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Fish Faunal Diversity and Species Composition in Rupnarayan River, West Bengal, India

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ABSTRACT

A comprehensive fish diversity study in the Rupnarayan River in West Bengal, India, was undertaken for two years, once every month at four separate study locations. We recorded a total of 109 fish species, which were ultimately divided into 19 orders, 44 families and 82 genera. Seventy-one of the total number of fish species were designated as the first to be documented from the waters of the Rupnarayan. The order Cypriniformes has the highest composition (18.26%), followed by Siluriformes (13.80%) and Clupeiformes (13.42%), and so on. Cyprinidae represented 17.02% of the total, followed by Mugilidae (9.40%), Engraulidae (7.90%), and others. In the winter, Station II had the greatest Simpson's index of diversity (0.983), whereas in the summer, Station III had the lowest (0.961). Sorensen's findings reveal strong similarities between stations I and II (0.84) and II and III (0.76), moderate similarities between stations III and IV (0.63), and dissimilarity between stations I and IV (0.26). The current study is an up-to-date documentation of the fish faunal variety and spatial distribution along the entire length of the Rupnarayan River and will certainly provide helpful baseline data for future researchers and fishery planners.

Keywords: Conservation, Cypriniformes, Ichthyofauna, Rupnarayan River, Purba Medinipur

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Introduction

In India, rivers are the single largest source of inland fishing resources, both in terms of size and production potential. The fish fauna simply represents the diversity and number of fish in the river (Zhang et al. 2021). Indian rivers serve the fishing industry by sustaining a diverse range of fish species. Fish species are an important indicator of environmental health (Chovanec et al. 2003). The number and condition of fish will reflect how well the bodies of water are doing. India contributes to about 7.7% of global fish diversity, of which 1,673 are marine and 994 are freshwater (Froese and Pauly 2020) showing a rich diversity within the aquatic ecosystem. According to Muñoz-Mas et al. (2023) approximately 34,800 species of fish had been described as of February 2022. The biodiversity study is a key requirement for river ecosystem management in any riverine ecosystem, but due to a lack of appropriate documentation, it is portrayed in the literature as a minimal contribution (Addy et al. 2014). Fish are a diverse macrofaunal group of vertebrates that offer a rich supply of protein as well as other economic advantages (Aragão et al. 2022). Anthropogenic activities, overfishing, and pollution in river water reduce the diversity of riverine ichthyofauna. Pioneer researchers worked on fish faunal diversity in river water in West Bengal including the River Damodar, Torsa, Kangasabati, Keleghai, and Kapaleswari (Das 2015; Sit et al. 2020; Jana et al. 2021; Kar et al. 2017; Pahari et al. 2017; Saha and Patra 2013; Chanda and Jana, 2021). Das (2015) reported 105 fish species under 29 families and 9 orders from Torsa river; Jana et al. (2021) enlisted 56 fish species belonging to 22 families and 8 orders from Kapaleshwary river ; Kar et al. (2017) reported 45 species under 17 families and 8 orders

from Kangsabati river; Pahari et al (2017) enlisted 55 species under 21 families and 9 orders from Keleghai river; Sit et al. (2021) reported 9 species of *Puntius* genus from undivided Medinipur distric of West Bengal; Chanda and Jana, 2021 enlisted 345 species belonging 50 families and 14 orders from Middle east Indian sate (West Bengal & Odisha). The first study on fish fauna of the Rupnarayan river was conducted by Mishra et al.(2003) and reported 17 species of fishes. Following that, studies revealed 27 and 38 fish species at Kolaghat, respectively by Ghorai et al. (2015) and Ghorai (2018). The present study is the first comprehensive study on ichthyofaunal diversity of the Rupnarayan River. Therefore, the current study will be an indicator of the health of the fish biodiversity of the Rupnarayan River and also beneficial tool for the fish researchers of the river.

Materials and Methods

The river has started its journey from Bandarghat of Paschim Medinipur District where the Dwarakeshar and Shilabati rivers meet to form the Rupnarayan, and it ends its journey at Gadiara in Howrah District by meeting with Hoogly River. The 72 km long watershed of Rupnarayan River was divided into four study stations (Table-1, Figure 1) for fish sample collection- Bandar Ghat (SI), Baksi (SII), Kolaghat (SIII), and Gadiara (SIV).

Table 1. Information and Location of all four Sampling stations

Sampling Stations	Latitude & Longitude	Distance from Station-I (km)	Width of river at the Station
Station- I (Bandar Ghat)	22°39’53.68’’N & 87°47’01.21’’E	0 KM	0.09KM (86 m)
Station- II (Baksi)	22°31’34.78’’N & 87°53’32.90’’E	25.4 KM	0.35KM (346 m)
Station- III (Kolaghat)	22°26’50.66’’N & 87°52’27.19’’E	36.6 KM	0.79 KM (789 m)
Station- IV (Gadiara)	22°13’19.48’’N & 88°02’14.76’’E	72.0 KM	1.46 KM (1459 m)

During the study period from March 2019 to February 2021, fish samples were collected every fifteen days during the Pre-monsoon/Summer (March-June), Monsoon/Rainy (July-Oct), and Post-monsoon/Winter (Nov-Feb) seasons from four designated study locations in the morning (5.00A.M.-8.00A.M.) with the assistance of local fishermen using various types of fishing equipment such as gill nets, cast nets, box traps, hooks and lines, seine nets, and others. Some species were taken from local fish markets and landing areas along the river. The fish specimens were photographed and immediately preserved in 10% formalin solution (Joshi and Sreekumar 2015) before being transported to the laboratory of PG Zoology, Raja N. L. Khan Women's College (Autonomous) for further research. Identification was accomplished using available literature (Talwar and Jhingran 1991; Jayaram 1999).

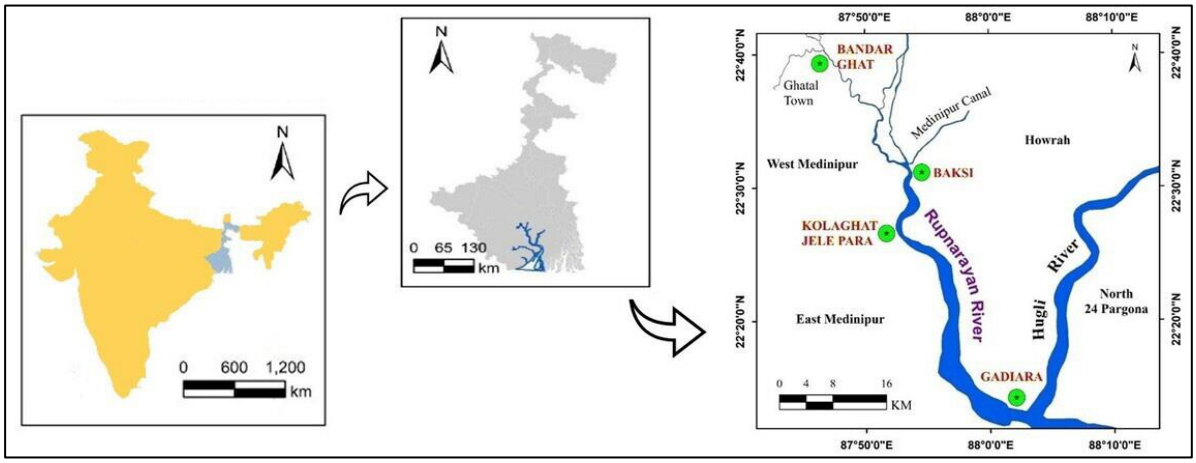

Figure 1. Schematic map showing all four sampling stations (green circles) of the Rupnarayan

Rhinomugil corsula, *Terapon jarbua*, *Ompok bimaculatus and Mastacembelus armatus* were identified by Dr. L. Kosygin Singh, Scientist-E, at the Zoological Survey of India in Kolkata. Biodiversity indices like Shannon’s Index, Simpson’s Index,

Pielou's Evenness Index, Margalef's Index and different diagram were calculated/formed by using PAST v4.11 software and MS Excel 2016.

Relative Abundance (RA):

$$RA_i = \frac{n_i}{N} \times 100$$

Where,

n_i= number of individuals in i-th species

N= total no. of individuals in whole community

Can only be between 0% and 100%. A 100% indicates presence of only one species.

