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Status of fish biodiversity of tilai river in the northern part of Bangladesh

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Abstract

The study was conducted in the Kharkharia-Tilai River in the Northern part of Bangladesh to assess the present status of fish biodiversity. To study the fish biodiversity, fish samples were collected from January to September 2019. A total of 57 species belonging to 20 families was recorded of which cypriniformes were found to be most dominant order during the study period. Out of 57 species cypriniformes were 32 species and then siloriformes (13), perciformes (10) and others. The value of H ranged from 0.40 (March) to 0.95 (October), D varied from 3.29 (March) to 6.48 (October), and e ranged from 6.89 (October) to 1.00 (May and June). H and D values showed that the diversity of fish fauna was the highest within the month of October. Among the total 56 fish species of Tilai rivers which of them 8.92% was endangered, 10.71% vulnerable, 16.07% near threatened, 62.5% least concern and 1.78% were data deficient. However, fish species diversity of Tilai river were decreasing day by day due to siltation, pollution, constructions of obstacles for fish movement.

Keywords: Diversity, richness, evenness, declining, tilai river

1. Introduction

The rich aquatic biodiversity of the country has been attributed to the world's one of the largest wetlands (Bengal Delta) and three large river systems (Brahmaputra, Ganges and Jamuna) that flow from the Himalayan Mountains into the Bay of Bengal. Bangladesh is ranked fourth position in Inland fishery production just after China, India, and Mymenmar and fifth position in closed waters^[1]. Fisheries sector are inseparable from the life and lifestyle of the people of Bangladesh this contributes 4.37% to the national GDP and almost one-fourth (23.37%) to the agricultural GDP^[2]. Huge inland fisheries resources supply fish and other aquatic animals and plants to millions of people living in the delta^[3]. A total of 54 fish species of Bangladesh have been declared threatened by IUCN^[4] however, most of the wild populations have seriously declined in rivers and streams of Bangladesh due to over exploitation augmented by various ecological changes and degradation of the natural habitat^[5]. All these findings clearly indicate the need for water body specific detailed biodiversity studies which is essential to assess the present status and for the sustainable management of a body of water^[6] the first scientific account of freshwater fish fauna of Bangladesh began with the work of^[7]. Recently,^[8] has made significant contribution on freshwater fishes and recorded 265 species of fish under 55 families from Bangladesh. A number of other workers also have described freshwater fish fauna from different parts of the country.^[9] Have described 251 species of freshwater fishes under 61 families from Bangladesh^[10]. The Tilai River is a small river in Nilphamari and Dinajpur districts in the north of Bangladesh. It's originated from the "Singimari Bill" of sadar of Nilphamari district (25°57'01.0"N 88°48'03.0"E). Then the river flowed through Saidpur of Nilphamari district and Parbatipur and Fulbari of Dinajpur district for 75 km to its confluence with the "Isamoti river" (25°30'52"N 88°56'26"E). Finally, the river merged into the small Jamuna river near the Fulbari upazila. The length of the river is 75 km. Average width is 30 m and depth is 6 m. The area of the river basin is 265m. Water flow of the river is seasonal. Its water flow is high from June to October. The approximate amount of flow is 5 cubic meters / second. This river has no tidal effect. There has a sub-vision on the "Singimari Bill" under "Bangladesh Water Development Board - (BWDB)". There have 2 switch-gates on the river. One is near Parbatipur, the another at Chakkbir near Fulbari (25°30'59.9"N 88°56'14.7"E). Trend of

decreasing fisheries biodiversity is well documented in Bangladesh and has been reported ^[11] in Talma River at Northern part of Bangladesh and ^[12] in Padma Distributaries of the Ganges River, Northwestern Bangladesh. Although Tilai is a local river but it's a rich is small indigenous fish species but declining day by day due to manmade activities and decreasing the water level of the river. A very few researches were recorded in the diversity of fish in the local river of Rangpur region. Hence, the present study was designed to know the biodiversity status, diversity index fish assemblage in the Tilai river.

