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Diversity and Abundance of Ichthyofaunal Species in Karingali Wetland of Central Kerala, India

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ABSTRACT

Background: Karingali wetland is a collection of wetlands in Alappuzha and Pathanamthitta district. It is one of the major wetland paddy fields of central Travancore and had been considered as the rice bank of Mavelikara kingdom. This wetland has not yet been the subject of study. The present study is an inventorization of fish species in this wetland. This will eventually be utilised as a database.

Methods: The study areas were divided into five sites; fish samples were collected monthly for a period of June 2020 - May 2022. The collected fish samples were stored in 10% formalin solution and identified with the help of standard literature.

Result: During the course of the current study, a total of 35 species from 11 orders were discovered from the Karingali wetland. Cypriniformes, Siluriformes, Perciformes, Anabantiformes, Cichliformes, Beloniformes, Elopiformes, Synbranchiformes, Gobiiformes, Clupeiformes and Mugiliformes were the principal orders. The diversity value ranges high during march and low in July. Even though Karingali wetland are not as much polluted but at the verge of contamination.

Key words: Cypriniformes, Eveness, Fish, Margalf richness index, Shannon-Weiner index, Siluriformes, Simpson's dominance index, Wetland.

INTRODUCTION

Wetlands serves an important role in human survival. They are among the most prolific habitats on Earth; cradles of biological diversity that supply the water and production essential to the survival of innumerable plant and animal species. The Ramsar Convention defines wetlands as areas of marsh, fen, peat land, or water, whether natural or manmade, long-lasting or momentary, with water that is still or flowing, fresh, brackish, or salt, including regions of marine water, whose depth at low tide does not exceed six meters (Ramsar Convention Secretariat, 2013). There are five different types of wetlands: oxbow lakes, freshwater lakes, freshwater ponds, marshes, swamps and bogs and reservoirs (Kar *et al.*, 2007). Of all vertebrates in the world, fish make up nearly half. There are 1,027 different species of freshwater fish in India, including native, alien and secondary species. The wetlands serve as water filters. They convert dissolved nitrogen into nitrogen gas, trap pollutants like heavy metals and phosphorus in their soils and decompose suspended particles to kill hazardous bacteria. For the various advantages, or "ecosystem services," they offer humanity, including freshwater supply, food and building materials, biodiversity, flood control, groundwater recharge and climate change mitigation, they are important. Although the importance of wetlands for the preservation of fish and wildlife has long been understood, other advantages, such as the preservation of biodiversity, the maintenance of water quality, the regulation of water recharge and discharge, *etc*., have only recently come to light.

Freshwater fish are one of the most threatened taxonomic groups because of their high sensitivity to the quantitative and qualitative alteration of aquatic habits. Fishes are very important from the biodiversity point of view living in different ecosystems, habitats and niches of aquatic environment. Over 18,000 different species of fish are thought to exist in freshwater biomes, making them one of the world's most productive and diversified ecosystems (Fricke *et al*., 2020). Fish make up almost half of all vertebrates in the world and are the most prevalent class of vertebrates in terms of quantity and diversity in size, biology, form and habitat. In addition to serving as a vital source of water for drinking, farming, recreation and sewage disposal, wetlands also significantly support a sizable fishery. It not only complements a healthy diet but also provides the local fishing community with a means of subsistence.

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MATERIALS AND METHODS

Description of the study area

'Karingali puncha' is a collection of wetlands of Alappuzha and Pathanamthitta districts (Fig 1). It is one of the major wetland paddy fields of central Travancore and had been considered as the rice bank of Mavelikkara kingdom.

The area falls under 4 panchayaths (Pandalam Thekkekkara, Nooranad, Palamel and Thumpamon) and Pandalam municipality. About 28 cultivating wetlands including Mavara, Karivellooor, Chiramudi, Puthuvakkal, Shasthampadi, Chittilappadam, Ampadakam, Noorukodi and Nedumpadakam, coming under two sections of the total land area: Mavera (near Pandalam) and Karingali (around the Karingali thodu, which is flowing through the centre of the wetland collection). The rivulets and streams of padashekharam are emptying to River Achencovil.

