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## Present Status of Fish Biodiversity in Talma River at Northern Part of Bangladesh

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### Abstract

The study was conducted to investigate the present status of fish biodiversity and abundance of fish fauna of an Indo-Bangladesh common river Talma in Northern part of Bangladesh. The study was conducted from March to October, 2014. A total of 56 species of fishes have been recorded belonging to eight orders, 21 families and 37 genera. Cypriniformes was the most diversified fish group in terms of both number of species and individuals observed. Among 56 species, 32 species under the order Cypriniformes, nine species of Siluriformes, five species of Perciformes, three species of Channiformes, three species of Synbranchiformes, one species of Beloniformes, one species of Clupeiformes and two species of Decapoda were found. The study revealed that 32.14% of fish species were threatened. Among the threatened species, 12.5% were vulnerable, 16.07% endangered and 3.57% were critically endangered. Overall values of diversity, richness and evenness indices were found 1.42, 6.64 and 0.86, respectively. From the investigation, it was found that the fish biodiversity of the Talma River has declined day by day due to over exploitation, natural causes (such as siltation, flooding, drought and calamities), construction of obstacle for fish migration and lack of public awareness.

**Keywords:** Biodiversity, Talma River, Bangladesh, Richness, Evenness, Threatened species

### 1. Introduction

Biodiversity includes the variety and variability of all life forms viz. the different animals, plants and microorganisms, their genes and the ecosystems of which they are a part. Biodiversity and its conservation are regarded as one of the major issues for sustainable development. Bangladesh is exclusively endowed with extremely rich and extensive inland and marine water resources, which mainly includes floodplains, haors (back swamp), baors (ox-bow lake), beels (lake-like wetland with static water), rivers, estuaries, coastal belt and vast marine waters. Due to having variety of water resources, Bangladesh is blessed with a wide range of freshwater and marine biodiversities. The country is ranked third in fish biodiversity in Asia behind China and India with approximately 800 species of fresh, brackish and marine waters (Hussain and Mazid, 2001)<sup>[7]</sup>. Among all aquatic organisms, fish are the most dominant and major source of dietary protein for rural poor. This sector also generates employment opportunity that forms the lifeline for rural economy. But the aquatic systems are changing worldwide in profound ways, and as the human population continues to grow, the impacts of anthropogenic stressors are likely to increase. The primary threat for most terrestrial and freshwater species is the destruction of their habitats (Baillie *et. al.*, 2004)<sup>[3]</sup>. Environmental degradation and human interventions reduce the habitat available of the species, resulting in a reduction in their numbers. As a consequence, many fish are under different levels of threat, such as, vulnerable (VU), endangered (EN) and critically endangered (CR), which category was provided by IUCN (2000)<sup>[9]</sup>. Such categories of threat levels provide an assessment of the likelihood of extinction under the current circumstances. Fish biodiversity in Bangladesh has been degraded due to many reasons such as overfishing, aquaculture practice, pollution, habitat loss and degradation etc. Among 260 freshwater fish species of Bangladesh, 54 species are threatened of which 12 are critically endangered, 28 are endangered and 14 are vulnerable (IUCN, 2000)<sup>[9]</sup>. Bangladesh is called a riverine country due to the presence of plenty of rivers. A fairly large numbers of big rivers with their tributaries and branches criss-cross the country. This riverine country got tributaries and distributaries flow through the country constituting a water way of total length of about 24,14km

and the area of about 8,53,863 hectares (DoF, 2014) [5]. The major river systems of South Asia, the Padma, the Brahmaputra and the Jamuna flow into the sea through Bangladesh. About 54 rivers of Bangladesh are shared with India. The rivers are offering immense scope and potentiality for augmenting fish production and socio-economic security of the people living around.