2. Materials and Method

2.1 Study area and working period

The study was carried out in the local Kharkharia-Tilai River located at the (Nilphamari sadar, Saidpur of Nilphamari district and Parbatipur, Fulbari of Dinajpur district. The Length of the river is 75km (47mi), and width- 30m and Depth- 6m the Basin area is also-265m². The river is selected for study for its geographical area, wide range of biodiversity and there is no study is this local river (Fig 1). The working period was 09 month from January 2019 to September 2019.

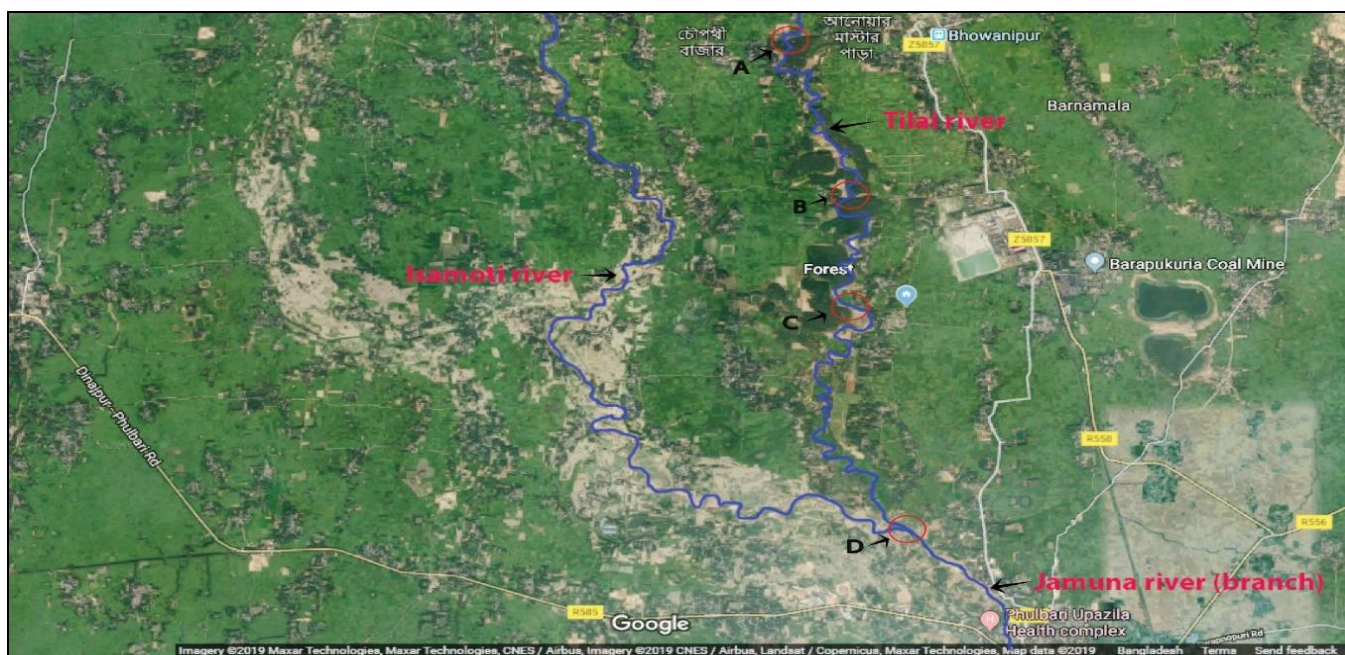


Fig 1: Google Map of Tilai River indicating the block of the study area

2.2 Collection, identification and assessment of fish sample

Fish samples were collected from Tilai River, sampling sites were basically 03 different blocks of the rivers, sites were selected on the basis of fishing activities. Sampling of catch and assessment was carried out every month of the study period; fish were catch with the help of different types of fishing gears and traps such as seine net, gill net, ber jal, jaki jal, khora jal etc. Interviews with the local fishermen in the study area were done to provide additional information regarding fishing activity and determine which fish have potential as candidates for aquaculture. Collected fish sample were identified primarily on the spot and some of the species were appeared to difficult to identify immediately preserved in 10% formalin in plastic box and transfer to the Bangladesh Fisheries Research Institute Freshwater Sub-Station, Saidpur, Nilphamari Laboratory. Each plastic box was labeled separately against data sheet of the sampling and further taxonomic identification of the samples. Collected fish sample were then identified by morphometric and meristic characteristics and with the help of Books by ^[5-13] and search by google in fish base etc. and Inland Fishes of India and adjacent countries by ^[14] were also used for their identification. After identification, fish species were systematically classified according to Nelson. Recorded data were sorted, tabulated and analyzed to calculate different diversity indices and percent composition of fish species.

