivers like Meenachil, in Kerala, which is in need of immediate restoration measures.

3. Methodology

Fishes were collected using a variety of active and passive gears such as scoop nets, drag nets, cast nets, gill nets and specially designed and fabricated net made of mosquito nets.

The best way to collect fish for scientific study is to catch them alive using fishing nets, traps or other similar devices, except poisoning with toxic chemicals or dynamiting. Gill nets and cast nets are predominantly used. Fish have different ecological preferences and inhabit waters best suited to them. Many environmental factors influence where a certain species will predominate.

The fishes were collected from Kumarakom region of Meenachil River with the help of local fishermen using different types of nets like gill net, cast net; drag net, for a period of five months (September 2019 to January 2020) at an interval of 15 days.

The collected fishes with known identity were released back into the river after counting and photography. The other species were preserved in 10% formalin for further taxonomic studies.

The fishes were caught by cast nets (8 muzham) and gill nets (2-2.5 cm mesh size). Drag nets, sweeping nets, towing nets and bag nets were also employed for suitable places like stagnant water. The cast nets were operated 10 times, covering a distance of about 200m in the sampling area. The number of fish species collected during each sampling was recorded. Before beginning the cast net operations, the gill net was set across the river. Morphological and morphometric identification of fish species were done according to the fish identification manual by Day (1875 – 78; 1889).

The collected fishes were released into the river after counting and photography. Minimum numbers of specimens were retained for the purpose of identification.

4. Observations and Results

Fishes are the keystone species which determine the distribution as well as an abundance of others organisms in the ecosystem they represent and are good indicators of the water quality and health of the ecosystem. Kerala is the land of rivers, harboring a rich and diversified fish fauna with many rare and endemic fish species. World conservation monitoring center has identified Western Ghats as one of the important freshwater biodiversity hotspots. Data base on fish diversity is very essential as a decision making tool. The six months spanned study resulted in the collection of 15 species of fishes under 9 families, 6 orders. The finding on the vast occurrence of exotic and culture species like *Catla catla, Labeo rohita* etc., over the years in a fish diversity hotspot is critical in concern, since the river harbor many endemic and threatened fish species that have small population size and greater chances of getting endangered. An urgent need has therefore arisen to tools in to the possible impacts that the exotic fish species may have on the native fish fauna. Due to the same habitat preference, finally there will be competition for food, place, etc.

The fishes of Meenachil River Thazhathangady Region are subjected to severe overfishing leading to killing of spawned fish population. Over exploitation of fishery resources due to its extraordinary economic value has been a causative factor exacerbating the vulnerability of the population in different ecosystem. Owing to ever increasing demand of fish as food, the aquatic ecosystems are under constant pressure which leads to the depletion fish fauna.

The following is the list of fishes collected from Meenachil River Thazhathangady Region

Table: 1 (Fishes caught during the period 01/06/2019 to 31/12/2019)

Sl.No.	Common name	Scientific name	Family	Average no. of fishes observed
1	Catla	*Catla catla*	Cyprinidae	25
2	Rohu	*Labeo rohita*	Cyprinidae	28
3	Pearl spot	*Etroplus suratensis*	Cichlidae	35
4	Orange chromide	*Etroplus maculatus*	Cichlidae	44
5	Black line rasbora	*Rasbora daniconius*	Cyprinidae	26
6	Helicopter catfish	*Wallago attu*	Siluridae	14
7	Blackspot barb	*Dawkinsia filamentosa*	Cyprinidae	11
8	Needle fish	*Xenentodon cancila*	Belonidae	13
9	Olive barb	*Puntius sarana*	Cyprinidae	16
10	Mahecola barb	*Puntius mahecola*	Cyprinidae	24
11	Malabar labeo	*Labeo dussumieri*	Cyprinidae	35
12	Tilapia	*Oreochromis mossambicus*	Cichlidae	43
13	Stinging catfish	*Heteropneustes fossilis*	Heteropneustidae	25
14	Yellow catfish	*Horabagrus brachysoma*	Bagridae	27
15	Climbing perch	*Anabas testudineus*	Anabantidae	23
16	Snake head	*Channa striatus*	Channidae	21
17	River eel	*Anguilla bengalensis*	Anguillidae	16
18	Cat fish	*Clarias batrachus*	Claridae	17
19	Sucker fish	*Garra mullya*	Cyprinidae	10
20	Dwarf pufferfish	*Carinotetraodon travancoricus*	Tetraodontidae	9

