



# Maiden study on fish diversity of the Diring River in Baksa District, Assam, India

Phwjwngsa Baro • Jwngma Narzary

Department of Zoology, Science College, Kokrajhar, Assam-783370, India

## Correspondence

Jwngma Narzary; Department of Zoology, Science College, Kokrajhar, Assam-783370, India

 [jwngma@rediffmail.com](mailto:jwngma@rediffmail.com)

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## Abstract

The Northeast India has several natural water resources that support a variety of aquatic fauna. However, many parts of the region have remained unexplored for ichthyofauna. Research on the diversity of fishes in large water bodies has received significant attention from many researchers in the region. In contrast, studies on small stream rivers are very scant. Therefore, the present study aims to record the diversity of fish fauna in the small stream Diring River of Baksa District, Assam. In this survey, 27 species of fishes were recorded from five study sites. The dominant family was Cyprinidae, comprising 48% of the total fish species. The conservation status of the majority of species was Least Concern (88.8%) followed by Near Threatened (3.7%) and Vulnerable (3.7%). However, conservation status of 3.7% of the fish species was not evaluated by IUCN. The Shannon diversity index ranged from 1.5 to 2.6, the evenness index from 0.84 to 0.98, and the richness index from 1.1 to 2.6, indicating a good status of ichthyofaunal resources in the study sites. Since there were no existing records on the fish diversity of the Diring River, this maiden study might serve as baseline information for further research.

**Keywords:** Cyprinidae; Diring; fish diversity; freshwater fish; threatened fish

## 1 | INTRODUCTION

Fish represent one of the most diverse vertebrate groups globally, comprising approximately 36,484 species, with 18,495 inhabiting freshwater environments (Fricke *et al.* 2023). They are extensively studied aquatic organisms (Tornwall *et al.* 2015), closely linked to human well-being due to their nutritional, socio-economic, and cultural significance (Öztürk *et al.* 2021). Despite occupying only about 1% of the Earth's surface, lakes and rivers harbour an estimated 13,000 freshwater fish species, belonging to 2,513 genera (Lévêque *et al.* 2008), making them a crucial element of global biodiversity (Dudgeon *et al.* 2006; Sedeno-Diaz and Lopez-Lopez 2012). Freshwater fish are among the taxonomic group facing the highest threat as a result of their susceptibility to changes in the quantity and quality of aquatic habitats (Darwall and Vie 2005). Consequently, they are frequently utilized as a bioindica-

tor to evaluate water quality, river network connectivity, and flow patterns (Chovance *et al.* 2003). The decline of river freshwater fishes worldwide stems from various factors, including overexploitation, habitat degradation, climate change, pollution, and water extraction, rendering them the most endangered vertebrate group globally (Foote *et al.* 2020). Therefore, understanding the diversity, distribution, and abundance of fish species is crucial for developing management and conservation initiatives. Consequently, examining spatial and temporal patterns of freshwater fish diversity, composition and distribution is essential as they can influence fish community structure (Galacatosa *et al.* 2004). Continuously evaluating the diversity of fish species in aquatic ecosystem is essential to effectively manage and conserve these resources (Das *et al.* 2021).

Northeast region of India is renowned as a highly

concentrated region with freshwater fish species (Ramanujam *et al.* 2010). The region benefits from two primary river systems, the Brahmaputra and Barak, along with their tributaries. The Brahmaputra and Barak river system host a significant diversity of ichthyofauna, comprising approximately 33.13% of India's total freshwater fish species (Sen 2000). Goswami *et al.* (2012) documented a total of 422 fish species from Northeast India, covering the Himalayan and Indo-Burma biodiversity hotspots. Recent anthropogenic activities pose a significant threat to the valuable and distinctive fish germplasm resources of the Northeast region (Dutta *et al.* 2018). As reports from earlier studies shows that fish species formerly abundant in the aquatic habitats of this area are now experiencing declines in their wild populations. Habitat loss and degradation, unsustainable fishing practices, and unauthorized collection are contributing factors to the diminishing numbers of these species in their natural habitats (Dutta *et al.* 2018).

The loss of freshwater fish diversity in Assam has been extensively documented in recent studies (Chiary *et al.* 2015; Nayak and Biswas 2020). These studies have recognized several threats to fish diversity, including habitat destruction, overfishing of brood fish and juveniles, competition from exotic species, agricultural pollution, and increasing human population pressure (Chiary *et al.* 2015; Nayak and Biswas 2020; Pathak and Goswami 2021). These factors have been emphasized as major contributors to the significant decline in biodiversity within the region (Chiary *et al.* 2015). Therefore, a continuous monitoring and diversity study is become very essential for the conservation of ichthyofauna of this region.