2.3 Species assemblage and fish diversity analysis

In this study, the Shannon- Weaver diversity index (H),

Pielou's evenness index (e) and Margalef's richness index (D) were calculated for evaluating the status of fish diversity using the following formulae:

Shannon- Weaver diversity index (Shannon, 1948),

$$H = - \sum P_i \ln P_i$$

Here, H is the diversity index and P_i is the relative abundance (s/N).

Margalef's richness index (Margalef, 1958),

$$D = s-1/\ln N$$

Here, s is the number of individuals for each species, N is the total number of individuals and D is the richness index

Pielou's Evenness index (Pielou, 1966),

$$e = H/\ln S$$

Here, S is the total number of species, e is the similarity or evenness index, ln is the natural logarithm and H is the diversity index.

3. Result

3.1. Fish biodiversity of Tilai River

Tilai River during our study period, among the total individuals' fishes were categorized into 08 orders and 20 family, which of them Cypriniformes were highest in numbers with 23 genera, and then were Siloriformes which include 13 genera. Total list of biodiversity of fishes include in Table-1 and threatened fishes of the river were also estimated out of the total individuals according to ^[15].

Table 1: List of fish biodiversity of Tilai river and current status

S. No.	Order	Family	Scientific Name	Local Name	Conservation Status of IUCN
1	Cypriniformes	Cyprinidae	<i>Esomus danricus</i>	Darka,	LC
2	"	"	<i>Chela laubuca</i>	Laubuca	LC
3	"	"	<i>Salmostoma phulo</i>	Ful chela	NT
4	"	"	<i>Salmostoma bacaila</i>	Narkali chela	LC
5	"	"	<i>Amblypharyngodon mola</i>	Mola	LC
6	"	"	<i>Osteobrama cotio</i>	Dhela, Moua,	NT
7	"	"	<i>Puntius ticto</i>	Tit punti	VU
8	"	"	<i>puntius terio</i>	Teri punti	LC
9	"	"	<i>Puntius conchoniis</i>	KanchonPunti	LC
10	"	"	<i>Puntius sophore</i>	Jat punti	LC
11	"	"	<i>Puntius chola</i>	Chola punti	LC
12	"	"	<i>Puntius gelius</i>	Gili punti	NT
13	"	"	<i>Puntius guganio</i>	Mola punti	LC
14	"	"	<i>Puntius sarana</i>	Sar punti	NT
15	"	"	<i>Cirrhinus reba</i>	Khorki	NT
16	"	"	<i>Cirrhinus cirrhosus</i>	Mirka, Mrigel	NT
17	"	"	<i>Labeo bata</i>	Bata	LC
18	"	"	<i>Labeo calbasu</i>	Kalbaus	LC
19	"	"	<i>Labeo rohita</i>	Rui	LC
20	"	"	<i>Catla catla</i>	Katla	LC
21	"	Cobitidae	<i>Lepidocephalus guntea</i>	Puiya, Gutum	LC
22	"	"	<i>Botia lohachata</i>	Dari	EN
23	"	"	<i>Acanthocobitiis botia</i>	Balichata	LC
24	Siluriformes	Clariidae	<i>Clarias batrachus</i>	Magur	LC
25	"	Siluridae	<i>Wallago attu</i>	Boal	VU
26	"	"	<i>Ompok pabda</i>	Pabda	EN
27	"	Heteropneustidae	<i>Heteropneustes fossilis</i>	Shingi	LC
28	"	Schilbeidae	<i>Pseudeutropius atherinoides</i>	Batasi	LC
29	"	"	<i>Eutropiichthys vacha</i>	Bacha	LC
30	"	Bagridae	<i>Sperata aor</i>	Ayr	VU
31	"	"	<i>Rita rita</i>	Eta, Rita	EN
32	"	"	<i>Mystus cavasius</i>	Gulsha tengra	NT
33	"	"	<i>Mystus vittatus</i>	Dora tengra	LC
34	"	"	<i>Mystus tengara</i>	Bazari tengra	LC
35	"	Sisoridae	<i>Glyptothorax telchitta</i>	Telchitta	VU
36	"	Erethistidae	<i>Hara jerdoni</i>	Khutakata	LC
37	Channiformes	Channidae	<i>Channa punctata</i>	Shati, Taki	LC
38	"	"	<i>Channa striatus</i>	Shol	LC
39	"	"	<i>Channa orientalis</i>	Cheng	LC
40	Clupeiformes	Notopteridae	<i>Notopterus notopterus</i>	Foli	VU
41	"	"	<i>Chitala chitala</i>	Chitol	EN
42	Synbranchiformes	Synbranchidae	<i>Monopterus cuchia</i>	Kunchia	VU
43	"	Mastacembelidae	<i>Macrogathus pancalus</i>	Gochi	LC
44	"	"	<i>Macrogathus aculeatus</i>	Fal gochi	NT
45	"	"	<i>Mastacembelus armatus</i>	Baim Sal gochi	EN
46	Perciformes	Anabantidae	<i>Trichogaster chuna</i>	Chuna khailsha	LC
47	"	"	<i>Colisa fasciatus</i>	Khailsha	LC
48	"	"	<i>Colisa lalia</i>	Lal khailsha	LC
49	"	"	<i>Anabas testudineus</i>	Koi	LC
50	"	Pristolepididae	<i>Badis badis</i>	Napit koi	DD
51	"	Ambassidae	<i>Chanda nama</i>	Chanda	LC
52	"	"	<i>Pseudambassis lala</i>	Lal chanda	LC
53	"	"	<i>Pseudambassis ranga</i>	Gol chanda	LC
54	"	Gobidae	<i>Glossogobius giuris</i>	Balia, Bele	LC
55	"	Nandidae	<i>Nandus nandus</i>	Dhedai, Vedai	NT
56	Cichliformes	Cichlidae	<i>Oreochromis niloticus</i>	Nil tilapia	
57	Beloniformes	Belonidae	<i>Xenentodon cancila</i>	Kalila	LC