<1%- Satellite species, <5%- Subdominant species, >5%- Dominant Species. (Trojan, 1992).

Shannon's diversity index 'H' (1948):

$$H = -\sum_{i=1}^{s} P_i ln P_i$$

Where,

P_i= proportion of 'i'-th species upon all individuals in a community.

ln= natural log

s = total species number within community

Value ranges between 1.5 to 3.5.

This index rarely goes greater than 4. Higher 'H' means high species diversity.

H=0 indicates presence of only one species in entire community.

Simpson Index 'D' (1949):

$$D = 1 - \sum_{i=1}^{k} \frac{n_i(n_i - 1)}{N(N-1)}$$

Where,

n_i= individual numbers in 'i'-th species

N= total individuals present in community.

k = number of species within community

'D' ranges between 0 to 1.

When 'D' increases, there is a decrease in diversity.

0=Infinite diversity,

0.1=extremely high diversity,

0.5=moderate diversity,

1=No diversity

Simpson Index of Diversity '1-D' (1949):

$$1 - D = \sum_{i=1}^{k} \frac{n_i(n_i - 1)}{N(N-1)}$$

Where,

n_i= individual numbers in 'i'-th species

N= total individuals present in community.

k = number of species within community

It's range lies between 0 and 1. Greater the value of 1-D, greater diversity

Pielou Evenness Index 'J' (1966):

$$\mathrm{J} = \frac{H}{\ln(S)}$$

Where,

H= Shannon's diversity index

S = richness of a species

It's range lies between 0 and 1. 1=Highest evenness

0=No evenness

Margalef Richness Index 'Ma' (1958):

$$Ma = \frac{(S-1)}{\ln(N)}$$

Where,

S = richness of a species

N= total individuals of existing community.

This richness index is limitless. >4= High species richness

4 to 2.5= medium richness

<2.5 = low species richness

Sorensen's similarity index 'DSC' (1948):

$$DSC = \frac{2C}{s_1 + s_2}$$

Where,

C = number of common species from both communities

s_1= species number in community 1

s_2= species number in community 2

Sorensen's similarity index value varies between 0 and 1.

>0.70= strongly similar species

0.61 to 0.70= moderately similar spies

<0.40= dissimilar species

Results

A total of 109 fish species (Table 2) were identified and categorised using Nelson's scheme of classification (2016). They fall into 19 orders, 44 families, 82 genera. Nineteen fish orders in all were reported from the current study, with Stations II and III having the maximum number of fish orders (16 orders each), and Stations I and IV having the lowest number of fish orders (12 orders each). In terms of seasons, the winter and rainy seasons had higher fish orders than the summer (Table 3). A high number of 19 species have been reported from each of the orders Siluriformes and Cypriniformes. Next, the orders Clupeiformes and Gobiformes have each recorded 10 species, followed by 8 species for the order Perciformes, seven species for the order Acanthuriformes, and six species for the order Anabantiformes. Additionally, four species each belong to the Beloniformes, Carangiformes, Synbranchiformes, and Pleuronectiformes groups of

animals. There are three species in each of the two orders, Spariformes and Mugiliformes. Both Osteoglossiformes and Cichlidiformes have two species each. The orders Anguilliformes, Moroniformes, Scombriformes, and Scorpaeniformes all have a single species.

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Amongst the total collected fish species, the dominant group is Cypriniformes (18.26%) with their compositions followed by Siluriformes with 13.80%, Clupeiformes with 13.42%, Gobiformes with 10.49%, Mugiliformes with 9.40%, Perciformes with 7.87%, Anabantiformes with 5.25%, Carangiformes with 3.72%, Spariformes with 3.40%, Acanthuriformes with 3.25%, Pleuronectiformes with 2.97%, Synbranchiformes with 2.22%, Cichlidiformes with 1.78%, Beloniformes with 1.22%. Scorpaeniformes, Osteoglossiformes, Scombriformes, Anguilliformes, and Moroniformes accounted for 0.94%, 0.69%, 0.56%, 0.41%, and 0.37% of the total group, respectively. Cyprinidae, the most abundant and diverse family of fish (Ghimire and Narayan 2021), continued to lead the group with 17.02% of all fish families. With 9.40%, Mugilidae came in second, followed by Engraulidae (7.90%), Clupeidae (5.37%), Bagridae (4.75%), and so on. In contrast, Sisoridae came in last with a proportion of 0.06%, then Pristigasteridae (0.16%), Eleotridae (0.22%), Mullidae (0.31%), Sparidae and Hemiramphidae (0.34%), and so on. The Ven diagram represent fourteen common species that are found in all four stations are *Setipinna taty*, *Setipinna phasa*, *Gudusia chapra*, *Tenualosa ilisha*, *Rhinomugil corsula*, *Mugil cephalus*, *Chelon parsia*, *Lates calcarifer*, *Terapon jarbua*, *Terapon puta*, *Pangasius pangasius*, *Ompok bimaculatus*, *Ompok pabo* and *Mastacembelus armatus.* Fishes namely *Otolithoides biauritus*, *Paranibea semiluctuosa*, *Johnius borneensis*, *Thryssa polybranchialis*, *Coilia ramcarati*, *Coilia dussumieri*, *Drepane longimana*, *Upeneus sulphureus*, *Polydactylus sextarius*, *Pampus argenteus*, and *Osteogeneiosus militaris* are the 11 unique species identified at station-IV; five species namely *Puntius terio*, *Gobiopsis macrostomus*, *Eleotris fusca*, *Rita rita* and *Erethistes hara* are present only at station-II and *Strongylura strongylura* is the sole species of station-I (Figure 2, Table 4).

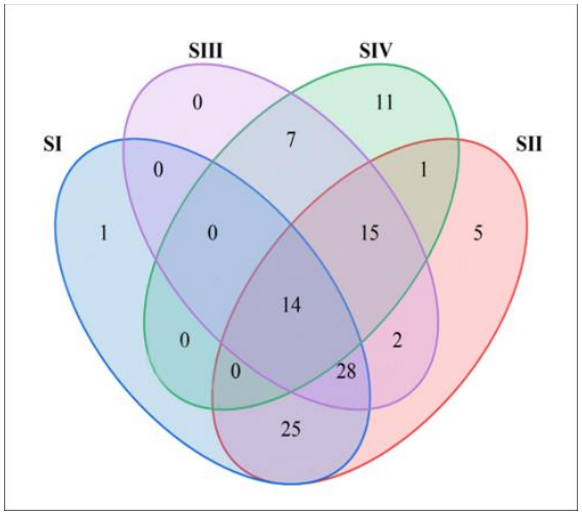

Figure 2. Venn diagram of common species count among all stations.

Table 2. Presentation of fish specimens collected in families and in accordance with orders.

ORDERS	FAMILIES	NAME OF FISH SPECIES
Acanthuriformes	Sciaenidae	*Macrospinosa cuja* (Hamilton, 1822)
		Otolithoides biauritus (Cantor, 1849)
		Paranibea semiluctuosa (Cuvier, 1830)
		Otolithes cuvieri (Trewavas, 1974)
		Johnius dussumieri (Cuvier, 1830)
		Protonibea diacanthus (Lacepède, 1802)
		Johnius borneensis (Bleeker, 1851)
Anabantiformes	Anabantidae	*Anabas testudineus* (Bloch, 1792)
	Osphronemidae	*Trichogaster fasciata* (Bloch & Schneider, 1801)
	Channidae	*Channa gachua* (Hamilton, 1822)
		Channa striata (Bloch, 1793)
		Channa punctata (Bloch, 1793)
	Nandidae	*Nandus nandus* (Hamilton, 1822)