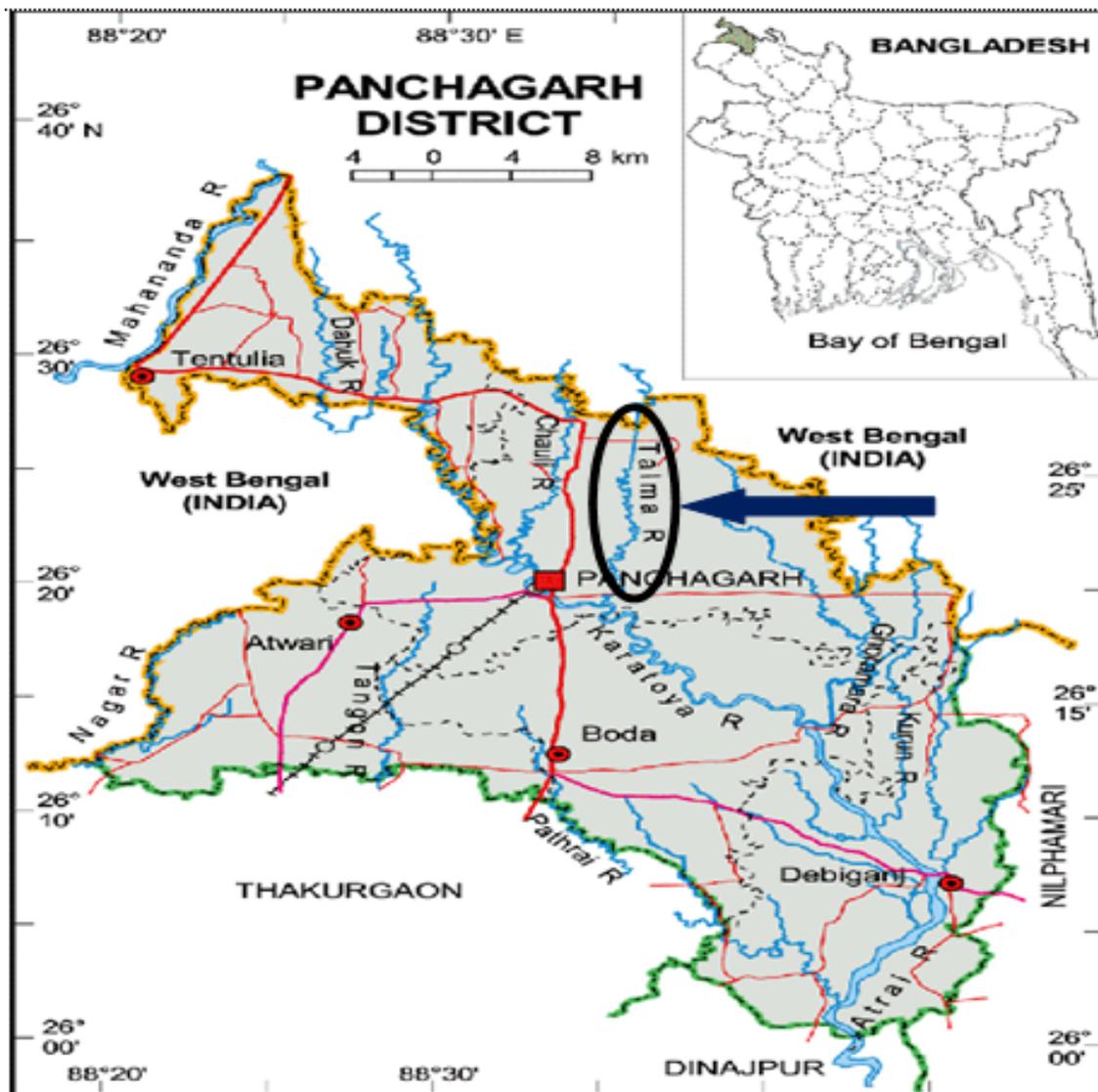
The river Talma is a small but important water body in the northern part of Bangladesh since it plays an important role in the fisheries sector of in this region. This river is shared by India and Bangladesh (Nahid, 1992) [13]. The total length of the river is 130 kilometers. Talma River originates from the Guzmari (26°36'37.92"N 88°34'41.87"E) in Jalpaiguri district of the Indian state of West Bengal and flows southward and entered into the border of Bangladesh closed to Salilan Tea Estate near the place 'Bahir Ghor' in Panchagarh district of Bangladesh. The river then flows past to the town of Model haat, and entered the Southern part of 'Vetor Ghor'. The river then courses its way at Talma bazar and finally merging with the Karatoya River near Tular Danga. The Talma River is said to be the lifeline of the locality, 'Vetor Ghor' of Panchagarh district. The River plays very important role in earning and supplying food to the poor fishing community of the river

