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A Detailed Checklist of Freshwater Plankton and Fish Species of Karingali Wetland of Central Kerala, India

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Abstract

The most productive ecosystem is found in wetlands, which also serve as a haven for aquatic life. This study lists the plankton and fish species found in the Karingali wetland, which is located in the districts of Alappuzha and Pathanamthitta in central Kerala, India. The research was carried out between June 2020 and May 2022.The sampling techniques follow the relevant literature. From this wetland, a total of 35 fish species, 22 phytoplankton species, and 25 zooplankton species have been identified. The major groups of Phytoplankton were Chlorophyceae >Bacillariophycea >Cyanophyceae, Zygnematophyceae >Euglenophyceae >Trebouxiophyceae >Xanthophyceae. A percentage analysis of the various zooplankton species reveals that rotifers were the dominating group, accounting for 41% of the zooplankton, followed by 34% of cladocerans, 21% of copepods, and 4% of rhizopoda. By percentage of composition, Cypriniformes accounted for 42%, Siluriformes 15%, Perciformes 5%, Anabantiformes 12%, Cichliformes 12%, Beloniformes 5%, and Elopiformes 1%. Synbranchiformes make up 2%, Gobiiformes 2%, Mugiliformes 3%, and Clupeiformes 1% of all fish species. The wetland is productive according the results.

***Key words*:** Phytoplankton, Zooplankton, Fishes, Wetland, Rotifers, Diatoms, Cyrpiniformes, Chlorophyceae

Wetlands are extremely productive and ecologically varied ecosystems that improve the quality of water, manage erosion, keep streams flowing, store carbon, and are habitat to at least one-third of all species on the brink of extinction. Over time, wetlands have come to be recognized and valued more and more as a result of people's interactions with them and their experiences with them. Wetlands are distinguished by change and variety, whether they are produced naturally or artificially. It is crucial to use a range of dynamic, creative, interactive, and useful ways to fully engage people's senses, comprehension, and adoration of wetlands.

Understanding the diversity of species is crucial for managing and preserving life for future generations as well as for understanding life in its whole [45]. Gopal [24] provided an excellent illustration of the critical need for biodiversity study in poor nations. For the future growth of biodiversity research, systematics and taxonomy are essential [37]. There is a serious threat to global biodiversity's extinction. Aquatic biodiversity is vanishing far more quickly than terrestrial biodiversity. which is most agitated [13]. A highly precise and accurate description of biotic integrity and environmental conditions can be found in the taxonomic arrangement of algae. A water body's taxonomic composition fluctuates both geographically and temporally, and autecological descriptions of environmental circumstances based on taxonomic composition reliably reflect the variations in both physical and chemical properties.

The movement of phytoplankton, which are unicellular, filamentous, and colonial autotrophic forms of aquatic habitat, is somewhat dependent on water currents. They are an essential source of food for other creatures in many aquatic systems and are the dominant producer at the top of the food chain in many aquatic ecosystems. They contribute significantly to maintaining the ecological balance and quality of the aquatic ecosystem in addition to providing food for aquatic animals [6], [46]. The primary means by which fish and phytoplankton exchange energy is through zooplankton [26]. Zooplankton biomass abundance and diversity of species have been used to assess the state of the aquatic environment [20], and they have been regarded as the ecological markers of water bodies [36].

A lot of fish relies on the small organisms known as planktons for food. They are only able to move with the water's incredibly constrained stream [66]. Mainly due to the influence of both extrinsic and intrinsic factors, the ichthyofaunal diversity in the wetlands has been decreasing over the past few years. Both the diversity of the ecosystems and the fish production in the wetlands have been damaged by this. However, these wetlands provide economic benefits to the vast majority of rural residents. The primary source of the life and income of the fishing community is these wetlands. Although several works on plankton and fish have been reported from various parts of Kerala and from India, as per literature reviews. The species checklist provides information about the region's biodiversity. The aim of the current study is to provide a checklist of fishes and plankton found in the Karingali wetlands in central Kerala, India.

