



## Research Article

# Assessment of Comparative Ichthyofaunal Venerability and Diversity Indexes in Tulsiganga River, Bangladesh

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## Abstract

**Background and Objectives:** Tulsiganga river is rich in aquatic biodiversity in Joypurhat, Bangladesh. Present survey narrated the venerability and diversity indexes of ichthyofaunal distribution here. **Materials and Methods:** On-pot data collection and questioner survey was conducted thoroughly among fishermen and tabulated data were analyzed by different population diversity index. **Results:** About 36 species from 13 different family were reported in this study. The most dominant fishes are included this family Cyprinidae. Based on view of the local fisherman, the three fish species from Siluriformes i.e., *Colisa laila*, *Clarias batrachus* and *Hara hara* under threat. Fourteen species was reports as less common in that area such as *Rohtee cotio*, *Labeobata*, *Acanthocobitis botia*, *Anabas testudineus* etc. With 1 vulnerable species, 22 were less concern, 2 near threaten, 1 data deficient and 9 fish species not evaluated in International Union for Conservation of Nature (IUCN) red list. Order Siluriformes (19.44%) was higher in amount after order Cypriniformes (44.44%), followed by Perciformes (16.67%). Fish group of Carps shows a higher index of H (Shannon-Weiner) and Glassfish were less. **Conclusion:** The species composition of family Gobiidae, Clariidae, Sisoridae, Siluridae, Heteropneustidae and Belonidae were similar. Channiformes and mastacem beliformes are newly reported species.

**Key words:** Biodiversity, endangered, red list, ichthyofaunal biodiversity, fish distribution, diversity index

**Citation:** Alok Kumar Paul, Shapon Kumar Bashak, Mohammad Shahanul Islam, Sunuram Ray, M. Manjurul Alam and M. Afzal Hussain, 2018. Assessment of comparative ichthyofaunal venerability and diversity indexes in Tulsiganga river, Bangladesh. *J. Applied Sci.*, 18: 33-40.

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Bangladesh prides itself on being very rich in fish diversity, a list of 253 freshwater fish species was identified and recorded by International Union for Conservation of Nature<sup>1</sup>. The fish contain most important elements like protein, lipid etc., which are essential for the nutritional health and remedy for various diseases<sup>2</sup>. The fish alone provide about 60% of animal protein<sup>3</sup>. In addition, the fish create the employment opportunity and foreign exchange earnings<sup>4</sup> as well as economic development to the people<sup>5-8</sup>. It is truly said that it reflects the lifestyle, customs and the history of the people of Bangladesh<sup>8</sup>.

Rivers are the main sources of freshwater fishes in Bangladesh. Bangladesh is a sub-tropical agro-based riverine country having 700 rivers according to Department of Fisheries, Bangladesh<sup>9</sup>. It consists of 7,82,559 ha of inland closed waters and 39,16,828 ha of inland open waters along with huge areas of the Bay of Bengal<sup>10</sup> which continuously contributing in the fisheries sector of Bangladesh<sup>11</sup>. But now a days, a multitude of factors including rapid population growth, water pollution by industry, natural disasters, sea intrusion, salinity and the over-exploitation of fisheries, that

diversity has started to diminish. So determining the biodiversity status of all rivers is to days burning concern.

Out of those 700 rivers<sup>9</sup> Tulsiganga is the main river<sup>12</sup> which sited at Khetlalupazila, Joypurhat which is selected for current study. Some studies on ichthyo-diversity were done by the researchers. Rahman *et al.*<sup>3</sup> reported that 8 fish species positioned under vulnerable stage from Hakaluki haor, Bangladesh. The scientists, Mohsin *et al.*<sup>13</sup> stated that 2 species are critically endangered, 3 endangered and 5 vulnerable fish species from Andharmanik river.

However, in this study area, less information about ichthyofaunal biodiversity has been found. So the objective of present study was to show the different levels of threat and current status of ichthyofaunal biodiversity along the study area. Therefore, the findings of this study would add the information in the database for long term research and it would contribute to form management action plan for the threatened freshwater fish species.

## MATERIALS AND METHODS

**Study area:** This study was conducted for a period of 8 months from May, 2014 to December, 2014 in Tulsiganga river<sup>14</sup> under Khetlalupazila at Joypurhat district (Fig. 1).

Fig. 1: Study area<sup>14</sup>

The bazar (Market) areas were selected for mass evaluation and questioner reviews. The fish species were collected from river and also cross checked with the selling fish list in local market area by visiting. The single strait of Tulsiganga river bordered by only Khetlalupazila were covered by researchers which is marked as red box in Fig. 1.

