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Ichthyofaunal Diversity Correlates Hydrological Parameters in Wetlands of Nameri National Park and its Adjacent Area, Assam, India

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ABSTRACT

Excessive anthropogenic activities such as heavy fishing, the fish fauna in northeast India has been declining at a rapid rate. The wetlands in Nameri National Park (NNP) witness the severe decline of fish fauna due to overfishing and human interference in the buffer zone. The present study has been carried out from May 2017 to April 2019 in 12 random sampling sites. A total of 79 fish species were recorded belonging to 6 orders and 24 families. The order Cypriniformes was found to be dominant with 44 fish species followed by Siluriformes with 18 species, Perciformes with 11 species, Synbranchiformes with 4 species, and Beloniformes and Cluepiformes with one species each. The Shannon-Wiener diversity index (3.81), Margalef richness index (8.07), Pielou's evenness index (0.59) was high, while Simpson dominance index (0.02) was low in the pre-monsoon season, which indicates that during pre-monsoon the fish diversity has been highest than the other seasons of the year. As far as biodiversity status (IUCN Status) is concerned, 78.48% Least Concern (LC), 3.79% Data Deficient (DD), 5.06% Not Evaluated (NE), 7.59% Near Threatened (NT), 2.53% Vulnerable (VU) and 2.53% Endangered (EN) respectively. However, two vulnerable and endangered species have been found during the survey.

Key words: *Habitat alteration, Anthropogenic activity, Biodiversity status, Sonitpur district*

Introduction

Fishes are the keystone species that determine the distribution and abundance of other organisms in the ecosystem they represent and are good indicators of water quality and health of the ecosystem (Moyle *et al*., 1992). India is one of the mega biodiversity countries in the world and occupies the ninth position in terms of freshwater biodiversity (Mittermeier *et al*., 1997). The Northeastern region of India is one of the hot spots of freshwater fish biodiversity in the world (Kottelat and Whitten, 1996). The geomorphology of the northeast region of India supports rich biodiversity. Though the region is rich in biodiversity, many endemic and rare species including fish fauna are now under anthropogenic pressure and many species are at the verge of extinction. However, fish species of the Northeastern region have been reported from time to time by various authors. Works of Motwani *et al*. (1962), Sinha (1994), Sarma *et al.* (2004) and Das *et al*. (2015) are worth mentioning. Reports are also available on the fishes of protected areas of Assam. Wakid and Biswas (2006) recorded 76 fish species under 24 families and 49 genera in Dibru-Saikhowa National Park of Assam. Literature survey also revealed that

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various workers have studied the beels of Assam and reported fish diversity in the various study sites (Acharjee, 1997; Bhattacharya, 2002; Lahon, 1979; Dey, 1981; Goswami, 1985; Baishya *et al*., 2010; Goswami, 2012).

Nameri National Park and its adjacent areas are unique for their topographical position as well as undulating terrain, hill streams, and river networks. It not only holds unique wildlife diversity but also provides an ideal and convenient habitat for hill stream ichthyofauna. To the best knowledge of the authors, the study area has no basic information on fish species and thus it becomes a major hindrance for the conservation action plan. Sticking to the above fact, the present study aimed to carry out a field survey on the distribution of fish faunal diversity of Nameri National Park and its adjacent areas.

Materials and Methods

Study Area

The present work was carried out in Nameri National Park (27.01° N-92.79° E) and its adjacent area. Nameri shares its northern boundary with the Pakhui Wildlife Sanctuary of Arunachal Pradesh. Together they constitute an area of over 1000 km^2 of which Nameri has a total area of 200 km^2 (Fig.1). Nameri National Park is a major conservation area. It is an internationally renowned protected area in India. The area is crisscrossed by the river Jia-Bharali and its tributaries including many small and medium-sized streams (locally known as nallas). The detailed habitat characteristic of Nameri National Park has been studied by Saikia and Saikia, (1999). The vegetation type of Nameri is of semi-evergreen, moist deciduous forest with cane and bamboo brakes and narrow strips of open grassland along the rivers. The surface water temperature 22°-27 °C in wet seasons and 17°-23 °C in the dry seasons and water is slightly alkaline during both the seasons (Khound *et al.,* 2012). The adjacent study area includes three major rivers viz; Mansiri, Jarakhar, and Banikhara which originates in Arunachal Pradesh and drains into the mighty Brahmaputra. The distance of the rivers from Nameri National Park is about 16-20 km^2 each. Two streams viz; Onai and Torajan and four beels viz; Silonibeel, Maguribeel, Bogoribeel and kosubeel are also extensively surveyed during the study period.