MATERIALS AND METHODS

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Study area

Karingali wetland (9°11.9538'N76°38.9334'E) is a group of wetlands in the districts of Alappuzha and Pathanamthitta in Kerala. It was once thought of as the rice bank of the Mavelikkara kingdom and is one of the largest wetland paddy fields in central Travancore, India. The region is governed by Pandalam municipality and 4 panchayaths (Pandalam Thekkekkara, Nooranad, Palamel, and Thumpamon). 28 cultivating wetlands, including Mavara, Karivellooor, Chiramudi, Puthuvakkal, Shasthampadi, Chittilappadam, Ampadakam, Noorukodi, and Nedumpadakam, are located in two different parts of the total land area: Karingali (around the Karingali thodu), which runs through the centre of the wetland collection, and Mavera (near Pandalam). There is a perennial stagnant water source in the northern part of the Padanilam bund of Karingali cultivated land, which serves as a supply of water in the summer and other dry seasons. It is an important location for fishing and breeding in the Karingali wetland system. The river Achencovil receives the rivulets and streams of farming land. It is a part of Shanthi Theeram eco-tourism (Santheeram Village Tourism Centre).

Five sites comprised the study areas. S1 through S5 are Nedumpadakam (9°11.8001'N 76°39.1616'E), Mavara (9°12.7659'N 76°418584'E), Puthuvakkal (9°14.9579'N 76°40.4856'E), Chittilapadam (9°14.9579'N 76°39.3365'E) and Chiramudi (9°12.4065'N 76°7708'E). The region of Nedumpadakam is bounded by deep waters. Mavara is a rocky agricultural region, Chittilappadam and Chiramudi are rice cultivation areas, and Puthuvakkal is a territory covered with many kinds of vegetation.

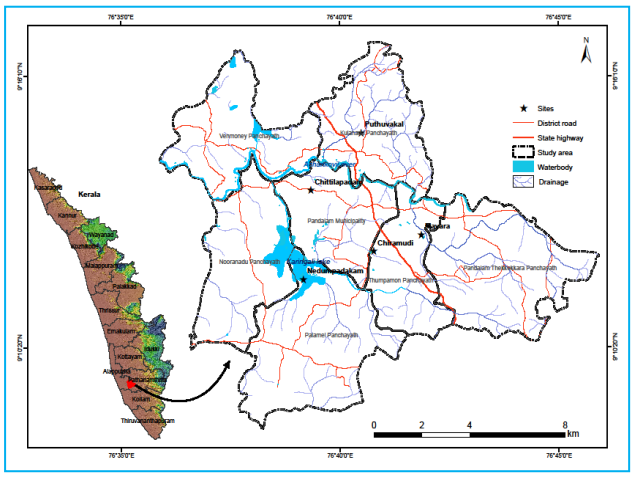

Fig 1 Study area

Sampling procedure

Samples were collected for two years from June 2020 to May 2022. Collection of samples were taken on a regular basis, in every month, from 6:00 am to 9:00 am.

Phytoplankton sampling

A plankton net made of bolting silk (No: 25, Mesh size 40 m) was used to filter 40 L of water, the plankton was collected using the accepted procedures stated in APHA [2]. Phytoplankton was allowed to settle following the sample was concentrated to 100 ml and preserved immediately by adding 2 drops of 4% formalin and lugols iodine. For the analysis of phytoplankton, only 1ml sample was taken in the Sedgwick Rafter counting chamber. The sediment was then meticulously investigated for taxonomic analysis under an optical microscope. Using the standard keys of Desikachary [11], Edmondson [18], Whitford and Schumacher [64], Prescott [50], Palmer [44], and Anand [1], the phytoplankton was systematically identified up to the species level. Following the descriptions of Davis [9], Needham and Needham [40], Prescott [49], Bellinger and Sigee [5], Sharma [55], Seamer [54].