(Rahman *et. al.*, 2015) [18]. Production and diversity of fish in this river is declining day by day as known from the fishers. However, no methodical study has been known on the fish diversity, catch composition, seasonal variation of fish availability and the causes of decreasing diversity in Talma River which will consequently limit establishment of biodiversity conservation strategies. Therefore, the present study attempted to collect information on fish biodiversity in the Talma River at Northern region of Bangladesh.

**2. Materials and Methods**

**2.1 Selection of study site**

The study was carried out in a village named Talma, under Panchagarh Sadar Upazila in Panchagarh district. The village is situated on the bank of the river Talma. The primary criterion for the selection of the study area was a suitable geographical coverage for wider variety of fish biodiversity and good numbers of fishermen. For this, information was collected from Upazila Fisheries Officer of Panchagarh Sadar regarding the fish biodiversity and concentration of fishing activities in the Talma River, and finally Talma village was selected for sample collection.



**Fig 1:** Map of Talma River in Panchagarh district

### 2.2 Collection and identification of samples

In the study, a total of 50 of both professional and subsistence fishermen living around the area of Talma River in Talma village were selected. The study was conducted for a period of eight months from March 2014 to October 2014. Sampling of catches and their assessment were carried out fortnightly i.e. twice in a month. Fish sampling were accomplished with the help of fishing nets locally known as Jhaki Jal (cast net), Fash/current jal (gill net), Khora jal (lift net) and fishing traps locally called Dohair, Britti and Kholsun. The representative samples were immediately separated to overcome repetition of the same gear in each sampling day. Collected species were then identified and categorized. All these fishing gears were operated at the same spot within 0.5 km area to ensure harvesting of maximum species of study site in the catch. Gill net and fishing traps were set in late afternoon and left overnight to check in the morning. Twenty throws and fifteen hauls were made for cast and lifts net, respectively during the operation of cast and lift nets. The fish collected during sampling were identified primarily on the spot. Those, which appeared difficult to identify, were marked properly and preserved in 10% buffered formalin in the plastic jars and then transferred to the Aquatic Bioresource Research Laboratory in the Department of Fisheries, Sher-e-Bangla Agricultural University at Dhaka, and to the Laboratory of the Department of Fisheries Management in Bangabandhu Sheikh Mujibur Rahman Agricultural University at Gazipur, Bangladesh. The collected fish samples were identified by evaluating their morphometric and meristic characteristics as well as the color of the specimens referring the books, Fish Base etc. The taxonomic guide by Rahman (2005) [16] and Inland Fishes of India and adjacent countries by Talwar *et al.* (1991) [21] were also used for their identification. After identification, fish species were systematically classified according to Nelson (2006) [14].

### 2.3 Evaluation of abundance and biodiversity status

For assessment of abundance and biodiversity status, the observed fishes were categorized as different levels of threatened condition such as vulnerable (VU), endangered (EN), critically endangered (CR) and not threatened (NO) following IUCN Red list (IUCN, 2000) [9]. Based on the interview and reporting of the fishermen, and on the availability during study period the fishes were further categorized and evaluated as available throughout the year (TY), throughout the year but in small amount (TYS), throughout the year in large amount (TYL), found in small amount during monsoon (SM), found in large amount during monsoon (LM), rare (R) and very rare (VR).

