Journal of Animal Diversity

Online ISSN 2676-685X

Volume 7, Issue 2 (2025)

Research article

http://dx.doi.org/10.22034/JAD.2025.7.2.2

Distribution, abundance, and diversity of Ichthyofauna in the Imphal River of Manipur, India

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Citation: Singh, N. I., Borthakur, A., Singh, Y. L., Motilan, Y., Bhattacharya, A. and Sarkar, P. (2025). Distribution, abundance, and diversity of Ichthyofauna in the Imphal River of Manipur, India. *Journal of Animal Diversity*, 7 (2): 10–24. http://dx.doi.org/10.22034/JAD.2025.7.2.2

Abstract

The present study provides a comprehensive assessment of the ichthyofaunal diversity, distribution, and abundance in the Imphal River of Manipur, India. Sampling was conducted across five sites: Lilong, Koirengei, Kangpokpi, Maharabi, and Sekmai in the Manipur River basin of the Thoubal, Kangpokpi, Imphal East, and Imphal West districts of Manipur. A total of 2,265 individual fishes were recorded, representing 55 species, 40 genera, 20 families, and 10 orders. Diversity indices such as the Shannon-Wiener Diversity index (H′ = 3.21) indicated high ichthyofaunal diversity. This was attributed to high species richness (Margalef's Diversity index, d= 6.99) and even distribution (Pielou's Evenness index, J′ = 0.41, Simpson's Diversity index, D= 0.92). Cypriniformes emerged as the most dominant order in terms of both species' richness and abundance, with the Cyprinidae family exhibiting the highest diversity among all families. Among the sampling sites, species richness was highest at Lilong, while Kangpokpi recorded the highest species abundance. The study identified four species potentially new to science and 29 species are endemic to Chindwin River basin in Manipur. Conservation assessments revealed that 16.36% of recorded species fall under threatened categories (EN, VU), while 6.36% remain unevaluated and 3.64% are data deficient according to the IUCN. Major threats to the ichthyofauna in the study area include habitat degradation from sand mining and deforestation, overfishing, and the introduction of invasive species. The study highlights the ecological, economic, and socio-cultural importance of the Imphal River and underscores the urgent need for sustainable conservation strategies to protect endemic and threatened fish species.

Editor-in-Chief: Dr. Ali Gholamifard
Associate Editor: Professor Christopher Tudge

Received: 28 January 2025
Revised: 14 March 2025
Accepted: 22 June 2025
Published online: 30 June 2025

Key words: Chindwin drainage system, diversity, fish fauna, Imphal River, species

Introduction

Fishes represent a heterogeneous group of aquatic vertebrates, comprising approximately half of all known vertebrate species worldwide, with 37,273 identified species (Fricke et al., 2025). They offer vital ecosystem services, including nutrient cycling, flood regulation, and climate change mitigation (Lynch et al., 2023) and act as bioindicator of the health of aquatic ecosystems (Moog et al., 2018; Lee et al., 2019). Since

fishes form a major part of the human diet globally and considered abundantly nutritional, economic, socio-cultural, and psychological significance to human civilization has been paramount since its inception (Lynch et al., 2023). Recent studies indicate that the decline in freshwater biodiversity has been significantly more pronounced in last few decades compared to that of marine and terrestrial ecosystems (Darwall et al., 2009; Garcia-Moreno et al., 2014). Alarmingly, nearly one-quarter of fresh water species are currently at risk of extinction (Sayer et al., 2025). Therefore, evaluating site-specific ichthyofaunal diversity and understanding species associations, particularly in biodiversity-rich yet unexplored regions of the world is crucial. Such assessments play significant roles in conserving aquatic biodiversity, monitoring ecosystem health, enhancing local livelihood, and promoting economic growth through sustainable resources (Lokeshwor, 2019).

Indian's ichthyofaunal diversity comprises 2246 native and 291 exotic fishes. Of these, 223 are endemic species constituting 8.75% of the total, and 128 belonging to monotypic genera, accounting for 13.20% of all ichthyofaunal genera identified in the country (NBFGR, 2023). Among these, 1257 species are freshwater fishes, spread across 24 orders, 85 families, and 324 genera (Kosygin et al., 2024). India ranks ninth globally in freshwater fish diversity (Mittermeier and Mittermeier, 1997). According to IUCN (2024), 1,275 ichthyofaunal species are categorized threatened, including 688 fish species native to Asia. Indian freshwater fish diversity has been declining alarmingly in recent years.

The fish fauna of the Indian state of Manipur comprises representatives of both Indo-Gangetic (commonly associated with Assamese regions) and Indo-Burmese (linked to the adjacent Burmese biodiversity hotspot) biogeographic elements (Hora and Mukerji, 1935; Jajo et al., 2021; Shomorendraa and Romenb, 2024; Abonmai et al., 2025; Devi et al., 2025). It is also noteworthy that the ichthyofaunal diversity of Manipur and the greater northeastern region is represented only in a minuscule number of scientific literature (Hamilton, 1822; Hora and Mukerji, 1935; Suresh et al., 2006; Allen et al., 2010; Goswami et al., 2012; Lokeshwor, 2014; Vishwanath et al., 2014; Shangningam, 2015; Singh, 2019). The current study is conducted to bridge the gap between the ichthyofaunal diversity studies in other regions of the Indian Subcontinent particularly in Manipur. The study establishes the distribution, abundance, and diversity of ichthyofauna of the Imphal River across four districts of Manipur.