Zooplankton sampling

Zooplankton samples from five sites have been collected using a plankton net of bolting no. 25 with a mesh size 63 connected with a collecting tube at the bottom of the net. The samples collected in the collection tube were moved to a plastic container, and preserved in 4% formalin. Sedge Wick Rafter Plankton counting cells with dimensions of 50 mm x 20 mm x 1 mm were selected to measure zooplankton productivity, and total organisms per litre were used as the unit of measurement. Under a light microscope, the variety of zooplankton was investigated. According to the conventional literature of Needham and Needham [40], Battish [4], Michael and Sharma [38], Sharma and Sharma [56], Yule and Yong [65], Petterson [48] the specimen was identified.

Fish sampling

Using a range of fishing nets, including cast nets, gill nets, and traps, monthly fish samples were taken with the support of local fishermen. The 10% formalin solution were used to preserve the collected samples. Pictures were taken before the preservation. To complete the identification Day (1889), Easa and Shaji (2003), and Jayaram's (1993 and 2013), standard keys were employed.

RESULTS AND DISCUSSION

Phytoplankton

In aquatic habitats, phytoplankton are crucial indicators of the health of the ecosystem and the water quality. Due to their sensitivity to environmental changes, plankton dispersion fluctuates greatly depending on elements such seasonal variations, water quality, and nutrient concentrations [41]. Throughout the study period, sampling stations recorded various phytoplankton species. They are listed as the following; Chlorophyceae, Bacillariophyceae, Cyanophyceae, Zygnematophyceae, Euglenophyceae, Trebouxiophyceae, and Xanthophyceae. The 22 species of phytoplankton that were discovered were divided into 7 classes and 5 categories. The green algae consist of Chlorophyceae, Zygnematophyceae and Trebouxiophyceae. The diatoms include Bacillariophyceae, Cyanophyceae included in blue green algae, Euglenophyceae in euglenoids and Xanthophyceae in yellow- green algae correspondingly.

Within green algae eight species of the Chlorophyceae class reported were *Ankistrodesmus falcatus, Coelastrum microporum, Tetraedron trigonum, Pediastrum boryanum, Scenedesmus quadricauda, Pediastrum duplex, Chlorococcum humicola, Tetraspora lubrica. Chlorella vulgaris* and *Spirogyra varians* belonged to the Zygnematophyceae class, while *Closterium setacium* belonged to the Trebouxiophyceae class. The majority of the plankton population (50%) was made up of green algae, with Chlorophyceae representing 36%, Zygnematophyceae for 9%, and Trebouxiophyceae for 4%. *Asterionella formosa, Navicula tripunctata, Amphora ovalis, Nitzschia Vitara* and *Melosira granulate* are only a few of the five species that make up the class Bacillariophyceae (Diatoms), which was the second dominating group in the population with 23% of the overall population.

Three species, *Oscillatoria subbrevis, Lyngbya sp.*, and *Spirulina platensis*, are included in the Cyanophyceae family (Blue green algae), which makes up 14% of the total populace.

The members of the Euglenophyceae which were identified were *Euglena viridis* and *Phacus longicauda*, and they only constituted 9% of the population as a whole. With 4% of the total population, Xanthophyceae in the yellow-green algae group was the least reported class. *Tribonema sp*. was the sole species recognized.

The order of the classes in percentage were Chlorophyceae > Bacillariophycea > Cyanophyceae, Zygnematophyceae >Euglenophyceae >Trebouxiophyceae > Xanthophyceae. Similar outcomes were noted with the Chlorophyceae dominating after the Bacillariophycea and the Cyanophyceae [12], [22], [27], [34-35] [53], [61].

Table 1 List of phytoplankton collected from Karingali wetland during the year June 2020 - May 2022

Group	Phytoplankton class	Genus and species
Green algae	Chlorophyceae	*Ankistrodesmus falcatus*
		Coelastrum microporum
		Tetraedron trigonum
		Pediastrum boryanum
		Scenedesmus quadricauda
		Pediastrum duplex
		Chlorococcum humicola
		Tetraspora lubrica
	Trebouxiophyceae	*Chlorella vulgaris*
	Zygnematophyceae	*Closterium setacium*
		Spirogyra varians
Diatoms	Bacillariophyceae	*Asterionella Formosa*
		Navicula tripunctata
		Amphora ovalis
		Nitzschia Vitara
		Melosira granulate
Blue green algae	Cyanophyceae	*Oscillatoria subbrevis*
		Lyngbya sp
		Spirulina platensis
Euglenoids	Euglenophyceae	*Euglena viridis*
		Phacus longicauda
Yellow-green algae	Xanthophyceae	*Tribonema sp*

