Original Research Article

Assessment of diversity, diversity indices, and abundance of fish species in Longnit River, Karbi Anglong, Assam, India.

ABSTRACT:

The present study uses standard methodologies to document diversity, diversity indices, abundance, and conservation status of the fishes found in the Longnit area. An extensive survey was done for a period of 8 months, from November 2020 to June 2021, in two catchment areas of Longnit River, Karbi Anglong. 23 species belonging to 14 families and 6 orders have been reported. Cyprinidae was the dominant family, and the majority of the fish were found to be of least concern. Important hill stream fishes include genera: *Botia, Crossocheilus, Garra, Glyptothorax, Labeo, Psilorhynchus*, etc. The Diversity Index (H'), The Simpson's Index of Dominance (D), and Simpson's Index of Diversity (1-D) were found to be 3.0, 0.05, and 0.95, respectively. This study has documented the fish species present in the Longnit River, and the value of diversity indices revealed considerable diversity in the river. As a preliminary study, the results can be useful in preparing conservation methods for the aquatic hill stream fish fauna and their proper implementation.

KEYWORDS: Assam; Diversity; Diversity Indices; Fish; Hill stream; Karbi Anglong; Longnit River,

1. INTRODUCTION

Fish and fisheries have always contributed to human well-being as millions of people, globally rely on fisheries either directly or indirectly for food, employment and income purpose. Human involvement is higher in case of developing countries as compared to developed countries, highlighting the importance of fisheries as a source of income in developing countries (Gebremedhin et al., 2021). It is estimated that more than 30,000 species of fishes are present on earth (FishBase, 2005), which is eventually projected to be around 32,500 (Coad and Murray, 2006). Of these, about 13,000 species live in freshwater occupying around 40-45% of the total fish population (Lévêque et al., 2008). Being one of the megadiversity countries, India contributes to about 7.7% of total fish diversity (Thakur et al., 2021).

Comprising of eight states, the region of North East India is a biodiversity hotspot. The diversity in its freshwater ecosystem can be attributed to the Himalayas and the Indo-Burma ranges, providing a varied geomorphology consisting of hills, plateaus, and valleys, which further give rise to a variety of lakes, hill streams, and rivers (Goswami et al., 2012). These hill streams form large rivers, which finally become a part of the Ganga-Brahmaputra-Barak-Chindwin-Kolodyne-Gomati-Meghna system (Kar and Khynriam, 2022). A total of 422 species of fish were reported from the NE region belonging to 133 genera and 38 families showcasing its species diversity richness (Goswami et al., 2012). Assam has the largest number of fish species, followed by the states of Arunachal Pradesh, Meghalaya, Tripura, Manipur, Nagaland, Sikkim and Mizoram (Mahanta et al., 2003).

The Karbi Anglong district of Assam is a hilly region with its highest peak measuring 1360m. It has numerous torrential streams which eventually flow into small rivers forming a part of large

rivers. It extends between 25º33′ North to 26º35′ North Latitude and 92º10′ East to 93º50′ East Longitude (https://karbianglong.gov.in). The Longnit River (*Longnit Aroi* in the Karbi language) originates from the Khonbamon Hills. It flows through the Langrik-Langroithom area before flowing through the areas of Siloni (Langsokangthu) and Longnit Bazar. The Longnit River is a Perennial River; hence, during the monsoon rains, contains a considerable amount of mineral sand transported by the flow of the river water. It originates from a peak in the hills and flows through various villages as the main source of water for the people residing in those areas before merging with the Jamuna River, a tributary of Brahmaputra, forming the drainage network of the district along with Dhansiri and Kopili rivers.

However, the region's streams have yet to be scientifically explored and researched, which has led to an incomplete assessment of the species diversity in the area. The position of the hill streams in high elevated areas with thick forest covering has been a major hindrance in studying the fish species richness. (Teronpi et al., 2015). Therefore, the present study is an effort to investigate the ichthyofaunal diversity of Longnit River, Karbi Anglong District, Assam, India.