*Status DD, CR, EN, LC and VU are based on (IUCN, 2015); DD, Data deficient; CR,

Critically Endangered; EN, Endangered; LC, Least Concerned. EX, Exotic.

Among the total 56 fish species of Tilai rivers which of them 8.92% was endangered, 10.71% vulnerable, 16.07% near threatened, 62.5% least concern and 1.78% were data deficient based on the species diversity under different

groups. Out of 57 species 35 species were least concern (LC), 9 species were near threatened among the rest species 5 species were endangered, 6 species were vulnerable and 1 species were data deficient of the present study.

3.2 Characteristics of the different groups of fish in total population and diversity

A total of 57 species from 8 orders were collected in the Tilai River over the study period. The least abundance of some species during the study period represented five orders as minor namely Cichliformes (1.75%), Beloniformes (1.75%), Clupeiformes (3.51%), Channiformes (5.26%) and Synbranchiformes (7.02%). Contrarily, the exorbitance of the species from other three orders (Perciformes (17.54%), Siluriformes (22.81%) and Cypriniformes (40.35%) posed them as mammoth order of the Tilai River (Fig 1).

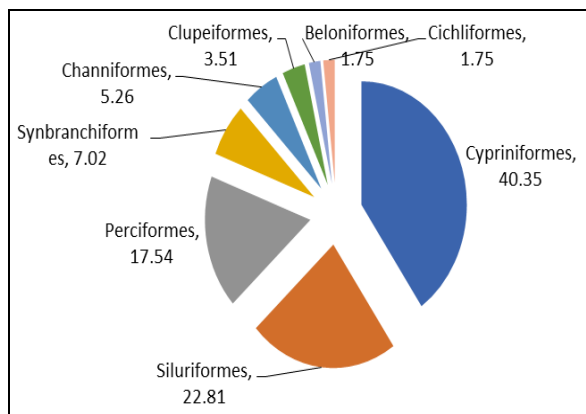


Fig 1: Percentage of fish species composition under different order found in Tilai River.