Table 2. Continued

Anguilliformes	Anguilladae	*Anguilla bengalensis* (Gray, 1831)
Beloniformes	Hemiramphidae	*Hyporhamphus limbatus* (Valenciennes, 1847)
	Belonidae	*Xenentodon cancila* (Hamilton, 1822)
		Strongylura leiurus (Bleeker, 1850)
		Strongylura strongylura (Van Hasselt, 1823)
Carangiformes	Carangidae	*Alepes melanoptera* (Swainson, 1839)
		Chloroscombrus chrysurus (Linneaeus, 1766)
		Megalaspis cordyla (Linneaeus, 1758)
		Atropus atropos (Bloch & Schneider, 1801)
Cichlidiformes	Cichlidae	*Oreochromis mossambicus* (Peters, 1852)
		Oreochromis niloticus (Linneaeus, 1758)
Clupeiformes	Pristigasteridae	*Ilisha megaloptera* (Swainson, 1838)
	Engraulidae	*Setipinna phasa* (Hamilton, 1822)
		Setipinna taty (Valenciennes, 1848)
		Thryssa polybranchialis (Wongratana, 1983)
		Coilia dussumieri (Valenciennes, 1848)
		Coilia ramcarati (Hamilton, 1822)
	Clupeidae	*Gudusia chapra* (Hamilton, 1822)
		Hilsa kelee (Cuvier, 1829)
		Tenualosa ilisha (Hamilton, 1822)
		Tenualosa toli (Valenciennes, 1847)
Cypriniformes	Cyprinidae	*Puntius chola* (Hamilton, 1822)
		Puntius sophore (Hamilton, 1822)
		Puntius terio (Hamilton-Buchanon, 1822)
		Systomus sarana (Hamilton, 1822)
		Pethia conchonius (Hamilton, 1822)
		Pethia ticto (Hamilton, 1822)
		Cirrhinus mrigala (Hamilton, 1822)
		Labeo bata (Hamilton, 1822)
		Labeo calbasu (Hamilton, 1822)
		Labeo catla (Hamilton, 1822)
		Labeo rohita (Hamilton, 1822)
		Amblypharyngodon mola (Hamilton, 1822)
		Osteobrama cotio (Hamilton, 1822)
		Salmostoma bacaila (Hamilton, 1822)
		Salmostoma phulo (Hamilton, 1822)
		Cyprinus carpio (Linnaeus, 1758)
		Hypophthalmichthys molitrix (Valenciennes, 1844)
	Cobitidae	*Lepidocephalichthys guntea* (Hamilton, 1822)
		Lepidocephalichthys thermalis (Valenciennes, 1846)

Table 2. Continued

Gobiformes	Gobiidae	*Pseudapocryptes elongatus* (Cuvier, 1816)
		Apocryptes bato (Hamilton, 1822)
		Glossogobius giuris (Hamilton, 1822)
		Gobiopsis macrostomus (Steindachner,1861)
	Odontobutidae	*Odontamblyopus rubicundus* (Hamilton, 1822)
	Eleotridae	*Eleotris fusca* (Bloch & Schneider, 1801)
	Oxudercidae	*Taenioides cirratus* (Blyth, 1860)
	Ambassidae	*Parambassis lala* (Hamilton, 1822)
		Parambassis ranga (Hamilton, 1822)
		Chanda nama (Hamilton, 1822)
Moroniformes	Drepaneidae	*Drepane longimana* (Bloch & Schneider, 1801)
Mugiliformes	Mugilidae	*Rhinomugil corsula* (Hamilton, 1822)
		Mugil cephalus (Linnaeus, 1758)
		Chelon parsia (Hamilton, 1822)
Osteoglossiformes	Notopteridae	*Notopterus notopterus* (Pallas, 1769)
		Chitala chitala (Hamilton, 1822)
Perciformes	Haemulidae	*Pomadasys maculatus* (Bloch, 1793)
	Mullidae	*Upeneus sulphureus* (Cuvier, 1829)
	Latidae	*Lates calcarifer* (Bloch, 1790)
	Terapontidae	*Terapon jarbua* (Fabricus, 1775)
		Terapon puta (Cuvier, 1829)
	Polynemidae	*Polynemus paradiseus* (Linnaeus, 1758)
		Polydactylus sextarius (Bloch & Schneider, 1801)
		Eleutheronema tetradactylum (Shaw, 1804)
Pleuronectiformes	Soleidae	*Brachirus orientalis* (Bloch & Schneider, 1801)
	Cynoglossidae	*Cynoglossus arel* (Bloch & Schneider, 1801)
		Cynoglossus lingua (Hamilton, 1822)
		Cynoglossus puncticeps (Richardson,1846)
Scombriformes	Stromateidae	*Pampus argenteus* (Euphrasen,1788)
Scorpaeniformes	Platycephalidae	*Platycephalus indicus* (Linnaeus, 1758)
Siluriformes	Bagridae	*Rita rita* (Hamilton, 1822)
		Sperata seenghala (Sykes, 1839)
		Mystus bleekeri (Day, 1877)
		Mystus cavasius (Hamilton, 1822)
		Mystus gulio (Hamilton, 1822)
		Mystus vittatus (Bloch, 1794)
	Ariidae	*Osteogeneiosus militaris* (Linnaeus, 1758)
		Arius gagora (Hamilton, 1822)
		Arius platystomus (Day, 1877)
		Gagata cenia (Hamilton, 1822)
	Sisoridae	*Erethistes hara* (Hamilton, 1822)
	Ailiidae	*Clupisoma garua* (Hamilton, 1822)

Table 2. Continued

Siluriformes	Pangasidae	*Pangasius pangasius* (Hamilton, 1822)
	Heteropneustidae	*Heteropneustes fossilis* (Bloch, 1794)
	Clariidae	*Clarias batrachus* (Linneaeus,1758)
	Siluridae	*Wallago attu* (Bloch&Schneider, 1801)
		Ompok bimaculatus (Bloch,1794)
		Ompok pabda (Hamilton, 1822)
		Ompok pabo (Hamilton, 1822)
Spariformes	Sillaginidae	*Sillaginopsis domina* (Cuvier, 1816)
		Sillago sihama (Fabricius,1775)
	Sparidae	*Acanthopagrus latus* (Houttuyn,1782)
Synbranchiformes	Mastacembelidae	*Macrognathus aral* (Bloch & Schneider, 1801)
		Macrognathus pancalus (Hamilton, 1822)
		Mastacembelus armatus (Lacepede, 1800)
	Synbranchidae	*Ophichthys cuchia* (Hamilton, 1822)
19 Orders	**44** Families	**109** Fish species

Table 3. Abundance by fish orders

Sl. No.	**Order**	**Spatial Abundance**				**Seasonal Abundance**		
		S-I	S-II	S-III	S-IV	S	R	W
1	Acanthuriformes	0	7	23	74	12	30	62
2	Anabantiformes	71	75	22	0	43	49	76
3	Anguilliformes	5	5	3	0	5	1	7
4	Beloniformes	20	14	5	0	11	7	21
5	Carangiformes	0	0	35	84	22	38	59
6	Cichlidiformes	27	28	2	0	10	27	20
7	Clupeiformes	50	95	112	173	78	160	192
8	Cypriniformes	237	302	46	0	95	250	240
9	Gobiformes	127	153	56	0	90	117	129
10	Moroniformes	0	0	0	12	0	5	7
11	Mugiliformes	36	94	75	96	65	112	124
12	Osteoglossiformes	11	11	0	0	3	8	11
13	Perciformes	14	44	61	133	33	85	134
14	Pleuronectiformes	0	31	39	25	28	24	43
15	Scombriformes	0	0	0	18	4	9	5
16	Scorpaeniformes	0	17	5	8	6	16	8
17	Siluriformes	119	192	79	52	91	148	203
18	Spariformes	0	38	31	40	24	36	49
19	Synbranchiformes	20	31	18	2	29	11	31
No. of Orders Present		**12**	**16**	**16**	**12**	**18**	**19**	**19**
S-I=Site -I, S-II=Site-II, S-III=Site-III, S-IV=Site-IV, S=Summer, R=Monsoon, W=Winter								

Table 4. Data on fish specimens is based on location and season.