To understand the seasonal diversity of fishes in the study area, month-wise data were collected. In this study, the Shannon-Weaver diversity index (*H*), evenness index (*e*) and Margalef's richness index (*D*) were calculated for understanding the status of diversity using the following formulas:

**Shannon- Weaver diversity index,  $H = - \sum Pi \ln Pi$**  (Shannon and Weaver, 1949) [20]

Here, *H* is the diversity index and *Pi* is the relative abundance (s/N). The Shannon-Weaver index has been a popular diversity index in the ecological literature. It is also known as Shannon index, Shannon's diversity index, the Shannon-Wiener index and the Shannon entropy.

**Margalef's richness index,  $D = \frac{s-1}{\ln N}$**  (Margalef, 1968)

[11] Here, *s* is the number of individual for each species, *N* is the total number of individuals and *D* is the richness index

**Evenness index,  $e = \frac{H}{\ln S}$**  (Pielou, 1966) [15]

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.

For calculation of Shannon-Weaver diversity index and evenness index, we used Shannon-Weaver Species Diversity Index Calculator from the website <https://www.easycalculation.com/statistics/shannon-wiener-diversity.php> Shannon-Weaver diversity index, *H* (Shannon, 1949; Ramos *et al.*, 2006) [20] [19] considers both the number of species and proportion of each species while evenness index, *e* represent the number of species present in an ecosystem as well as the relative abundance of each species. The value of Shannon-Weaver diversity index usually falls between 1.5 and 3.5, only rarely it surpasses 4.5. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species (Bibi and Ali, 2013) [4].

## 3. Result

### 3.1 Composition of fish species

A total of 3964 individuals of fish were counted and categorized at Talma River during the study period. Among those, 56 fish species were found which belong to 37 genera, 21 families and eight orders. Cypriniformes was found as the most dominant order considering species variety and abundance, and Siluriformes and Perciformes occupied second and third position in abundance, respectively.

During investigation, 32 species from four families named Cyprinidae, Cobitidae, Balitoridae, Psilorhynchidae and Cyprinodontidae under the order Cypriniformes were recorded which consist 57.14% of species diversity and 54.59% of fish individuals.

Catch composition survey for the study of fish biodiversity of the Talma River revealed three species of snakehead under the order Channiformes. Among them taki (*Channa punctatus*) was found throughout the year in small amount. Shol (*Channa striatus*) was found in small amount in monsoon season but cheng (*Channa orientalis*) was rare during the study period.

**Table 1:** Fish diversity of Talma River with their availability and present status.

Order	Family	Local name	English Name	Scientific name	Availability	Status	% of catch
	Cyprinidae	Rui	Indian major carp	<i>Labeo rohita</i>	R	NO	0.88
		Kalibaus	Orange-fin Labeo	<i>Labeo calbasu</i>	VR	EN	0.45
		Catla	Indian major carp	<i>Gibelion catla</i>	R	NO	0.86