Material and Methods

Study area

Manipur is in the northeastern region of India at the foothills of the extended Eastern Himalayas and is a part of the Indo-Burma biodiversity hotspot. This region lies at the confluence of the Indo-Malayan, Indo-Chinese, and Indian biogeographical realms, naturally giving rise to a diverse array of habitats that contribute to its exceptionally high biodiversity (Rao, 1994). The state comprises a total area of 22,327 km^2 with 1820 km^2 of flat alluvial valley including the Loktak Lake and 20,507 km^2 of hilly terrain. The average annual precipitation is 1400 mm. The state is administratively divided into 16 districts and contains a population of 2,570,390 (Indian Census Report, 2011; Surjata and Thongam, 2019).

The three major water resources of Manipur include the Loktak Lake, the Barak River basin in the West which is a part of the greater Barak-Surma-Meghna drainage system, and the Manipur River basin in the east which is a part of the greater Chindwin-Irrawaddy drainage system and Sittaung-Irrawaddy ecoregion (Abell et al., 2008). The Imphal River, also known as the Turrel Achouba (principal river) is a major river of the Manipur River basin and originates from the Kangpokpi area. It ultimately drains to the Chindwin River of Myanmar, which is a major tributary of the Irrawaddy River (Singh, 2019; Government of Manipur, 2024).

The current study was conducted in 5 different locations of the Imphal River located in four districts of the Indian state of Manipur viz. Lilong Municipal Town (24°43′15.00″ N, 93°56′33.24″ E) in Thoubal district, Koirengei village (24°52′57.11″ N, 93°56′39.66″ E) in Imphal East district, Kangpokpi town (25°08′33.67″ N, 93°58′14.57″ E) in Kangpokpi district, Maharabi village (24°56′14.11″ N, 93°53′09.32″ E) and Sekmai village (24°56′58.00″ N, 93°53′09.13″ E) in Imphal West district (Fig. 1).

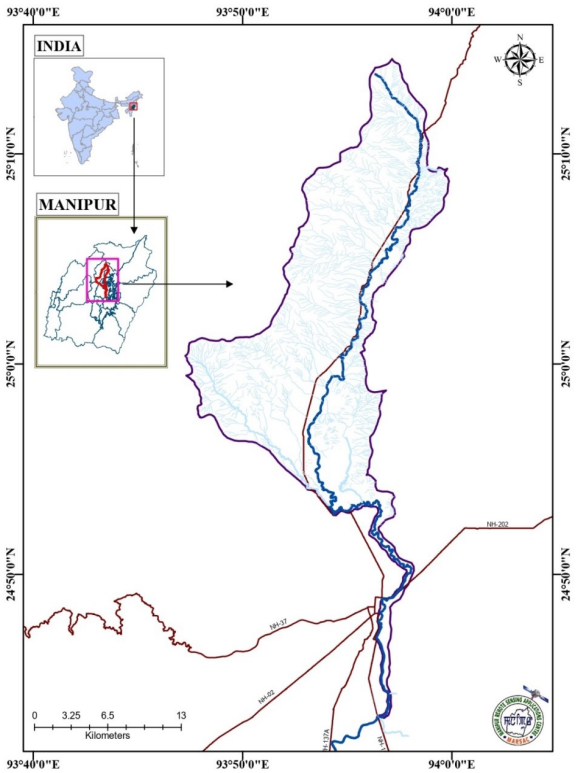

Figure 1: Map of Manipur showing the Imphal River with its tributaries (Source: Manipur Remote Sensing Application Centre).

Sampling

Both traditional and modern fishing equipment were used for collection of fish from different sites of the Imphal River in Manipur through standard procedures (Armontrout, 1990). Since most of the hill stream fishes hide under stones and rocks, the traditional methods used for the study include hand picking using scoop nets, traps, and diverting some parts of the stream.

Sampling was conducted on monthly basis from April, 2022 to March, 2024. Sampling details including the area of sampling, coordinates of GPS reading at the sampling sites, date and time of sampling, local names of fishes, and color observed in freshly caught samples. Sampling was carried out 4 times per sampling station both in the morning and evening, during every month of the study period (Pathak et al., 2025).

Preservation

Specimens were fixed and preserved in 10% formalin buffer solution in translucent plastic bottles with tight-fitted lids to prevent spills from breakage when preserving specimens in glass containers, following Walsh and Meador (1998), after which the samples were deposited at the Fishery Museum in University of Science and Technology Meghalaya, India.

Identification

Identification of species was conducted using morphological keys from previous literature using Talwar and Jhingran, 1991; Jayaram, 1999; Vishwanath et al., 2014: for the genera *Garra*, *Pethia*, *Psilorhynchus* and group Nemacheilids (Kullander and Fang, 2004; Kullander and Britz, 2008; Conway and Kottelat, 2010); for catfishes (Ng and Lim, 1997) and genera *Sperata*, *Hemibagrus*, *Pseudecheneis*, and *Gagata* (Ng and Kottelat, 1998; Ferraris and Runge, 1999; Ng and Ferraris, 2000; Ng and Rainboth, 2001) were followed. Classification of the samples was performed based on Nelson et al. (2016). Diversity indices like Shannon-Weiner (Shanon and Weiner, 1949), Evenness (Pielou, 1966), Simpson Diversity (Simpson, 1949), and Margalef's diversity (Margalef, 1958) were calculated.