Sample collection and preservation

The study areas were divided into five sites. Nedumpadakam (S1), Chittilappadam (S2), Puthuvakkal (S3), Mavara (S4) and Chiramudi (S5). Nedumpadakam is an area encircled by deep waters. Puthuvakkal is a land covered with various types of vegetation, Chittilappadam and Chiramudi are paddy fields and Mavara is a rocky agricultural area. From June 2020 to May 2022, monthly fish samples were collected with the assistance of local fishermen, samples were collected using a variety of fishing nets, including cast nets, gill nets and traps. Collected samples were preserved in 10% formalin solution. Prior to preservation, photographs were taken. The standard keys from Jhingran and Thalwar (2002); Day (1889); Easa and Shaji (2003) and Jayaram (2012) were used to accomplish the identification. Software from Past 3 and Biodiversity Professional were used to compute the biodiversity indices.

RESULTS AND DISCUSSION

A total of 35 piscine species from 28 genera of 18 families and 11 orders were found in the Karingali wetland over the course of the current study. The prominent orders were Cypriniformes, Siluriformes, Perciformes, Anabantiformes, Cichliformes, Beloniformes, Elopiformes Synbranchiformes, Gobiiformes, Clupeiformes and Mugiliformes (Table 1). Horabagridae, Bagridae, Pangasiidae, Heteropneustidae and Siluridae are the families that belongs to the Order Siluriformes which represent more in number, whereas Channidae, Osphronemidae and Anabantidae are the three families recorded for the Order Anabantiformes. Ambassidae and Nandidae, two families in the Order Perciformes, were reported, with the remaining orders having one family each.

Whereas Elopiformes and Clupeiformes were the least frequently reported, the order Cypriniformes were the most numerous. There are more species in the Cyprinidae family. All five study regions reported identifying Channa striata, Anabas testudineus, Xenentodon cancila, Amblypharyngodon melettinus, Rasbora daniconius, Puntius mahecola, Heteropneustes fossilis and Dawkinsia filamentosa. Nevertheless, Nedumpadakam (site-1) were the only place in which *Channa diplogramme*, *Pangasinodon hypothalamus*, *Megalops cyorinoides* and *Stolephorus indicus* were identified. Among which, *Amblypharyngodon melettinus* and the *Puntius* species, which were found in substantial numbers in this wetland, were much more numerous than *Pangasinodon hypothalamus* and *Channa micropeltes* species.

The only family listed for the order Cypriniformes was Cyprinidae, which has 11 species within 8 genera. The species were *Amblypharyngodon melettinus, Rasbora daniconius, Tor khudree, Puntius euspilurus, Puntius mahecola, Puntius sophore, Dawkinsia filamentosa, Labeo dussumeri, Systomus chryseus, Systomus rufus, Hypselobarbus curmuca.*

During the study period, seven species from genus and five families of the order Siluriformes were reported. *Horabagrus brachysoma, Mystus oculatus, Mystus armatus, Pangasinodon hypothalamus, Heteropneustes fossilis, Wallago attu* and *Ompok malabaricus* are among the species on the list. The least frequently observed species from the Karingali wetland is Pangasinodon hypothalamus, which belongs to this order.

Three species from two genus comprise the Order Perciformes. They were *Parambassis dayi* and *Parambassis thomassi* from Ambassidae family, Nandus from Nandidae, the order Anabantiformes was represented by 5 species that are members of 3 genera and 3 families. *Pseudosphromenus cupanus* from the *Osphronemidae, Channa diplogramme, Channa micropeltes, Channa striata* (Channidae), *Anabas testudineus* (Anabantidae). The only family identified from the order Cichliformes is Cichlidae. The three species were *Etroplus suratensis, Pseudoentroplus maculatus* and *Orechromus niloticus.*

Only one species, *Xenentodon cancila* of the Belonidae family, comprises the Order Beloniformes. Another solitary species was *Megalops cyorinoides* of the Megalopidae family of the order Elopiformes. The other orders that had a single species represented them were (*Macrognathus fasciatus*) Gobiiformes (*Glossogobius giuris*) Clupeiformes (*Stolephorus indicus*) and Mugiliformes (*Mugil cephalus*).

