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Original Article

Diversity, distribution and conservation significance of freshwater fishes in the Veeyapuram stretch of the Pamba River of Kuttanad, Kerala, India

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Abstract
The present study investigated the species composition, distribution patterns, and conservation significance of freshwater fishes in the Veeyapuram stretch of the Pamba River, a major river system within the Kuttanad wetland of Kerala, India, focusing on a previously unstudied river segment. Fish sampling conducted between June and December 2025 yielded 7909 specimens comprising 33 species belonging to 13 orders and 17 families. The assemblage was dominated by Cypriniformes (47.40%), followed by Anabantiformes (20.63%), while Perciformes (12.27%) and Cichliformes (12.24%) also contributed substantially to the total abundance. Several species such as *Channa striata*, *Pseudetroplus maculatus*, and *Puntius sophore* were numerically dominant, whereas a few species were represented by low abundance, indicating heterogeneity in species distribution within the study area. The occurrence of ecologically and economically important species, along with species of conservation concern such as *Wallago attu* and *Horabagrus brachysoma*, indicates the ecological importance of the study area. In addition, the documentation of species not explicitly reported in earlier regional studies suggests spatial variation in species composition within the Pamba River system. The findings provide baseline information on fish diversity in this river segment and underscore the need for habitat conservation, regulated fishing practices, and long-term monitoring to ensure the sustainability of fish populations.

Keywords: conservation ecology; Cypriniformes; ichthyofauna; Pamba River system; species diversity; tropical river ecosystem

1 | INTRODUCTION

Kuttanad, situated in the coastal lowlands of Kerala, India, represents a distinctive geomorphological setting and forms an important component of the Vembanad–Kol Ramsar wetland system of international ecological significance. The region is characterised by its unique below sea-level agricultural system, where paddy cultivation is practised in extensive areas lying below mean sea level (approximately 900 km²), making it one of the few such regions in the world (George and Mathew 2022; Sudhesh *et al.* 2025).

The region comprises an intricate mosaic of wetlands, garden lands, and aquatic systems, including lakes and backwaters, extending across the districts of Alappu-

zha, Kottayam, and Pathanamthitta, and constituting a key component of the Vembanad wetland system (Sreejith 2013; Rao and Balasubramanian 2018; Ranjith Kumar *et al.* 2020). The hydrological regime is primarily regulated by four major river systems— Pamba, Achankovil, Manimala, and Meenachil—which play a crucial role in shaping nutrient dynamics and ecological functioning of the wetland complex (George *et al.* 2016).

The Pamba River is one of the major river systems associated with the Kuttanad wetland, forming an extensive fluvial network that supports diverse ichthyofaunal communities. Previous investigations have documented considerable fish diversity in the river system, highlighting its ecological significance within the region (Renjithkumar *et al.* 2011). However, existing studies have primarily focused on major landing centres or broader regional scales, with limited emphasis on fine-scale spatial variation within specific river stretches (George and Mathew 2022). Such large-scale assessments may overlook localised variations in species composition that arise due to habitat heterogeneity, hydrological fluctuations, and local environmental variations (Vijayasree and Radhakrishnan 2014).

In particular, no detailed, site-specific investigation has been conducted for the Veeyapuram stretch of the Pamba River, despite its ecological connectivity within the Kuttanad wetland system. Addressing this gap is important for understanding local biodiversity patterns and identifying conservation priorities at a microhabitat level. Therefore, the present study aims to provide a systematic assessment of fish species composition and distribution patterns in the Veeyapuram stretch of the Pamba River. The study provides baseline data for site-specific ecological assessment and contributes to future monitoring and management of freshwater fish diversity in the region.

2 | METHODOLOGY

2.1 Study area

The present study was conducted in the Veeyapuram stretch of the Pamba River, located within the Kuttanad wetland system of Kerala, India (9°19′35.5″N 76°27′40.4″E). The study area (Figure 1) is characterised by interconnected river channels, marginal vegetation, and seasonal floodplain habitats that support diverse fish assemblages.