2. METHODOLOGY

2.1 Study Area:

During the study period, fish samples were collected from two different catchment areas 3-4 km apart. The selected catchment areas are Siloni (26º02′54.37″N, 93º39′00.42″E) and Longnit (26º04′66.40″N, 93º41′05.48″E). The exact location of the sampling sites was recorded using Mobile UTM Geo map application for GPS (Global Positioning System) coordinates as shown in Figure 1 (Kumar et al., 2020).

2.2 Fish Sample Collection:

The study on fish species in the river was conducted by collecting data from captured fish. Fishing was done by experienced fishermen using electro-fishing and indigenously used fishing gears such as gill nets, hooks, lines, etc. (Teronpi et al., 2015). Photographs were taken after placing the fishes in a clean paper with a scale along the length of the specimen (Chhetry and Deka, 2016). The fish specimens were further preserved individually in 10% formalin for detailed examination and identification purposes (Gandotra and Sharma, 2015). Identification and classification of fishes were done as per standard literature (Talwar and Jhingran, 1991), (Jayaram, 1999), and online database (https://fishbase.se/home.htm). The present work is based on the studies conducted for 8 months, from November 2020 to June 2021.

The collected fish samples were counted and percentage abundance was calculated using the following formula:

2.3 Statistical Analysis:

Data analysis was done using Microsoft excel and the diversity indices were calculated using standard formula.

a) The Shannon-Weiner Species Diversity Index (H'):

The Shannon-Weiner (S-W) diversity index was used to measure the diversity in the fish population using the following formula:

$$H' = -\sum_{i=1}^{s}(pi)(\ln pi)$$

$$Pi = ni/N$$

Where, H' = index of diversity

ni = number of individuals of species i

N = total number of individuals of all species

b) Simpson's Diversity Index (D):

Simpson's Diversity Index was used to measure the diversity of the community using the following formula:

$$D = \sum \frac{n-1}{N(N-1)}$$

Where, n = number of individuals of a particular species

N = total number of individuals of all species

c) Simpson's Index of Diversity (1-D):

Simpson's Index of Diversity was used to measure the diversity of the community using the following formula:

1-D,

Where, D = Simpsons's Diversity Index

d) Margalef's Species Richness (R)

Margalef's Index is a species richness index. The formula is-

$$R = (S-1) / \ln N$$

Where, S = number of species

N = total number of individuals

e) Pielou's Measure of Species Evenness (J)

Pielou's evenness is an index to measure evenness in a diverse community. The formula is-

$$J = H' / \ln (S)$$

Where, H' = Shannon Weiner diversity

S = total number of species in a sample

2.4 Secondary Data: Secondary data was collected through observation and interaction with the local people and fishermen of the area. Occurrences of fish species other than the ones collected directly from the sampling sites were also recorded (Nag et al., 2017). Information on local names, food value, and indigenous fishing methods was obtained from the fishermen and local people.