Results

Distribution of Ichthyofauna

The study documented a total of 55 ichthyofaunal species, representing 40 genera, 20 families, and 10 orders in the Imphal River across five sampling stations (Table 1, Appendix). A total of 38 species belonging to 31 genera, 17 families, and 10 orders were recorded from Lilong. In Koirengei, 22 species representing 20 genera, 13 families, and 7 orders were identified. A total of 16 species from 14 genera, 9 families, and 6 orders were recorded at Maharabi, while 21 species from 14 genera, 9 families, and 7 orders were reported from Sekmai. Additionally, 18 species belonging to 12 genera, 6 families, and 4 orders were recorded from Kangpokpi (Fig. 2).

The highest number of families were recorded in the order Siluriformes (5 families: Amblycipitidae, Sisoridae, Clariidae, Bagridae, and Siluridae), followed by Cypriniformes (4 families: Botiidae, Cobitidae, Cyprinidae, and Nemacheilidae), and Anabantiformes (3 families: Anabantidae, Osphronemidae, and Channidae). Among the families, Cyprinidae exhibited the greatest species richness (S= 19), followed by Nemacheilidae (S= 7) (Fig. 3).

Relative abundance of Ichthyofauna

A total of 2,265 individual fishes were recorded during the study, with 799 individuals collected from Lilong (35%), 487 from Kangpokpi (22%), 417 from Sekmai (18%), 328 from Koirengei (15%), and 234 from Maharabi (10%). The overall low Pielou's Evenness index (J′= 0.41) indicates an uneven distribution of species across the study area. Notably the evenness values across all sampling stations were relatively uniform: Lilong (J′= 0.42), Koirengei (J′= 0.39), Maharabi (J′= 0.43), Sekmai (J′= 0.46), and Kangpokpi (J′= 0.36).

The order Cypriniformes exhibited the highest species abundance (n= 1,208), followed by Perciformes (n= 550). In contrast, the lowest abundances were recorded for Cichliformes (n= 9), Anguilliformes (n= 10), and Osteoglossiformes (n= 11). At the family level, Nemacheilidae exhibited the greatest abundance (n= 573, 25.3%), followed by Ambassidae (n= 550, 24.28%) and Cyprinidae (n= 455, 20.09%). The lowest abundance was observed in the family Siluridae (n= 2, 0.09%) (Fig. 4).

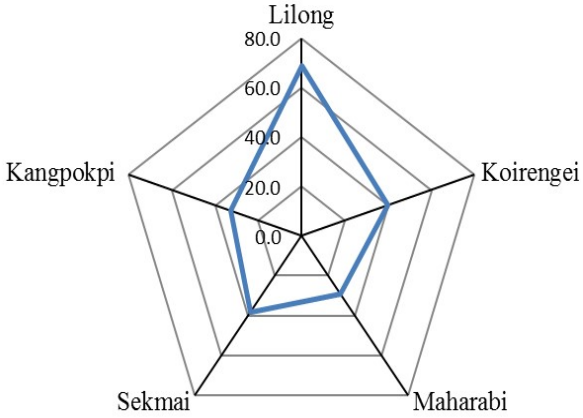

Figure 2: Distribution of Ichthyofauna across 5 sampling stations of Manipur, India.

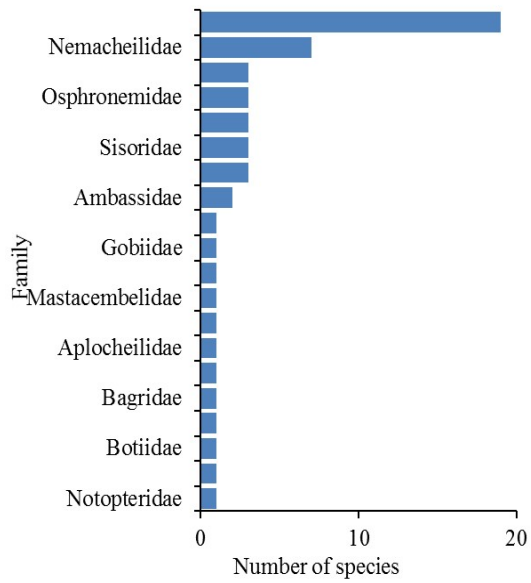

Figure 3: Distribution of species across different Ichthyofaunal families.

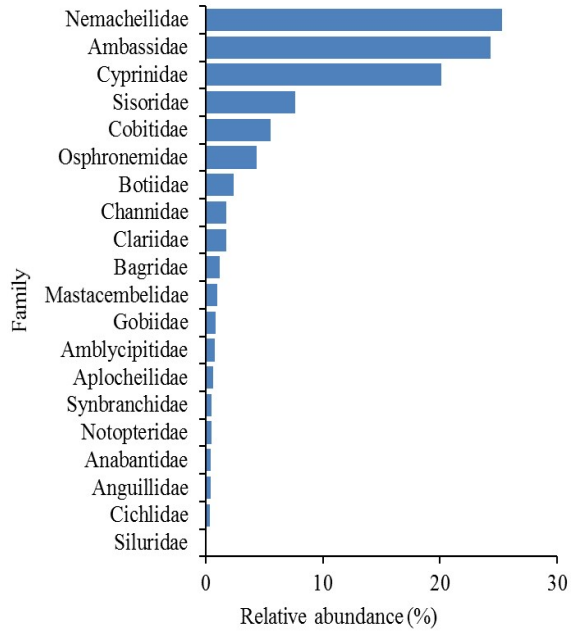

Figure 4: Relative abundance of species among different Ichthyofaunal families.