Name of Fish Species	Station I				Station II				Station III				Station IV				Total Abun	Re.Abun (%)
	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun		
M. cuja	0	0	0	**0**	0	0	0	**0**	0	0	5	**5**	2	5	7	**14**	**19**	0.59
O. biauritus	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	4	3	9	**16**	**16**	0.50
P. semiluctuosa	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	2	3	**5**	**5**	0.16
O. cuvieri	0	0	0	**0**	0	0	3	**3**	0	3	2	**5**	3	4	6	**13**	**21**	0.65
J. dussumieri	0	0	0	**0**	0	0	2	**2**	0	4	5	**9**	0	5	7	**12**	**23**	0.72
P. diacanthus	0	0	0	**0**	0	0	2	**2**	0	1	3	**4**	1	2	4	**7**	**13**	0.40
J. borneensis	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	2	1	4	**7**	**7**	0.22
A. testudineus	3	2	6	**11**	2	4	5	**11**	0	0	5	**5**	0	0	0	**0**	**27**	0.84
T. fasciata	6	8	9	**23**	5	9	9	**23**	4	0	3	**7**	0	0	0	**0**	**53**	1.65
C. striata	1	0	2	**3**	2	0	3	**5**	3	0	0	**3**	0	0	0	**0**	**11**	0.34
C. punctata	3	3	7	**13**	4	8	7	**19**	3	0	2	**5**	0	0	0	**0**	**37**	1.15
C. gachua	2	2	4	**8**	0	2	3	**5**	0	0	0	**0**	0	0	0	**0**	**13**	0.40
N. nandus	3	4	6	**13**	2	5	5	**12**	0	2	0	**2**	0	0	0	**0**	**27**	0.84
A. bengalensis	2	1	2	**5**	2	0	3	**5**	1	0	2	**3**	0	0	0	**0**	**13**	0.40
H. limbatus	4	2	2	**8**	1	0	2	**3**	0	0	0	**0**	0	0	0	**0**	**11**	0.34
X. cancila	2	0	3	**5**	3	1	5	**9**	0	2	3	**5**	0	0	0	**0**	**19**	0.59
S. leiurus	0	1	2	**3**	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**	**5**	0.16
S. strongylura	1	1	2	**4**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	**4**	0.12
A. melanoptera	0	0	0	**0**	0	0	0	**0**	0	2	4	**6**	5	7	9	**21**	**27**	0.84
C. chrysurus	0	0	0	**0**	0	0	0	**0**	0	0	3	**3**	6	8	11	**25**	**28**	0.87
M. cordyla	0	0	0	**0**	0	0	0	**0**	0	2	5	**7**	3	4	7	**14**	**21**	0.65
A. atropos	0	0	0	**0**	0	0	0	**0**	3	7	9	**19**	5	8	11	**24**	**43**	1.34
O. mossambicus	4	7	7	**18**	2	9	8	**19**	0	2	0	**2**	0	0	0	**0**	**39**	1.22
O. niloticus	2	5	2	**9**	2	4	3	**9**	0	0	0	**0**	0	0	0	**0**	**18**	0.56
I. megaloptera	0	0	0	**0**	0	0	0	**0**	0	1	1	**2**	0	1	2	**3**	**5**	0.16
S. taty	4	7	9	**20**	7	10	12	**29**	7	9	11	**27**	4	6	10	**20**	**96**	3.00
S. phasa	2	5	8	**15**	5	11	13	**29**	6	12	15	**33**	4	9	11	**24**	**101**	3.15
T. polybranchialis	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	3	3	**6**	**6**	0.19
C. ramcarati	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	6	8	7	**21**	**21**	0.65
C. dussumieri	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	4	10	15	**29**	**29**	0.90
G. chapra	0	4	7	**11**	6	9	14	**29**	6	8	15	**29**	8	11	15	**34**	**103**	3.21
H. kelee	0	0	0	**0**	0	1	0	**1**	0	2	3	**5**	2	5	3	**10**	**16**	0.50
T. ilisha	0	2	2	**4**	0	4	3	**7**	3	6	5	**14**	3	8	8	**19**	**44**	1.37
T. toli	0	0	0	**0**	0	0	0	**0**	0	2	0	**2**	1	6	0	**7**	**9**	0.28
P. terio	0	0	0	**0**	0	5	3	**8**	0	0	0	**0**	0	0	0	**0**	**8**	0.25
S. sarana	6	11	8	**25**	5	12	7	**24**	0	0	0	**0**	0	0	0	**0**	**49**	1.53
P. conchonius	0	5	5	**10**	3	8	5	**16**	0	0	0	**0**	0	0	0	**0**	**26**	0.81
P. ticto	3	5	5	**13**	0	6	5	**11**	0	0	3	**3**	0	0	0	**0**	**27**	0.84
P. chola	0	7	5	**12**	0	6	9	**15**	0	6	4	**10**	0	0	0	**0**	**37**	1.15
P. sophore	8	10	12	**30**	6	15	9	**30**	0	0	0	**0**	0	0	0	**0**	**60**	1.87
C. mrigala	1	2	0	**3**	0	3	3	**6**	0	0	0	**0**	0	0	0	**0**	**9**	0.28
L. rohita	0	5	0	**5**	0	6	0	**6**	0	0	0	**0**	0	0	0	**0**	**11**	0.34

S, R, W and Re. Abun are abbreviations for Summer, Winter, Rainy and Relative Abundance respectively

Table 4. Continued

Name of Fish Species	Station I				Station II				Station III				Station IV				Total Abun	Re.Abun (%)
	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun		
L. bata	0	4	4	**8**	3	5	8	**16**	0	0	0	**0**	0	0	0	**0**	**24**	0.75
L. calbasu	0	0	3	**3**	0	3	2	**5**	0	0	0	**0**	0	0	0	**0**	**8**	0.25
L. catla	0	2	0	**2**	0	3	0	**3**	0	0	0	**0**	0	0	0	**0**	**5**	0.16
A. mola	10	12	15	**37**	11	14	17	**42**	4	9	12	**25**	0	0	0	**0**	**104**	3.25
O. cotio	0	5	8	**13**	4	7	8	**19**	0	8	0	**8**	0	0	0	**0**	**40**	1.25
S. phulo	8	10	12	**30**	7	11	15	**33**	0	0	0	**0**	0	0	0	**0**	**63**	1.97
S. bacaila	5	7	11	**23**	8	12	14	**34**	0	0	0	**0**	0	0	0	**0**	**57**	1.78
C. carpio	0	0	2	**2**	0	0	5	**5**	0	0	0	**0**	0	0	0	**0**	**7**	0.22
H. molitrix	0	4	0	**4**	0	6	0	**6**	0	0	0	**0**	0	0	0	**0**	**10**	0.31
L. guntea	3	5	7	**15**	0	7	9	**16**	0	0	0	**0**	0	0	0	**0**	**31**	0.97
L. thermalis	0	0	2	**2**	0	4	3	**7**	0	0	0	**0**	0	0	0	**0**	**9**	0.28
P. elongatus	4	4	7	**15**	6	8	9	**23**	0	4	5	**9**	0	0	0	**0**	**47**	1.47
L. bata	0	4	4	**8**	3	5	8	**16**	0	0	0	**0**	0	0	0	**0**	**24**	0.75
L. calbasu	0	0	3	**3**	0	3	2	**5**	0	0	0	**0**	0	0	0	**0**	**8**	0.25
L. catla	0	2	0	**2**	0	3	0	**3**	0	0	0	**0**	0	0	0	**0**	**5**	0.16
A. mola	10	12	15	**37**	11	14	17	**42**	4	9	12	**25**	0	0	0	**0**	**104**	3.25
O. cotio	0	5	8	**13**	4	7	8	**19**	0	8	0	**8**	0	0	0	**0**	**40**	1.25
S. phulo	8	10	12	**30**	7	11	15	**33**	0	0	0	**0**	0	0	0	**0**	**63**	1.97
S. bacaila	5	7	11	**23**	8	12	14	**34**	0	0	0	**0**	0	0	0	**0**	**57**	1.78
C. carpio	0	0	2	**2**	0	0	5	**5**	0	0	0	**0**	0	0	0	**0**	**7**	0.22
H. molitrix	0	4	0	**4**	0	6	0	**6**	0	0	0	**0**	0	0	0	**0**	**10**	0.31
L. guntea	3	5	7	**15**	0	7	9	**16**	0	0	0	**0**	0	0	0	**0**	**31**	0.97
L. thermalis	0	0	2	**2**	0	4	3	**7**	0	0	0	**0**	0	0	0	**0**	**9**	0.28
P. elongatus	4	4	7	**15**	6	8	9	**23**	0	4	5	**9**	0	0	0	**0**	**47**	1.47
A. bato	3	0	4	**7**	6	5	8	**19**	6	0	0	**6**	0	0	0	**0**	**32**	1.00
G. giuris	5	4	8	**17**	4	7	9	**20**	2	0	5	**7**	0	0	0	**0**	**44**	1.37
G. macrostomus	0	0	0	**0**	0	3	0	**3**	0	0	0	**0**	0	0	0	**0**	**3**	0.09
O. rubicundus	12	11	8	**31**	11	8	5	**24**	5	4	4	**13**	0	0	0	**0**	**68**	2.12
E. fusca	0	0	0	**0**	0	3	4	**7**	0	0	0	**0**	0	0	0	**0**	**7**	0.22
T. cirratus	0	4	0	**4**	4	5	0	**9**	0	6	0	**6**	0	0	0	**0**	**19**	0.59
P. lala	2	6	4	**12**	1	3	4	**8**	0	0	0	**0**	0	0	0	**0**	**20**	0.62
P. ranga	3	4	12	**19**	2	5	11	**18**	0	0	0	**0**	0	0	0	**0**	**37**	1.15
C. nama	7	8	7	**22**	5	9	8	**22**	2	6	7	**15**	0	0	0	**0**	**59**	1.84
D. longimana	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	5	7	**12**	**12**	0.37
R. corsula	4	7	8	**19**	11	19	17	**47**	8	12	13	**33**	11	18	15	**44**	**143**	4.46
M. cephalus	0	1	3	**4**	2	3	5	**10**	2	4	5	**11**	5	7	6	**18**	**43**	1.34
C. parsia	0	5	8	**13**	8	13	16	**37**	7	11	13	**31**	7	12	15	**34**	**115**	3.59
N. notopterus	2	4	4	**10**	1	3	5	**9**	0	0	0	**0**	0	0	0	**0**	**19**	0.59
C. chitala	0	1	0	**1**	0	0	2	**2**	0	0	0	**0**	0	0	0	**0**	**3**	0.09
P. maculatus	0	0	0	**0**	0	0	4	**4**	0	0	4	**4**	3	7	9	**19**	**27**	0.84
U. sulphureus	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	3	3	4	**10**	**10**	0.31
L. calcarifer	0	0	2	**2**	1	2	2	**5**	1	2	3	**6**	1	3	4	**8**	**21**	0.65