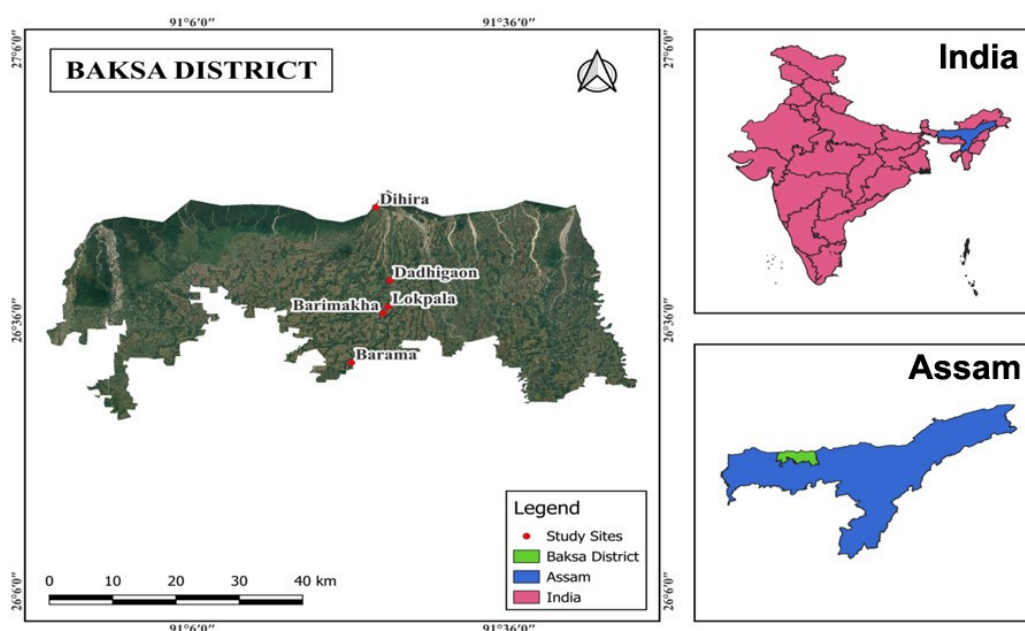
In Northeast India, studies on the diversity of fishes in the River Brahmaputra and its tributaries or large water

bodies have received significant attention from many researchers (Sen 2000; Goswami *et al.* 2012; Kalita 2015; Goswami and Singha 2023). However, records of studies from small stream rivers are very scanty. Therefore, in the present investigation, an ichthyofaunal diversity study has been undertaken in a small stream tributary of the river Brahmaputra named Diring, located in the Baksa district of Assam. Baksa district is situated in the northeastern state of Assam, occupying approximately 2,485 km<sup>2</sup> and boasting a rich blend of natural splendor and cultural variety. The main tributaries of the river Brahmaputra in the district are the Manas and Beki rivers. Diring originates from the foothills of Bhutan. Since there are no existing records on the fish fauna diversity of the Diring River, this study was conducted to investigate and document the fish species diversity in the river.

## 2 | METHODOLOGY

### 2.1 Study area

This study was conducted in the Diring River, also known as Mora Pagladiya, which originates from the foothills of Bhutan and flows through the Baksa and Nalbari districts of Assam, India (Figure 1). The river has a total length of 61 km before it joins the Tihu River at Pakhumara, Tihu, in the Nalbari district of Assam. It enters India through the Baksa district, starting from the Daragaon picnic spot at Dihira, Nikashi, where it is known as the Diring River. From the Daragaon picnic spot (26.803401°N 91.397862°E) to Barimakha (26.6175°N 91.4036°E), it is known as the Diring River. From Barimakha to Pakhumara, Tihu, the river is known as Mora Pagladiya. In this study, the research was carried out in the upstream section of the Diring River.