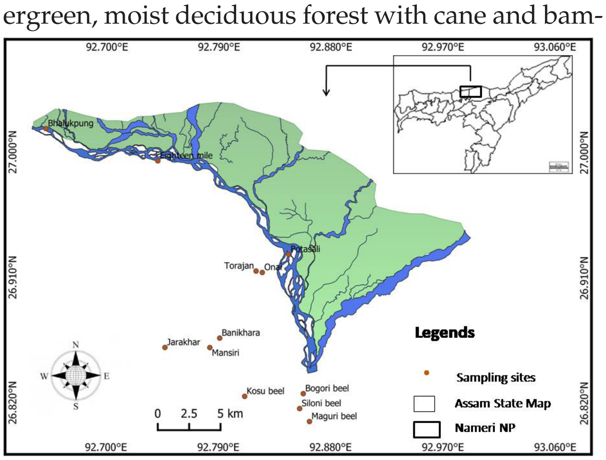

Fig. 1. Geographical locations of the study area

Data Collection and Identification

The survey was carried out from May 2017 to April 2019 at twelve random sampling sites in different water bodies (lotic and lentic) of Nameri national park and its adjacent areas. To ascertain the species composition, samples were also collected from the fringe village area's fish markets of the study area. During the survey, fish samples were collected from the previously designed random sample sites following Jayaram (1999) in each month of the year. Cast net of mesh size (8-15) mm, gill net of mesh size 1cm, 3cm, 5.6 cm, 7 cm, and bamboo traps was used for species collection. Collected fishes were preserved in 10% formaldehyde and brought to the laboratory for identification. Identification of fishes was done using the methods of Talwar and Jhingran (1991), Jayaram (1999), and Vishwanath (2002). During fish sample collection, the total numbers of each species were recorded for every field trip and sampling site. Altogether four prime in situ water quality parameters viz; DO, pH, water temperature, and water currents were measured on the spot in each sampling location. Nomenclature of fish was done based on the fish species-wise database and the conservation status (threat criteria) of the ichthyofauna was based on IUCN (2019).

Data Analysis

The collected data were pooled together, quantified carefully and then statistical comparison was performed. Preliminary data sheets were created and data were sorted out and analyzed by using Microsoft office excels 2007. Tables, pie charts, etc. were used to interpret the results. The hierarchical clustering (Clarke and Warwick, 1994) was computed to produce a dendrogram for investigating similarities among all the sampling sites in Bio-Diversity Pro software (Open source). The one-way analysis of variance (ANOVA) in SPSS (Version 16.0, IBM) was used for hydrological parameters viz; (DO, pH, temperature, and water current) to determine which means were significantly different at 0.05 level of probability (Spjotvoll and Stoline, 1973) in the various seasons and sites within the study area. Diversity indices were performed by using PAST (Version 3.24, Open source). Species diversity was assessed using four different indices viz; Shannon-Wiener diversity, species richness, evenness, and dominance index.

The Shannon Weiner diversity was calculated by following formula

$$H' = \sum_{i=1}^{s} P_i * \log P_i$$

Where, S is the total number of species, $P_i = n_i \backslash N$, n_i = no. of individuals of a species, N = Total number of individuals and H' = Shannon-Weaver index.

Margalef species richness (d)

$$d = (S - 1)/\log(N)$$

Where, S = Total species,   Total individuals.

Pielou's evenness index (J')

$$J' = \frac{H(s)}{H(max)}$$

Where, H(s) = the Shannon-Weaver information function, H(max) = the theoretical maximum value for H(s) if all species in the sample were equally abundant.