The scenario of the species wise diversity was also almost similar of the species contribution to form the order richness of this study. Among the total counted of 16,029 individuals, the percentage of species diversity contributed to form the minor order richness was 0.59%, 0.69%, 0.95%, 5.75% and 8.36% for Clupeiformes, Beloniformes, Cichliformes, Synbranchiformes, and Channiformes, respectively. The other maximum species (83.67%) found from the Tilai River during

this study, appurtenant to the other three colossal orders were Siluriformes (9.93%), Perciformes (18.14%) and Cypriniformes (55.60%) (Fig 2).

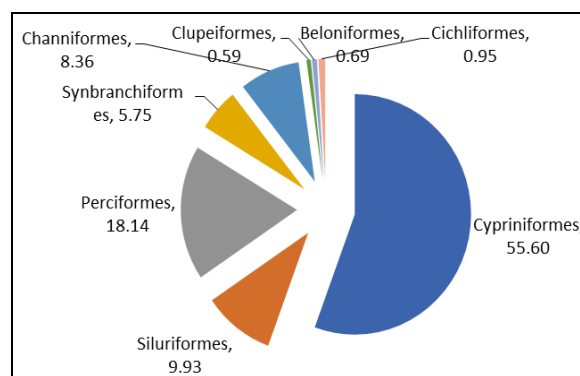


Fig 2: Percentage of fish species diversity under different order found in Tilai River.

3.3 Diversity, richness and evenness indices of Tilai river

The month-wise values of Shannon-Weaver diversity (H), Margalef’s richness (D) and Pielou’s evenness (e) indices square measure shown in Table 2. Considering all the samples studied within the present survey on Tilai river, the values of H, D and e were 1.04, 5.42, and 0.24, severally. The value of H ranged from 0.40 (March) to 0.95 (October), D varied from 3.29 (March) to 6.48 (October), and e ranged from 0.89 (October) to 1.00 (May and June). H and D values showed that the diversity of fish fauna was the highest within the month of October. The utmost variety of fish species was conjointly recorded throughout this time. The lowest variety of species was recorded within the month of March (Table 2).

Table 2: Shannon-Weaver diversity, Margalef richness and evenness indices in each sampling month of Tilai River

Month	No. of species	No. of individual	H*	D**	e***
January	31	1375	0.47	4.15	0.95
February	30	1409	0.48	4.00	0.96
March	24	1081	0.40	3.29	0.90
April	30	1574	0.51	3.94	0.97
May	30	1960	0.59	3.83	1.00
June	30	2483	0.68	3.71	1.00
July	37	2870	0.73	4.52	0.99
August	44	3666	0.83	5.24	0.96
September	54	4379	0.90	6.32	0.92
October	56	4878	0.95	6.48	0.89
All	56	25675	1.04	5.42	0.24

* Shannon-Weaver diversity index, [41] ** Margalef’s richness index, [42] *** Pielou’s evenness [43] index

The focus of species richness (D) typically may be an additional reliable measure of biodiversity in terms of order. Species richness was found highest for Cypriniformes followed by catfishes (Siluriformes) as well as perch-like

fishes (Perciformes) and the richness values calculated 2.38, 1.38, and 1.07, respectively (Table 3). The lowest D value was found in Clupeiformes (D = 0.15)

Table 3: Tilai river fish species richness by order

Order	Number of species	Species richness (D)
Cypriniformes	23	2.38
Siluriformes	13	1.38
Perciformes	10	1.07
Synbranchiformes	4	0.40
Channiformes	3	0.28
Clupeiformes	2	0.15
Beloniformes	1	0.16
Cichliformes	1	0.16