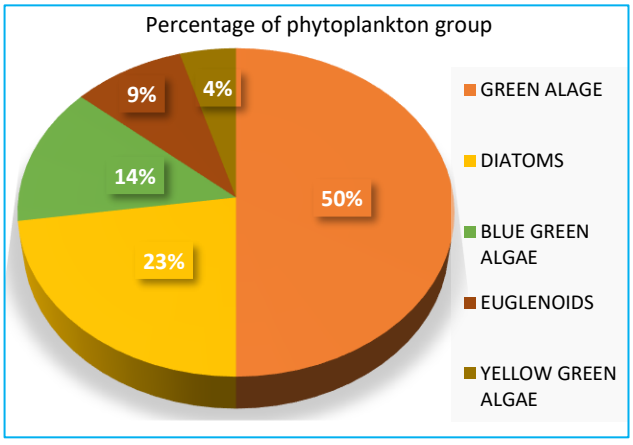

Fig 2 Graph showing the percentage of phytoplankton groups

Zooplankton

A total of 25 species of zooplankton were detected from the Karingali wetland during this particular research. The main zooplankton groups discovered in this study include Rhizopoda, Rotifera, Cladocera, and Copepoda. There are 10 species of Rotifers, of which Cladocera makes up eight, Copepoda four, and Rhizopoda three. Three species of rhizopods were discovered in the current investigation. *Euglypha tuberculate*, *Centropyxis aculeate*, and *Centropyxis ecornis*. Rhizopods made up 4% of the entire zooplankton population, according to a comparison of the different zooplankton species.

Ten species from six families comprised Rotifera's representation. *Brachionus angularis, Brachionus calyciflorus, Brachionus caudatus, Keratella tropica, Lecane luna, Lecane bulla, lecane lunaris, Asplanchna priodonta, Filinia terminalis* and *Testudinella patina* were the species. In the current study, rotifers, which made up 41% of the zooplankton community, were the most prevalent kind of zooplankton. Numerous researchers have also claimed that rotifers are the major zooplankton group in freshwater systems, according to the literature [3], [19], [23], [28], [43], [57-58].

Eight species, *Bosmina longirostris, Bosmina fatalis, Ceriodaphnia cornuta, Daphnia carinata, Diaphanosoma excisum, Moina micrura, Chydorus ventricosis, Alonella dentifers* representing five families, comprised Cladocera. From a sustainability perspective, cladocerans are regarded as a significant part of zooplankton, according to Basawarajeshwari Indur *et al*. [3] Along with being a key food source for many of the cultivated fish, both juveniles and adults, they were also said to occupy a prime position in pisciculture since they reach their maximum population in a short amount of time [30], [62].

Table 2 List of zooplankton collected from Karingali wetland during the year June 2020 - May 2022

	Family	Species
Rhizopoda	Centropyxidae	*Centropyxis aculeate*
	Euglyphidae	*Centropyxis ecornis*
		Euglypha tuberculate
Rotifer	Brachionidae	*Brachionus angularis*
		Brachionus calyciflorus
		Brachionus caudatus
		Keratella tropica
	Lecanidae	*Lecane luna*
		Lecane bulla
		Lecane lunaris
	Asplanchnidae	*Asplanchna priodonta*
	Filinidae	*Filinia terminalis*
	Testudinellidae	*Testudinella patina*
Cladocera	Bosminidae	*Bosmina longirostris*
		Bosmina fatalis
	Daphnidae	*Ceriodaphnia cornuta*
		Daphnia carinata
	Sididae	*Diaphanosoma excisum*
	Moinidae	*Moina micrura*
	Chydoridae	*Chydorus ventricosis*
		Alonella dentifers
Copepoda	Cyclopidae	*Mesocyclops hyalinus*
	Diaptomidae	*Gigantodiaptomus angularis*
		Diaptomus dorsalis
	Pseudodiaptomus	*Nauplis*

