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Ichthyofaunal Diversity of Bornadi River Basin with Special Reference to Indo-Bhutan Landscape, BTR, Assam (India): Present Status and Conservation Threats

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Abstract: The present study was conducted to assess the ichthyofaunal diversity of the Bornadi River Basin with special reference to Indo-Bhutan Landscape, BTR, Assam, India. A total of 94 different species, representing 62 genera, 26 families, and 9 orders have been recorded in the Bornadi River basin. The study revealed that Cypriniformes showed the highest diversity (54 species and 33 genera) followed by Siluriformes (20 species and 15 genera), Anabantiformes (9 species and 5 genera), Synbranchiformes (4 species and 3 genera), Mugiliformes (3 species and 2 genera) and Beloniformes, Cichliformes, Gobiformes, and Osteoglossiformes each contain (1 species and 1 genus). The IUCN status of all the recorded 94 species of ichthyofauna in the Bornadi River Basin showed 78 species (82.98 %) as Least Concern, 6 species as Near Threatened (6.38%), 5 as Vulnerable (5.32%) and 2 as Endangered (2.13%), while 3 are Not Evaluated (3.19%). *Leiodon cutcutia* is a prime example of a locally extinct fish due to overfishing and irresponsible fishing practices in the Bornadi River Basin in Indo-Bhutan landscape. Again, sand mining of Bornadi River poses a serious threat to the ichthyofaunal diversity of the river which further highlights immediate conservation measures.

Keywords: Ichthyofaunal diversity, Bornadi Wildlife Sanctuary, Indo-Bhutan landscape, Siluriformes, Conservation threats

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Introduction

Fishes are considered to be the most diversified group of vertebrates. The distribution and diversity of riverine fishes varies from basin to basin. About 2500 different species of fish are

found on the Indian subcontinent, of which 930 species are freshwater fish (Kar, 2003). Among these 930 freshwater species, there are about 20 orders, 100 families, and 300 genera. India is

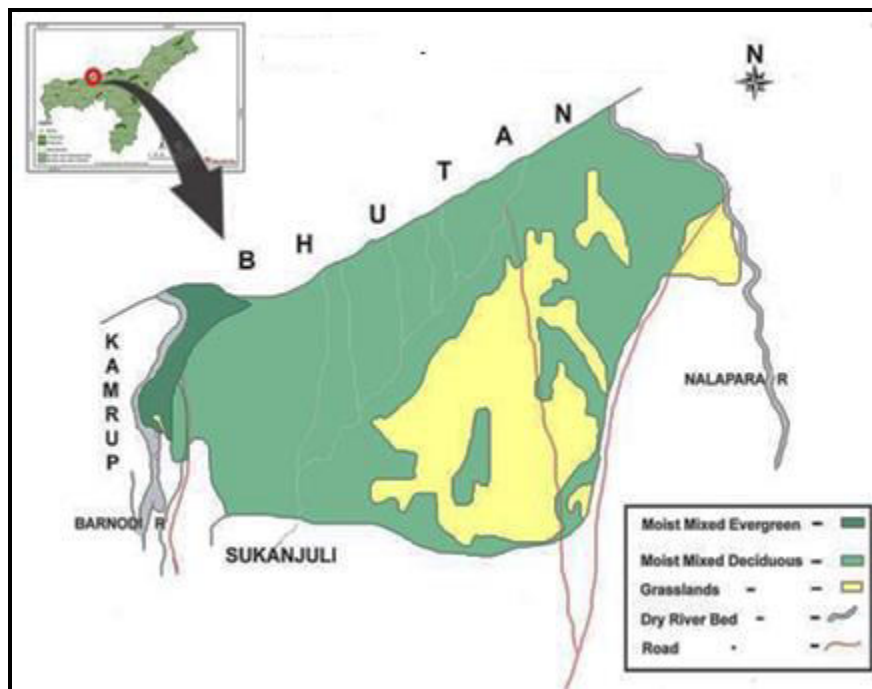


Fig. 1: Bornadi Wildlife Sanctuary, Assam showing the Bornadi River basin (Source: Assam Biodiversity Portal).

