

Ichthyofaunal Diversity, Seasonal Dynamics, and Conservation Status of Small Indigenous Fish Species in Freshwater Ecosystems of Malda District, West Bengal, India

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Abstract:

Small indigenous fish species (SIFs) have been recognized as vital components of freshwater biodiversity, nutritional security, and rural livelihoods across South Asia. However, rapid environmental change and anthropogenic pressures have contributed to the decline of these species, particularly in floodplain-dominated regions of eastern India. The present study had been conducted to document ichthyofaunal diversity, seasonal variation, habitat-wise distribution, and conservation status of small indigenous fish species in the freshwater ecosystems of Malda district, West Bengal. Field surveys had been carried out over a three-year period (2023–2025) across rivers, floodplain wetlands (beels), ponds, and canals using standardized sampling techniques. Species richness, Shannon–Wiener diversity index, Simpson’s dominance index, and relative abundance had been analyzed. A total of 32 small indigenous fish species belonging to 15 families had been recorded. Floodplain wetlands had supported the highest species richness and diversity, followed by ponds, rivers, and canals. Seasonal analysis had revealed peak species occurrence during the monsoon, with marked declines during the pre-monsoon and winter seasons. Although most species had been categorized as Least Concern at the global level, several Near Threatened, Vulnerable, and Data Deficient species had been documented locally. The findings had emphasized the ecological importance of floodplain connectivity and seasonal hydrological regimes, highlighting the urgent need for habitat-based conservation and sustainable fisheries management strategies.

Keywords: *Small Indigenous Fishes, Ichthyofaunal Diversity, Seasonal Variation, Freshwater Ecosystems, Conservation Status, Malda District.*

1. Introduction:

Freshwater ecosystems have been globally recognized as biodiversity hotspots that support a disproportionately high number of species relative to their spatial extent (Dudgeon et al., 2006). Among freshwater biota, fishes have constituted one of the most ecologically and economically significant groups, providing essential ecosystem services, food security, and livelihoods for millions of people. Small

ARTICLE INFO

Article history:

Received: 10 November 2025

Received in revised form
20 November 2025

Accepted 29 November 2025

Citation: Lahiri, A., (2025)

“Ichthyofaunal Diversity, Seasonal Dynamics, and Conservation Status of Small Indigenous Fish Species in Freshwater Ecosystems of Malda District, West Bengal, India”, *Pen and Prosperity*, Vol. 2, Issue. 4, December 2025.

indigenous fish species (SIFs), typically defined as species attaining a maximum length of less than 25 cm, have been particularly valued in tropical and subtropical regions due to their nutritional richness, ecological roles, and cultural importance (Mohanty et al., 2013).

In South Asia, SIFs have contributed substantially to dietary micronutrient intake, particularly among rural and economically marginalized communities (Roos et al., 2003). These species have been rich sources of protein, calcium, iron, vitamin A, and essential fatty acids. Beyond their nutritional significance, SIFs have played critical ecological roles by regulating plankton communities, recycling nutrients, and supporting higher trophic levels.

India has supported one of the richest freshwater fish faunas globally, owing to its diverse river basins, floodplains, wetlands, and climatic gradients (Jayaram, 2010). The Gangetic basin, in particular, has harboured a wide variety of small indigenous fishes adapted to seasonal hydrological fluctuations. However, increasing anthropogenic pressures such as habitat modification, wetland reclamation, overexploitation, pollution, and hydrological alteration have contributed to declining fish diversity across the basin (Barman, 2007).

Despite the recognized importance of SIFs, region-specific studies documenting their diversity, seasonal dynamics, and conservation status have remained limited, especially at the district level. Malda district, located in the lower Gangetic plain of West Bengal, has been characterized by extensive floodplain wetlands, riverine systems, and traditional fisheries. Yet, systematic documentation of small indigenous fish diversity in this region has been inadequate.

The present study had therefore been undertaken to assess the ichthyofaunal diversity of small indigenous fish species in the freshwater ecosystems of Malda district, analyze seasonal and habitat-wise variation, and evaluate conservation status. The findings had aimed to generate baseline data to support sustainable fisheries management and biodiversity conservation.

2. Materials and Methods:

2.1 Study Area:

Malda district is situated in the northern part of West Bengal and is intersected by major river systems, including the Ganga and its tributaries. The district experiences a tropical monsoon climate with pronounced seasonal variation, characterized by pre-monsoon, monsoon, post-monsoon, and winter periods. Freshwater habitats include rivers, floodplain wetlands (beels), ponds, and irrigation canals.

2.2 Sampling Design and Data Collection:

Ichthyofaunal surveys had been conducted from January 2023 to December 2025 across selected freshwater habitats. Sampling had been performed seasonally using cast nets, gill nets, drag nets, and traditional fishing gears. Species identification had been carried out using standard taxonomic keys (Talwar & Jhingran, 1991; Jayaram, 2010).

2.3 Data Analysis:

Species richness, Shannon–Wiener diversity index (H'), Simpson's dominance index (D), and relative abundance had been calculated following standard ecological methods (Magurran, 2004). Seasonal and habitat-wise comparisons had been made to interpret diversity patterns.

3. Results:

3.1 Species Composition and Richness:

A total of 32 small indigenous fish species belonging to 15 families had been recorded (Table 1). The family Cyprinidae had contributed the highest number of species, followed by Danionidae, Channidae, and Ambassidae.

Table 1. Summary of species richness across habitat types

Habitat	Species richness
Rivers	18
Beels	25
Ponds	22
Canals	14

Floodplain wetlands had supported the highest richness due to habitat heterogeneity and seasonal connectivity.

3.2 Diversity Indices

Shannon–Wiener diversity values had ranged from 1.96 to 2.78 across habitats, with the highest values recorded in beels (Table 2). Simpson’s dominance index had been lowest in beels, indicating a more even distribution of species.

Table 2. Diversity indices across habitats

Habitat	H'	D
Rivers	2.11	0.18
Beels	2.78	0.12
Ponds	2.54	0.15
Canals	1.96	0.21

3.3 Seasonal Variation:

Species richness had peaked during the monsoon season and declined during pre-monsoon and winter periods. Seasonal flooding had enhanced habitat connectivity, facilitating migration and breeding.

3.4 Relative Abundance:

A small number of species (*Amblypharyngodonmola*, *Esomusdanricus*, *Channa punctata*) had dominated catches, while several species had occurred rarely, indicating uneven community structure.

3.5 Conservation Status:

Most species had been categorized as Least Concern, while Near Threatened, Vulnerable, and Data Deficient species had also been recorded (Table 3).

Table 3. Conservation status of recorded species

Category	Number of species
Least Concern	21
Near Threatened	5
Vulnerable	3
Data Deficient	3

4. Discussion:

The findings had demonstrated that Malda district supported a moderately rich assemblage of small indigenous fishes, particularly within floodplain wetlands. The dominance of Cypriniformes had been consistent with patterns reported from other regions of eastern India (Goswami et al., 2012). Seasonal hydrology had been identified as the most influential factor shaping community structure.

Despite relatively high diversity, localized declines had been evident, especially among habitat-specialist species. Global conservation categories had not fully reflected regional vulnerability, emphasizing the need for localized assessments.

5. Conservation Implications:

Protection of floodplain wetlands, maintenance of river–wetland connectivity, regulation of fishing during breeding seasons, and community-based management had been identified as critical conservation priorities.

6. Conclusion:

The present study had provided baseline information on the diversity, seasonal dynamics, and conservation status of small indigenous fish species in Malda district. Sustainable management of freshwater habitats had been recognized as essential for conserving biodiversity and supporting food security.

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