Ichthyofauna diversity

The Shannon–Wiener species diversity index indicates a high overall diversity in the study area (H′= 3.21), primarily attributed to the high species richness, subsequently supported by Margalef's diversity index (d= 6.99). However, Simpson's diversity value of 0.92 represents low diversity, which is a reflective of uneven distribution of species, as previously supported by Pielou's index. Relative diversity values across the sampling stations are comparatively consistent: Lilong (H′= 2.78), Koirengei (H′= 2.27), Maharabi (H′= 2.35), Sekmai (H′= 2.79), and Kangpokpi (H′= 2.24) (Table 2). Among taxonomic groups, the family Cyprinidae (H′= 2.59, d= 2.94) and order Cypriniformes (H′= 2.97, d= 4.09) exhibited the highest species diversity. Species richness was highest in the order Cypriniformes (S= 30), followed by Siluriformes (S= 9) and Anabantiformes (S= 7). Among families, Cyprinidae exhibited the greatest richness (S= 19, 34.54%), followed by Nemacheilidae (S= 7, 12.73%), while 12 families, viz. Amblycipitidae, Anabantidae, Anguilidae, Aplocheilidae, Bagridae, Botiidae, Cichlidae, Gobiidae, Mastacembelidae, Notopteridae, Siluridae, and Synbranchidae, are represented by a species richness of S= 1 (1.82%).

Conservation status

Nine recorded species are yet to be evaluated by IUCN (6.36%), 6 of which belong to Cypriniformes order (Cyprinidae family-04 and Nemacheilidae-02), 2 belong to Siluiriformes order (Sisoridae and Bagridae families), and 1 belong Perciformes order (Ambassidae family). Of the 46 evaluated species, 2 species, viz. *H. nobilis* (Cypriniformes: Cyprinidae) and *A. torrentis* (Siluiriformes: Amblycipitidae) are listed under the DD category (3.64%). Three species (5.45%) are listed as EN: *S. kangjupkhulensis* (Cypriniformes: Nemacheilidae), recorded from Maharabi, Sekmai, and Kangpokpi; *C. magur* (Siluriformes: Clariidae), reported from Lilong, Koirengei, and Maharabi; and *P. manipurensis* (Cypriniformes: Cyprinidae), reported from all five sampling stations. Five species (Cypriniformes family-04, Anguilliformes-01) are listed as NT (9.09%), 6 species (Cypriniformes family-04, Siluiriformes and Cichliformes 01 each) are listed as VU (10.91%), while the rest are listed in the LC category (54.55%). Notably, all species reported from Osteoglossiformes, Cyprinodontiformes, Synbranchiformes, Gobiiformes, and Anabantiformes families are listed under the LC category (Fig. 5).

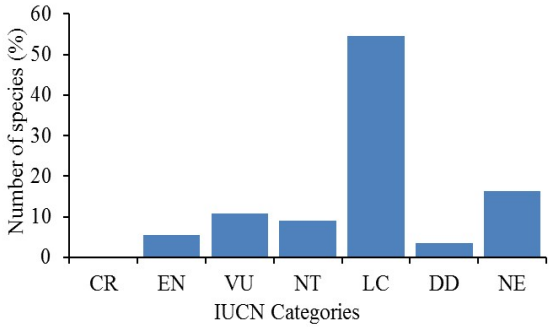

Figure 5: Percentage distribution of species across IUCN categories. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, NE: Not Evaluated.

Table 1: Taxonomic details and conservation status of the ichthyofauna recorded from the Imphal River of Manipur, India.

Family	Scientific name	Relative abundance	IUCN status	
			Category	Citations
Notopteridae	*Notopterus notopterus* (Pallas, 1769)	0.49	LC	Ng (2020)
Anguillidae	*Anguilla bengalensis* (Gray, 1831)	0.44	NT	Pike et al. (2020)
Cyprinidae	*Cyprinus carpio* Linnaeus, 1758	1.06	LC	Ford (2024)
	Osteobrama belangeri (Valencienes, 1844)	0.49	NT	Vishwanath (2010)
	Pethia manipurensis (Menon, Rema and Vish., 2000)	3.27	EN	Singh (2015)
	Pethia sp.	0.18	NE	--
	Puntius chola (Hamilton, 1822)	1.37	LC	Dahanukar (2010)
	Puntius sophore (Hamilton, 1822)	0.57	LC	Dahanukar (2010)
	Schizothorax chivae Arunkumar and Moyon, 2016	0.18	NE	--
	Bangana devdevi (Hora, 1937)	0.49	LC	Vishwanath (2010)
	Garra aboyai Hora, 1921	2.52	NE	--
	Labeo rohita (Hamilton, 1822)	0.35	LC	Dahanukar (2010)
	Ctenopharhyngodon idella (Valencienes, 1844)	0.97	LC	Bogutskaya (2022)
	Hypopthalmichthys molitrix (Valencienes, 1844)	0.26	NT	Zhao (2011)
	Hypopthalmichthys nobilis (Richardson, 1845)	0.22	DD	Huckstorf (2012)
	Amblypharyngodon mola (Hamilton, 1822)	2.16	LC	Chaudhry (2010)
	Obsarius barnoides (Vinciguerra,1890)	2.25	LC	Vidthayanon (2012)
	Devario acuticephalus (Hora, 1921)	0.40	VU	Vishwanath (2010)
	Devario sp.	0.35	NE	--
	Esomus danrica (Hamilton, 1822)	2.21	LC	Devi and Boguskaya (2009)
	Rasbora ornata Vishwanath and Laishram, 2004	0.79	VU	Vishwanath (2010)
Botiidae	*Synchrossus berdmorei* (Blyth, 1860)	2.38	NT	Chaudhry (2010)
Cobitidae	*Lepidocephalichthys berdmorei* (Blyth, 1863)	2.69	LC	Daniels and Dahanukar (2020)
	Lepidocephalichthys irrorata Hora, 1921	0.40	LC	Devi and Boguskaya (2009)
	Pangio cf. *pangia* (Hamilton, 1822)	2.47	LC	Chaudhry (2010)
Nemacheilidae	*Paracanthocobitis marmorata* Singer, Pfeiffer and Page, 2017	0.93	NE	Singer, Pfeiffer and Page, 2017
	Mustura prasadi (Hora, 1921)	2.69	VU	Singh (2010)
	Schistura kangjupkhulensis (Hora, 1921)	3.31	EN	Vishwanath (2010)
	Schistura manipurensis (Chaudhuri, 1912)	3.13	NT	Vishwanath (2010)
	Schistura nagaensis (Menon, 1987)	3.00	VU	Vishwanath (2010)
	Schistura sikmaiensis (Hora, 1921)	1.77	LC	Vishwanath (2010)
	Schistura sp.	10.46	NE	--