among the nations with the highest levels of biodiversity and ranks ninth in the world for freshwater megadiversity (Mittermeier and Mittermeier, 1997). In addition to being highly diverse, Northeast India's freshwater ecosystem variety is important to the region's economy (Allen *et al.*, 2010). Hundreds of fish species have been newly described from this region since Hamilton's (1822) groundbreaking research (Goswami *et al.*, 2012). Assam is a state in northeastern India that is well-known for its vibrant cultures, lush scenery, and abundant biodiversity, which includes a large number of fish species. Regarding diversity and species richness, the Bornadi River, which rises in the northern foothills of the Bhutan Himalaya from the "Ranga Noi" stream, has a colossal potential for fish. Although a great deal of research has been done on the diversity of ichthyofauna in Northeast India, particularly Assam, there does not appear to have been an exhaustive study of the ichthyofaunal diversity and conservation threats in the Bornadi River Basin, particularly in the Indo-Bhutan landscape, BTR, Assam, India.

The present study was conducted to assess the ichthyofaunal diversity of the Bornadi River Basin with special reference to Indo-Bhutan Landscape, BTR, Assam, India.

Materials and Methods

Study area

The river Bornadi or Barnadi, which dominates the Bornadi river basin, is one of the main northern tributary river basins of the Brahmaputra Valley of Assam, India. The Bornadi and its tributaries namely, the Kalpani, Dimila, Ranganoi, etc. along with some wetlands like Ken, Dipling, Bodiasisha, etc. cover the part of the present Udalguri and Darrang districts in the east and a northern part of the Baksa and Kamrup districts in the west of the river. The Bornadi River itself represents the present political boundary between the present Udalguri and Darrang districts (formerly Darrang District), the present Baksa district, and the northern part of Kamrup district. The name Bornadi or 'Barnoi' originates from the 'Ranga Noi' in the northern foothills of the Bhutan Himalaya at an altitude of 550 m above

the mean sea level and flowing for about 205 km from north to south meets the Brahmaputra at the place named “Rohinimukh” near North Guwahati (Sarma, 2008)(Fig. 1).

Methodology

The current study was conducted from October 2021 to September 2024. A basic survey of the diversity of ichthyofauna was conducted using standard methodologies (Armontrout, 1990). The survey was conducted in six separate fish landing zones and the sampling was carried out 4 times per sampling site in every month during the study period. Samples of fish were taken in the morning and evening from every landing zone and by going to nearby locations where the most active fishing methods were being used. Following Jhingran (1991), Talwar and Jhingran (1991), Jayaram (1999), and Vishwanath *et al.* (2014), several taxonomic keys were used for taxonomic categories, systematic position, and identification of fishes. The classification of fishes was done after Nelson (2006). With the aid of online resources, such as <https://www.calacademy.org/scientists/catalog-of-fishes-classification> and <https://www.fishbase.org.au/v4>, the recent taxonomic position of various orders of common species were placed in the proper taxon.

Results

Ichthyofaunal diversity of Bornadi River Basin

A total of 94 different species representing 62 genera, 26 families, and 9 orders have been recorded in the Bornadi River basin during the three-year study period (Table 1). Two exotic species were also identified in the river including the Common carp (*Cyprinus carpio*) and Japani Kawoi (*Oreochromis mossambica*), which were recorded in the study locations.

Among the 9 orders, Cypriniformes showed the highest diversity comprising 54 species and 33 genera which account for 57.45% of species and 53.23% of genera. This was followed by Siluriformes with 20 species and 15 genera contributing 21.28% of species and 24.19% of genera, Anabantiformes with 9 species and 5

genera, representing 9.57% of species and 8.06% of genera, Synbranchiformes with 4 species and 3 genera, contributing 4.26% of species and 4.84% of genera, Mugiliformes with 3 species and 2 genera, accounting for 3.19% of species and 3.23% of genera. Beloniformes, Cichliformes, Gobiformes, and Osteoglossiformes each contain 1 species and 1 genus, contributing 1.06% of species and 1.61% of genera, respectively (Fig. 2).

Among the 26 families, Cyprinidae showed the greatest species diversity, comprising 27 species across 15 genera. This was succeeded by Danionidae with 17 species in 11 genera, Bagridae with 6 species in 3 genera, Sisoridae with 5 species in 4 genera, Nemacheilidae with 4 species in 2 genera, Channidae with 4 species in 1 genus, and Ambassidae, Mastacembelidae, and Siluridae, each containing 3 species in 2 genera. Cobitidae and Schilbeidae each encompass 2 species and 2 genera, whilst Botiidae, Osphronemidae, and Psilorhynchidae each consist of 2 species and 1 genus.