The percentage composition among various orders reveals that the order Cypriniformes were represented by 42%, Siluriformes 15%, Perciformes 5%, Anabantiformes 12%, Cichliformes 12%, Beloniformes 5%, Elopiformes 1% Synbranchiformes 2%, Gobiiformes 2%, Mugiliformes 3% and Clupeiformes 1% (Fig 2).

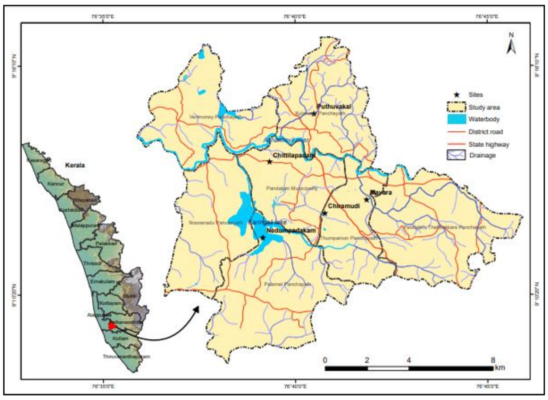

Fig 1: Map showing the Karingali Wetland.

Table 1: List of fish species collected from Karingali wetland during the period of June 2020 to May 2022.

Order	Family	Scientific name	Iucn status
Anabantiformes	Channidae	*Channa diplogramme*	VU
		Channa striata	LC
		Channa micropeltes	LC
	Anabantidae	*Anabas testudineus*	LC
	Osphronemidae	*Pseudosphromenus cupanus*	LC
Beloniformes	Belonidae	*Xenentodon cancila*	LC
Cichliformes	Cichlidae	*Etroplus suratensis*	LC
		Pseudoetroplus maculatus	LC
		Oreochromis niloticus	LC
Clupeiformes	Engraulidae	*Stolephorus indicus*	LC
Cypriniformes	Cyprinidae	*Amblypharyngodon melettinus*	LC
		Rasbora daniconius	LC
		Tor khudree	LC
		Puntius euspilurus	DD
		Puntius mahecola	DD
		Puntius sophore	LC
		Dawkinsia filamentosa	LC
		Labeo dussumeri	LC
		Systomus chryseus	Not evaluated
		Systomus rufus	Not evaluated
		Hypselobarbus curmuca	EN
Elopiformes	Megalopidae	*Megalops cyprinoides*	DD
Gobiiformes	Gobiidae	*Glossogobius giuris*	LC
Mugiliformes	Mugilidae	*Mugil cephalus*	LC
Perciformes	Ambassidae	*Parambassis dayi*	LC
		Parambassis thomassi	LC
	Nandidae	*Nandus nandus*	LC
Siluriformes	Horabagridae	*Horabagrus brachysoma*	VU
	Bagridae	*Mystus oculatus*	LC
		Mystus armatus	LC
	Pangasiidae	*Pangasinodon hypothalamus*	EN
	Heteropneustidae	*Heteropneustes fossilis*	LC
	Siluridae	*Wallago attu*	VU
		Ompok malabaricus	LC
Synbranchiformes	Mastacembelidae	*Macrognathus fasciatus*	Not evaluated