5. Discussion and Conclusion

The fish fauna of Meenachil River is very unique and diverse. Out of the 44 freshwater species identified in our survey; 20 species is used for our study. Fishes are the keystone species which determine the distribution as well as an abundance of other organisms in the ecosystems they represent and are good indicators of the water quality and health of the ecosystem. The capture fisheries in the rivers, lakes, channels, flood plain water bodies, tanks and ponds, were always the rural livelihoods and food security base. Considering the extent to which small indigenous species of freshwater fish play a role in providing nutrition to the rural poor and in maintaining biodiversity, it is important to consider promoting sustainable use of small indigenous species in both capture and culture fishery systems. Though the Indian major carps and other exotic carps would have gone up in production and found its way to distant markets, the indigenous variety remained the income source of traditional fishers in the rural area mainly catering to subsistence, or local markets. It is, however, important to locate these efforts within specific cultural and socioeconomic contexts, looking also at critical issues of ownership and access rights over water bodies, and to formulate relevant strategies, as appropriate. If such factors are taken into consideration, the objectives of nutritional security, promotion of employment and conservation of biodiversity can be better met especially in some of the most disadvantaged areas of rain fed agriculture area, showing poor human development indicators. Studies on fish diversity of Meenachil River, showed abundance of Tilapia and Orange chromide population. The alien invasive species are the major threat to biodiversity conservation and second major cause of extinction of native and endemic species around the world. Non-native fish are introduced around the world mainly for improving fisheries, sport, ornamental fish trade and for bio control of mosquito. Introduced fish frequently alter the aquatic ecology by changing water quality and also cause the extinction of native fish by predation and resource competition. Loss of in stream vegetation, sand and gravel in the river bed not only affect the feeding and hiding grounds of fishes and other freshwater animals but also induce spawning disorders to phytophilic and psammophilic fishes in the aquatic environment. The fishes of Meenachil River are subjected to severe overfishing leading to

killing of spawner fish population. Over exploitation of fishery resources due to its extra ordinary economic value has been a causative factor exacerbating the vulnerability of the population in different ecosystems. Owing to ever increasing demand of fish as food, the aquatic ecosystems are under constant pressure which leads to the depletion fish fauna

The fish fauna of Pampa River is very unique and diverse. Twenty six species of fishes were identified in the exploited fishery of Pamba River The fish fauna of Pampa River is very unique and diverse. Twenty six species of fishes were identified in the exploited fishery of Pamba Ri.

The present study shows that the rivers and streams of Kerala have exceptional fish biodiversity with a high degree of endemism due to the presence of many rare and localized forms. These areas are conspicuous among the biodiversity hotspot of the world and therefore call for protection and preservation as bio reserves long term management plans are needed to conserve and preserve this treasury of fish germplasam. The present study also revealed that the physical habitat variables play a leading role in the distribution of fishes in rivers and the habitat alteration brought about in various rivers contribute significantly to the endangerment of freshwaters in the river of Kerala.

The aquatic biodiversity of the world is getting depleted alarmingly as a result of various factors like habitat loss, pollution, introduction of exotic species, overexploitation and other anthropogenic activities. The diversity of fish in Meenachil River Thazhathangady Region are excellent indicators of water quality. It is very necessary to maintain the diversity of fish and thereby maintaining the biodiversity. Several measures can be taken to preserve our biodiversity, which includes prevention of harvesting during the spawning period, devoid of harvesting juveniles, educate locals about the life cycle of freshwater fish and the negative impacts of pollution with sewage, fertilizers, pesticides and other chemicals as anthropogenic activities have also led to the degradation of Meenachil River at faster pace. Hence conservation and management strategy is needed to conserve this important ecosystem.

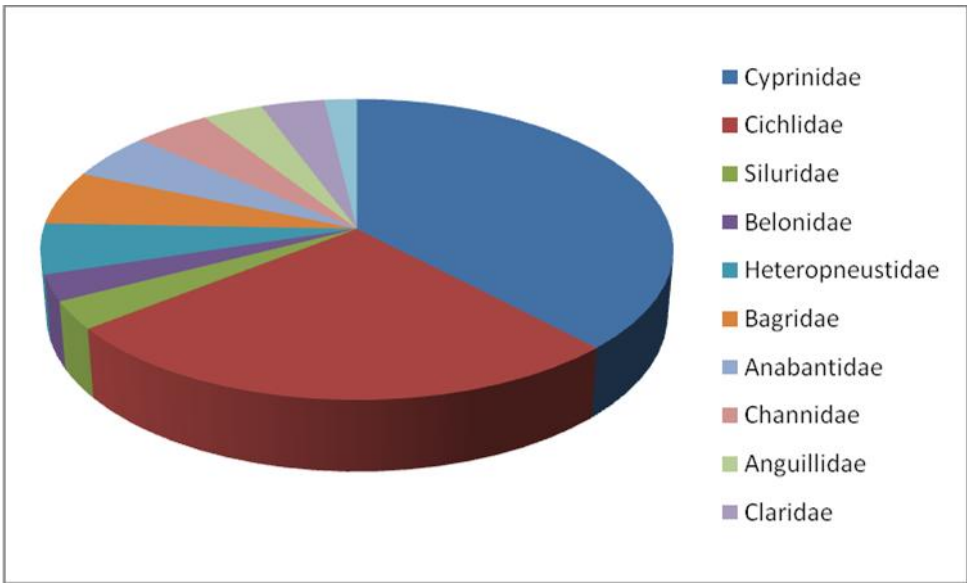
Table: 2. No. of fishes observed family wise.

Sl.No	Fish family	No. of fishes observed
1	Cyprinidae	175
2	Cichlidae	122
3	Siluridae	14
4	Belonidae	13
5	Heteropneustidae	25
6	Bagridae	27
7	Anabantidae	23
8	Channidae	21
9	Anguillidae	16
10	Claridae	17
11	Tetraodontidae	9

Table: 3. Percentage of fishes observed family wise.