S, R, W and Re. Abun are abbreviations for Summer, Winter, Rainy and Relative Abundance respectively

Table 4. Continued

Name of Fish Species	Station I				Station II				Station III				Station IV				Total Abun	Re.Abun (%)
	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun	S	R	W	Abun		
T. jarbua	0	2	3	**5**	0	3	5	**8**	2	7	9	**18**	4	6	9	**19**	**50**	1.56
T. puta	0	2	5	**7**	1	4	5	**10**	0	3	5	**8**	0	5	8	**13**	**38**	1.19
P. paradiseus	0	0	0	**0**	0	4	6	**10**	4	8	9	**21**	7	13	17	**37**	**68**	2.12
P. sextarius	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	2	3	6	**11**	**11**	0.34
E. tetradactylum	0	0	0	**0**	0	3	4	**7**	0	0	4	**4**	4	5	7	**16**	**27**	0.84
B. orientalis	0	0	0	**0**	2	0	3	**5**	4	0	4	**8**	0	0	0	**0**	**13**	0.40
C. arel	0	0	0	**0**	2	5	5	**12**	4	3	8	**15**	5	4	7	**16**	**43**	1.34
C. lingua	0	0	0	**0**	4	2	3	**9**	5	3	4	**12**	2	2	5	**9**	**30**	0.94
C. puncticeps	0	0	0	**0**	0	3	2	**5**	0	2	2	**4**	0	0	0	**0**	**9**	0.28
P. argenteus	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	4	9	5	**18**	**18**	0.56
P. indicus	0	0	0	**0**	4	8	5	**17**	0	5	0	**5**	2	3	3	**8**	**30**	0.93
R. rita	0	0	0	**0**	2	1	0	**3**	0	0	0	**0**	0	0	0	**0**	**3**	0.09
S. seenghala	0	2	5	**7**	0	3	8	**11**	0	1	3	**4**	0	0	0	**0**	**22**	0.69
M. gulio	4	0	8	**12**	0	0	6	**6**	0	0	0	**0**	0	0	0	**0**	**18**	0.56
M. vittatus	6	11	9	**26**	7	12	10	**29**	0	2	3	**5**	0	0	0	**0**	**60**	1.87
M. bleekeri	0	2	2	**4**	1	3	4	**8**	0	1	1	**2**	0	0	0	**0**	**14**	0.44
M. cavasius	2	2	4	**8**	3	7	8	**18**	0	4	5	**9**	0	0	0	**0**	**35**	1.09
O. militaris	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	3	3	**6**	**6**	0.19
A. gagora	0	0	0	**0**	2	3	2	**7**	2	3	3	**8**	3	0	0	**3**	**18**	0.56
A. platystomus	0	0	0	**0**	0	2	1	**3**	1	2	2	**5**	2	3	2	**7**	**15**	0.47
G. cenia	0	3	4	**7**	4	5	0	**9**	0	0	0	**0**	0	0	0	**0**	**16**	0.50
E. hara	0	0	0	**0**	2	0	0	**2**	0	0	0	**0**	0	0	0	**0**	**2**	0.06
C. garua	0	0	0	**0**	0	4	6	**10**	2	7	8	**17**	5	8	10	**23**	**50**	1.56
P. pangasius	1	2	1	**4**	1	3	2	**6**	0	2	0	**2**	0	1	0	**1**	**13**	0.40
H. fossilis	3	5	7	**15**	0	6	8	**14**	0	2	0	**2**	0	0	0	**0**	**31**	0.97
C. batrachus	2	5	5	**12**	2	7	3	**12**	0	2	0	**2**	0	0	0	**0**	**26**	0.81
W. attu	0	1	3	**4**	3	0	3	**6**	0	1	0	**1**	0	0	0	**0**	**11**	0.34
O. bimaculatus	0	0	5	**5**	4	2	8	**14**	4	2	5	**11**	3	0	0	**3**	**33**	1.03
O. pabda	2	1	5	**8**	3	4	7	**14**	0	0	4	**4**	0	0	0	**0**	**26**	0.81
O. pabo	2	0	5	**7**	7	5	8	**20**	2	1	4	**7**	4	2	3	**9**	**43**	1.34
S. domina	0	0	0	**0**	8	8	9	**25**	6	7	9	**22**	5	8	11	**24**	**71**	2.22
S. sihama	0	0	0	**0**	0	3	5	**8**	1	3	5	**9**	2	4	4	**10**	**27**	0.84
A. latus	0	0	0	**0**	2	0	3	**5**	0	0	0	**0**	0	3	3	**6**	**11**	0.34
M. pancalus	4	0	5	**9**	5	0	7	**12**	3	0	2	**5**	0	0	0	**0**	**26**	0.81
M. aral	2	0	3	**5**	3	0	3	**6**	0	0	0	**0**	0	0	0	**0**	**11**	0.34
M. armatus	1	2	1	**4**	2	4	2	**8**	1	0	0	**1**	2	0	0	**2**	**15**	0.47
O. cuchia	0	0	2	**2**	1	2	2	**5**	5	3	4	**12**	0	0	0	**0**	**19**	0.59

S, R, W and Re. Abun are abbreviations for Summer, Winter, Rainy and Relative Abundance respectively

Shannon's diversity index *H* climbs above 4.1 (Table 5) during the rainy (4.111) and winter (4.211) seasons at station-II, indicating greater species diversity there (4.230) than at other stations. Compared to the summer (4.164), the winter (4.350) and rainy (4.310) are little more diversified. The Simpson index *D* is much less than 0.1 and ranges from 0.018 (S-II) to 0.030 (S-IV) in terms of station and from 0.016 (winter) to 0.020 (rainy) in terms of season. It would therefore not be an overstatement to say that the river is extremely diverse throughout the year. Pielou's evenness index J (the upper limit of this index is 1, indicating maximum evenness) never falls below 0.923 (S-III) and has even climbed as high as 0.947 (S-IV) across all locations and seasons. It is straightforwardto deduce that station-IV and station-III, respectively, exhibit the highest and lowest evenness. A high species richness is indicated by a Margalef's index (Ma) value exceeding 4. Ma is significantly higher at station-II during the winter (12.920) and lowest at station-III during the summer (6.696). Station-wise, station-II exhibits the highest richness (12.650), while station-IV exhibits the lowest richness (7.147). Figure 3 and 4 are graphical representations of the studied biodiversity indices. The biodiversity indices for the entire river, both spatially and seasonally are shown in Table 6.