Fish from other genera, specifically Ailiidae, Amblycipitidae, Anabantidae, Badidae, Belonidae, Cichlidae, Clariidae, Gobidae, Heteropneustidae, Nandidae, Notopteridae, and Synbranchidae, were noted to contain one species and one genus in each category (Fig. 3).

IUCN status

As per the IUCN Red List category Version-2024-1, the conservation status of all the recorded 94 species of ichthyofauna in the Bornadi River Basin showed 78 species (82.98 %) as Least Concern, 6 species Near Threatened (6.38%), 5 Vulnerable (5.32%) and 2 Endangered (2.13%), while 3 are Not Evaluated (3.19%). The present study recorded six Near threatened species namely *Ailia coila*, *Glyptothorax striatus*, *Neolissochilus hexagonolepis*, *Ompok bimaculatus*, *Ompok pabda*, and *Parambassis lala*. The study also records five Vulnerable species viz. *Bagarius bagarius*, *Cyprinion semiplotum*, *Cyprinus carpio*, *Oreochromis mossambicus* and *Wallago attu* along with two Endangered species namely *Clarias*

Table 1: Fish taxa recorded from the Bornadi river basin with IUCN status

S. No.	Order	Family	Species	Vernacular Name	Common Name	IUCN
1	Anabantiformes	Anabantidae	<i>Anabas testudineus</i> (Bloch, 1792)	Kawoi	Climbing perch	LC
2	Anabantiformes	Badidae	<i>Badis badis</i> (Hamilton,1822)	Vacheli	Badis	LC
3	Anabantiformes	Channidae	<i>Channa gachua</i> (Hamilton,1822)	Cheng	Red seam snakehead	LC
4	Anabantiformes	Channidae	<i>Channa punctata</i> (Bloch, 1793)	Goroi	Spotted snakehead	LC
5	Anabantiformes	Channidae	<i>Channa striata</i> (Bloch, 1793)	Sol	Striped snakehead	LC
6	Anabantiformes	Channidae	<i>Channa quinquefasciata</i> (Praveenraj, Uma, Knight, Moulitharan, Balasubramanian, Bineesh & Bleher, 2018)	Sol	--	NE
7	Anabantiformes	Nandidae	<i>Nandus nandus</i> (Hamilton,1822)	Gedgedi	Gangetic leafish	LC
8	Anabantiformes	Osphronemidae	<i>Trichogaster fasciata</i> (Bloch & Schneider, 1801)	Khaleehana	Banded gourami	LC
9	Anabantiformes	Osphronemidae	<i>Trichogaster lalius</i> (Hamilton,1822)	Khaleehana	Dwarf gourami	LC
10	Beloniformes	Belonidae	<i>Xenentodon cancila</i> (Hamilton,1822)	Kokila	Freshwater garfish	LC
11	Cichliformes	Cichlidae	<i>Oreochromis mossambicus</i> (Peters, 1852)*	Telapia	Mozambique tilapia	VU
12	Cypriniformes	Botiidae	<i>Botia dario</i> (Hamilton,1822)	Ranibotia	Bengal loach	LC
13	Cypriniformes	Botiidae	<i>Botia histrionica</i> (Blyth, 1860)	Ranibotia	Loach	LC
14	Cypriniformes	Cobitidae	<i>Canthophrys gongota</i> (Hamilton,1822)	Cucur botia	Gongota loach	LC
15	Cypriniformes	Cobitidae	<i>Lepidocephalichthys guntea</i> (Hamilton,1822)	Botia	Guntea loach	LC
16	Cypriniformes	Cyprinidae	<i>Bangana dero</i> (Hamilton,1822)	Goria/ Naru	Kalabans	LC
17	Cypriniformes	Cyprinidae	<i>Barbonymus gonionotus</i> (Bleeker, 1849)	China puthi	Silver barb	LC
18	Cypriniformes	Cyprinidae	<i>Chagunius chagunio</i> (Hamilton,1822)	Pithkaita	Chaguni	LC
19	Cypriniformes	Cyprinidae	<i>Cirrhinus mrigala</i> (Hamilton,1822)	Mirika	--	LC
20	Cypriniformes	Cyprinidae	<i>Cirrhinus reba</i> (Hamilton,1822)	Lachim bhangon	Reba carp	LC
21	Cypriniformes	Cyprinidae	<i>Cyprinion semiplotum</i> (McClelland, 1839)	Sundaree	Assamese kingfish	VU
22	Cypriniformes	Cyprinidae	<i>Cyprinus carpio</i> (Linnaeus, 1758)*	Common carp	Common carp	VU
23	Cypriniformes	Cyprinidae	<i>Garra annandalei</i> (Hora, 1921)	Siltuka	--	LC
24	Cypriniformes	Cyprinidae	<i>Garra gotyla</i> (Gray, 1830)	Siltuka	Sucker head	LC
25	Cypriniformes	Cyprinidae	<i>Garra lamta</i> (Hamilton,1822)	Siltuka	--	LC