Simpson dominance index (c)

$$c = \sum_{i=1}^{S} \left(\frac{n_i}{N}\right)^2$$

Where, number of individuals in the 'each' species, N = total number of individuals, S = total number of species.

Results

Species Abundance

The study recorded 79 fish species in all the selected sampling sites. The list of fishes available during the survey period is depicted in Table 1. Of the total number of fish species found during the study period, the highest number of species was found to be the Cyprinidae family with 35 numbers of fish species, followed by Bagridae with five species and family Sisoridae and Nemacheilidae with four species each. The family Cobitidae, Mastacembelidae, and Siluridae with three species each and two species each in case of family Ambassidae, Badidae, Osphronimidae and Channidae and one species each in the family Belonidae, Nandidae, Gobiidae, Anabantidae, Botidae, Ailiidae, Schilbeidae, Amblycipitidae, Erethistidae, Claridae, Heteropneustidae, Synbranchidae, and Cluepidae respectively. Cyprinidae family was found to be most dominant among all the family as shown in Fig 2. As far biodiversity status was concerned (as per IUCN-2019), of the total fish species, 78.48% was least concern (LC), 3.79% data deficient (DD), 5.06% was not evaluated (NE), 7.59% near threatened (NT), 2.53% vulnerable (VU) and 2.53% endangered (EN) status respectively. (Fig. 3).