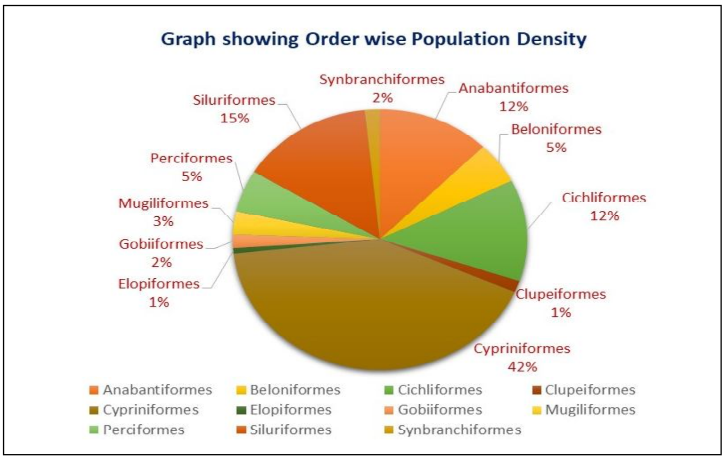

Fig 2: Graph showing order wise population density of fish species.

Fisheries in India have great potential of contributing to the food security of the country. Reservoirs and lakes are the main resources exploited for inland fisheries and understanding of fish faunal diversity is a major aspect for its development and the sustainability management. Fisheries in India have great potential of contributing to the food security of the country. Reservoirs and lakes are the main resources exploited for inland fisheries and understanding of fish faunal diversity is a major aspect for its development and the sustainability management. Fisheries in India have great potential of contributing to the food security of the country. Reservoirs and lakes are the main resources exploited for inland fisheries and understanding of fish faunal diversity is a major aspect for its development and the sustainability management.

In Karingali wetland, cyprinids have been discovered to be dominant. Additionally, Das and Nath (1966); Tilak (1971); Malhotra and Dutta (1975); Dutta and Malhotra (1984); Dutta and Kour (1999); Dutta (2003); Johnson and Arunachalam (2010); Kantaraj *et al*., (2011); Hoque Rabiul (2023) have reported on the dominance of cyprinids. These three Orders Cypriniformes, Siluriformes are the most prevalent groups in the freshwater bodies hence the findings indicated above are typical (Rahman, 2005). Due to their high adaptive behaviour and capacity to inhabit the various habitats that are available to them, cyprinids predominate in all research sites. Nisa *et al*., 2021). The same point of view has been supported by several researchers (Gandotra *et al*., 2015; Wani *et al*., 2015).

Table 2: Shannon-Weiner index of fish species in Karingali wetland.

Months	S1	S2	S3	S4	S5
Jun 20-21	3.024	2.919	2.632	3.111	2.814
Jul 20-21	3.021	2.911	2.632	2.979	2.814
Aug 20-21	3.045	2.909	2.65	3.074	2.818
Sep 20-21	3.03	2.919	2.645	3.103	2.826
Oct 20-21	3.045	3.062	2.691	3.163	2.858
Nov 20-21	3.205	3.034	2.694	3.135	2.863
Dec 20-21	3.158	3.057	2.685	3.119	2.858
Jan 21-22	3.056	2.944	2.776	3.091	2.911
Feb 21-22	3.056	2.966	2.804	3.105	2.926
Mar 21-22	3.212	3.067	2.813	3.177	2.954
Apr 21-22	3.057	3.004	2.813	3.132	2.954
May 21-22	3.053	3.002	2.811	3.126	2.944

The diversity and abundance of the Karingali Wetland were determined using the Shannon-Weiner, Simpson's, Margalf, Richness and Eveness indices. The Simpson's dominance index ranges from 0.04284 to 0.08185 (Table 3). S3 recorded the greatest value and S1 reported the lowest value. The value demonstrates a peak in July and a slow decline in March. Whereas the range of the Shannon-Weiner index value is 2.632 to 3.212 (Table 2). The highest values were from S1 and the lowest values from S3. March marked the Shannon-Weiner index's peak and July its low point. The lower dominance value suggests that individual species are not quantitatively significant. This trait once again supports the findings of (Sharma and Sharma, 2008). Wilhm and Dorris (1968) assert that clean water is specified if the Shannon's index (H') value is greater than three. A score between 1 and 3 indicates generally clean water. Because of anthropogenic activity and the discharge of domestic sewage, the study area were at the verge of pollution. The evenness value ranges from 0.7567 (S4)-0.9818 (S5) (Table 4). Evenness levels peaked in February and declined in July. The Margalaf richness index was peak in S1 at 5.189 and least in S3 at 3.112. (Table 5). March had seen the greatest values, while February had seen the lowest values. In this study, January and February have seen highest number of freshwater fish recorded. Due to the absence of rainfall, the water depth has been lowered to the barest minimum, allowing fisherman to use their fishing gear more efficiently.