26	Cypriniformes	Cyprinidae	<i>Garra parastenorhynchus</i> (Thoni, Gurung & Mayden, 2016)	Siltuka	--	NE
27	Cypriniformes	Cyprinidae	<i>Labeo bata</i> (Hamilton,1822)	Bhangan	Bata	LC
28	Cypriniformes	Cyprinidae	<i>Labeo boga</i> (Hamilton,1822)	Bhangan	Boga labeo	LC
29	Cypriniformes	Cyprinidae	<i>Labeo catla</i> (Hamilton,1822)	Bhakua	Catla	LC
30	Cypriniformes	Cyprinidae	<i>Labeo dyocheilus</i> (McClelland, 1839)	Silgharia		LC
31	Cypriniformes	Cyprinidae	<i>Labeo gonius</i> (Hamilton,1822)	Kurhi	Kuria labeo	LC
32	Cypriniformes	Cyprinidae	<i>Labeo rohita</i> (Hamilton,1822)	Rou	Rohu	LC
33	Cypriniformes	Cyprinidae	<i>Neolissochilus hexagonolepis</i> (McClelland, 1839)	Buka pethia	Copper mahseer	NT
34	Cypriniformes	Cyprinidae	<i>Osteobrama cotio</i> (Hamilton,1822)	Herbaggi	Cotio	LC
35	Cypriniformes	Cyprinidae	<i>Pethia conchonius</i> (Hamilton,1822)	Puthi	Rosy barb	LC
36	Cypriniformes	Cyprinidae	<i>Pethia ticto</i> (Hamilton,1822)	Kanee Puthi	Ticto barb	LC
37	Cypriniformes	Cyprinidae	<i>Puntius chola</i> (Hamilton,1822)	Puthi	Swamp barb	LC
38	Cypriniformes	Cyprinidae	<i>Puntius sophore</i> (Hamilton,1822)	Puthi	Pool barb	LC
39	Cypriniformes	Cyprinidae	<i>Puntius terio</i> (Hamilton,1822)	Puthi	One spot barb	LC
40	Cypriniformes	Cyprinidae	<i>Systomus sarana</i> (Hamilton,1822)	Seni puthi	Olive barb	LC
41	Cypriniformes	Cyprinidae	<i>Tariqilabeo latius</i> (Hamilton,1822)	Kala Bata	Gangetic latia	LC
42	Cypriniformes	Cyprinidae	<i>Tor putitora</i> (Hamilton,1822)	Junga pithia	Golden mahseer	EN
43	Cypriniformes	Danionidae	<i>Amblypharyngodon mola</i> (Hamilton,1822)	Moa	Mola carplet	LC
44	Cypriniformes	Danionidae	<i>Barilius barila</i> (Hamilton,1822)	Bairali	Barred baril	LC
45	Cypriniformes	Danionidae	<i>Barilius vagra</i> (Hamilton,1822)	Moneoree	Vagra baril	LC
46	Cypriniformes	Danionidae	<i>Cabdio jaya</i> (Hamilton,1822)	Bariala	Jaya	LC
47	Cypriniformes	Danionidae	<i>Cabdio morar</i> (Hamilton, 1822)	Bariala	Morari	LC
48	Cypriniformes	Danionidae	<i>Danio rerio</i> (Hamilton, 1822)	Kandarikana	Zebra danio	LC
49	Cypriniformes	Danionidae	<i>Devario aequipinnatus</i> (McClelland, 1839)	Lauputhi	Giant danio	LC
50	Cypriniformes	Danionidae	<i>Devario devario</i> (Hamilton,1822)	Lauputhi	Bengal danio	LC
51	Cypriniformes	Danionidae	<i>Esomus danrica</i> (Hamilton, 1822)	Darikana	Flying barb	LC
52	Cypriniformes	Danionidae	<i>Laubuka laubuca</i> (Hamilton, 1822)	Lauputhi	Indian glass barb	LC
53	Cypriniformes	Danionidae	<i>Opsarius barna</i> (Hamilton,1822)	Ozola	Barna baril	LC
54	Cypriniformes	Danionidae	<i>Osparius bendelisis</i> (Hamilton,1807)	Korang	Hamilton's barila	LC