**Data collection:** The present study was completed in this river for 8 months; the setting aim of the study was to find out the diversity of available fish species in that river. To address this desired aim, the fish samples were collected from fishing spots of study area and identified on the spot based on their morphometric and meristic characters following the procedures of Bhuiyan<sup>15</sup> and Talwar and Jhingran<sup>16</sup>. Specimen which was difficult to identify in field was brought to the laboratory for proper identification followed by Rahman<sup>17,18</sup>.

**Data analysis:** Data were analyzed with simple statistical equation by using MS Excel, 2016. Different diversity index were used to have a clear view of fish community and their dominance. Diversity Indexes were calculated using following equation from Rahman *et al.*<sup>19</sup>

- Shannon-wiener Index (H) for better understanding of fish biodiversity:

$$H = - \sum \left[ \left( \frac{n_i}{N} \right) \times \ln \left( \frac{n_i}{N} \right) \right]$$

- Simpson's dominance index:

$$D = \sum \left[ \frac{n_i(n_i - 1)}{N(N - 1)} \right]$$

- Margalef's diversity index:

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

where,  $n_i$  is number of individuals and  $N$  is total number of individuals for the area,  $S$  is total number of species and  $\ln$  is the natural log of the number.

Monthly data were noted on time in standby tables. After finishing study period, collected data were tabulate carefully with standard unit and subjected to simple descriptive analysis using latest computer software Microsoft Excel, 2016.

## RESULTS AND DISCUSSION

**Fish diversity of Tulsiganga river:** The river system of Bangladesh and their tributary travels through varied geo-climatic zone, displaying high diversity in their biotic and abiotic characteristics. Fisheries resources in the study areas of Tulsiganga river are mostly capture fisheries. In the present study, economically important fishes are recorded with their relative abundance. A total of 36 open water fish species belonging to 28 genera, 13 families and 6 orders were identified (Table 1) during the study period. Highest abundant (44.44%) order was Cypriniformes in this study, which is also higher in Hakaluki (Table 2), reported by Rahman *et al.*<sup>3</sup>. However, Perciformes was reported higher (Table 2) by Ali *et al.*<sup>20</sup> and Rahman *et al.*<sup>19</sup>. Cyprinidae was most dominant family among others reported families (Fig. 2). Order Channiformes and Mastacembeliformes are newly reported abundant species in study area (Table 2).

Bhuiyan *et al.*<sup>21</sup> published a checklist of the fishes of Rajshahi Qureshi<sup>22</sup> in his monograph of freshwater fishes of Pakistan included 133 species, most of which occur in Bangladesh. Various studies from 1973-2017 showed that rivers have higher species diversity (Table 3) than beels (wetlands). Paira river shows the highest (114) and Karnafully showed the lowest (27) species diversity. According to Table 3, Tulsiganga river occurred the lower average species biodiversity during study period. Considering Table 2 and 3, the recent study showed that the fish species is gradually declining from the river Tulsiganga due to various manmade and natural causes.

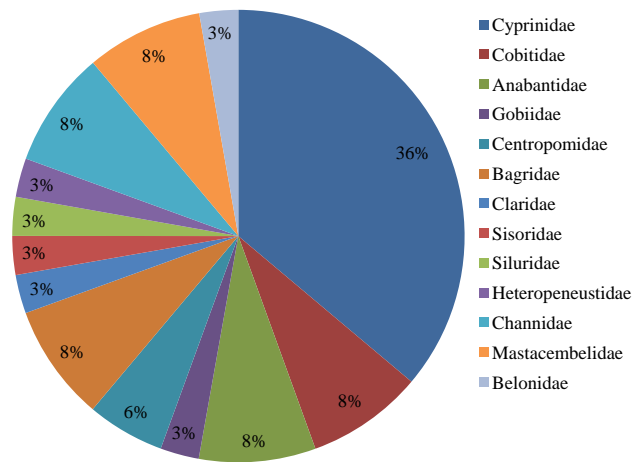


Fig. 2: Percentage contribution of different families in species composition in the river