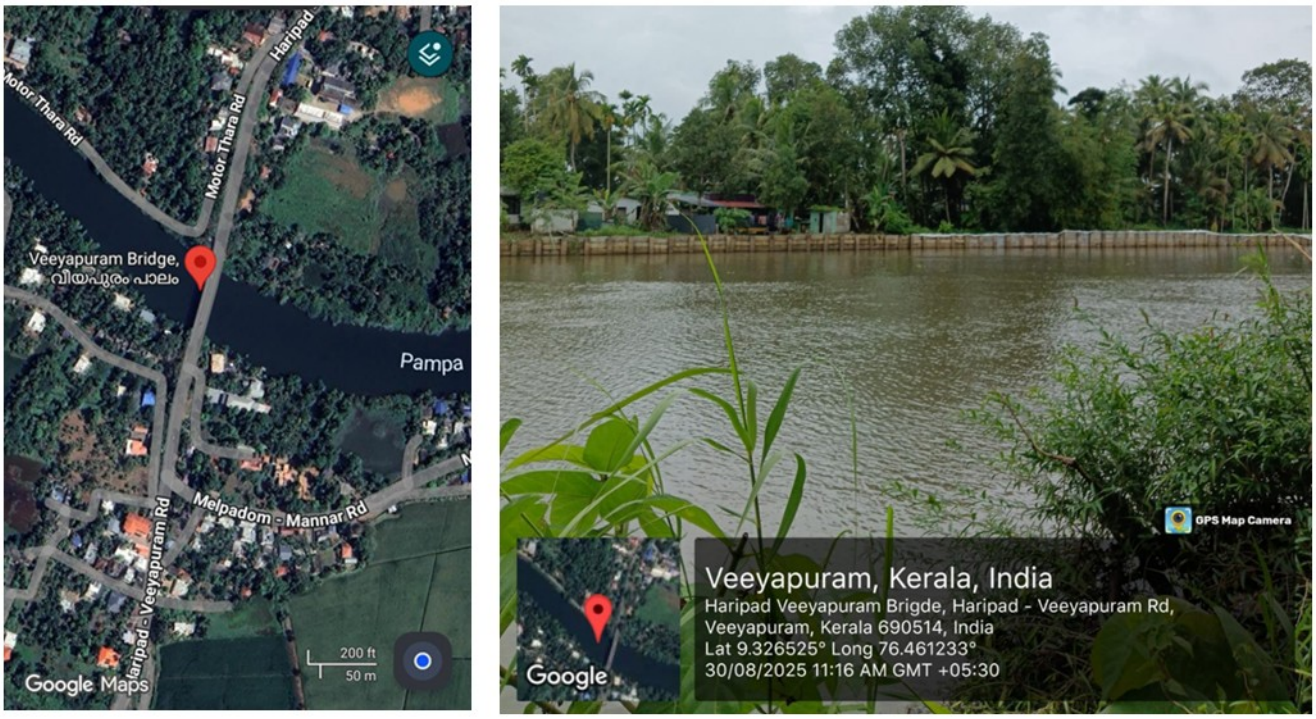


FIGURE 1 Site map of the study area: Veeyapuram region within the Pamba River, located in Alappuzha District, Kerala, India.

2.2 Fish sampling and collection

Fish sampling was carried out from June to December 2025 at regular intervals, three times per month, ensuring temporal coverage across the study period. Sampling was undertaken across representative microhabitats, including open channels, vegetated margins, and shallow floodplain areas, to capture spatial variation in fish distribution.

Fish specimens were collected with the assistance of local fishermen using traditional fishing gears, primarily cast nets, supplemented by gill nets and traps (Kechu and Pankaj 2025). The mesh size of the nets ranged approxi-

mately from 6 mm to 25 mm, enabling the capture of both small- and medium-sized fish species. Efforts were made to maintain consistency in sampling locations and duration across sampling events to minimise sampling bias.

2.3 Identification of fish species

Fish specimens were identified based on external morphological characteristics, meristic counts, and diagnostic features using standard taxonomic keys and reference literature (Das *et al.* 2010; Froese and Pauly 2025). Key identification criteria included body shape, fin configuration, scale pattern, and coloration (Bijukumar *et al.* 2013; George *et al.* 2025). Conservation status of each species is based on IUCN Red List database (IUCN 2026).

2.4 Data analysis

Species composition and abundance were analysed based on the total number of individuals recorded for each species during the study period. The relative abundance of different taxonomic groups was calculated to determine order-wise distribution patterns.