55	Cypriniformes	Danionidae	<i>Raiamas bola</i> (Hamilton, 1822)	Korang	Trout barb	LC
56	Cypriniformes	Danionidae	<i>Rasbora daniconius</i> (Hamilton,1822)	Darikana	Slender rasbora	LC
57	Cypriniformes	Danionidae	<i>Rasbora rasbora</i> (Hamilton, 1822)	Darikana	Gangetic Scissor tailed rasbora	LC
58	Cypriniformes	Danionidae	<i>Salmostoma bacaila</i> (Hamilton, 1822)	Chelekona	Large razorbelly minnow	LC
59	Cypriniformes	Danionidae	<i>Salmostoma phulo</i> (Hamilton, 1822)	Chelekona	Finescale razorbelly minnow	LC
60	Cypriniformes	Nemacheilidae	<i>Aborichthys elongatus</i> (Hora, 1921)	Botia	--	LC
61	Cypriniformes	Nemacheilidae	<i>Mustura dikrongensis</i> (Lokeshwor and Vishwanath,2012)	Botia	--	NE
62	Cypriniformes	Nemacheilidae	<i>Paracanthocobitis botia</i> (Hamilton, 1822)	Botia	Mottled loach	LC
63	Cypriniformes	Nemacheilidae	<i>Paracanthocobitis zonalternans</i> (Blyth, 1860)	Botia	--	LC
64	Cypriniformes	Psilorhynchidae	<i>Psilorhynchus balitora</i> (Hamilton, 1822)	Siltuka	Balitora minnow	LC
65	Cypriniformes	Psilorhynchidae	<i>Psilorhynchus sucatio</i> (Hamilton, 1822)	Siltuka	River stone carp	LC
66	Gobiformes	Gobiidae	<i>Glossogobius giuris</i> (Hamilton,1822)	Panimutura	Tank goby	LC
67	Mugiliformes	Ambassidae	<i>Chanda nama</i> (Hamilton,1822)	Chanda	Elongate glass-perchlet	LC
68	Mugiliformes	Ambassidae	<i>Parambassis lala</i> (Hamilton,1822)	Lal chanda	Highfin glassy perchlet	NT
69	Mugiliformes	Ambassidae	<i>Parambassis ranga</i> (Hamilton,1822)	Boga chanda	Indian glassy fish	LC
70	Osteoglossiformes	Notopteridae	<i>Notopterus notopterus</i> (Pallas, 1769)	Kandulee	Bronze featherback	LC
71	Siluriformes	Ailiidae	<i>Ailia coila</i> (Hamilton,1822)	Kajali	Gangetic ailia	NT
72	Siluriformes	Amblycipitidae	<i>Amblyceps laticeps</i> (McClelland, 1842)	--	--	LC
73	Siluriformes	Bagridae	<i>Batasio tengana</i> (Hamilton,1822)	Singara		LC
74	Siluriformes	Bagridae	<i>Mystus cavasius</i> (Hamilton,1822)	Bartengara	Gangetic mystus	LC
75	Siluriformes	Bagridae	<i>Mystus dibrugarensis</i> (Chaudhuri, 1913)	Tengara		LC
76	Siluriformes	Bagridae	<i>Mystus tengara</i> (Hamilton,1822)	Tengara	Tengara catfish	LC
77	Siluriformes	Bagridae	<i>Mystus vittatus</i> (Hamilton,1822)	Tengara	Striped dwarf catfish	LC
78	Siluriformes	Bagridae	<i>Sperata seenghala</i> (Skyes, 1839)	Aarii	Giant river-catfish	LC
79	Siluriformes	Clariidae	<i>Clarias magur</i> (Hamilton,1822)	Magur	--	EN
80	Siluriformes	Heteropneustidae	<i>Heteropneustes fossilis</i> (Bloch,1794)	Singi	Stinging catfish	LC