2.5 Map of Study Area:

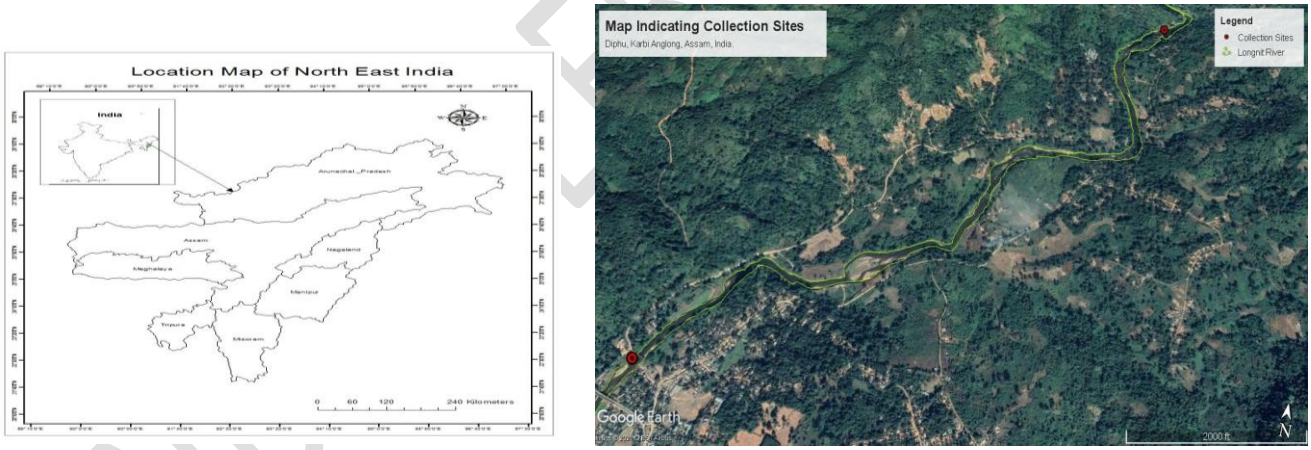


Figure 1: Map of Karbi Anglong district showing sampling sites in Longnit Area.

3. RESULTS AND DISCUSSION:

3.1 Fish Diversity:

A total of 23 species belonging to 20 genera, 14 families and 6 orders have been recorded in the Longnit River during the study period of 8 months *viz.*, Nov 2020 to June 2021. Table 1 lists the fish species that have been recorded at the present study site. The updated fish nomenclature is based on Fish Base ver. (06/2021). (https://fishbase.se/home.htm).

Out of the total of fourteen families observed throughout the study period, the dominant family was found to be Cyprinidae, as illustrated in figure 2. Cyprinidae accounts for 26% of the total, followed by Danionidae (13%), Channidae and Mastacembelidae each 9% and the rest of the families: Badidae, Anguillidae, Cobitidae, Gobiidae, Heteropneustidae, Botiidae, Psilorhynchidae, Clariidae, Sisoridae and Synbranchidae accounting 4% each. Other studies on fish diversity of rivers and beels of Karbi Anglong also show Cyprinidae to be the most dominant family (Chhetry and Deka, 2016).

TABLE 1: Fish species found in Longnit River.

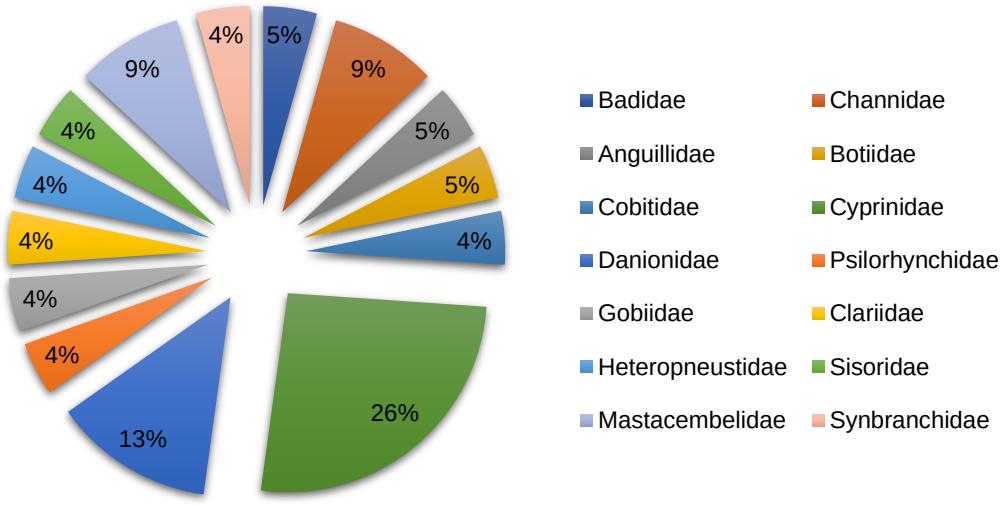
SL NO.	**LOCAL NAME**	**SCIENTIFIC NAME**	**FAMILY**
1.	Ok Nujung	*Anguilla bengalensis* (Gray,1831)	Anguillidae
2.	Arnam Chekengke	*Badis badis* (Hamilton, 1822)	Badidae
3.	Ok Charplup	*Barilius bendelisis* (Hamilton, 1807)	Danionidae
4.	Ok Phakleng	*Botia rostrata* (Gunther, 1868)	Botiidae
5.	Ok Langso	*Channa gachua* (Hamilton, 1822)	Channidae