Table 1: List of fish species recorded in Tulisganga river during study period

Order	Family	Group name	Local name	English name	Scientific name	Local abundance status	IUCN status			
Cypriniformes	Cyprinidae	Barbs and Minnows	Tit-puti	Ticto barb	1. <i>Puntius ticto</i> (Hamilton)	Common	LC			
			Jatputi/puti	Spotfin swamp barb	2. <i>Puntius sophore</i> (Hamilton)	Common	LC			
			Cholaputi	Glass barb	3. <i>Puntius chola</i> (Hamilton)	Common	LC			
			Molaputi	Swamp barb	4. <i>Puntius guganio</i> (Hamilton)	Common	LC			
			Mola	Pale carplet	5. <i>Amblypharyngodon mola</i> (Hamilton)	Common	LC			
			Dhela	Cotio	6. <i>Rohitee cotio</i> (Hamilton)	Less common	NT			
			Darkina	Slender rasbora	7. <i>Rasbora daniconius</i>	Common	LC			
			Rui	Rohu	8. <i>Labeo rohita</i> (Hamilton)	Less common	LC			
			Indian major Carps			Kalbaus	Black rohu	9. <i>Labeo calbasu</i> (Hamilton)	Common	LC
						Katol	Catla	10. <i>Catla catla</i>	Common	LC
Mrigel	Mrigel	11. <i>Cirrhinus cirrhosus</i>				Less common	VU			
Bata	Bata labeo	12. <i>Labeo bata</i> (Hamilton)				Less common	LC			
Baliachata	Mottled loach	13. <i>Acanthocobitis botia</i> (Hamilton)				Less common	LC			
Gutum	Guntea loach	14. <i>Lepidocephalus guntea</i> (Hamilton)				Common	LC			
Puiya	Annandale loach	15. <i>Lepidocephalus annandalei</i> (Hamilton)				Common	LC			
Koi	Climbing perch	16. <i>Anabas testudineus</i> (Bloch)				Less common	DD			
Lal kholisa	Red gourami	17. <i>Colisa laila</i> (Bloch)				Vulnerable	NE			
Kholisa	Gaint gourami	18. <i>Colisa fasciatus</i> (Bloch)				Common	NE			
Perciformes			Bele	Tank goby	19. <i>Glossogobius giuris</i> (Ham and Buch)	Common	LC			
			Chanda	Indian glass fish	20. <i>Chanda ranga</i> (Hamilton)	Common	LC			
			Chanda	Elongate glass perchlet	21. <i>Chanda nama</i> (Hamilton)	Common	LC			
			Tengra	Bagrid catfish	22. <i>Mystus bleekeri</i> (Day)	Less common	LC			
			Tengra	Bagrid catfish	23. <i>Mystus cavasius</i>	Common	LC			
			Tengra	Bagrid catfish	24. <i>Mystus tengra</i>	Common	NE			
			Magur	Mangur	25. <i>Clarias batrachus</i> (Linneus)	Vulnerable	LC			
			Tit magur	South Asian river cat fish	26. <i>Hara hara</i> (Hamilton)	Vulnerable	LC			
			Boal	Freshwater shark	27. <i>Wallago attu</i> (Bloch and Schincidei)	Less common	NT			
			Shing	Stinging catfish	28. <i>Heteropneustes fossilis</i> (Bloch)	Less common	NE			
Channiformes	Channidae	Murels	Taki	Spotted snake head	29. <i>Channa punctatus</i> (Bloch)	Common	NE			
			Chang	Walking snake head	30. <i>Channa orientalis</i> (Bloch and Schincidei)	Common	NE			
			Shol	Stripped snake head	31. <i>Channa striatus</i> (Bloch)	Less common	NE			
			Baim	Tick-track spiny eel	32. <i>Mastacembelus armatus</i> (Lacepede)	Less common	LC			
			Tara Baim	Spotted spiny eel	33. <i>Macroganathus aculeatus</i> (Bloch)	Less common	NE			
			Guchi	Spotted spiny eel	34. <i>Mastacembelus punctatus</i> (Hamilton)	Common	NE			
			Kaklia	Freshwater garfish	35. <i>Xenentodon cancila</i> (Hamilton)	Less common	LC			
			Mastacembelliformes	Mastacembelidae	Spiny eels					
Beloniformes	Belontiidae	Miscellaneous								

LC: Least Concern, NT: Near threaten, VU: Vulnerable, DD: Data deficient, NE: Not evaluated