Strong similarities are found (Table 7) between stations I & II (0.84) and stations II & III (0.76), according to the dice similarity coefficient. Stations III and IV have species that are moderately similar (0.63). The species compositions are dissimilar between stations I and IV (0.26), which is desirable because station I is freshwater habitat and station IV is esturine in nature. As shown in Figure 5, along with the change in species richness (lnS), a corresponding improvement in Shannon's diversity (H) and Pielou's evenness (lnE) is observed as the volume of fish samples gathered over time increases across the entire river. Overall, there is no evidence of unscientific abrupt variation in the richness, evenness, or diversity of species. The fish species studied in this work have been listed and the degree of conservation determined to be 70% Least Concern (LC), representing 75 fish species of the total data, 11% Not Evaluated (NE), representing 12 fish species of the total data, 9% Near Threatened (NT), representing 10 fish species, 7% Data Deficient (DD), representing 8 fish species, and 3% Vulnerable (VU), representing 4 fish species filling this category (Figure 6). The hierarchical clustering process involved standardizing abundance scores from table 2 (z scores) and computing Pearson's correlation of sum of squares. The group average cluster method demonstrates clustroid similarity (fish orders). Cichlidiformes are the most representative, while Anabantiformes are the least. Interestingly, the third level cluster (shown in Figure 7) ranging from Anabantiformes to Cichlidiformes shares a less-saline habitat.

Discussion

The maximum number of species observed in orders Siluriformes and Cypriniformes as well as the high abundance of these orders is also seen in the Brahamputra River (Galib, 2015) and lotic water in Arunachal Pradesh (Gurumayum et al. 2016). The present observation agree with similar findings reported by Chakraborty et al. (2021), Chapin et al. (2000), Saha and Chakraborty (2021) in the Rajar Beel wetland, West Bengal. Based on Shannon-Wiener Index (H) (Jewel et al. 2018), the Atari River habitat showed more diversity in fish population than the Lakhandaha Wetland habitat in Bangladesh. Higher Shannon index in December while a lower one in April was reported from Meghna River, Bangladesh (Hossain et al. 2012) and Bakkhali River estuary (Rashed-Un-Nabi et al. 2011). Previous work on Rupnarayan River at Kolaghat region received scores of 3.251 for 'H' index, 0.049 for the Simpson's dominance index, and Simpson's index of diversity (1-D) of 0.951, 0.947 and 0.932 (Ghorai et al.2015). The similarity index shows maximum similarity was observed between Hooghly River and surrounded study canals (0.6418) whereas the river and ponds showed moderate similarity (0.6153) in the study (Nath and Patra 2017). The values of Pielou's Evenness Index of sample stations I, II, III and IV were 0.938, 0.940, 0.923 and 0.947 respectively (Table- 5). When the value approaches one, it indicates that the individuals are distributed equally. Here the value is 0.928 (Summer), 0.932 (Rainy), 0.943 (Winter) indicates towards the equitability of the river ecosystem under study. The fish diversity study in Ghaghara River (Kumar et al. 2020) in Northern India showed the evenness index varied from 0.754 to 0.847 in his study. The Margalef value ranges spatially 7.148- 12.650 and highest value encoded in rainy season (Table-5).

Table 5. Spatial Indices by Season (utilised application software PAST v4.11)

Biodiversity Indices	Station I			Station II			Station III			Station IV		
	S	R	W	S	R	W	S	R	W	S	R	W
Species (Richness)	42	55	62	58	73	81	33	50	53	39	45	43
Individuals (Abundance)	154	247	336	227	422	488	119	211	282	149	253	315
Shannon's diversity index (H)	3.544	3.800	3.968	3.855	4.111	4.211	3.347	3.681	3.786	3.528	3.625	3.620
Simpson Index (D)	0.034	0.026	0.021	0.025	0.019	0.017	0.039	0.030	0.027	0.033	0.031	0.030
Simpson's Index of Diversity (1-D)	0.966	0.974	0.979	0.975	0.981	0.983	0.961	0.970	0.973	0.967	0.969	0.970
Pielou's Evenness Index (J)	0.948	0.948	0.961	0.949	0.958	0.958	0.957	0.941	0.954	0.963	0.952	0.962
Simpson's Reciprocal Index (1/D)	29.061	38.447	46.773	40.161	52.411	57.937	25.517	33.300	37.341	30.202	32.446	33.333
Margalef's Richness Index (Ma)	8.140	9.801	10.490	10.510	11.910	12.920	6.696	9.156	9.217	7.594	7.952	7.301

Table 6. Biodiversity indices for the entire river, both spatially and seasonally

Biodiversity Indices	Station I	Station II	Station III	Station IV	Summer	Rainy	Winter
Species (Richness)	68	90	66	48	89	102	101
Individuals (Abundance)	737	1137	612	717	649	1133	1421
Shannon's diversity index (H)	3.957	4.230	3.867	3.665	4.164	4.310	4.350
Simpson Index (D)	0.023	0.018	0.027	0.030	0.020	0.017	0.016
Simpson's Index of Diversity (1-D)	0.977	0.982	0.973	0.970	0.980	0.983	0.984
Pielou's Evenness Index (J)	0.938	0.940	0.923	0.947	0.928	0.932	0.943
Simpsons Reciprocal Index (1/D)	43.290	56.243	37.397	33.795	49.702	58.411	62.305
Margalef's Richness Index (Ma)	10.150	12.650	10.130	7.148	13.590	14.360	13.780

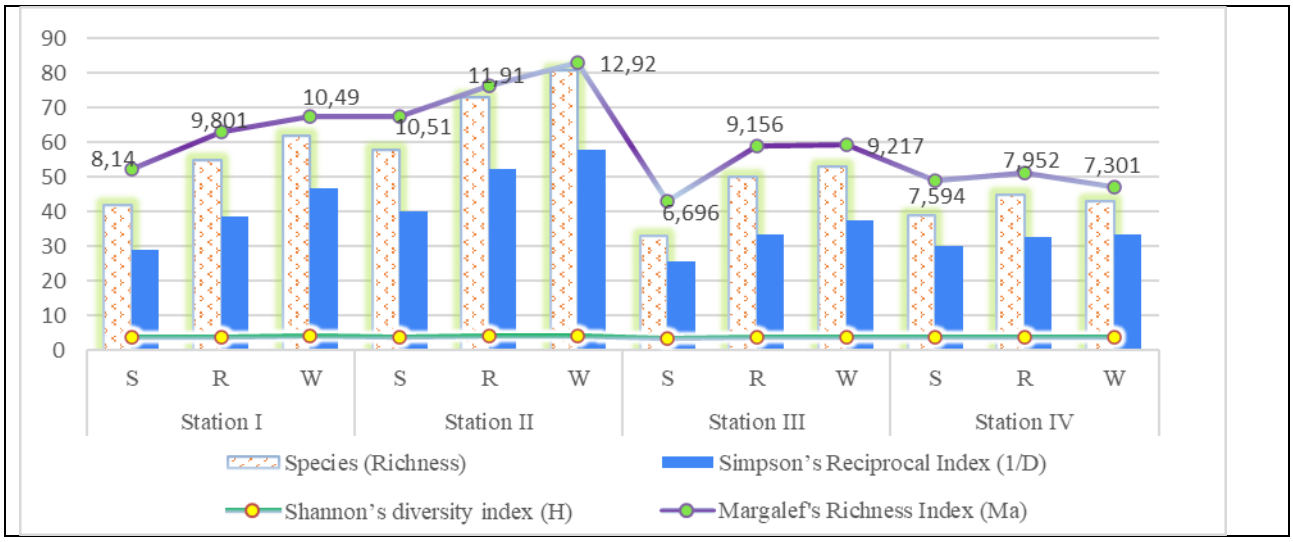

Figure 3. Various indices are compared both in terms of station and seasons as on Table 4. (1 of 2)