**FIGURE 1** Map of the Baksa district showing the sampling sites.

## 2.2 Fish sampling

The survey was conducted in both upstream and downstream of the Diring River. Fish specimens were collected from 1st of February to middle of April 2024 *i.e.* in pre-monsoon time. Due to the state government rule in Assam, fishing period is restricted from the month of April to October in streams and rivers. Most of the local fishermen of Baksa district believe that pre-monsoon is the best time to collect stream fishes. Therefore, the present study was conducted in pre-monsoon. Five sampling sites were chosen for the collection of fish specimens. The sampling sites were Dihira (site 1; 26.808289°N 91.389521°E), Dadhigaon (site 2; 26.673121°N 91.911859°E), Lokpala (site-3; 26.6247°N 91.408956°E), Barimakha (site 4; 26.61248°N 91.401088°E) and Barama (site 5; 26.521905°N 91.35108°E). Fishes were collected with the help of local Fisherman using standardized fishing efforts. For fishing, one lift net (mesh size 25 mm), one hand net (mesh size 25 – 70 mm) and one gill net (mesh size 14 – 45 mm) were used. The collected fish specimens were immediately preserved in 8% formaldehyde solution and later, transported to the Department of Zoology of Science College, Kokrajhar for identification. Before preservation live photographs were taken. The fish identification was done with the help of standard literatures (e.g. Jayaram 1999; Sarma 2017). For IUCN redlist status of species, we followed IUCN (2024).

## 2.3 Data analysis

Statistical analysis was done using the Microsoft Excel. Shannon diversity index, Pielou's Evenness index and Margalef's Richness index were calculated using the following equations:

Shannon diversity index  $H' = -\sum n/N \ln n/N = -\sum P_i \ln P_i$  (Shannon and Weaver 1949). Where  $H' < 1$  indicates low species diversity whereas,  $1 < H' < 3$  indicates medium species diversity, and  $H' > 3$  indicates high species diversity.

Evenness index  $J = H' / \ln S$  (Pielou 1966). Where  $J$  approaches 0 indicate unstable species abundance distribution, and  $J$  approaches 1 indicate stable species abundance distribution conditions.

Margalef Richness index  $R = (S - 1) / \ln N$  (Margalef 1968). Where,  $R < 2.5$  indicates low species richness,  $2.5 < R < 4$  indicates medium species richness, and  $R > 4$  indicates high species richness.

Here,  $n$  is the total number of individual species,  $N$  is the total number of species population,  $S$  for number of species in a study site, and  $\ln$  is the natural logarithm.

## 3 | RESULTS AND DISCUSSION

### 3.1 Fish diversity

Throughout the study, a total of 27 species, belonging to 12 families and 5 orders, were sampled from five study

sites over three months in the Diring River. In terms of numbers, the most abundant and diverse family was Cyprinidae, consisting of 13 species, followed by Danionidae with 3 species and Nemacheilidae with 2 species. The families with the least diversity were Anabantidae, Nandidae, Gobiidae, Bagridae, Heteropneustidae, Channidae, Mastacembelidae, Ambassidae, and Osphronemidae, each represented by one species (Figure 2). Majority of the fish species (16 species, 59% of the total species) were belonging to Cypriniformes, followed by Perciformes with 6 species (22%), and Siluriformes with 3 species (11%) (Table 1).

A total of 526 individual fishes were collected during the study period. *Opsarius bendelisis* was found as most dominant species which comprising 11.5% of the total fish abundance followed by *Cyprinion semiplotum* (8.5%) and *Puntius sophore* (7.4%). Two species, *Chagunius chagunio* and *Barilius barila* were recorded as the most frequently found species (80%) among the all the species in the habitat (Table 3).

### 3.2 Conservation status

In the present study, majority of the species (24 species) were found as Least Concern. One Vulnerable and one Near Threatened were also recorded while conservation status of one species was Not Evaluated (Table 1). India hosts 868 of fish species, constituting 5.75% of the global freshwater fish diversity (Lakra *et al.* 2010). Among these, 192 are endemic species and 327 species were listed as the threatened species in India by the International Union for the Conservation of Nature.