Table 2: Percentage of Ichthyofaunal diversity

Order (%)	Present study	Ali <i>et al.</i> <sup>20</sup>	Rahman <i>et al.</i> <sup>19</sup>	Rahman <i>et al.</i> <sup>3</sup>
Perciformes	16.67	34.38	33.33	20
Siluriformes	19.44	21.88	19.30	23
Cypriniformes	44.44	17.19	21.05	36
Beloniformes	2.78	1.56	2.51	3
Channiformes	8.33	-	-	-
Mastacembeliformes	8.33	-	-	-
Area	Tulshiganga river, Joypurhat	Ramnabad river, Patuakhali	Pairst river, Patuakhali	Hakaluki hoar, Bangladesh

Table 3: Species abundance reported by various researchers from Bangladesh

References	Year	Species	Area
Doha <sup>26</sup>	1973	106	Mymensing and Tangail district
Ahmed and Hasan <sup>27</sup>	1981	27	Karnafully reservoir
Rahman <sup>18</sup>	1989	257	Freshwater areas of Bangladesh
FAP 6 <sup>28</sup>	1992	154	Northwest region of Bangladesh
Hasan <sup>29</sup>	2007	33	Chitra and Fatki rivers
Rabbani <sup>30</sup>	2007	36	Karatoya river
Zafar <i>et al.</i> <sup>31</sup>	2007	75	Pagla river
Mahmud <sup>32</sup>	2007	56	Chalan beel
Alam <i>et al.</i> <sup>33</sup>	2009	45	Basantapur beel
Shahriar <i>et al.</i> <sup>34</sup>	2010	44	Morgangi beel
Khan <i>et al.</i> <sup>35</sup>	2013	42	Tista river
Barua <i>et al.</i> <sup>36</sup>	2014	56	Bangladesh marine waters
Islam <i>et al.</i> <sup>37</sup>	2015	114	Pairst river
Ali <i>et al.</i> <sup>20</sup>	2015	64	Ramnabad river
Rahman <i>et al.</i> <sup>3</sup>	2016	51	Hakaluki haor
Rahman <i>et al.</i> <sup>38</sup>	2016	57	Pairst river
Ghosh <i>et al.</i> <sup>39</sup>	2016	52	Cox's Bazar and Teknaf
Bhouiyan <i>et al.</i> <sup>40</sup>	2016	71	Turag river
Rahman <i>et al.</i> <sup>19</sup>	2017	47	Agunmukha river
Present study	2014-15	36	Tulshiganga river

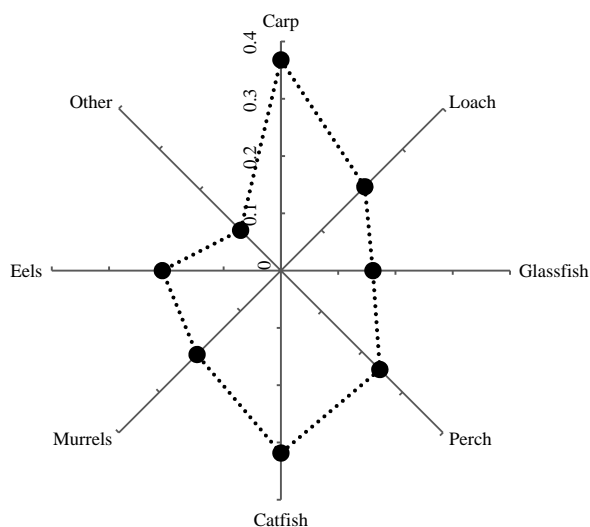


Fig. 3: Shannon-wiener index for different fish groups in the Tulshiganga river

During questioner review among local fishermen, this study found that 18 species were common, 14 species were

less common and 3 species were vulnerable. About 1 vulnerable species, 22 were less concern, 2 near threaten, 1 data deficient and 9 fish species not evaluated in International Union for Conservation of Nature (IUCN) red list (Fig. 5). According to IUCN<sup>23</sup> only 1 species from study is vulnerable. Rahman *et al.*<sup>3</sup> reported 8 vulnerable species from Hakaluki hoar, Bangladesh. Mohsin *et al.*<sup>13</sup> reported 2 critically endangered, 3 endangered and 5 vulnerable fish species from Andharmanik river. Galib *et al.*<sup>24</sup> found 10 vulnerable, 10 endangered and 6 critically endangered species from river Choto Jamuna. The present study found, 22 less concern, 2 near threaten, 1 data deficient and 9 not evaluated fish species (Table 1).