6.	Ok Borok	*Channa punctata (*Bloch, 1793)	Channidae
7.	Magur	*Clarias magur* (Hamilton, 1822)	Clariidae
8.	Nuter	*Crossocheilus latius* (Hamilton, 1822)	Cyprinidae
9.	Nune k er	*Devario aequipinnatus* (McClelland, 1839)	Danionidae
10.	Ok Nune	*Devario assamensis* (Barman, 1984)	Danionidae
11.	Nuhong Chainong	*Garra nasuta* (McClelland, 1838)	Cyprinidae
12.	Patimutura	*Glossogobius giuris* (Hamilton, 1822)	Gobiidae
13.	Bengsirkep	*Glyptothorax trilineatus* (Blyth, 1860)	Sisoridae
14.	Singhi	*Heteropneustes fossilis* (Bloch, 1794)	Heteropneustidae
15.	Ok Nutun	*Labeo dyocheilus* (McClelland, 1839)	Cyprinidae
16.	Nutheng Morok	*Labeo pangusia* (Hamilton, 1822)	Cyprinidae
17.	Ok Sangti	*Lepidocephalichthys guntea* (Hamilton, 1822)	Cobitidae
18.	Turi	*Macrognathus aral* (Bloch & Schneider, 1801)	Mastacembelidae
19.	Bamuni	*Mastacembelus armatus* (Lacepede, 1800)	Mastacembelidae

20.	Kumchirui	*Monopterous cuchia (*Hamilton, 1822)	Synbranchidae
21.	Nutheng	*Neolissochilus hexagonolepis* (McClelland, 1839)	Cyprinidae
22.	Nuhong So	*Psilorhynchus balitora* (Hamilton, 1822)	Psilorhynchidae
23.	Ok Puthi	*Puntius sophore* (Hamilton, 1822)	Cyprinidae

FIGURE 2: Pie-chart showing percentage of family-wise distribution of fish species in Longnit River.

Fig. 2: Percentage of family-wise distribution of fish species



3.2 IUCN Status of the fish species:

The species found in the river were identified and categorized into various groups viz., Least Concern (LC), Near Threatened (NT), Vulnerable (VU) and Endangered (EN) as shown in Table 2, according to the standard IUCN list (IUCN, 2021). Seventeen (17) fish species were found to be under the Least Concern category, which included common species such as *Garra nasuta*, *Puntius sophore*, and *Barilius bendelisis*. *Anguilla bengalensis*, *Labeo pangusia*, and *Neolissochilus hexagonolepis* were all listed under the Near Threatened category, with *L. pangusia* and *N. hexagonolepis* being abundant in the river and *A. bengalensis* being rare. Only one species, *Clarias magur*, was found under the Endangered category of the Red List, while two less abundant species, *Botia rostrata*, and *Devario assamensis*, came under the Vulnerable category.