Four species *Mesocyclops hyalinus, Gigantodiaptomus angularis, Diaptomus dorsalis* and *Nauplis* from three families Copepoda were found. Copepods made up the third-largest category, making up 21% of the entire population. The distribution of copepods, according to Pennak [47], seems to be hardly affected by environmental factors. According to Juday [25], [32], [52] and other authors, copepods are regarded as a significant source of food for a variety of fish species. They also play a significant role in the transformation of energy at various trophic levels. Furthermore, Basawarajeshwari Indur *et al*. [3] hypothesized that the presence of a high concentration of organic matter is supported by the low density and diversity of

copepods. Thus, by comparing the percentages of the different zooplankton species reveals that rotifers made up 41% of the zooplankton, followed by cladocerans (34%), copepods (21%), and rhizopods (4%).

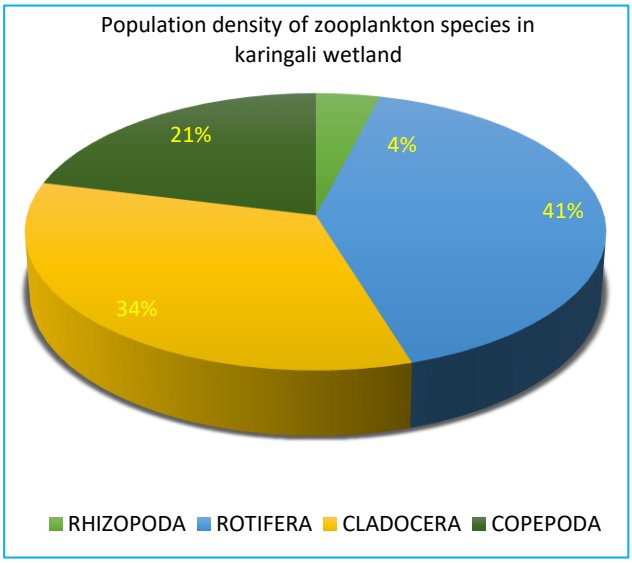

Fig 3 Graph showing population density of zooplankton species in Karingali wetland

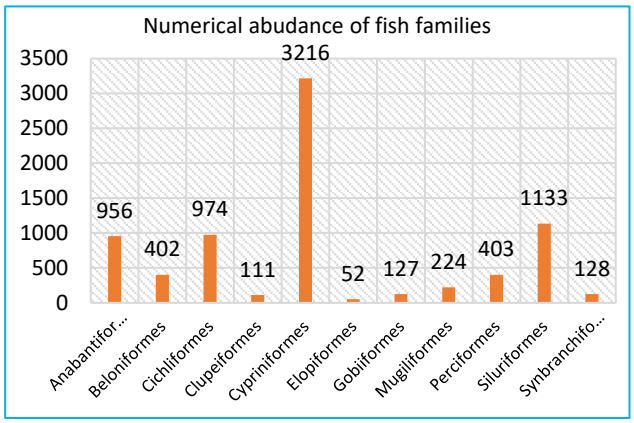

Fig 4 Graph showing the numerical abundance of fish families in Karingali wetland

Fishes

Throughout the course of the current investigation, a total of 35 fish species from 11 orders were discovered in the Karingali wetland. Cypriniformes, Siluriformes, Perciformes, Anabantiformes, Cichliformes, Beloniformes, Elopiformes, Synbranchiformes, Gobiiformes, Clupeiformes, and Mugiliformes were among the notable orders. The families that make up the Order Siluriformes are Horabagridae, Bagridae, Pangasiidae, Heteropneustidae, and Siluridae; in contrast, the Order Anabantiformes is represented by three families: Channidae, Osphronemidae, and Anabantidae. There were reported to be two families in the Order Perciformes, the Ambassidae and Nandidae. The remaining orders each having one family; Beloniformes (Belonidae), Cichliformes (Cichlidae) Clupeiformes (Engraulidae), Cypriniformes (Cyprinidae), Elopiformes (Megalopidae), Gobiiformes (Gobiidae) and Mugiliformes (Mugilidae).