Cypriniformes		Mrigal	Indian major carp	<i>Cirrhinus cirrhosus</i>	R	NO	0.81
		Bhagna/ Rayek	Reba carp	<i>Cirrhinus reba</i>	VR	VU	0.53
		Pathorchata	Tileo Baril	<i>Barilius tileo</i>	TYL	DD	3.28
		Joiya	Hamilton's Barila	<i>Barilius bendelisis</i>	TY	EN	2.9
		Saku koksha	Shacra Baril	<i>Barilius shacra</i>	TYL	DD	5.68
		Barali	Barna Baril	<i>Barilius barila</i>	TYS	DD	2.65
		Bhol	Trout Barb	<i>Raiamas bola</i>	SM	EN	1.14
		Katari	Large Razorbelly Minnow	<i>Salmostroma bacaila</i>	TY,LM	NO	2.27
		Chap chela	Silver Hatchet Barb	<i>Chela cachius</i>	TYS	DD	1.46
		Laubuca/mulungi chela/ Chap chela	Indian Glass Barb	<i>Chela laubuca</i>	LM	EN	2.17
		Utta	Medium carp	<i>Chagunius chagunio</i>	TYS	DD	2.27
		Banspata/Debari	Sind Danio	<i>Devario devario</i>	SM	DD	1.14
		Ful chela	Finescale Razorbelly Minnow	<i>Salmostoma phulo</i>	R	NO	0.17
		Jatputi/ Vadiputi	Pool Barb	<i>Puntius sophore</i>	TYL	NO	3.15
		Titputi	Fire-fin barb/Ticto Barb	<i>Puntius ticto</i>	TY	VU	2.77
		Alog	Megarasbora	<i>Bengala elonga</i>	SM	EN	0.58
		Sharputi	Olive Barb	<i>Puntius sarana</i>	LM	CR	1.89
		Mola	Mola carplet	<i>Amblypharyngodon mola</i>	TY	NO	1.39
		Jaya/cilkan	Jaya	<i>Aspidoparia jaya</i>	LM	NO	2.04
	Thutia puti/raicon	Silver shark minnow	<i>Osteochilus hasseltii</i>	TYS	DD	1.64	
	Darkina	Flying Barb	<i>Esomus danricus</i>	TY	DD	2.40	
Psilorhynchidae	Titary	River stone carp	<i>Psilorhynchus sucatio</i>	R,SM	DD	0.63	
	Balitora	Balitora minnow	<i>Psilorhynchus balitora</i>	DD	DD	1.21	
Balitoridae	Korika/ Khorka	Polka Dotted loach	<i>Schistura corica</i>	R	DD	1.19	
Cobitidae	Ghor poia/Cheng Gutum	Gongota loach	<i>Somileptes gongota</i>	SM	NO	1.97	
	Rani	Queen Loach	<i>Botia dario</i>	R,SM	EN	1.39	
	Gutum	Peppered loach	<i>Lepidocephalichthys guntea</i>	R	NO	0.86	
	Puiya/Gutum	Annandale Loach	<i>Lepidocephalichthys annandalei</i>	TYS	NO	0.63	
	Rani	Reticulated Loach	<i>Botia lohachata</i>	TY	NO	1.69	
Channiformes	Channidae	Shol	Snakehead murrel	<i>Channa striata</i>	SM	NO	1.31
		Taki	Spotted snakehead	<i>Channa punctata</i>	TYS	NO	1.51
		Cheng/Raga	Walking snakehead	<i>Channa orientalis</i>	R R	VU	0.58
Perciformes	Osphronemidae	Khalisha	Banded Gourami	<i>Colisa fasciata</i>	TY, LM	NO	2.77
		Lal khalish	Dwarf Gourami	<i>Colisa lalia</i>	SM	NO	3.15
	Ambassidae	Lal chanda	Highfin glassy perchlet	<i>Parambassis lala</i>	R	VU	0.91
	Gobiidae	Bailla	Tank Goby	<i>Glossogobius giuris</i>	TYS	NO	2.02
Badidae	Koi bandi/ Napit Koi	Blue Perch	<i>Badis badis</i>	VR	EN	0.30	
Synbranchi-formes	Mastacembelidae	Guchi	Barred Spiny Eel	<i>Macrognathus pancalus</i>	TY	NO	2.14
		Baim	Zig Zag Eel	<i>Macrognathus armatus</i>	TYS	EN	1.41
		Tara baim	Lesser Spiny Eel	<i>Macrognathus aculeatus</i>	R	VU	0.88
Siluriformes	Bagridae	Tengra	Striped dwarf catfish	<i>Mystus vittatus</i>	TYL	NO	3.03