Rising water levels during the rainy season in tropical environments with seasonal flood pulses cause fish to travel laterally onto floodplains or longitudinally upstream to spawn and feed. Junk *et al.* (1983) Winemiller and Jepsen (1998). Seasonal rainfall may have had an impact on nutrient inputs, affecting the usage of fish habitat, the availability of food resources and reproductive effort. Archis and Krik (2018) Overfishing, alien species invasion, uncontrolled water pollution from different sources causes and damaging fishing techniques are considered to be

Table 3: Simpson's dominance index of fish species in Karingali wetland.

Months	S1	S2	S3	S4	S5
Jun 20-21	0.05629	0.06244	0.08185	0.05086	0.06752
Jul 20-21	0.05629	0.06325	0.08185	0.06389	0.06773
Aug 20-21	0.05325	0.06323	0.07962	0.05294	0.06717
Sep 20-21	0.0543	0.0622	0.08018	0.0502	0.06596
Oct 20-21	0.04957	0.04943	0.07271	0.04634	0.06147
Nov 20-21	0.04344	0.05058	0.07262	0.04536	0.06114
Dec 20-21	0.04644	0.05007	0.07418	0.04852	0.06156
Jan 21-22	0.05266	0.05496	0.06541	0.04742	0.05623
Feb 21-22	0.04843	0.05297	0.06228	0.04591	0.05457
Mar 21-22	0.04284	0.04893	0.06115	0.04532	0.05429
Apr 21-22	0.04849	0.05151	0.06129	0.04543	0.05429
May 21-22	0.049	0.05169	0.06139	0.04587	0.0553

the main concerns to fisheries management in the fresh water (Dinesh Kumar *et al*., 2020). The loss in fish variety is caused by habitat destruction, fishing pressure and foreign fish invasion (Lakra *et al*., 2008; 2009). In rivers, lakes with river sources and reservoirs, fish populations' abundance varies greatly from year to year and the relative frequency of various species varies in population. Floods and variations in rainfall have an impact on this change. Spawning, growth and survival rates are improved by the expanding area and flood flow time (Hashemi, 2015).

Freshwater fish variety is decreasing as a result of the combined and interrelated effects of overfishing, contamination of aquatic environment, altered flow patterns, habitat degradation and exotic species invasion (Dudgeon, 2006). The increase in polluting inputs, including as industrial effluents, pesticides and fertilisers from aquaculture, agriculture and home sewage, was caused by an expanding population and more intensive land use (Adikari, 2009). The primary cause of freshwater declining water quality is because of entry of industrial effluents and other pollutants through inflowing drains (Rao and Rao, 2000; Rao and Shekar, 2003). It has been proposed that foreign species introduced for various reasons could constitute a hazard to the local fish population. Recreational activities and other anthropogenic activities are frequent in this wetland. These techniques will affect the wetland and leads to habitat destruction of fish species. Previous researches about freshwater habitat concurs the same (Raju and Simachalam, 2014).