**Diversity Index:** Rahman *et al.*<sup>19</sup> reported a lower H (Shannon-wiener index) value of Eels which is opposite of present study. Carp and Catfish were higher H in present study which is also supported by Rahman *et al.*<sup>19</sup>. Lower H value observed (Fig. 3) for Glassfish and other species during present study. Rahman *et al.*<sup>19</sup> also showed a lower value of D (Simpson's dominance index) for Carps which is revealed opposite (Fig. 4) in present study. The lower D value was for Perch in this study

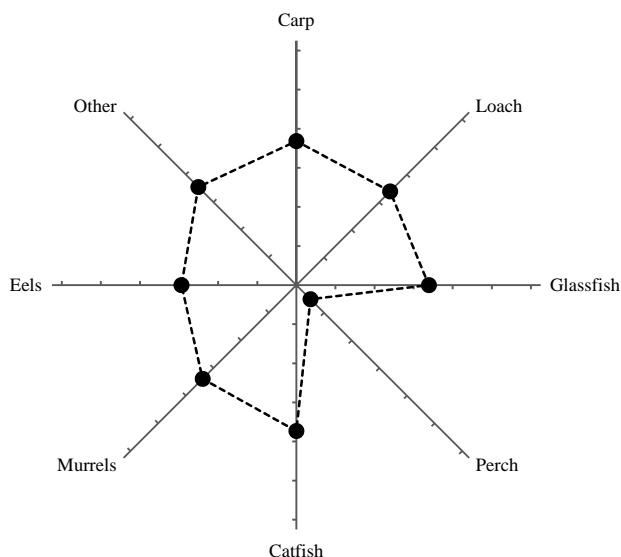


Fig. 4: Simpson's dominance index for different fish groups in the Tulsiganga river

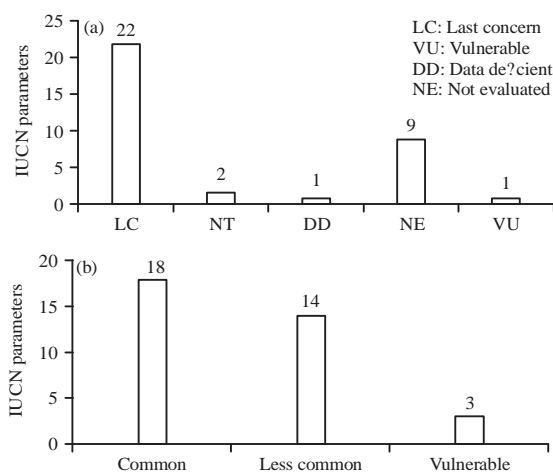


Fig. 5: Red list status (IUCN) and local status of available fishes

and higher of Eels which is supported by Rahman *et al.*<sup>19</sup>. Shukla and Shing<sup>25</sup> studied three stations in Aami river and showed Shannon-wiener index (H) in site-1 as 0.0213 followed by site-2 (0.0088) and the lowest in site-3 (0.00422). The Simpson's dominance index (D) value as high at site-1 (0.064) and site-2 (0.0280) and low at site-1 (0.0133). May be the fish availability and environmental factors are liable behind it. Margalef's index (d) of Fish family richness was 3.35 where in Rahman *et al.*<sup>19</sup> the species richness was 5.13 for all reported fish population. From here the future endangered group of fish (Perch) were easily detected.

This study found some of less concern and vulnerable ichthyofaunal species that can be beneficial for the livelihood

of fishermen<sup>12</sup> as well as governmental development. This study will help the researcher to uncover the critical areas to innovate the suitable way of applying correct conservation program to increase the biodiversity around the Tulsiganga river. Thus, a new way of ichthyofaunal conservation may introduce in future by applying natural or induced breeding to increase the least concern and vulnerable species as well.

### CONCLUSION AND FUTURE RECOMMENDATIONS

In this study, 36 open water species with 6 orders were identified in which, Channiformes and mastacem beliformes were newly reported species and cypriniform was highly abundant (44.44%) specie. Crap and Catfish were higher Shannon-wiener index in present study. Tulsiganga river is a vast livelihood for many fisherman. Due to lower diversity of fishes, it became not only venerable for fish but also risky for fishermen. Necessary steps are recommended to protect the biodiversity by conducting further conservative research in this area.

### SIGNIFICANCE STATEMENT

This study found some of less concern and vulnerable ichthyofaunal species that can be beneficial for the livelihood of fishermen 42 as well as governmental development. This study will help the researcher to uncover the critical areas to innovate the suitable way of applying correct conservation program to increase the biodiversity around the Tulsiganga River. Thus, a new way of ichthyofaunal conservation may introduce in future by applying natural or induced breeding to increase the least concern and vulnerable species as well.

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