		Aair	Long whiskered catfish	<i>Sperata aor</i>	R	VU	2.32
		Gulsa Tengra	Day's Mystus	<i>Mystus bleekeri</i>	TYS, SM	VU	1.81
	Clariidae	Magur	Walking catfish	<i>Clarias batrachus</i>	TY	NO	1.89
	Heteropneustidae	Shing	Stinging catfish	<i>Heteropneustes fossilis</i>	LM	NO	2.39
	Schilbeidae	Bacha	Batchwa Vacha	<i>Eutropiichthys vacha</i>	VR	CR	0.81
	Siluridae	Pabda	Pabdah Catfish	<i>Ompok pabda</i>	SM	EN	1.64
		Boal	Freshwater shark	<i>Wallago attu</i>	SM	NO	1.38
	Erethistidae	Cheka/kurkati/Kutakati	Gangetic Erethistes	<i>Erethistes pussilus</i>	VR	NO	0.25
Clupeiformes	Clupeidae	Kachki	Gangas river sprat	<i>Corica soborna</i>	SM	NO	4.04
Decapoda	Palaemonidae	Beel Chingri	River prawn	<i>Macrobrachium daganum</i>	TY	×	3.78
		Gura Chingri	Monsoon river prawn	<i>Macrobrachium lumarre</i>	TYS	×	3.03
Beloniformes	Belonidae	Kakila	Asian Needlefish	<i>Xenentodon cancila</i>	TY	NO	2.02

- TY, throughout the year; TYS, throughout the year in small amount; TYL, throughout the year in large amount; SM, found in small amount during monsoon; LM, found in large amount during monsoon; R, rare; VR, very rare.
- Status in the IUCN Red List according to IUCN (2000), EN, endangered; VU, vulnerable; CR, Critically endangered; NE, not evaluated; DD, data deficient; NO, not threatened.

In case of Perciformes, five species belong to four families viz. Osphronemidae, Ambassidae, Gobiidae and Pristolepidae were found during the study period. Among these fishes, Napit Koi (*Badis badis*) and Lal chanda (*Parambassis lala*) were rare in study areas. Khalisha (*Colisa fasciata*) was found throughout the year with higher amount in monsoon. Bailla (*Glossogobius giuris*) was also found around the year but in small amount. The order Siluriformes (Catfish) was found as the second most dominant group considering species diversity. Nine species of Siluriformes belong to six families i.e. Bagridae, Clariidae, Heteropneustidae, Erethistidae, Schilbeidae and Siluridae were recorded which were about 15.54% of the total fish population in numbers and 16.07% regarding species diversity. Among different species of catfishes, *Mystus vittatus* and *Clarias batrachus* was found throughout the year. *Ompok pabda* and *Wallago attu* were available in small amount during monsoon. On the other hand, *Heteropneustes fossilis* was found in large numbers in this season. *Sperata aor*, *Eutropiichthys vacha*, *Erethistes pussilus* were very rare in the study periods. In the study, three fish species of the order Synbranchiformes were observed. All of these species were belong to the same family which is Mastacembelidae. About 4.43% of total fish population was found from this family which included 5.36% in species diversity. Guchi (*Macrognathus pancalus*) was found throughout the year. Baim (*Macrognathus armatus*) was also found throughout the year but in small amount. Tara baim (*Macrognathus aculeatus*) was rare in the river Talma. During the study period two species of Decapode under Palaemonidae family was observed which are *Macrobrachium daganum* and *Macrobrachium lumarre*. Both of these prawn species were found throughout the year but *M. lumarre* was found relatively in small amount. The lowest number of species was counted for the order Beloniformes and Clupeiformes. Only one species was obtained for each during the period of investigation. Those fish species were *Xenentodon cancila* and *Corica soborna* belong to the family Belonidae and Clupeidae, respectively.