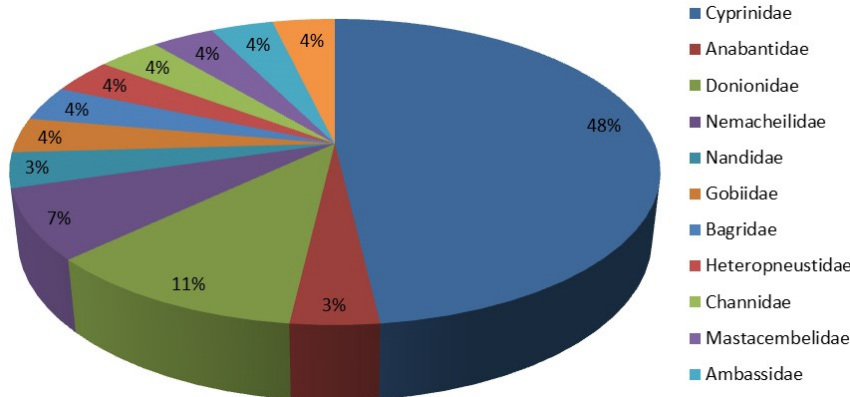
### 3.3 Biodiversity indices

The Shannon index ranged from 1.5 to 2.6, with the highest value in Lokpala which reflects that the Diring River has moderate fish diversity. The evenness index ranged from 0.84 to 0.98, approaching 1, indicating that species abundance and their distribution in the Diring River were in a stable condition. Species richness was found to be low in the upstream areas of Dihira and Dadhigaon, with a richness index of 1.1 to 1.3. In the downstream areas, species richness was higher, with a richness index of 2.5 to 2.6, the highest being in Lokpala. According to Sleen and Albert (2022), larger river basins generally have greater habitat diversity and thus more potential niches that can be exploited compared to smaller rivers. Therefore, larger river basins hold more species than smaller ones. In the present investigation, it was also found that upstream areas with smaller habitat diversity had less species diversity than downstream areas with larger habitat diversity.

The diversity of fish fauna in different rivers of Assam, originating from the foothills of Bhutan, has been studied by many researchers. Kalita (2015) conducted a survey in the freshwater of Manas National Park and its

adjacent villages in Assam, recording a total of 85 indigenous fish species. Goswami and Singha (2023) studied the fish diversity of the Beki River in the Baksa district and found 31 species belonging to 9 families. Diring River is also a small stream originating from the Bhutan hills. In

the present study, 27 species were recorded in this small stream. Since there were no existing records on the fish diversity of the Diring stream, this preliminary study assumes some importance for further research.



**FIGURE 2** Family-wise diversity of fishes in the Diring River, Assam, India.

**TABLE 1** Checklist of fish fauna recorded from the Diring River in Baksa District of Assam along with IUCN status.

Order and family	Species name	Common name	IUCN status
<b>Order: Cypriniformes</b>			
Cyprinidae	<i>Barilius barila</i> (Hamilton, 1822)	Barred baril	LC
	<i>Chagunius chagunio</i> (Hamilton, 1822)	Chaguni	LC
	<i>Cirrhinus mrigala</i> (Hamilton, 1822)	Mrigal	LC
	<i>Cyprinion semiplotum</i> (McClelland, 1839)	Assamese kingfish	VU
	<i>Garra gotyla</i> (Gray, 1830)	Sucker head	LC
	<i>Labeo calbasu</i> (Hamilton, 1822)	Orange fin labeo	LC
	<i>Labeo gonius</i> (Hamilton, 1822)	Kuria labeo	LC
	<i>Labeo rohita</i> (Hamilton, 1822)	Rohu	LC
	<i>Neolissochilus hexagonolepis</i> (McClelland, 1839)	Copper mahseer	NT
	<i>Opsarius bendelisis</i> (Hamilton, 1807)	Hamilton's barila	LC
	<i>Pethia conchonius</i> (Hamilton, 1822)	Rosy Barb	LC
	<i>Puntius sophore</i> (Hamilton, 1822)	Pool Barb	LC
	<i>Systemus sarana</i> (Hamilton, 1822)	Oliver barb	LC
Danionidae	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	Mola carplet	LC
Nemacheilidae	<i>Acanthocobitis botia</i> (Hamilton, 1822)	Mottled loach	LC
	<i>Schistura fasciata</i> Lokeshwor & Vishwanath, 2011	Stone loach	NE
<b>Order: Perciformes</b>			
Ambassidae	<i>Parambassis ranga</i> (Hamilton, 1822)	Indian glassy fish	LC
Anabantidae	<i>Anabas testudineus</i> (Bloch, 1792)	Climbing Perch	LC
Channidae	<i>Channa punctata</i> (Bloch, 1793)	Spotted Snakehead	LC
	<i>Channa stewartia</i> (Playfair, 1867)	Assamese snakehead	LC
Nandidae	<i>Nandus nandus</i> (Hamilton, 1822)	Gangetic Leaffish	LC
Osphronemidae	<i>Trichogaster fasciata</i> Bloch & Schneider, 1801	Banded gourami	LC
<b>Order: Gobiiformes</b>			
Gobiidae	<i>Glossogobius giuris</i> (Hamilton, 1822)	Tank goby	LC
<b>Order: Siluriformes</b>			
Bagridae	<i>Mystus vittatus</i> (Bloch, 1794)	Striped dwarf catfish	LC
Heteropneustidae	<i>Heteropneustes fossilis</i> (Bloch, 1794)	Stinging catfish	LC
Horabagridae	<i>Pachypterus atherinoides</i> (Bloch, 1794)	Indian potasi	LC
<b>Order: Synbranchiformes</b>			
Mastacembelidae	<i>Macrognathus aral</i> (Bloch & Schneider, 1801)	One stripe spiny eel	LC