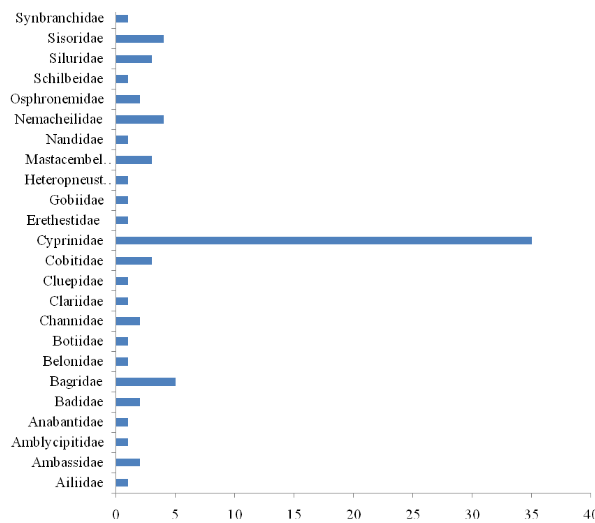

Fig. 2. Overall family dominant in the sampling sites

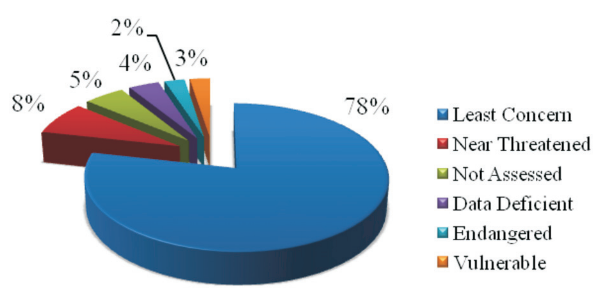

Fig. 3. Percentage distribution of conservation status of recorded fish species

Table 1. List of fishes with their habitat and IUCN status are given below

Sl.No.	Order	Family	Name of species	IUCN
1			*Barilius bendelisis* (Hamilton, 1807)	LC
2			*Opsarius tileo* (Hamilton, 1807)	LC
3			*Barilius shacra* (Hamilton, 1807)	LC
4			*Barilius barila* (Hamilton, 1807)	LC
5			*Opsarius barna* (Hamilton, 1807)	LC
6			*Pethia conchonius* (Hamilton, 1807)	LC
7			*Pethia guganio* (Hamilton, 1807)	LC
8			*Puntius chola* (Hamilton, 1807)	LC
9			*Puntius sophore* (Hamilton, 1807)	LC
10	Cypriniformes	Cyprinidae	*Pethia ticto* (Hamilton, 1807)	LC
11			*Rasbora daniconius* (Hamilton, 1807)	LC
12			*Salmostoma bacaila* (Hamilton, 1807)	LC
13			*Garra Kalpangi* (Das, 2012)	NA
14			*Garra anandalei* (Hora, 1921)	LC
15			*Garra tamangi* (Kosygin,2016)	NE
16			*Garra gotyla* (Gray, 1830)	LC
17			*Devario devario* (Hamilton, 1822)	LC
18			*Devario aequipinnatus* (McClelland, 1839)	LC
19			*Chagunius chagunio* (Hamilton, 1822)	LC
20			*Cyprinion semiplotum* (McClelland, 1839)	VU
21			*Tor putitora* (Hamilton, 1822)	EN
22			*Tor tor* (Hamilton, 1822)	DD
23			*Labeo catla* (Hamilton, 1822)	LC
24			*Amblypharyngodon mola* (Hamilton, 1822)	LC
25			*Danio rerio* (Hamilton, 1822)	LC
26			*Cirrhinus mrigala* (Hamilton, 1822)	LC
27			*Ctenopharyngodon idella* (Valenciennes, 1844)	NE
28			*Cirrhinus reba* (Hamilton, 1822)	LC
29			*Hypophthalmichthys molitrix* (Valenciennes, 1844)	NT
30			*Labeo bata* (Hamilton, 1822)	LC
31			*Labeo calbasu* (Hamilton, 1822)	LC
32			*Labeo gonius* (Hamilton, 1822)	LC
33			*Labeo rohita* (Hamilton, 1822)	LC
34			*Cyprinus carpio* (Kottelat, 2001)	VU
35			*Tariqilabeo latius* (Saboohi,1990)	LC
36			*Bangana dero* (Hamilton, 1822)	LC
37			*Cabdio morar* (Hamilton, 1822)	LC
38		Nemacheilidae	*Acanthocobitis botia* (Hamilton, 1822)	LC
39			*Neonoemacheilus assamensis* (Menon, 1987)	NT
40			*Schistura savona* (Hamilton, 1822)	LC
41		Cobitidae	*Lepidocephalichthys berdmorei* (Blyth, 1860)	LC
42			*Lepidocephalichthys guntae* (Hamilton, 1822)	LC
43			*Canthophrys gongota* (Hamilton, 1822)	LC
44		Botiidae	*Botia dario* (Hamilton, 1822)	LC
45	Siluriformes	Bagridae	*Mystus cavasius* (Hamilton, 1822)	LC
46			*Mystus tengara* (Hamilton, 1822)	LC
47			*Mystus dibrugarensis* (Chaudhury, 1913)	LC
48			*Mystus vittatus* (Bloch, 1794)	LC
49			*Batasio fasciolatus* (Blyth, 1860)	LC
50		Siluridae	*Ompok pabda* (Jayaram, 2006)	NT
51			*Ompok pabo* (Hamilton, 1822)	NT
52			*Wallago attu* (Schneider, 1801)	NT
53		Ailiidae	*Ailia coilia* (Hamilton, 1822)	NT