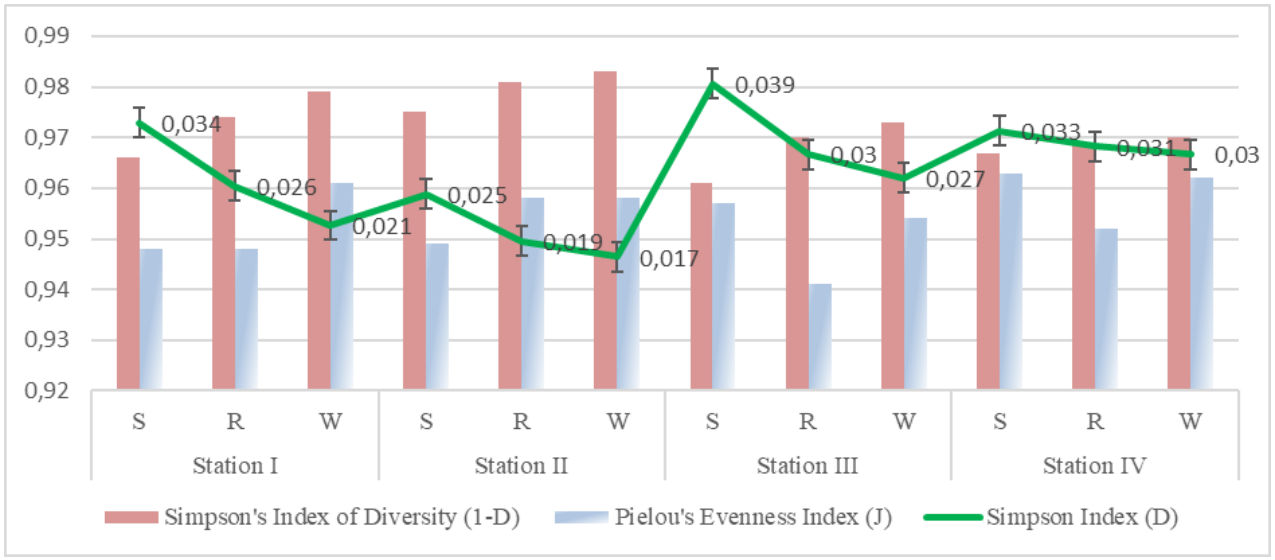

Figure 4. Various indices are compared both in terms of station and seasons as on Table 4. (2 of 2)

Table 7. Sorensen's resemblance Between each pair across the four sampling locations

Between Stations	Species Richness				Common Species	Coefficient (DSC)
	Station I	Station II	Station III	Station IV		
Station -I & Station -II	68	90	-	-	67	0.84
Station -II & Station -III	-	90	66	-	59	0.76
Station -III & Station -IV	-	-	66	48	36	0.63
Station -I & Station -III	68	-	66	-	42	0.63
Station -II & Station -IV	-	90	-	48	30	0.43
Station -I & Station -IV	68	-	-	48	15	0.26

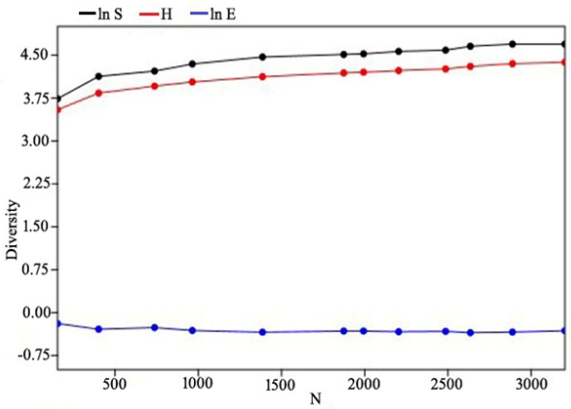

Figure 5. SHE(Richness-Diversity-Evenness) plotting. Each value along X axis from left to right represent SI-Summer, SI-Rainy, SI-Winter, SII Summer, SII-Rainy and so on. (Past v4.11)