TABLE 2: IUCN status of fish species:

SL NO.	**SCIENTIFIC NAME**	**IUCN STATUS**
1.	*Anguilla bengalensis* (Gray,1831)	Near Threatened (NT)
2.	*Badis badis* (Hamilton, 1822)	Least Concern (LC)
3.	*Barilius bendelisis* (Hamilton, 1807)	Least Concern (LC)
4.	*Botia rostrata* (Gunther, 1868)	Vulnerable (VU)
5.	*Channa gachua* (Hamilton, 1822)	Least Concern (LC)

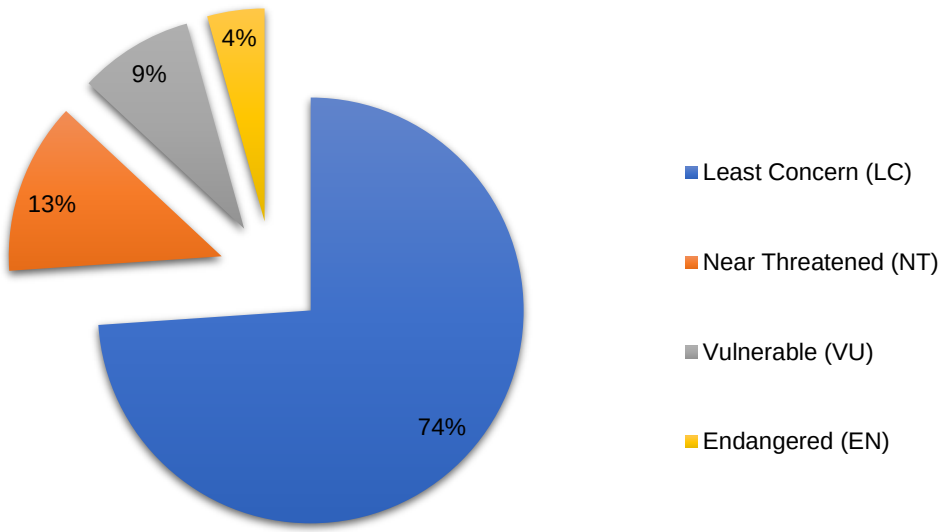
6.	*Channa punctata* (Bloch, 1793)	Least Concern (LC)
7.	*Clarias magur* (Hamilton, 1822)	Endangered (EN)
8.	*Crossocheilus latius* (Hamilton, 1822)	Least Concern (LC)
9.	*Devario aequipinnatus* (McClelland, 1839)	Least Concern (LC)
10.	*Devario assamensis* (Barman, 1984)	Vulnerable (VU)
11.	*Garra nasuta* (McClelland, 1838)	Least Concern (LC)
12.	*Glossogobius giuris* (Hamilton, 1822)	Least Concern (LC)
13.	*Glyptothorax trilineatus* (Blyth, 1860)	Least Concern (LC)
14.	*Heteropneustes fossilis* (Bloch, 1794)	Least Concern (LC)
15.	*Labeo dyocheilus* (McClelland, 1839)	Least Concern (LC)
16.	*Labeo pangusia* (Hamilton, 1822)	Near Threatened (NT)
17.	*Lepidocephalichthys guntea* (Hamilton, 1822)	Least Concern (LC)
18.	*Macrognathus aral* (Bloch & Schneider, 1801)	Least Concern (LC)

19.	*Mastacembelus armatus* (Lacepede, 1800)	Least Concern (LC)
20.	*Monopterous cuchia* (Hamilton, 1822)	Least Concern (LC)
21.	*Neolissochilus hexagonolepis* (McClelland, 1839)	Near Threatened (NT)
22.	*Psilorhynchus balitora* (Hamilton, 1822)	Least Concern (LC)
23.	*Puntius sophore* (Hamilton, 1822)	Least Concern (LC)

FIGURE 3: Pie-chart showing percentage of fish species under various threat categories as per the IUCN status.

Figure 3 shows the percentage of species under various threat categories. 75% of fish species were in the Least Concern category, 13% were Near Threatened, and 9% were vulnerable, whereas only 4% of the total fishes were in the endangered category.