81	Siluriformes	Schilbeidae	<i>Eutropiichthys vacha</i> (Hamilton,1822)	Vacha	Batchwa vacha	LC
82	Siluriformes	Schilbeidae	<i>Pachypterus atherinoides</i> (Bloch, 1794)	Bardiya	Indian potasi	LC
83	Siluriformes	Siluridae	<i>Ompok pabda</i> (Hamilton,1822)	Pabo	Pabdah catfish	NT
84	Siluriformes	Siluridae	<i>Ompok bimaculatus</i> (Hamilton,1822)	Pabo	Butter catfish	NT
85	Siluriformes	Siluridae	<i>Wallago attu</i> (Bloch and Schneider, 1801)	Borali	Wallago	VU
86	Siluriformes	Sisoridae	<i>Bagarius bagarius</i> (Hamilton,1822)	Garua	Goonch	VU
87	Siluriformes	Sisoridae	<i>Gagata cenia</i> (Hamilton,1822)	Garang	Indian gagata	LC
88	Siluriformes	Sisoridae	<i>Glyptothorax botius</i> (Hamilton,1822)	--	--	LC
89	Siluriformes	Sisoridae	<i>Glyptothorax striatus</i> (McClelland, 1842)	Pahari magur	--	NT
90	Siluriformes	Sisoridae	<i>Nangra assamensis</i> (Sen & Biswas, 1994)	Tengna	--	LC
91	Synbranchiformes	Mastacembelidae	<i>Macrogathus aral</i> (Bloch and Schneider, 1801)	Tura	One-stripe spiny eel	LC
92	Synbranchiformes	Mastacembelidae	<i>Macrogathus pancalus</i> (Hamilton,1822)	Tura	Barred spiny eel	LC
93	Synbranchiformes	Mastacembelidae	<i>Mastacembelus armatus</i> (Lacepede, 1800)	Bami	Zig-zag eel	LC
94	Synbranchiformes	Synbranchidae	<i>Monopterusuchia</i> (Hamilton,1822)	Kuchia	Cuchia	LC

EN: Endangered, VU: Vulnerable, LC: Least Concern, NT: Near Threatened, NE: Not Evaluated and * signify exotic carps

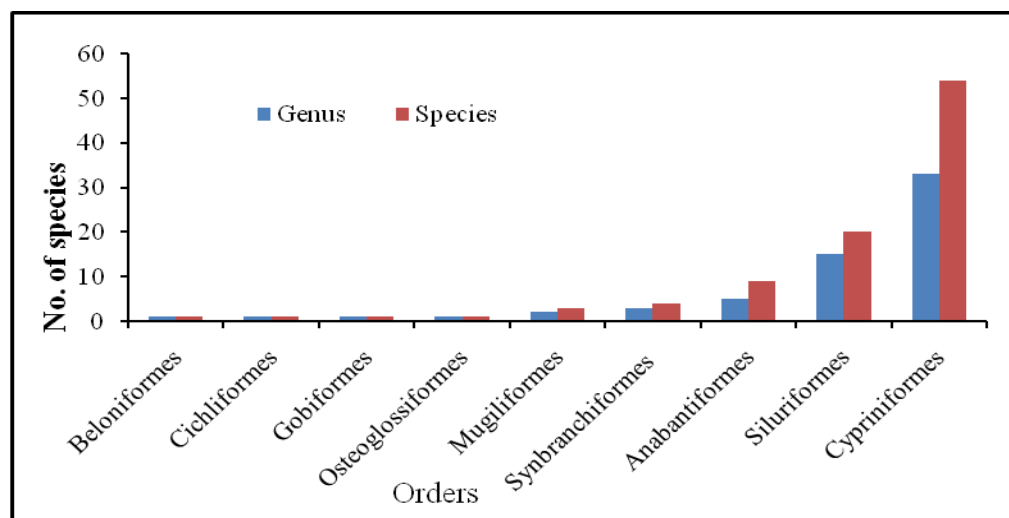


Fig. 2: Number of fish species and genus concerning orders.