Table 1: (Continued).

Family	Scientific name	Relative abundance	IUCN status	
			Category	Citations
Amblycipitidae	*Amblyceps torrentis* Linthoingambi and Vishwanath, 2008	0.79	DD	Vishwanath and Ng (2010)
Sisoridae	*Gagata dolichonema* He, 1996	0.40	LC	Ng (2010)
	Glyptothorax ngapang Vishwanath and Linthoingambi, 2007	0.97	LC	Ng (2010)
	Glyptothorax sp.	6.27	NE	--
Clariidae	*Clarias gariepinus* (Burchell, 1822)	0.31	LC	Konings et al. (2019)
	Clarias cf. *magur* (Hamilton, 1822)	0.75	EN	Vishwanath (2010)
	Heteropneustes fossilis (Bloch, 1974)	0.71	LC	Fernado et al. (2019)
Bagridae	*Mystus ngasep* Darshan, Vishwanath, Mahanta and Barat, 2011	1.24	NE	--
Siluridae	*Wallago attu* (Schneider,1801)	0.09	VU	Ng et al. (2019)
Aplocheilidae	*Aplocheilus panchax* (Hamilton, 1822)	0.62	LC	Chaudhry and Chakrabarty (2018)
Synbranchidae	*Monopterus javanensis* La Cepède, 1800	0.49	LC	Sayer (2020)
Mastacembelidae	*Mastacembelus armatus* (La Cepède, 1800)	1.02	LC	Fernado et al. (2019)
Ambassidae	*Chanda nama* Hamilton,1822	23.75	LC	Dahanukar (2010)
	Parambassis waikhomi Geetakumari and Bashudha, 2012	0.53	NE	--
Cichlidae	*Oreochromis mossambica* (Peters, 1852)	0.40	VU	Bills (2019)
Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	0.84	LC	Larson et al. (2025)
Anabantidae	*Anabas testudineus* (Bloch, 1792)	0.44	LC	Ahmad et al. (2019)
Osphronemidae	*Trichogaster chuna* (Hamilton,1822)	0.13	LC	Vishwanath (2010)
	Trichogaster fasciata Blotch and Schneider, 1801	1.15	LC	Vishwanath (2010)
	Trichogaster labiosa Day, 1877	3.09	LC	Vishwanath (2010)
Channidae	*Channa gachua* (Hamilton, 1822)	0.57	LC	Chaudhry (2010)
	Channa punctata (Bloch, 1793)	1.02	LC	Chaudhry et al. (2019)
	Channa striata (Bloch, 1793)	0.18	LC	Chaudhry et al. (2019)

Abbreviation: EN: Endangered, LC: Least Concern, NE: Not Evaluated, NT: Near Threatened, VU: Vulnerable, DD: Data Deficient**.**

Table 2: Biodiversity indices for different sampling sites of the study.

Sampling sites	Shannon-Weiner (H′)	Pielou's Evenness (J')	Simpson Diversity (D)	Margalef's Diversity (d)	Remark
Lilong	2.78	0.42	0.84	5.54	High species richness, low evenness (uneven distribution)
Koirengei	2.27	0.39	0.79	3.63	
Maharabi	2.35	0.43	0.86	2.75	
Sekmai	2.79	0.46	0.93	3.32	
Kangpokpi	2.24	0.36	0.82	2.75	
	High diversity	Low evenness (uneven distribution)	Low diversity indicative of low evenness	High diversity indicative of high richness	

Discussion

A sum of 55 ichthyofaunal species from 40 genera, 20 families, and 10 orders of the total 422 species from 133 genera, 38 families, and 13 orders of ichthyofauna in northeast India (NBFGR, 2023) have been recorded in the current study in the Imphal River of Manipur, India. The number of families (n= 20) and orders (n= 10) reported in this study adds to the record of previous literature (32 families by Lokeshwor, 2019 in Manipur; 27 families and 9 orders by Lokeshwor, 2014 and Shangningam, 2015 in Chindwin basin; 35 families by Vishwanath et al., 2014 in northeast India). In the present study conducted in the Imphal River of Manipur, a total of 55 ichthyofaunal species were recorded which account for approximately 13.03% of the total 422 species reported from Northeast India. Similarly, 40 genera were identified in the study, representing 30.08% of the total 133 genera recorded from this region. The study also reported 20 families which is 52.63% of the 38 families documented across Northeast India. Furthermore, 10 orders were recorded, contributing to 76.92% of the total 13 orders known from this region.

Existing literature on the ichthyofauna suggests that there may be four fish species (*Pethia* sp., *Devario* sp., *Schistura* sp., and *Glyptothorax* sp.) potentially new to science and is under observation for further investigation and comparative studies. This finding has immense conservation prospects in the near future.