### 3.2 Contribution of different groups of fish in total population and diversity

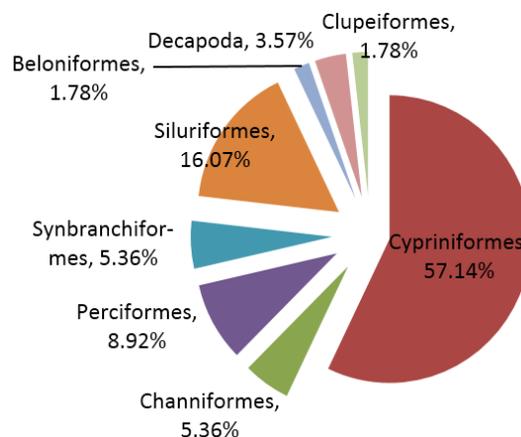


Fig 2: Percentage of fish species diversity under different order found in Talma River

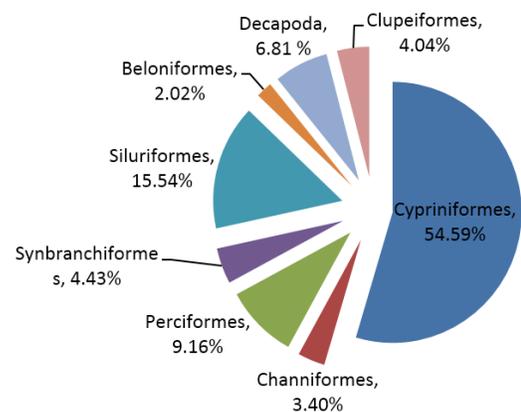


Fig 3: Percentage of fish species composition under different order found in Talma River

From the record of the study, the highest numbers of fishes were obtained in Cypriniformes in terms of both number of individuals and species diversity consisting 54.59% and 57.14%, respectively. Beloniformes was the lowest dominant group in terms of both number of species and individuals observed which contains 1.02% of total fish population and 1.78% in order based fish species diversity. For other five orders of fin fishes, diversity of fishes were measured 5.36%, 8.92%, 5.36%, 16.07% and 1.78% (Fig 2) and the number of fish individuals (among 3964 fishes) were counted 3.40%, 9.16%, 4.43%, 15.54% and 4.04%, for Channiformes, Perciformes, Synbranchiiformes, Siluriformes and Clupeiformes, respectively (Fig 3). About 6.81% of total number of species was Decapode which comprised of 3.57% regarding species diversity.

### 3.3 Threatened species detected in the study area

Out of the collected 56 species, 25 species were not threatened (NO). Among rest of the 31 fish species, seven species were ranked as vulnerable (VU), nine species as endangered, two species as critically endangered (CR) and 11 species as data deficient (DD), according to IUCN Red Book of threatened fishes of Bangladesh (Fig 4). Based on the species diversity under different groups 66.67% fish species of Synbranchiiformes, 44.44% of Siluriformes, 40% species from Perciformes and 28.12% under Cypriniformes were found threatened in fish biodiversity of Talma River. Only 41.07% fish species were available throughout the year, 21.42% fishes were rare and 8.93% fishes were found very rare in the current study.