Table 1. *Continued table*

Sl.No.	Order	Family	Name of species	IUCN
54		Sisoridae	*Gagata cenia* (Hamilton, 1822)	LC
55			*Glyptothorax telchitta* (Hamilton, 1822)	LC
56			*Glyptothorax dikrongensis* (Chaudhuri, 2011)	NE
57			*Nangra assamensis* (Sen & Biswas, 1994)	LC
58		Schilbeidae	*Pachypterus atherinoides* (Bloch, 1794)	LC
59		Amblycipitidae	*Amblyceps laticeps* (McClelland, 1842)	LC
60		Erethistidae	*Pseudolaguvia shawi* (Kottelat, 2005)	LC
61		Clariidae	*Clarias magur* (Hamilton, 1822)	EN
62		Heteropneustidae	*Heteropneustes fossilis* (Bloch, 1794)	LC
63	Beloniformes	Belonidae	*Xenentodon cancila* (Hamilton, 1822)	LC
64	Synbranchiformes	Mastacembelidae	*Mastacembelus armatus* (Lacepede, 1800)	LC
65			*Macrognathus pancalus* (Hamilton, 1822)	LC
66			*Macrognathus morehensis* (Tombi, 2000)	LC
67		Synbranchidae	*Monopterus cuchia* (Hamilton, 1822)	LC
68	Perciformes	Ambassidae	*Chanda nama* (Hamilton, 1822)	LC
69			*Parambassis ranga* (Hamilton, 1822)	LC
70		Badidae	*Badis badis* (Hamilton, 1822)	LC
71			*Badis assamensis* (Ahl, 1937)	DD
72		Nandidae	*Nandus nandus* (Hamilton, 1822)	LC
73		Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	LC
74		Anabantidae	*Anabas testudineus* (Bloch, 1792)	DD
75		Osphronemidae	*Trichogaster lalius* (Hamilton, 1822)	LC
76			*Trichogaster fasciata* (Bloch & Schneider, 1801)	LC
77		Channidae	*Channa gachua* (Hamilton, 1822)	LC
78			*Channa punctata* (Bloch, 1793)	LC
79	Cluepiformes	Cluepidae	*Gudusia chapra*(Hamilton, 1822)	LC

*LC (Least Concern), DD (Data deficient), NT (Near Threatened), VU (Vulnerable), NE (Not Evaluated), EN (Endangered)

Diversity Status

Diversity indices were calculated seasonally. The seasonal study revealed that the highest Shannon Weiner diversity index was H′ = 3.819 during the pre-monsoon season and the lowest H′ =3.474 during winter. The maximum Margalef richness value was recorded as 8.076 during the pre-monsoon season and the lowest of 7.762 during the winter season. The evenness index value was found to be highest of 0.5995 during pre-monsoon and lowest of 0.4139 during winter and monsoon season respectively (Fig.4). Moreover, the highest dominance index value of 0.04665 was recorded during winter and the lowest of 0.0295 during the pre-monsoon season. On the other hand, the site-wise study revealed that the highest Shannon Weiner diversity index value of 3.838 was found in Potasali (S_{10}) and the lowest of 3.005 was found in Torajan (S_{12}). Again, the highest Margalef richness value of 7.789 was recorded at Potasali and the lowest of 4.003 was found at Torajan. Higher (0.79) and lower (0.4862) Evenness index was found to be at Onai (S_9) and Bogoribeel respectively. The dominance index value was recorded highest (0.07182) in Bogoribeel (S_4) and lowest (0.0266) in Potasali (Fig. 5). Site wise study revealed that the maximum number of fish individuals was recorded at Bogoribeel followed by Silonibeel (S_{11}), Maguribeel (S_7), and Potasali and lowest in Banikhara (S_2) and the number of species was found to be highest in Potasali and lowest in Torajan (Fig. 6). A detailed study on the sampling sites showed that a close similarity in species composition was observed between the beels viz; Silonibeel, maguribeel, kosubeel (S_6), Bogoribeel. However, species composition of all the rivers adjacent to NNP was quite similar viz; Jarakhar (S_5), Potasali, Mansiri (S_8), and Onai. On the other hand, the species composition of Torajan showed close similarity with Bhalukpung (S_3) and Eighteenmile(S_1)compared to that of other sampling sites (all located inside the protected area) as shown in Fig 7.