IUCN listed *Pangasinodon hypothalamus* (Pangasiidae) and *Hypselobarbus curmuca* (Cyprinidae) from Cyprini form as endangered (EN), while *Horabagrus brachysoma* (Horabagridae) *Wallago attu* (Siluidae) and Channa diplogramme (Channidae) from Anabantiformes were vulnerable (UV). The remaining species were classified as Least Concerned (LC), Data Deficient (DD), and Not Evaluated (NE). The Cypriniformes were more in number and forms the major group. The order Cypriniformes was represented by 42%, Siluriformes 15%, Perciformes 5%, Anabantiformes 12%, Cichliformes 12%, Beloniformes 5%, and Elopiformes 1% by percentage composition. Synbranchiformes account for 2%, Gobiiformes account for 2%, Mugiliformes account for 3%, and Clupeiformes account for 1%. The dominance of cyprinids has also been discussed by Das and Nath [8], [13-15], [31], [59-60]. This trio of orders, the findings mentioned above are typical because Cypriniformes and Siluriformes are the most common taxa in freshwater bodies [51]. Cyprinids predominate in all research sites because of their high level of adaptive behaviour and ability to live in the varied habitats that are available to them. Nisa and others, [42] Several researchers [21], [63] have backed the same point of view.

Table 3 List of fish species collected from Karingali wetland during the year June 2020 - May 2022

Order	Family	Species
Anabantiformes	Channidae	*Channa diplogramma*
		Channa striata
		Channa micropeltes
	Anabantidae	*Anabas testudineus*
	Osphronemidae	*Pseudosphromenus cupanus*
Beloniformes	Belonidae	*Xenentodon cancila*
Cichliformes	Cichlidae	*Etroplus suratensis*
		Pseudoentroplus maculatus
		Oreochromus niloticus
Clupeiformes	Engraulidae	*Stolephorus indicus*
Cypriniformes	Cyprinidae	*Amblypharyngodon melettinus*
		Rasbora daniconius
		Tor khudree
		Puntius euspilurus
		Puntius mahecola
		Puntius sophore
		Dawkinsia filamentosa
		Labeo dussumeri
		Systomus chryseus
		Systomus rufus
		Hypselobarbus curmuca
Elopiformes	Megalopidae	*Megalops cyorinoides*
Gobiiformes	Gobiidae	*Glossogobius giuris*
Mugiliformes	Mugilidae	*Mugil cephalus*
Perciformes	Ambassidae	*Parambassis dayi*
		Parambassis thomassi
	Nandidae	*Nandus nandus*
Siluriformes	Horabagridae	*Horabagrus brachysoma*
	Bagridae	*Mystus oculatus*
		Mystus armatus
	Pangasiidae	*Pangasinodon hypothalamus*
	Heteropneustidae	*Heteropneustes fossilis*
	Siluridae	*Wallago attu*
		Ompok malabaricus
Synbranchiformes	Mastacembelidae	*Macrognathus fasciatus*

Table 4 The number of fishes collected from each order

Order	Number of fishes
Anabantiformes	956
Beloniformes	402
Cichliformes	974
Clupeiformes	111
Cypriniformes	3216
Elopiformes	52
Gobiiformes	127
Mugiliformes	224
Perciformes	403
Siluriformes	1133
Synbranchiformes	128

CONCLUSION

The current study reveals the plankton and fish variety of the Karingali wetland in the districts of Alappuzha and Pathanamthitta in Kerala. The current investigation discovered 22 species of phytoplankton, 25 species of zooplankton, and 35 species of fish. Plankton have the ability to serve as biological indicators of pollution and fishing offers economic benefits. This location provides both visual and economic benefits to the natives of this wetland, the majority of the people in the surrounding area rely on fishing for a living. As a result, it is possible to conclude that the Karingali wetland is a productive ecosystem with various phytoplankton groups, which would aid in raising fish production by increasing zooplankton mass. Considering the importance of the study, steps should be taken to maintain and conserve the freshwater wetland.

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