IUCN status is based on IUCN (2024). LC, Least Concerned; VU, Vulnerable; NT, Near Threatened; NE, Not evaluated

**TABLE 2** Fish sample collected from different study sites of the Diring River in Baksa district of Assam (+ represents present, – represents absent).

Species	Sampling Sites					Abundance	
	Dihira	Dadhigaon	Lokpala	Barimakha	Barama	n	%
<i>Barilius barila</i>	+	+	+	+	–	33	6.274
<i>Chagunius chagunio</i>	+	+	+	+	–	14	2.662
<i>Cirrhinus mrigala</i>	–	–	+	+	+	9	1.711
<i>Cyprinion semiplotum</i>	–	+	+	+	–	45	8.555
<i>Garra gotyla</i>	+	–	–	–	–	35	6.654
<i>Labeo calbasu</i>	–	+	+	+	–	26	4.943
<i>Labeo gonius</i>	–	+	–	+	–	14	2.662
<i>Labeo rohita</i>	–	–	+	–	+	11	2.091
<i>Neolissochilus hexagonolepis</i>	+	–	–	–	–	12	2.281
<i>Opsarius bendelisis</i>	–	+	+	+	–	61	11.597
<i>Pethia conchonus</i>	–	+	+	+	–	29	5.513
<i>Puntius sophore</i>	–	+	+	+	–	39	7.414
<i>Acanthocobitis botia</i>	–	+	–	+	–	14	2.662
<i>Systemus sarana</i>	–	+	+	+	–	37	7.034
<i>Amblypharyngodon mola</i>	–	–	+	–	+	6	1.141
<i>Schistura fasciata</i>	+	–	–	–	–	25	4.753
<i>Parambassis ranga</i>	–	–	–	+	+	9	1.711
<i>Anabas testudineus</i>	–	–	–	–	+	10	1.901
<i>Channa punctata</i>	–	–	–	–	+	8	1.521
<i>Channa stewartia</i>	–	–	–	–	+	9	1.711
<i>Nandus nandus</i>	–	–	–	–	+	6	1.141
<i>Trichogaster fasciata</i>	–	–	–	–	+	8	1.521
<i>Glossogobius giuris</i>	+	+	+	–	–	13	2.471
<i>Mystus vittatus</i>	–	+	+	+	–	28	5.323
<i>Heteropneustes fossilis</i>	–	–	–	–	+	6	1.141
<i>Pachypterus atherinoides</i>	–	–	+	–	+	12	2.281
<i>Macroglyptus aral</i>	–	–	–	–	+	7	1.331
<b>Total</b>	6	12	14	13	12	526	100

**TABLE 3** Fish species diversity indices at five study sites in the Diring River in Baksa district of Assam, India.

Diversity indices	Dihira	Dadhigaon	Barimakha	Lokpala	Barma
Shannon diversity index	1.5192402	2.3499611	2.47676246	2.6086744	2.19549
Pielou evenness index	0.8479041	0.9456939	0.96561846	0.9884872	0.88353
Margalef richness index	1.11392405	2.32253782	2.519857562	2.646227	2.589152

#### 4 | CONCLUSIONS

The present study focused on the diversity of fish, their abundance, and richness in the study area. This study represents the fish biodiversity reports of the Diring River, where there were no previous records. According to IUCN status, species of high conservation importance (e.g. Vulnerable and Near Threatened) and other species were also reported in the study. Therefore, it is quite important for understanding the diversity status of fish in the stream. This is only preliminary work, but it provides some guidance for future researchers.

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Kokrajhar, Assam for providing all necessary facility for conducting the study.

#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHORS' CONTRIBUTION

JN conceptualized and designed the study, supervised the work and finalized the manuscript. PB performed the survey, collected the data, analyzed the data and prepared the draft manuscript.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of the study will be made available on a reasonable request from the corresponding author.



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P Baro  <http://orcid.org/0009-0001-1030-8098>

J Narzary  <http://orcid.org/0000-0002-4612-8996>