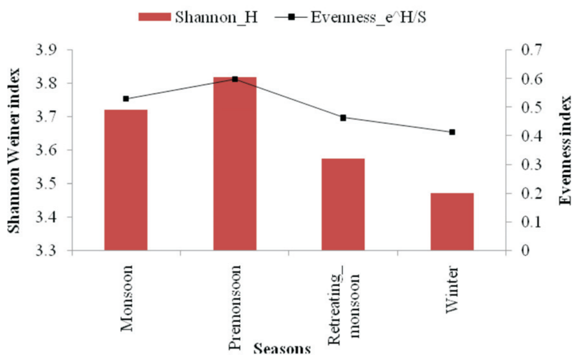

Fig. 4. Season wise representation of Shannon Weiner and Evenness index

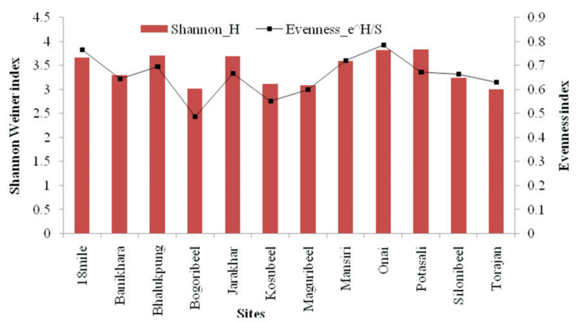

Fig. 5. Site wise representation of Shannon Weiner and Evenness index

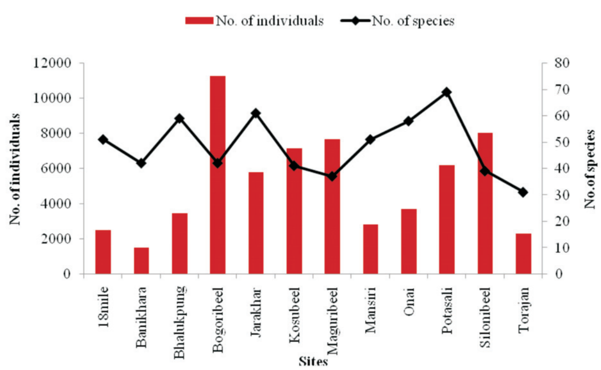

Fig. 6. No. of individual and no. of species present in the study sites

Similarity matrix

Physico-Chemical parameters

The variations of hydrological parameters viz; DO, water temperature, pH, and water current that were observed and recorded during the field survey are summarized in Table 2 and illustrated in Fig 8. DO was found to be highest at site Potasali (9.15±0.54) and lowest at Bogoribeel (4.07±0.86) and one-way ANOVA was performed where a significant differ-

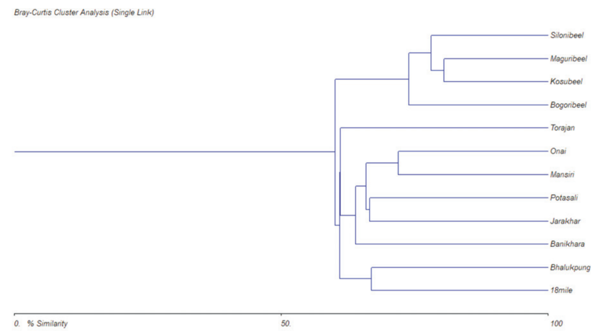

Fig. 7. Spatial and temporal cluster of fish assemblage based on Bray-Curtis

ence was found in dissolved oxygen concentration among the sampling sites (F = 532.66, P < 0.01). On the other hand, mean water temperature (29.75±2.31) remained highest at Kosubeel compared to other sites and lowest at Onai (20.06±2.44). A significant difference was found in water temperature among the selected sampling sites (F = 313.795, P < 0.01). Mean water pH value was found to be highest at Maguribeel (9.47±0.02) and lowest (6.44±0.03) at Silonibeel and pH values also showed significant differences among different sampling sites (F = 7.435, P < 0.01). Moreover, maximum water current was recorded at Bhalukpung (0.55±0.13) where lowest was at Banikhara (0.14±0.04). A significant difference was found in water current among the sites (F = 1.224, P < 0.01). Pearson correlation between abundance and water parameters showed that there is a negative significant correlation between abundance and Water current (r = -.224, P < 0.01), DO (r = -.181, P < 0.01), and pH (r = -.083, P < 0.01) and positive significant correlation