Of the total 55 species, 19 are categorised as the hill stream fish. Among them, distinct hill stream characteristics are found in a number of fish species (e.g. *Schizothorax chivae*, *Bangana devdevi*, *Paracanthocobitis mermorata*, *Mustura prasadi*, *Schistura kangjupkhulensis*, *S. manipurensis*, *S. nagaensis*, *S. sikmaiensis*, *Amblyceps torrentis*, *Glyptothorax ngapang*, etc.). Therefore, a policy must be drawn for the conservation of hill stream fishes of Manipur. On the other hand, 13 ichthyofaunal species viz., *Schizothorax chivae*, *Devario* sp., *Garra aboyai*, *Paracanthocobitis mermorata*, *Mustura prasadi*, *Schistura kangjupkhulensis*, *S. manipurensis*, *S. nagaensis*, *S. sikmaiensis*, *Amblyceps torrentis*, *Amblyceps torrentis*, *Glyptothorax ngapang*, *Glyptothorax* sp. were found to be restricted to the upper reaches of the river, while 39 species viz. *Notopterus notopterus*, *Anguilla bengalensis*, *Cyprinus carpio*, *Osteobrama belangeri*, *Pethia manipurensis*, *Puntius chola*, *P. sophore*, *Bangana devdevi*, *Labeo rohita*, *Ctenopharhyngodon idella*, *Hypopthalmichthys molitrix*, *H. nobilis*, *Amblypharyngodon mola*, *Esomus danrica*, *Rsbora ornata*, *Synchrossus berdmorei*, *Lepidocephalichthys berdmorei*, *L. irrorata*, *Pangio* cf. *pangia*, *Gagata dolichonema*, *Clarias gariepinnus*, *Clarias* cf. *magur*, *Heteropneustes fossilis*, *Mystus ngasep*, *Wallag attu*, *Aplocheilus panchax*, *Monopterus javanensis*, *Mastacembelus armatus*, *Chanda nama*, *Parambasis waikhomi*, *Oreochromis mossambica*, *Glossogobius giuris*, *Anabas testudineus*, *Trichogaster chuna*, *T. fasciata*, *T. labiosa*, *Channa punctata*, *C. gachua*, *C. striata* were recorded exclusively in the lower reaches. Only 3 species viz., *Pethia manipurensis*, *Lepidocephalichthys berdmori*, and *Mastacembelus armatus* were distributed throughout the entire stretch of the Imphal River.

Out of 55 species, 18 species are identified as ornamental species in the present study. Among the recorded species, 15 are considered exotic to this river system (e.g. *Ctenopharhyngodon idella*, *Hypopthalmichthys molitrix*, *Hypopthalmichthys nobilis*, *Clarias gariepinus*, *Oreochromis mossambica*, *Glossogobius giuris*, *Cyprinus carpio*, *Trichogaster chuna*, *Heteropneustes fossilis*, *Anabas testudineus*, *Amblypharyngodon mola*, *Labeo rohita*, *Esomus danrica*, *Aplocheilus panchax*, and *Oreochromis mossambica*) whereas 31 species are native to the region (e.g. *Paracanthocobitis mermorata*, *Pethia manipurensis*, *Pethia* sp., *Schistura kangjupkhulensis*) (Lokeshwor, 2019).

Diversity indices indicated high species richness but uneven distribution in the study area. This may be due to sand mining in the riverbed and clearing of forest in the catchment areas of the upper reaches of this river basin. The aquatic bio-resources of the Imphal River are under threat and urgently demand proper evaluation to strategize conservational measures. The lowest species richness (S= 1, 1.8%) was observed in the Amblycipitidae, Anabantidae, Anguillidae, Aplocheilidae, Bagridae, Botiidae, Cichlidae, Gobiidae, Mastacembelidae, Notopteridae, Siluridae, and Synbranchidae families may be due to niche specifications. These findings are consistent with those of Suresh et al. (2006), in which Notopteridae exhibited a species richness of 1.6%, while Amblycipitidae, Anabantidae, Aplocheilidae, Siluridae, and Synbranchidae each contributed 0.8% of the total ichthyofaunal diversity. However, a notable discrepancy is observed in the representation of the Bagridae family which may be due to seasonal variations, which accounted for 8% of total species in a study by Suresh et al. (2006), in contrast to only 1.8% in the current study. Cyprinidae family, previously reported to exhibit the highest species richness and diversity among all ichthyofaunal families in northeast India and Manipur (Singh, 2019; NBFGR, 2023) has exhibited the same in the current study. In context to the ichthyofaunal orders, species richness is highest within the order Cypriniformes followed by Siluriformes, which also aligns with the report on all ichthyofaunal orders of Manipur (Lokeshwor, 2019) and Assam by (Pathak et al., 2025). Orders such as Anguilliformes, Cichliformes, Cyprinodontiformes, Gobiiformes, and Osteoglossiformes were each represented by a single species (S= 1) in the current study. Similar patterns for Anguilliformes and Osteoglossiformes were also documented previously in Manipur (Singh, 2019), and for Cichliformes, Gobiiformes, and Osteoglossiformes in Assam (Pathak et al., 2025).