3 | RESULTS

3.1 Species composition and abundance

A total of 7909 individual fish specimens representing 33 species were recorded from the Veeyapuram stretch of the Pamba River during the study period from June to December 2025. These species belonged to 13 orders and 17 families, indicating a diverse ichthyofaunal composition in the study area. The taxonomic composition, conservation status, and abundance of the recorded species are presented in Table 1 and illustrated in Figure 2.

Among the recorded species, *Channa striata* (1019 individuals), *Pseudetroplus maculatus* (970 individuals), *Puntius sophore* (907 individuals), and *Systomus sarana* (812 individuals) were the most abundant. In contrast, species such as *Pristolepis rubripinnis*, *Parambassis thomassi*, and *Labeo catla* were represented by very low numbers (Table 1). The assemblage comprised both highly abundant and less frequently occurring species, reflecting variation in species distribution within the study area.

3.2 Order-wise composition

The order-wise distribution of fish fauna is presented in Figure 3. Cypriniformes constituted the dominant order, accounting for 47.40% of the total individuals, followed by Anabantiformes (20.63%). Perciformes (12.27%) and Cichliformes (12.24%) also contributed substantially to the total assemblage. The remaining orders, including Siluriformes (2.97%), Mugiliformes (2.23%), and other minor groups, contributed comparatively lower proportions.

3.3 Conservation status of recorded species

The conservation status of the recorded species, based on IUCN categories, is presented in Table 1. The majority of the species recorded in the present study belonged to the Least Concern (LC) category. However, a few species of conservation concern were also observed, including *Wallago attu* and *Horabagrus brachysoma* (Vulnerable), as well as *Pristolepis rubripinnis* (Near Threatened). In addition, *Megalops cyprinoides* was recorded under the Data Deficient (DD) category, while *Puntius nelsoni* was classified as Not Evaluated (NE).

4 | DISCUSSION

The present study provides a site-specific account of fish diversity from the Veeyapuram stretch of the Pamba River, a region for which no prior detailed documentation is available. The identification of 33 species highlights the ecological relevance of this river segment within the Kuttanad wetland system.

Previous investigations conducted in the Pamba River and Kuttanad region have reported higher species richness, with 60 species documented by Renjithkumar *et al.* (2011) and 62 species recorded by Vijayasree and Radhakrishnan (2014). The comparatively lower number of species observed in the present study may be attributed to differences in spatial scale, sampling coverage, and habitat specificity, as the current investigation was confined to a single river stretch rather than multiple sampling locations.

The dominance of Cypriniformes observed in the present study is consistent with earlier reports from tropical freshwater ecosystems, where cyprinid fishes constitute a major component of the ichthyofauna due to their ecological adaptability and broad feeding strategies (Vijayasree and Radhakrishnan 2014; Temesgen *et al.* 2021; Wanjari *et al.* 2025). The substantial representation of Anabantiformes, Perciformes, and Cichliformes further reflects the availability of diverse habitat conditions, including vegetated margins and slow-flowing sections, which are known to support species with varied ecological preferences (Sun *et al.* 2020; Sharker *et al.* 2024).

The occurrence of both highly abundant and less frequently encountered species indicates heterogeneity in species distribution within the study area. Such variation may be influenced by microhabitat differences, resource availability, and species-specific ecological requirements (Kanoujiya *et al.* 2023; Hossain *et al.* 2025).

The presence of ecologically and economically important species such as *Etroplus suratensis*, *Labeo dussumieri*, and *C. striata* underscores the fisheries importance of the Veeyapuram stretch. Additionally, the occurrence of species of conservation concern, including *W. attu* and *H. brachysoma*, highlights the ecological sensitivity of the system. These species are typically associated with specific habitat requirements, and their presence may indicate the persistence of suitable environmental conditions within the study area.

TABLE 1 Fish samples recorded from the Veeyapuram stretch of the Pamba River during June to December 2025.