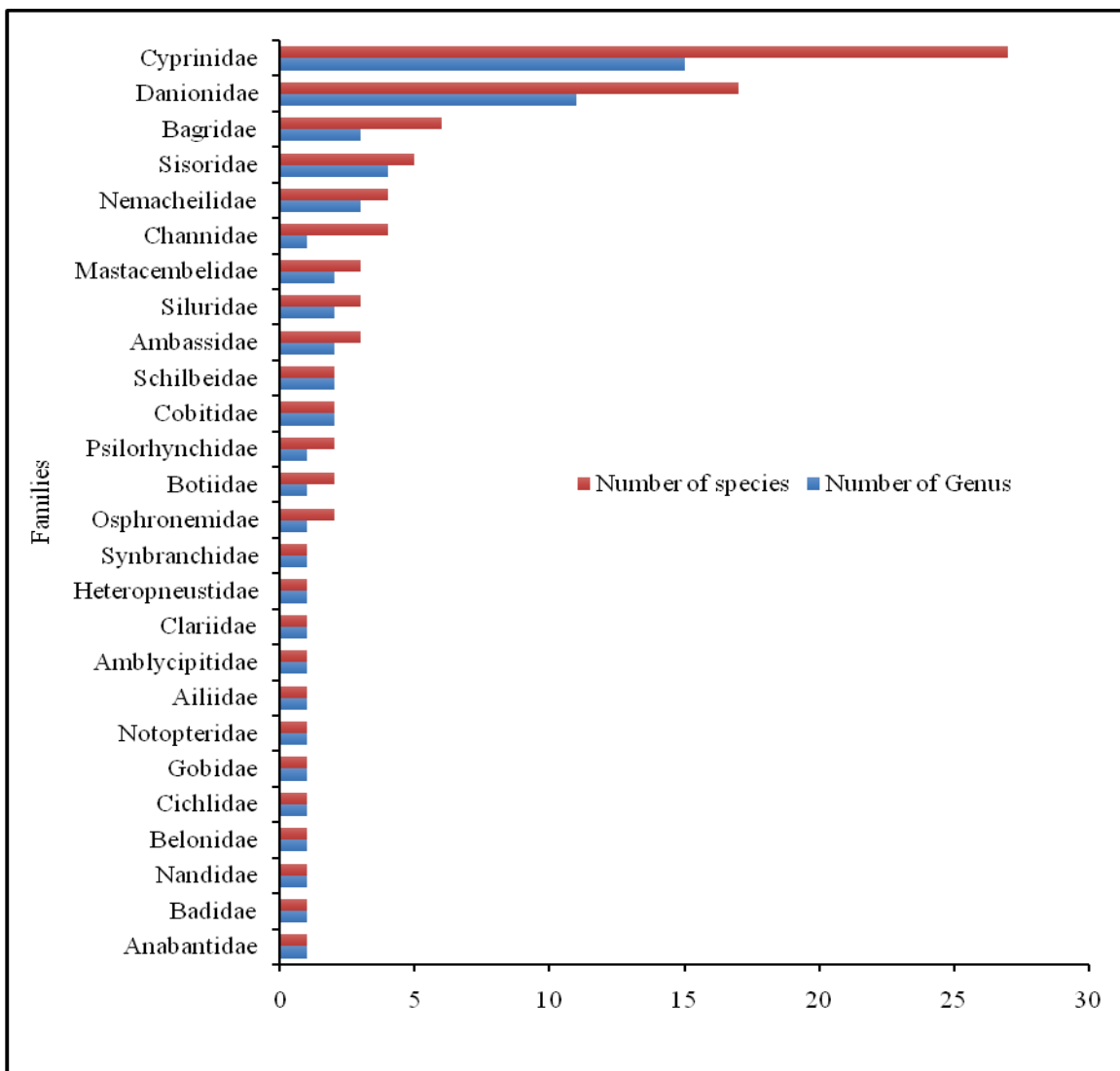


Fig. 3: Number of fish species and genus concerning families

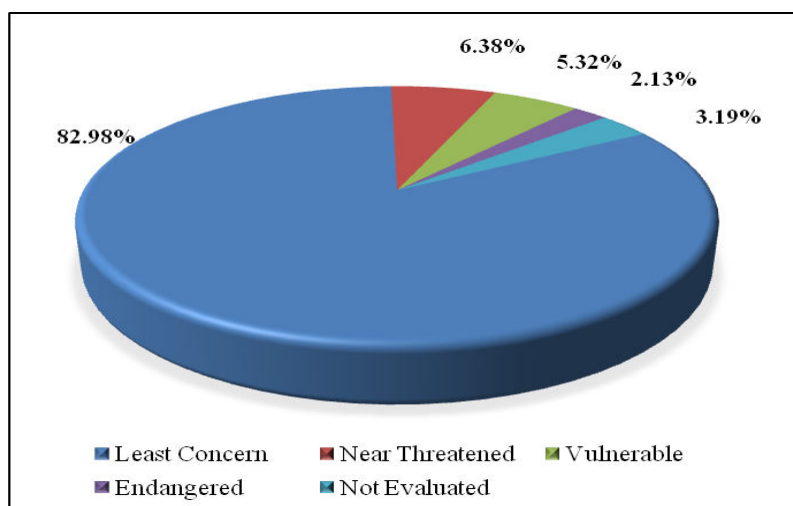


Fig. 4: IUCN Red List Category of Ichthyofauna in Bornadi river basin.

magur and *Tor putitora* (Fig. 4).

Discussion

Numerous studies have emphasized the distribution and abundance of various fish species found in the rivers of Assam. As stated by Ghosh and Lipton (1982), 172 types of fish have been identified in Assam and the neighboring areas of which many are commercially important. Das and Bordoloi (2012) analyzed the fish species of inland water bodies of River Island Majuli and reported 82 species of fish under 54 genera falling under 23 families and 10 orders. Another study conducted in the Sankosh River by Baro *et al.* (2014) reported 49 species of ornamental fish with 18 families, six orders, and 34 genera. Chetry *et al.* (2023) described the fish species of Jia Bharali River and documented 65 species of fishes which belonged to 6 orders and 20 families. Baro and Narzary (2024) found 27 species of fish in the Diring River of Baksa District, Assam. Rajbanshi (2024) reported 41 fish species belonging to 7 orders, 18 families, and 30 genera from the Nona River of Assam, India. The finding of 94 fish fauna further indicates a rich Ichthyofaunal diversity in the Bornadi river basin.

In the current context, several issues, including habitat loss and degradation, unsustainable fishing methods, illegal trade, and climate change, pose a serious threat to freshwater fish. However, human intervention and other various anthropogenic activities pose a significant threat to fish variety (Allen *et al.*, 2005; Carrizo *et al.*, 2017). Fish populations and their habitats are mainly threatened by habitat deterioration brought on by deforestation, industrial effluents and agricultural runoff, over-fishing, sand mining, and the effects of climate change.