Furthermore, 16.3% of fish species in Asia are endemic, underscoring the urgent need for targeted conservation efforts (De Silva et al., 2007). Kottelat (2001), Allen et al. (2005), Shangningam, (2014),

Carrizo et al. (2017), and Lokeshwor (2019) have highlighted multiple threats to the ichthyofauna of Manipur and the Indian subcontinent, especially the endemic species, primarily driven by anthropogenic pressures such as habitat deterioration due to expanding developmental activities in catchment areas such as sand and gravel mining for urbanization, construction of railway track and tunnel, deforestation, industrial effluents and agricultural runoff; overexploitation and destructive fishing practices such as the use of fish barrages, explosives, poisoning, dynamiting, and electrofishing; the introduction of invasive species; and climate change. Pathak et al. (2025) mention instances of local extinction of *Leiodon cutcutia* from the Bornadi River basin of Assam due to overfishing. Of the 42 ichthyofaunal species globally recognized as threatened (Lakra et al., 2010), 3 species categorized as EN in the IUCN Red List Version-2024-3 were documented in the Imphal River during the current study (5.45% of total reported ichthyofauna). This number is notably lower than the 15 EN species reported from the greater Chindwin River by Singh (2019). In the current study, 16.36% of the recorded species are listed as threatened, including the 10.9% VU species. These figures are marginally lower than those from the greater Chindwin River (25% threatened, including 21% VU) and marginally higher than those from the Barak River (10% threatened, including 5% VU) as documented by Singh (2019). About, 9.09% of the recorded species belong to the NT category, while 54.54% belong to the LC category, which is again marginally lower than that reported from the Barak River (66%) but stands in stark contrast to the greater Chindwin River, where only 38% of species were classified as LC (Singh, 2019). Comparative analysis of reports from the Bornadi River of Assam (Pathak et al., 2025) shows a greater proportion of species in the LC category (2.13% EN, 5.32% VU, 6.38% NT, and 82.98% LC). 20% of the ichthyofaunal species recorded in the current study have not been comprehensively assessed by the IUCN and are listed in the NE and DD categories. These observations underscore the urgent need for further ichthyofaunal diversity assessments in the unexplored regions of Manipur to enrich taxonomic and ecological research in the area and formulate the conservation strategies of ichthyofauna within their natural habitats.

Conclusion

The study investigates the ichthyofaunal diversity, distribution, and abundance in the Imphal River of Manipur, a key river within the Indo-Burma biodiversity hotspot. Sampling conducted at 5 sites in the Manipur River basin across 4 administrative districts of the state recorded 55 fish species from 40 genera, 20 families, and 10 orders, with the Cypriniformes order being the most dominant in both species' richness and abundance. The conservation analysis revealed that over 16% of the species are threatened, while over 10% remain either unassessed or data deficient. Key threats to the ichthyofauna in the study area include habitat degradation, overfishing, and the presence of invasive species. The findings emphasize the urgent need for sustainable conservation strategies, on account of profound ecological, economic, and socio-cultural importance of the river and its ichthyofauna in context of the state of Manipur and the Chindwin-Irrawaddy River basin extending to Myanmar and other regions of northeast India.

Acknowledgments

The authors extend gratitude to the Manipur Forest Department for granting permission and necessary help for conducting this study. The authors also acknowledge the Department of Zoology, University of Science Technology Meghalaya for providing the necessary facilities and co-operation for conducting the study. The authors are also grateful to Dr. B.D. Thumdal, Principal United College, Lambung Chandel, and Mr. Dorendro Takhellambam, HOD Department Zoology, United College Chandel, and other faculties for their generous help and support. Authors are thankful to Dr. Manabendra Sarma for editing the manuscript, anonymous reviewers and editors of the journal for their valuable suggestions for upgrading the paper.

Author contributions

NIS and YMS collected data, AB, NIS and AB analysed data and drafted the manuscript, YL, YM and PS designed the study and finalized the manuscript.

Conflict of interest

The authors declare that there are no conflicting issues related to this research article.

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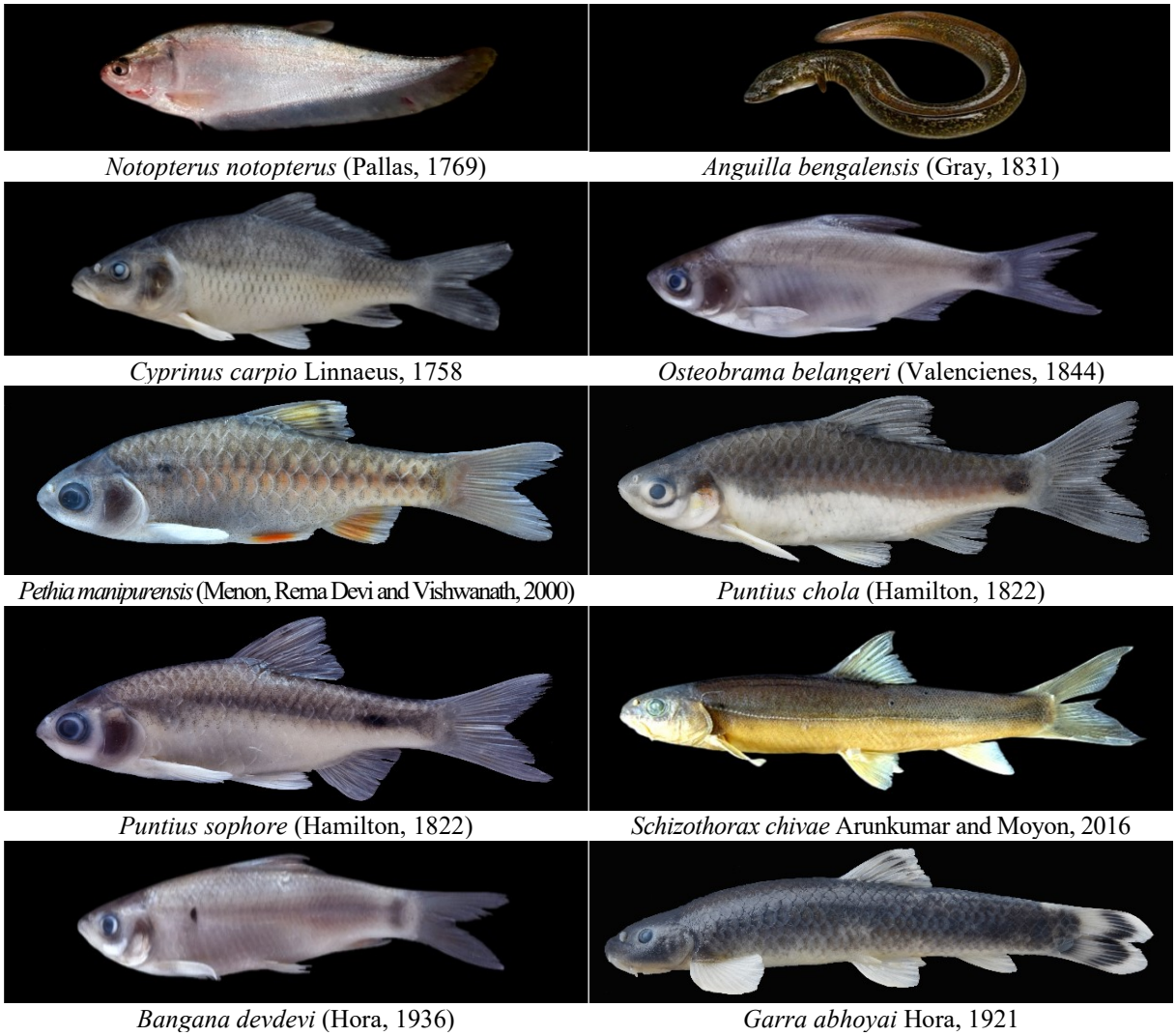
Appendix