Order	Family	Fish species	Conservation status*	Individuals (*n*)
Acanthuriformes	Lutjanidae	*Lutjanus argentimaculatus*	LC	7
Anabantiformes	Channidae	*Channa striata*	LC	1019
	Pristolepididae	*Pristolepis marginata*	LC	268
		Pristolepis rubripinnis	NT	3
	Nandidae	*Nandus nandus*	LC	55
	Anabantidae	*Anabas testudineus*	LC	287
Beloniformes	Hemiramphidae	*Hyporhamphus sajori*	LC	30
	Belonidae	*Xenentodon cancila*	LC	10
Carangiformes	Carangidae	*Caranx papuensis*	LC	20
Cichliformes	Cichlidae	*Etroplus suratensis*	LC	360
		Oreochromis mossambicus	VU	608
Clupeiformes	Engraulidae	*Stolephorus indicus*	LC	60
Cypriniformes	Cyprinidae	*Puntius sophore*	LC	907
		Puntius nelsoni	NE	640
		Labeo bata	LC	52
		Dawkinsia filamentosa	LC	54
		Labeo catla	LC	22
		Systomus sarana	LC	812
		Labeo dussumieri	LC	580
		Labeo rohita	LC	50
	Danionidae	*Amblypharyngodon melettinus*	LC	618
		Amblypharyngodon mola	LC	12
Elopiformes	Megalopidae	*Megalops cyprinoides*	DD	14
Gobiiformes	Gobiidae	*Glossogobius giuris*	LC	25
Mugiliformes	Ambassidae	*Ambassis nalua*	LC	171
		Parambassis thomassi	LC	5
Perciformes	Cichlidae	*Pseudetroplus maculatus*	LC	970
Siluriformes	Bagridae	*Mystus cavasius*	LC	22
	Heteropneustidae	*Heteropneustes fossilis*	LC	45
	Siluridae	*Wallago attu*	VU	42
	Horabagridae	*Horabagrus brachysoma*	VU	106
	Pangasiidae	*Pangasianodon hypophthalmus*	LC	20
Synbranchiformes	Mastacembelidae	*Macrognathus aculeatus*	LC	15

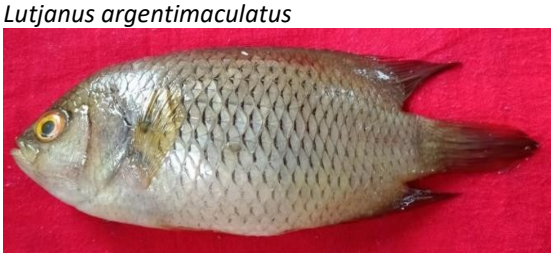
*Based on IUCN (2026): LC, Least Concern; NT, Near Threatened; VU, Vulnerable; NE, Not Evaluated; DD, Data Deficient.

The documentation of species such as *Puntius nelsoni*, *Systomus sarana*, *Amblypharyngodon mola*, *Pseudetroplus maculatus*, *Oreochromis mossambicus*, *Caranx papuensis*, *Stolephorus indicus*, *Lutjanus argentimaculatus*, and *Megalops cyprinoides*, which were not explicitly reported in earlier regional studies, suggests spatial variation in species composition within the Pamba River system. However, this observation should be interpreted with caution, as differences in sampling design, temporal coverage, and taxonomic resolution may also contribute to such variations. The differences observed between the present study and previous reports emphasise the importance of site-specific assessments in understanding freshwater biodiversity. Large-scale surveys may not adequately capture localised patterns, particularly in dynamic wetland systems such as Kuttanad, where hydrological fluctuations and habitat heterogeneity play a significant role in structuring fish communities.

Anthropogenic influences such as habitat modification, fishing pressure, and changes in water quality are known to affect fish assemblages in wetland ecosystems (Galib *et al.* 2018; Tesfay *et al.* 2024). Therefore, further investigations incorporating environmental parameters and long-term monitoring are necessary to evaluate such impacts.

Overall, the findings of the present study highlight the ecological importance of the Veeyapuram stretch of the Pamba River and reinforce the need for continued monitoring and conservation-focused management.


Lutjanus argentimaculatus


Pristolepis marginata


Anabas testudineus


Hyporhamphus sajori


Caranx papuensis


Oreochromis mossambicus


Puntius sophore


Channa striata


Nandus nandus


Pristolepis rubripinnis


Xenentodon cancila


Etroplus suratensis


Stolephorus indicus


Puntius nelsoni

FIGURE 2 (a) Fish samples recorded from the Veeyapuram stretch of the Pamba River.