According to Nisa (2021), anthropogenic activities like as fishing pressure, pollution and destroying habitat all have a direct correlation to one another. It is critical to emphasize that sites 1 and 4 have the highest level of anthropogenic activity, such as habitat destruction, runoff from agricultural regions, garbage disposal and exploitation. The least diversity index is justified because fish habitat and water quality are being merely destroyed. The less diverse fish fauna in the wetland may be attributed to habitat degradation, over-exploitation, the random destruction of young fish due to unregulated fishing pressures, and other factors. The findings from (Siddiq *et al.,* 2013; Galib *et al.,* 2009 and Chakraborty and Mirza, 2007), which found about the same causes for the loss in fish variety, support the conclusions from the present study.

Table 4: Evenness index of fish species in Karingali wetland.

Months	S1	S2	S3	S4	S5
Jun 20-21	0.8231	0.8419	0.869	0.8636	0.8779
Jul 20-21	0.8231	0.8356	0.869	0.7567	0.8778
Aug 20-21	0.9272	0.8339	0.8846	0.8654	0.8808
Sep 20-21	0.8628	0.8419	0.8804	0.8905	0.8883
Oct 20-21	0.9554	0.9287	0.9216	0.9097	0.9174
Nov 20-21	0.9134	0.9448	0.9243	0.9577	0.9214
Dec 20-21	0.9049	0.9243	0.9162	0.9049	0.9176
Jan 21-22	0.8495	0.9495	0.9448	0.9567	0.9668
Feb 21-22	0.9654	0.9706	0.9715	0.9699	0.9818
Mar 21-22	0.9197	0.9342	0.9801	0.9216	0.9595
Apr 21-22	0.9666	0.96	0.9795	0.9552	0.9595
May 21-22	0.9623	0.9587	0.9783	0.9497	0.9497

Table 5: Margalf index of fish species in Karingali wetland.

Months	S1	S2	S3	S4	S5
Jun 20-21	4.836	4.55	3.443	5.186	4.156
Jul 20-21	4.836	4.531	3.443	4.809	4.169
Aug 20-21	5.045	4.55	3.485	4.996	4.156
Sep 20-21	4.756	4.56	3.474	5.077	4.169
Oct 20-21	4.057	4.662	3.464	5.104	4.132
Nov 20-21	5.169	4.476	3.496	4.51	4.132
Dec 20-21	4.996	4.699	3.567	4.931	4.144
Jan 21-22	4.885	3.753	3.272	4.172	3.607
Feb 21-22	3.817	3.628	3.112	4.093	3.431
Mar 21-22	5.189	4.68	3.267	5.161	3.845
Apr 21-22	4.094	3.981	3.262	4.494	3.845
May 21-22	4.175	4.008	3.366	4.443	3.897

CONCLUSION

The Karingali Wetland is found to support a remarkably rich fish diversity and serves as a possible source of income for the local people. A total of 35 species from 28 genus of 18 families and 11 orders were reported from the Karingali wetland during the study period. The major orders were Cypriniformes, Siluriformes, Perciformes, Anabantiformes, Cichliformes, Beloniformes, Elopiformes Synbranchiformes, Gobiiformes, Clupeiformes and Mugiliformes. The percentage composition among various orders reveals that the order Cypriniformes were represented by 42%, Siluriformes 15%, Perciformes 5%, Anabantiformes 12%, Cichliformes 12%, Beloniformes 5%, Elopiformes 1% Synbranchiformes 2%, Gobiiformes 2%, Mugiliformes 3% and Clupeiformes 1%. The Cyprinidae family represent more number of individual species. The simpson's dominance index goes from 0.017 to 0.069 while the Shannon-Weiner index value spans from 0.985 to 1.428. Even though Karingali wetland are not as much polluted but at the verge of contamination. Because of human activity, agricultural pesticides and fertilisers and in addition, excessive reclamation and contamination from other sources are causing wetlands to lose some of their original qualities. As a result of the loss of biodiversity, there will soon be a shortage of basic foods and water. To effectively safeguard our wetlands and maintain wildlife for future generations, it is crucial to be aware of the situation. The preservation of fish diversity is crucial for preserving the ecological, dietary and economical balance.

Conflict of interest

All authors declared that there is no conflict of interest.

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