Notopterus notopterus (Pallas, 1769) | *Anguilla bengalensis* (Gray, 1831)

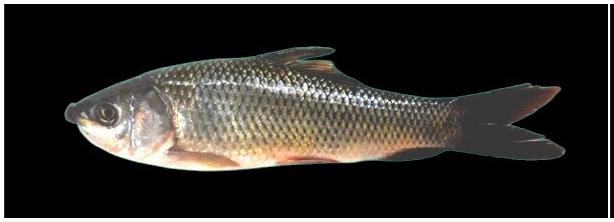
Cyprinus carpio Linnaeus, 1758 | *Osteobrama belangeri* (Valencienes, 1844)

Pethia manipurensis (Menon, Rema Devi and Vishwanath, 2000) | *Puntius chola* (Hamilton, 1822)

Puntius sophore (Hamilton, 1822) | *Schizothorax chivae* Arunkumar and Moyon, 2016

Bangana devdevi (Hora, 1936) | *Garra abhoyai* Hora, 1921

Appendix A: Fish fauna of the Imphal River in Manipur, India.



Labeo rohita (Hamilton, 1822)

Ctenopharhyngodon idella (Valenciennes, 1844)

Hypophthalmichthys molitrix (Valenciennes, 1844)

Hypophthalmichthys nobilis (Richardson, 1845)

Amblypharyngodon mola (Hamilton, 1822)

Opsarius barnoides (Vinciguerra, 1890)

Devario acuticephala (Hora, 1921)

Esomus cf. danrica (Hamilton, 1822)

Rasbora ornata Vishwanath and Laisram, 2004

Synchrossus berdmorei (Blyth, 1860)

Lepidocephalichthys berdmorei (Blyth, 1863)

Lepidocephalichthys irrorata Hora, 1921

Appendix B: Fish fauna of the Imphal River in Manipur, India.

Pangio cf. pangia (Hamilton, 1822)

Mustura prasadi (Hora, 1921)

Schistura kangjupkhulensis (Hora, 1921)

Schistura manipurensis (Chaudhuri, 1912)

Schistura nagaensis (Menon, 1987)

Schistura sikmaiensis (Hora, 1921)

Amblyceps torrentis Linthoingambi and Vishwanath, 2008

Gagata dolichonema He, 1996

Glyptothorax ngapang Vishwanath and Lithoingambi, 2007

Clarias gariepinus (Burchell, 1822)

Clarias cf. magur (Hamilton, 1822)

Heteropneustes fossilis (Bloch, 1794)

Appendix C: Fish fauna of the Imphal River in Manipur, India.

Mystus ngasep Darshan, Vishwanath, Mahanta and Barat, 2011

Wallago attu (Schneider, 1801)

Aplocheilus panchax (Hamilton, 1822)

Monopterus javanensis La Cepède, 1800

Mastacembelus armatus (La Cepède, 1800)

Chanda nama Hamilton, 1822

Parambassis waikhomi Geetakumari and Basudha, 2012

Oreochromis mossambica (Peters, 1852)

Glossogobius giuris (Hamilton, 1822)

Anabas testudineus (Bloch, 1792)

Appendix D: Fish fauna of the Imphal River in Manipur, India.

Trichogaster chuna (Hamilton, 1822)

Trichogaster fasciata Bloch and Schneider, 1801

Trichogaster labiosa Day, 1877

Channa gachua (Hamilton, 1822)

Channa punctata (Bloch, 1793)

Channa striata (Bloch, 1793)

Paracanthocobitis marmorata Singer, Pfeiffer and Page, 2017

Appendix E: Fish fauna of the Imphal River in Manipur, India.