Fig. 3: Percentage of species under various threat categories as per IUCN status



3.3 Abundance

Among the 23 fish species found in the Longnit River, *Neolissochilus hexagonolepis* was found to be the most abundant, as shown in Table 3 and Figure 4. It had a dominance percentage of 8.27%, whereas *Anguilla bengalensis* and *Monopterous cuchia* were found to be the least dominant, with 0.51% and 0.82% percent dominance, respectively. Other prevalent species after *N. hexagonolepis were Garra nasuta and Barilius bendelisis, with a dominance percentage of* 8% and 7.65%, respectively. Following these species were *Puntius sophore, Labeo dyocheilus, Labeo panguisa, Glyptothorax trilineatus,* and *Crossocheilus latius. Badis badis, Botia rostrata, Channa gachua, Channa punctata, Clarias magur, Devario aequipinnatus, Devario assamensis, Glossogobius giuris, Heteropneustes fossilis, Lepidocephalichthys guntea, Macrognathus aral, Mastacembelus armatus,* and *Psilorhynchus balitora* with dominance percentage lower than 5%.

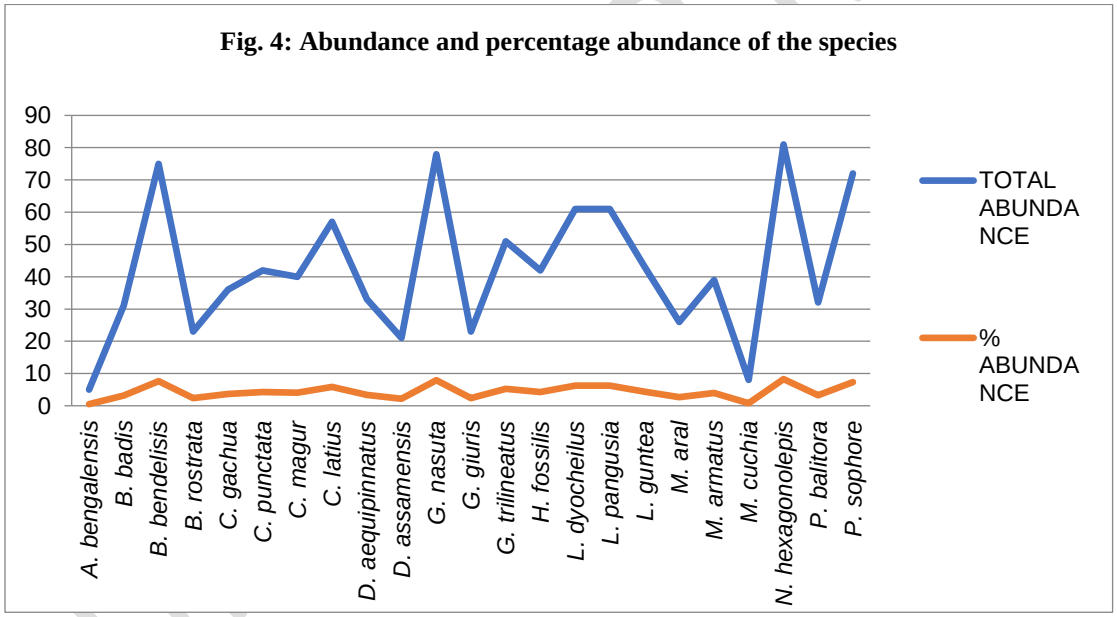
TABLE 3: Fish abundance in the river.

SL NO	SPECIES	WINTER	RETREATING WINTER	PRE MONSOON	TOTAL ABUNDANCE	% ABUNDANCE
1.	*Anguilla bengalensis*	3	0	2	5	0.510204
2.	*Badis badis*	10	11	10	31	3.163265
3.	*Barilius bendelisis*	23	21	31	75	7.653061
4.	*Botia rostrata*	8	0	15	23	2.346939
5.	*Channa gachua*	14	10	12	36	3.673469
6.	*Channa punctata*	15	11	16	42	4.285714
7.	*Clarias magur*	11	11	18	40	4.081633
8.	*Crossocheilus latius*	19	16	22	57	5.816327
9.	*Devario aequipinnatus*	10	9	14	33	3.367347