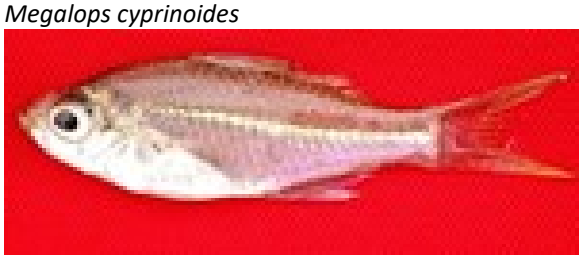

Labeo bata


Systomus sarana


Labeo rohita


Dawkinsia filamentosa


Megalops cyprinoides


Ambassis nalua


Pseudetroplus maculatus


Amblypharyngodon mola


Labeo dussumieri


Amblypharyngodon melettinus


Catla catla


Glossogobius giuris


Parambassis thomassi


Mystus cavasius

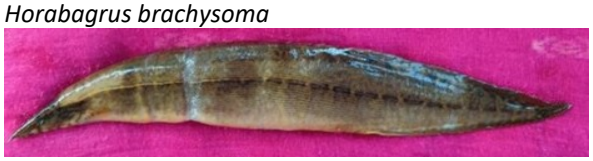
FIGURE 2 (b) Fish samples recorded from the Veeyapuram stretch of the Pamba River.

Heteropneustes fossilis

Wallago attu

Horabagrus brachysoma

Pangasianodon hypophthalmus



Macrognathus aculeatus

FIGURE 2 (c) Fish samples recorded from the Veeyapuram stretch of the Pamba River.

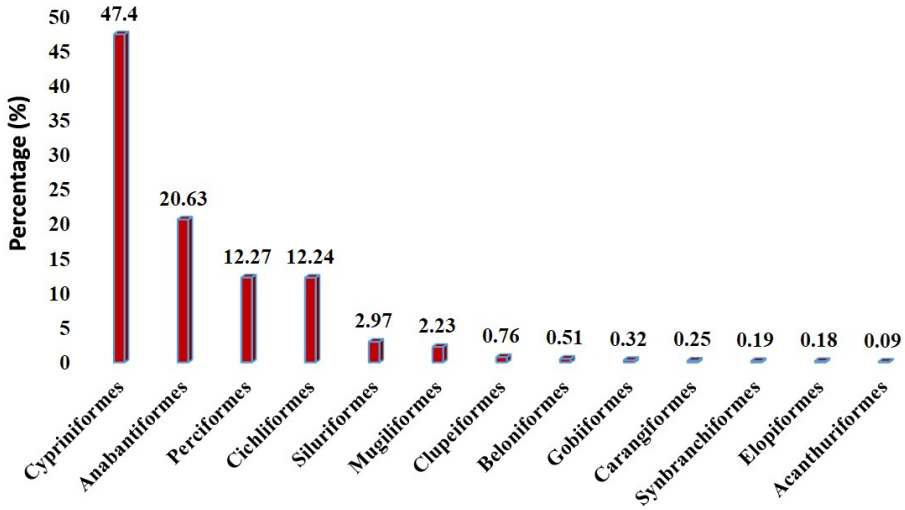


FIGURE 3 Order-wise percentage contribution of fish fauna in the Veeyapuram region of the Pamba River, Kerala.

5 | CONCLUSIONS

The present study provides the first site-specific assessment of fish diversity in the Veeyapuram stretch of the Pamba River within the Kuttanad wetland system. A total of 33 species were documented, representing multiple taxonomic groups and reflecting the ecological relevance of this river segment. The dominance of Cypriniformes, followed by Anabantiformes, with additional contributions from Perciformes and Cichliformes, indicates the presence of diverse habitat conditions supporting varied fish assemblages.

The occurrence of ecologically and economically important species, along with taxa of conservation concern such as *W. attu* and *H. brachysoma*, highlights the conservation value of the study area. The documentation of species not explicitly reported in earlier regional studies suggests spatial variation in species composition within the Pamba River system. However, such observations require further verification through long-term and standardised investigations.

In the absence of prior site-specific studies, the present work establishes a baseline dataset for the Veeyapuram region. The findings emphasise the need for habitat conservation, regulated fishing practices, and systematic monitoring to support sustainable management of fish diversity in this ecologically significant freshwater system.

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er regions of the river. Their support was essential for the successful completion of the fieldwork.

CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHORS' CONTRIBUTION

The first author was responsible for the conceptualisation, data analysis, and preparation of the manuscript (revised manuscript). The second and third authors were involved in field sampling and collection of fish specimens from the study area. All authors contributed to the revision of the manuscript and approved the final version for publication.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on a reasonable request from the corresponding author.

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