Sl. no	Fish family	Percentage of observation (%)
1	Cyprinidae	37.9
2	Cichlidae	26.4
3	Siluridae	3.03
4	Belonidae	2.8
5	Heteropneustidae	5.4
6	Bagridae	5.8
7	Anabantidae	5
8	Channidae	4.5
9	Anguillidae	3.5
10	Claridae	3.7
11	Tetraodontidae	1.9

Pie diagram showing percentage of fishes observed

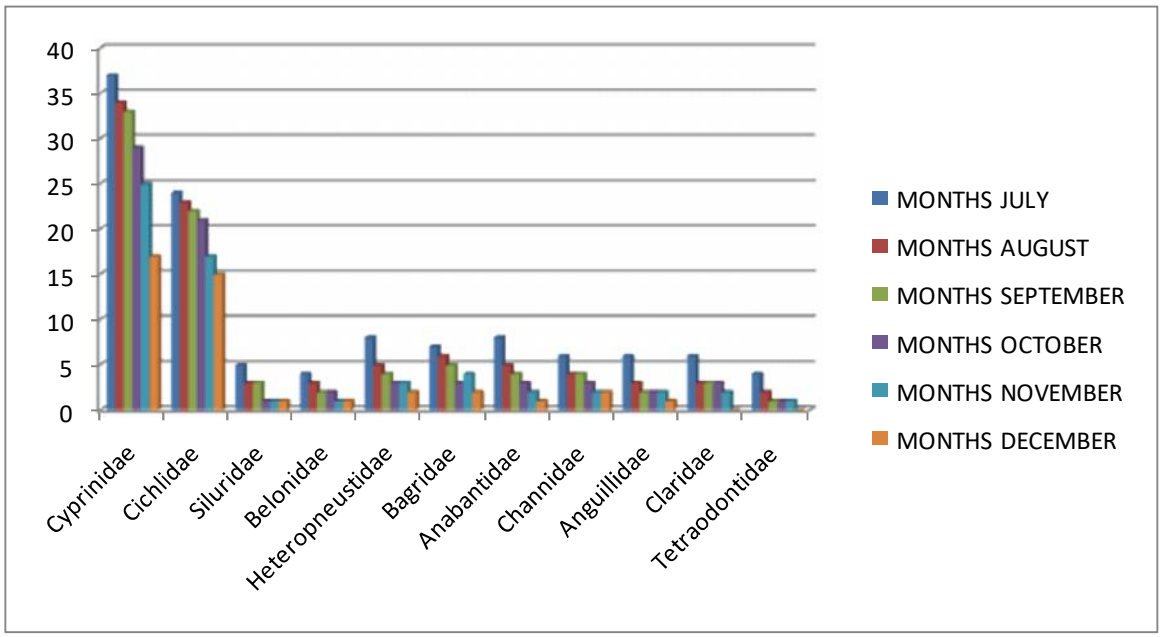


From the pie diagram, it is clear that fishes of the Cyprinidae Family dominates in the Thazhathangady Region of the Meenachil River. Tetraodontidae family contributes least number of fishes which is not shown in the diagram because of the enormous decrease in percentage.

Table No.4. Monthly observation of fishes.

Fish family	Months						Total
	July 2019	August 2019	September 2019	October 2019	November 2019	December 2019	
Cyprinidae	37	34	33	29	25	17	175
Cichlidae	24	23	22	21	17	15	122
Siluridae	5	3	3	1	1	1	14
Belonidae	4	3	2	2	1	1	13
Heteropneustidae	8	5	4	3	3	2	25
Bagridae	7	6	5	3	4	2	27
Anabantidae	8	5	4	3	2	1	23
Channidae	6	4	4	3	2	2	21
Anguillidae	6	3	2	2	2	1	16
Claridae	6	3	3	3	2	0	17
Tetraodontidae	4	2	1	1	1	0	9

Bar diagram showing monthly observation of fishes



From the Bar diagram, it is clear that more number of fishes caught during the month of July. There is a decline in fishes from the month of July onwards. Least number of fishes is collected during December.

Meenachil River is becoming extinct in a slow rate. Present study reveals different aspects of the river basin for conservation and sustainable utilization of the river ecosystem. The solid and liquid wastes from different sources such as the basin townships are polluting the river.

The aquatic biodiversity of the world is getting depleted alarmingly as a result of various factors like habitat loss, pollution, introduction of exotic species, overexploitation and other anthropogenic activities. The loss is severe in freshwater ecosystem and accounts for 0.1% of hydrosphere, but harbour 40% of the fish species so far recorded. Hence a thorough survey of the aquatic ecosystems and a national fish inventory would help to make a database. The diversity of fish in Thazhathangady region of Meenachil River is excellent indicators of water quality. Hence, conservation and management strategy is needed to conserve this important ecosystem.

Further study in this field will be very effective if the different regions of Meenachil river is considered with all monthes of observation . The effect of pollution on the fish biodiversity of this river can also be considered for study.

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