10.	*Devario assamensis*	4	9	8	21	2.142857
11.	*Garra nasuta*	34	15	29	78	7.959184
12.	*Glossogobius giuris*	2	7	14	23	2.346939
13.	*Glyptothorax trilineatus*	31	10	10	51	5.204082
14.	*Heteropneustes fossilis*	10	12	20	42	4.285714
15.	*Labeo dyocheilus*	18	16	27	61	6.22449
16.	*Labeo pangusia*	18	17	26	61	6.22449
17.	*Lepidocephalichthys guntea*	11	14	18	43	4.387755
18.	*Macrognathus aral*	4	7	15	26	2.653061
19.	*Mastacembelus armatus*	15	15	9	39	3.979592
20.	*Monopterous cuchia*	0	0	8	8	0.816327

21.	*Neolissochilus hexagonolepis*	27	22	32	81	8.265306
22.	*Psilorhynchus balitora*	9	9	14	32	3.265306
23.	*Puntius sophore*	26	17	29	72	7.346939
	TOTAL	322	259	399	980	100

FIGURE 4 Graph showing Abundance and percentage abundance of the fish population.



3.4 Statistical Analysis

The fish population of the Longnit River revealed that hill stream fishes make up the majority of the species, with some plain water species too. The following are the statistical results for the overall fish population.

A total of 980 numbers of fishes were found combining all eight months. The Shannon Weiner Diversity Index (H') was calculated to be 3.0, indicating a high level of diversity and a balance between total species and total individuals within each species. The ENS (Effective Number of Species) was discovered to be 20 (Table 4), which refers that around 20 number of species need to be equally abundant in the dataset that would result in the diversity index found.

The Simpson's Index of Dominance (D) and Simpson's Index of Diversity (1-D), respectively, were found to be 0.05 and 0.95, indicating considerable diversity.

Margalef's Species Richness (R) was 3.19, and Pielou's Species Evenness (J) was 0.94, indicating that most of the species in the population were distributed evenly.

TABLE 4: Species Richness and Diversity Indices of the fish population.

Indices						
No. of Individuals	(S)	(H')	(D)	(1-D)	(R)	(J)
980	23	3.0	0.05	0.95	3.19	0.94

S = Number of Species, H' = Species Diversity

D = Simpson Index of Dominance, 1-D = Simpson Index of Diversity

R = Margalef's Species Richness, J = Pielou's Species Evenness

4. CONCLUSION:

The present study's findings reveal that the Longnit River has rich ichthyofaunal diversity and serves as an important habitat for diverse fish species, showcasing a rich ecological system characterized by hillstream and plainwater fishes. This hillstream is an ideal habitat for critical indigenous fish genera such as *Botia, Crossocheilus, Garra, Glyptothorax, Labeo, Psilorhynchus,* etc.; these fishes feature structural adaptations like adhesive apparatus and suctorial mouth that aid in their adaptation to hilly aquatic habitat. Predominant fishes of this region include loaches, carp, eels, and a few catfish. The dominance of the Cyprinidae family is in line with earlier research conducted in the region, suggesting a consistent ecological trend across similar aquatic habitats.

The present IUCN status of the fish demonstrates the presence of vulnerable and endangered species, highlighting the ecological pressure these ichthyofauna face. Also, the observed decline in fish catches over the years, generally because of overexploitation and habitat degradation due to sand mining, indicates the urgent need for conservation strategies in the near future. The value of diversity indices from the study also indicates a relatively healthy ecosystem, revealing a rich fish diversity in the area, along with a balance between the total number of species and individuals within each species.

The results from this preliminary study underscore the necessity for further research in these hill stream rivers for proper monitoring of the fish population, which is crucial for the preparation and implementation of effective management and conservation measures to safeguard the biodiversity hotspot.

5. **ETHICAL APPROVAL:** The ethical statement is not applicable to our study. However, all the procedures for handling the fish samples were carried out according to the guidelines of the Institutional Animal Ethical Committee (IAEC).

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