4. Discussion

Bangladesh is a land of rivers. The rivers of the country are one of the largest networks in the world with a total number of about 700 rivers including tributaries. Generally, fish biodiversity status of large rivers of Bangladesh has been assessed by different studies. However, there are few works on the fish diversity of small rivers. Talma is a small river in the northern Part of Bangladesh. There is no previous information on the study of fish diversity of this river. The "species diversity" includes two components: the number of species or richness and the distribution of individuals among species. In the present study, a total of 56 species of fish fauna were recorded which is similar or somewhat lower than the diversity of some other small rivers previously studied.^[16] Found a total of 53 species in the river Chitra at Jessore district of Bangladesh.^[17] Recorded a total of 63 species of fishes in the river of Choto Jamuna at Naogaon district. In comparison with the large rivers, the species diversity of Tilai River is much lower. For example,^[12-18] found a total of 80 species of fishes in Padma River at Chapai Nawabganj district. The number of species in Halda river of Chittagong was found 63 by^[19] in the river Tista,^[20] observed 42 fish species. In the present study, the Order Cypriniformes was found as the most diversified fish group regarding both number of species and individuals, and the order Siluriformes ranked as the second. Similar findings were also reported for many other rivers of Bangladesh such as the river Choto Jamuna^[17-21] the river Mahananda^[22] the river Tista^[20-23] and the river Padma^[12, 18-24].

The main purpose of diversity index is to calculate quantitative estimate of biological variability which is used to compare biological entities and discrete components composition in space or time^[25]. Species diversity of natural water bodies has been dealt in the past years using different diversity index. Shannon's total diversity index, Margalef's richness and Pielou's evenness are the three most popular indexes^[26, 27] The Shannon diversity index for Tilai river was found 1.04 with the highest value (0.95) in the month October. This value of Shannon index was very much lower than that of the range (2.90-3.12) reported by^[28] for the freshwater Haor of Bangladesh. From the finding of this study it can be propagated that the aquatic assemblage of Tilai River was neither healthy nor rich in abundance as the ideal range of Shannon index value (≥ 3.5) reported by^[29] was not generated. The same trend was followed between the order assemblages of the Tilai River where the maximum value (2.38) was observed for Cypriniformes order. This low Shannon index value indicates that Tilai river diversity degeneration from manmade environmental stress^[30] and/or overfishing impacts^[31]. This suggests that the restoration of the Tilai river fish diversity can be attained by identifying and minimizing the major anthropogenic impacts on the open water ecology.

The second index of this study is the Margalef's richness which actually measure the total number of species in a community (but note already that the actual number of species in the community is usually unmeasurable) and also express that the community is evenly or unevenly distributed^[32]. For Margalef's richness here observed 5.42 overall value for Tilai River, where it was found maximum (6.48) in the same month of the previous index i.e. October. Following the study of^[33] who established that the Margalef's value less than 4.6 indicates an uneven distribution, consequently with this statement it can suggest in harmony that the diversity of Tilai

river was unevenly distributed between the months January – July (as the value was < 4.6) within this period) and evenly distributed between August – October period (when the value was > 4.6) of time. However, in terms of overall value (5.24 which is > 4.6) it can be concluded that the fish assemblage of Tilai River was evenly distributed. The reasons behind this fluctuation of population array is that the water level of all rivers of Bangladesh start to raise high from the end of July and continues till October^[34], peak breeding season within this time period^[35,36] and different activities of Department of Fisheries to protect the stock.

The last index calculated in this study was the evenness which expresses how evenly the individuals in the community are distributed over the different species^[25-37]. The value of evenness become high when the area subsists similar population density i.e. all species distributed identical^[38]. Overall evenness value of Tilai river was very poor (0.24) where the maximum value (1.00) was observed in both May and June month of the study period. This is because the fishermen in Tilai river prefer to use selective fishing gear which are susceptible to catch specific fish species and make the heterogeneity among the fish assemblage. Similar trend of using selective fishing gears which result in make heterogenous fish population array is observed by the other researches in different waterbodies of Bangladesh.^[39, 40]

5. Conclusion

Although Kharkharia-Tilai River is a small river in Northern part of Bangladesh. From the finding of this study it can be propagated that the aquatic assemblage of Tilai River was neither healthy nor rich in abundance as the ideal range of Shannon index value (≥ 3.5). A total of 57 species were found during the study period of which five species were endangered and six species were vulnerable. Fish species in this river were decreasing day by day due to anthropogenic causes (over fishing, destruction of habitat, destructive fishing gears, construction of damp, embankment and siltation etc. and some natural causes (high drought prone area and changing the river route) However, this study will act as a baseline study to formulate the future conservation and management of the fish diversity in the Kharkharia-Tilai River.

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