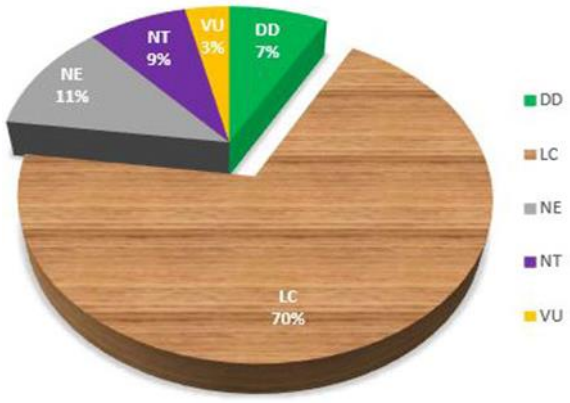

Figure 6. IUCN Status of fish fauna

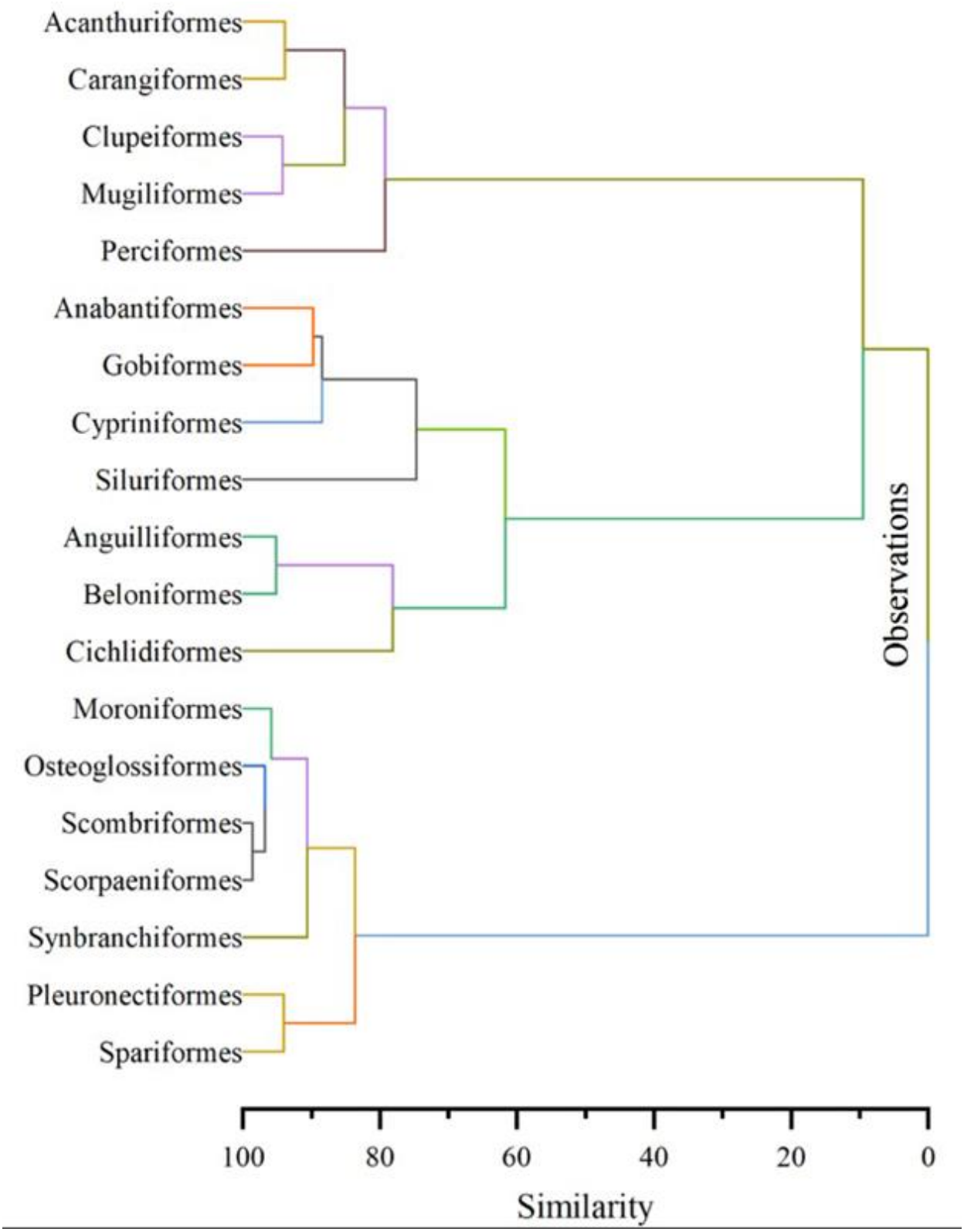

Figure 7. Hierarchical Clustering

This result supported in the previous work on Betwa River (Alam *et al.* 2013), Ponnani Kole wetland in Kerala (Akshad, 2021). The Rupnarayan river flow contains 10 fish species, which make up 9% of the overall richness are close to being vulnerable species i.e., near threatened. They are *P. diacanthus*, *A. bengalensis* (Ban Mach), *O. mossambicus* (Tilapia), *H. molitrix* (Silver Carp), *P. lala* (Chanda), *C. chitala* (Chitol), *W. attu* (Boal), and a three different species of pabda, consisting *O. bimaculatus*, *O. pabda*, and *O. pabo* (Figure 6). These species, including *T. toli, S. sarana, C. carpio*. and *P. conchonius* have experienced significant losses since the 1980s due to excessive fishing pressure (Adha et al. 2014). Over-exploitation by humans for food and habitat destruction (Hossain et al. 2010), has drastically decreased the population of *S. sarana*, which is mostly found in Asia and is found in Afghanistan, Pakistan, India, Nepal, Bangladesh, and Bhutan (Talwar and Jhingran, 1991) and Sri Lanka (Pethiyagoda and Kottelat 1994). According to Nelson's 2016 classification system, a compilation of earlier research with the current study provides the most recent list of fish species reported from the Rupnarayan River (Table 8). These 122 fish species are found in 94 genera, 47 families, and 19 orders. During the study period (2019–2021), 109 well-documented fish species were catalogued from the Rupnarayan River, of which 71 species (marked with **) were recorded for the first time.

Table 8. Comparative checklist of fish occurrence of Rupnarayan till date

Fish Species	Mishra (2003)	Ghorai (2018)	Present Study
Macrospinosa cuja **	x	x	✓
Otolithoides biauritus **	x	x	✓
Paranibea semiluctuosa **	x	x	✓
Otolithes cuvieri **	x	x	✓
Johnius dussumieri **	x	x	✓
Protonibea diacanthus **	x	x	✓
Johnius borneensis **	x	x	✓
Anabas testudineus **	x	x	✓
Trichogaster chuna	x	✓	X
Trichogaster fasciata	x	✓	✓
Channa striata	x	✓	✓
Channa punctatata	x	✓	✓
Channa gachua **	x	x	✓
Nandus nandus **	x	x	✓
Anguilla bengalensis	✓	✓	✓
Hyporhamphus limbatus **	x	x	✓
Xenentodon cancila	x	✓	✓
Strongylura leiurus **	x	x	✓
Strongylura strongylura **	x	x	✓
Alepes melanoptera **	x	x	✓
Chloroscombrus chrysurus **	x	x	✓
Megalaspis cordyla **	x	x	✓
Atropus atropus**	x	x	✓
Oreochromis mossambicus	x	✓	✓
Oreochromis nilotica **	x	x	✓
Ilisha megaloptera **	x	x	✓
Setipinna taty	✓	x	✓
Setipinna phasa	✓	✓	✓
Thryssa polybranchialis **	x	x	✓
Coilia ramcarati **	x	x	✓
Coilia dussumieri	✓	x	✓
Gudusia chapra	x	✓	✓

Table 8. Continued

Hilsa kelee **	x	x	✓
Tenualosa ilisha			
Tenualosa toli **	✓	✓	✓
Puntius terio **	x	x	✓
Systomus sarana	x	x	✓
Pethia conchonius **	x	✓	✓
Pethia ticto	x	x	✓
Puntius chola **	x	✓	✓
Puntius sophore **	x	x	✓
Puntius vittatus	x	x	✓
Chela cachius	x	✓	X
Cirrhinus mrigala **	x	✓	X
Labeo rohita **	x	x	✓
Labeo bata **	x	x	✓
Labeo calbasu**	x	x	✓
Labeo catla **	x	x	✓
Ambyphyaringodon mola	x	x	✓
Osteobrama cotio **	x	✓	✓
Salmostoma phulo**	x	x	✓
Salmostoma bacaila **	x	x	✓
Cyprinus carpio **	x	x	✓
Hypophthalmichthys molitrix **	x	x	✓
Lepidocephalichthys guntea **	x	x	✓
Lepidocephalichthys thermalis **	x	x	✓
Pseudapocryptes elongatus	x	x	✓
Apocryptes bato **	✓	x	✓
Glossogobius giuris	x	x	✓
Gobiopsis macrostoma **	x	✓	✓
Odontamblyopus rubicundus	x	x	✓
Eleotris fusca	✓	x	✓
Apocryptes cantoris	✓	x	✓
Apocryptes macrolepis	✓	x	X
Taenioides cirratus **	✓	x	X
Parambasis lala **	x	x	✓
Parambasis ranga **	x	x	✓
Chanda nama	x	x	✓
Drepane longimana **	x	✓	✓
Rhinomugil corsula **	x	x	✓
Mugil cephalus	x	x	✓
Chelon parsia	x	✓	✓
Notopterus notopterus **	x	✓	✓
Chitala chitala **	x	x	✓
Pomadasys maculatus **	x	x	✓
Upeneus sulphureus **	x	x	✓
Lates calcarifer	x	x	✓
***Amphipnous* sp.**	x	✓	✓
Terapon jarbua	x	✓	X
Terapon putta **	✓	x	✓
Pama pama	x	x	✓

Table 8. Continued

Johinus coitor	✓	x	X
Otolithes ruber	x	✓	X
Polynemus paradiseus	✓	x	X
Polydactylus sextarius **	✓	✓	✓
Eleutheronema tetradactylam	x	x	✓
Cynoglossus arel **	✓	x	✓
Cynoglossus puncticeps	x	x	✓
Cynoglossus cyanoglossus	✓	x	✓
Cynoglosus lingua	x	✓	X
Euryglossa orientalis **	✓	x	✓
Pampus argenteus **	x	x	✓
Platycephalus indicus **	x	x	✓
Rita rita **	x	x	✓
Sperata seenghala	x	x	✓
Mystus gulio **	x	✓	✓
Mystus vittatus	x	x	✓
Mystus bleekeri **	x	✓	✓
Mystus cavasius	x	x	✓
Mystus tengara	x	✓	✓
Osteogeneiosus militaris **	x	✓	X
Arius gagora **	x	x	✓
Arius platystomus **	x	x	✓
Arius maculatus	x	x	✓
Gagata cenia **	x	✓	X
Pangasius pangasius	x	x	✓
Clarias batracus	x	✓	✓
Heteropneustes fossilis	x	✓	✓
Clupisoma garua **	x	✓	✓
Erethistes hara **	x	x	✓
Wallago attu	x	x	✓
Ompak bimaculatus	x	✓	✓
Ompak pabo **	x	✓	✓
Ompak pabda	x	x	✓
Silonia silondia	x	✓	✓
Sillaginopsis domina **	x	✓	X
Sillago sihama **	x	x	✓
Acanthopagrus latus **	x	x	✓
Macrognathus pancalus	x	x	✓
Macrognathus aral **	x	✓	✓
Mastacembelus armatus **	x	x	✓
Ophichthys cuchia	x	x	✓
	x	✓	✓

**New Records (total 71) during present study period.

The current study serves as a thorough field investigation conducted at four locations for location to research fish biodiversity and the current status of the fish fauna in the Rupnarayan River. This investigation is necessary to ascertain the present status of the fish faunal diversity in the Rupnarayan River. Additionally, seasonal variations in fish diversity within this riverine water body should be noted. The river action plan along with conservation programs from the central and state governments' helps protect the river's environment from widespread anthropogenic activities that harm it.

This study provides an up-to-date documentation of the taxonomic characteristics of the various fish species, which will assist future researchers, decision-makers, taxonomists, and conservation organizations in obtaining the necessary information for future improvement.

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Conflict Of Interests

The authors declare that there are no conflicts of interest.

Ethics Approval

Ethical clearance from Institutional Animal Ethics Committee (IAEC), Approval no. 19/IAEC (05)/RNLKWC/2019, dated-27/07/2019

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