Overfishing and irresponsible fishing practices cause species extinction, disturbance of food webs, and an overall decline in biodiversity. Overfishing causes a species' population to decline, frequently to a point where recovery is challenging. For instance, *Leiodon cutcutia* is a prime example of a

locally extinct fish of the Bornadi River Basin in Indo Bhutan landscape. According to locals, it was found abundantly in the river 3-5 years before the current study. Similarly, the mining of sand and gravel from the Bornadi River is among the major threats affecting the fish diversity of the river since it has led to erosion of the riverbank. The extraction of sand modifies the way that water flows naturally, disrupting riverbanks and rerouting river channels. This may lessen the amount of water that reaches vital habitats, drying up places where fish formerly resided or lowering the quantity of oxygen-rich water that fish require to survive. Reduced oxygen levels in water bodies can result from sand mining-related changes in water flow. Fish habitats can become fragmented due to sand mining, which can also create barriers or deeper trenches that restrict fish migration to regions for feeding, spawning, or shelter.

Conclusion

The River Bornadi is home to numerous piscine species. The fishes of the river comprise both species of hill stream as well as of plains. The local fishing community is very much dependent on fishing as it is one of the main occupations of the people of the fringe villages. However, significant threats to fish conservation and management exist in the Bornadi River, including sand mining and extensive, irresponsible fishing practices. Increasing awareness among fishermen and enforcing strict regulations can contribute to improving as well as restoring fish diversity. The Bornadi River is endowed with abundant natural resources; however, its ichthyofaunal diversity has been significantly impacted by various serious anthropogenic pressures.

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Conflict of Interest

The authors declare no conflicts of interest.

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