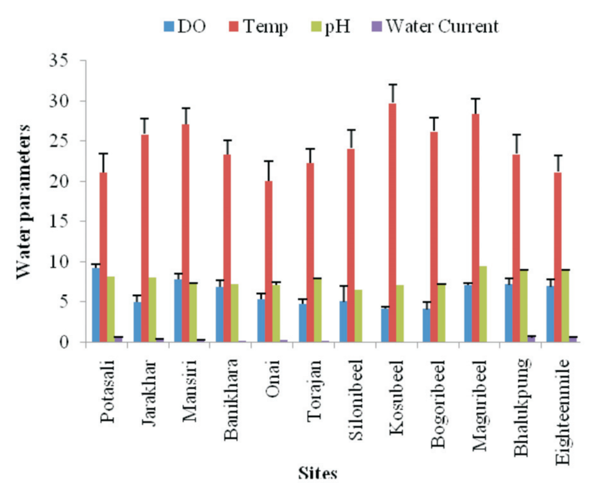

Fig. 8. Site wise variations of water parameters

between species abundance and water temperature (r = .156, $P < 0.01$) as shown in Table 3.

Discussion

The present study is the first-ever documentation of indigenous fish fauna in the wetlands of Nameri National Park and its adjacent areas. The present survey indicated that the family Cyprinidae is dominant among all the 24 families recorded in Nameri National Park. This is in accordance with the studies conducted by Negi *et al*. (2013), who reported cypriniformes as the most abundant order in hilly terrain in Uttarkhand. Negi and Rajput (2012) also reported cypriniformes to be dominant in two lakes of Kumaon Himalaya, Uttrakhand. However, present study showed that there are clear differences in diversity of fish fauna between protected and non-protected habitats of the study area showing the human interference and fishing pressure in the latter. A declining trend of the fishes in the study area to a large extent in recent years is also observed (Secondary data). This may be due to the heavy freshwater discharge from adjacent agricultural fields and from numerous Hydro Power Dams upstream of the JiaBharali River.

During the survey, species diversity was at its peak in pre-monsoon. This may be due to the availability of sufficient water and ample food resources during the season. Moreover, annual re-colonization of fish species from the fish stocks from the neighbouring areas as the flooding water connects smaller isolated habitats that have been suggested by Hossain *et al*. (2012) and Kar *et al*. (2006). Again, low diversity in winter might be due to shrinkage of water with the decreasing amount of rainfall, making the smaller habitats isolated from each other. According to Huh and Kitting (1985), nutrient variations in the river bed greatly affects the coexistence of fish species. Their findings support the present study, where the highest diversity index was found at Potasali and the lowest was in Bogoribeel. The Margalef richness value that is used as an indicator to compare the sampling sites generally shows deviation depending on the species number as suggested by Vyas *et al*. (2012). With the highest species number, Potasali showed the maximum Margalef richness value, whereas a minimum value was observed at Torajan with the lowest number of species. Alam *et al*. (2013) reported Margalef index from 7.91 to 6.60 in Halda River in Chittagong of Bangladesh and Vyas *et al*. (2012) reported Margalef index in the Betwa River in Madhya Pradesh of India ranging from 3.71 to 6.70. In the present study, the Margalef values were significantly higher than those studies due to the presence of large numbers of individuals. Evenness and species diversity index curves showed similar trends in different seasons of the

Table 2. Site-wise variation of water parameters in the sampling sites

Site	DO(ppm)	Temperature(ºC)	pH	Water Current (m/s)	
Potasali	9.15±0.54		21.03±2.44	8.09±0.02	0.48±0.12
Jarakhar	4.94±0.86	25.86±1.97	8.06±0.02	0.30±0.05	
Mansiri	7.79±0.75	27.10±1.97	7.26±0.01	0.16±0.06	
Banikhara	6.86±0.81	23.30±1.78	7.19±0.03	0.14±0.04	
Onai	5.34±0.73	20.06±2.44	7.07±0.35	0.18±0.02	
Torajan	4.70±0.66	22.28±1.72	7.77±0.14	0.16±0.01	
Silonibeel	5.03±1.95	24.09±2.27	6.44±0.03	0	
Kosubeel	4.16±0.28	29.75±2.31	7.05±0.01	0	
Bogoribeel	4.07±0.86	26.21±1.68	7.03±0.13	0	
Maguribeel	7.03±0.33	28.42±1.77	9.47±0.02	0	
Bhalukpung	7.13±0.81	23.38±2.42	8.89±0.02	0.55±0.13	
Eighteenmile	6.91±0.85	21.14±2.05	8.86±0.09	0.50±0.11	

Table 3. Pearson correlation between abundance and water parameters

		Water Current (m/s)	DO (ppm)	Temperature (ºC)	pH
Number	**Pearson Correlation**	-0.224**	-0.181**	0.156**	-0.083**

**. Correlation is significant at the 0.01 level (2-tailed) year. The evenness index was maximum in pre-monsoon and declined in the winter, which is similar to the diversity index. This result is in accordance with the findings of Hossain *et al*., (2012) in the Meghna river estuary of Bangladesh. The present study however reveals that the Dominance index value is opposite to the diversity index. Where high diversity index is associated with a low individual number and a lower diversity index is associated with a higher individual number. This finding is in conformity with the findings of Shahadat *et al.* (2012) as their study showed the same relationship of fish species diversity in the Meghna river estuary of Bangladesh.

In terms of the spatial and temporal assemblage of fishes, differences in species composition were observed among the sampling sites. The result of the present study support and extends the intuition and conclusions of Sheldon (1971), that fishes are mainly dependent on the habitat component. A close similarity in species composition was observed in the sampling sites located outside the protected area where human interference was high. Fishes were extremely concentrated during winter and heavy mortality occurred as the pools shrank. Moreover, the land in and around the wetlands is normally used for agriculture. But during summer, agricultural activities are disrupted due to floods, and the areas are covered by water bodies. However, the fish community composition of the sites inside the protected area bears a close resemblance. This may be due to the complexity of habitats present in the area and also the periodic phenomena, such as low-flow and water-quality characteristics which are responsible for determining the fish community structure as suggested by Zaret and Rand (1971) and Mendelson (1975) in their study. Moreover, food resources available in the sites were also another factor that contributed in determining the fish community of the selected sampling sites. A similar observation was also reported by Zaret and Rand (1971) and Mendelson (1975) in their study.

In the present study, it was observed that physical factors play a key role in the fish species assemblages and their distribution. According to Banerjee (1967), DO between 3.0-5.0 ppm in ponds is unproductive and for average or good production it should be above 5.0 ppm. However, in the present survey, DO below 5 ppm in four sites was recorded, this may be due to excessive algal bloom during the survey period. Moreover, due to the presence of a fish harbor station and extreme human interference, a high pH value was recorded at site Bogoribeel. Similar findings have been reported by Hossain *et al*. (2012) in which the presence of fish harbor station and extreme human interference encourage the high pH value. The high water temperature at Kosubeel recorded during the survey period was due to low water levels and high atmospheric pressure. Water current, another important physical parameter of river water was also recorded during the survey period. It was found that the velocity of water greatly depends on the nature of the gradient. However, the present study showed that species diversity was highest at Potasali which is situated at a low gradient plain. This is in agreement with the studies conducted by Shelford (1911), Thompson and Hunt (1930), Larimore *et al*. (1952), who in their studies have shown that, fish species diversity increases from upstream to downstream areas. Moreover, Correlation analysis indicated a significant correlation between various parameters. A negative significant correlation between abundance and water current, DO, pH, and positive significant correlation was recorded between abundance and water temperature. These results are in agreement with the findings of Negi and Mamgain (2013), who conducted studies in hilly streams of Uttarakhand.

Conclusion

From the above discussion, it can be concluded that variation in species diversity has been observed between the protected (NNP) and non protected areas (adjacent area). However, due to several anthropogenic factors including habitat degradation and irrational fishing, species diversity has been greatly affected in the non protected areas. The findings from the study also reveal the presence of two endangered species (*Tor putitora* and *Clarias magur*) in the sampling sites, which suggest the need for immediate conservation and management strategy for the species in the non protected areas also. Rearing and breeding of this species have emerged as needful action to be taken without any further delay before their extinction from this region. Moreover, as the local inhabitants of the region are mostly dependent on wetland resources, hence, the need for creating awareness programs regarding sustainable harvesting of bioresources and the prioritization of conservation is immensely necessary.

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Conflict of Interest

The author has no conflict of interest.

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