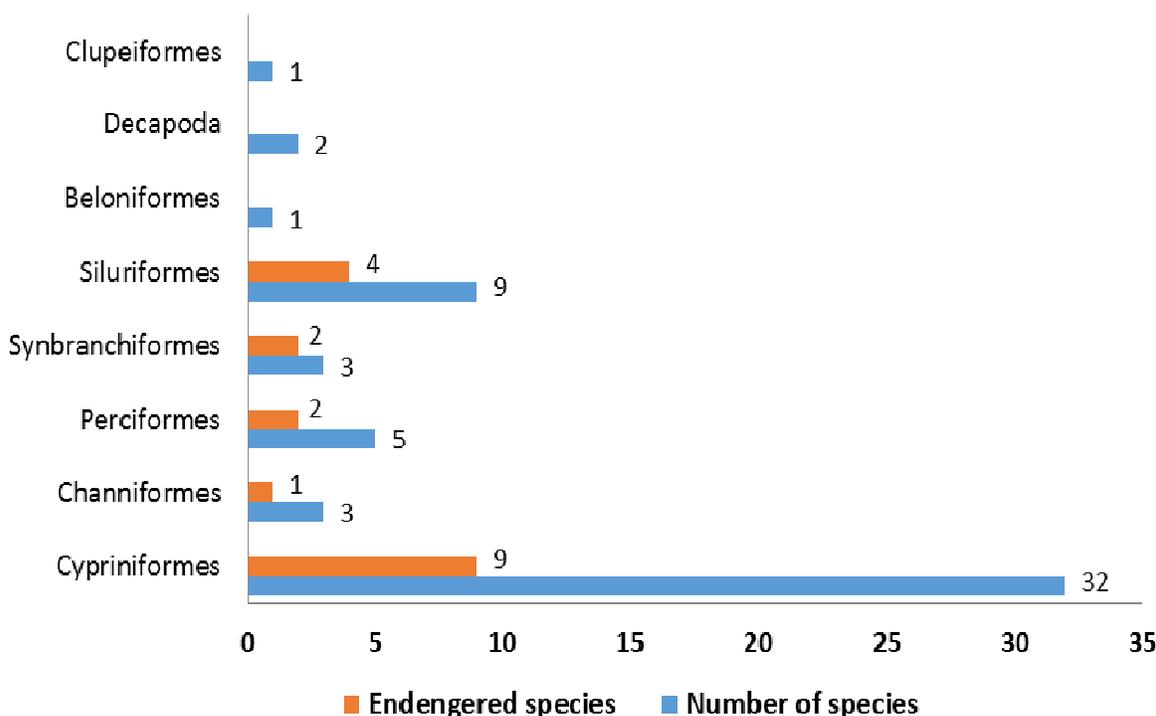


Fig 4: Number of endangered species under different orders detected in the study

### 3.4 Diversity, richness and evenness indices

The month-wise values of Shannon-Weaver diversity (*H*), Margalef's richness (*D*) and Pielou's evenness (*e*) indices are shown in Table 2. Considering all the samples studied in the present survey, the values of *H*, *D* and *e* were 1.42, 6.64, and 0.68, respectively. The value of *H* ranged from 1.06 (June) to

1.51 (October), *D* varied from 5.34 (July) to 7.41 (October), and *e* ranged from 0.65 (May) to 0.73 (October). *H* and *D* values showed that diversity of fish fauna was the highest in the month of October. The maximum number of fish species was also recorded during this time. The lowest number of species was recorded in the month of June (Table 2)

Table 2: Number of studied species and individuals, and respective values of Shannon-Weaver diversity (*H*), Margalef richness (*D*) and evenness (*e*) indices in each sampling month.

Month	No. of species	No. of individual	<i>H</i>	<i>D</i>	<i>e</i>
March	45	552	1.37	6.97	0.66
April	42	450	1.49	6.71	0.72
May	38	505	1.17	5.94	0.65
June	31	354	1.06	5.11	0.66
July	33	400	1.17	5.34	0.73
August	37	503	1.19	5.79	0.66
September	46	550	1.50	7.13	0.72
October	49	650	1.51	7.41	0.73
ALL	56	3964	1.42	6.64	0.68

*H*: Shannon-Weaver diversity index; *D*: Margalef's richness index;  
*e*: Pielou's evenness index

The focus of species richness ( $D$ ) generally is a more reliable measure of biodiversity. Species richness was found highest for Cypriniformes followed by cat fishes (Siluriformes) and the richness values calculated 4.27 and 1.38, respectively (Table 3). The lowest  $D$  value was found in Beloniformes and Clupeiformes ( $D = 0.13$ )

**Table 3:** Order wise species richness values of fishes.

Order	Number of species	Species richness ( $D$ )
Cypriniformes	32	4.27
Channiformes	3	0.40
Perciformes	5	0.66
Synbranchiformes	3	0.40
Siluriformes	9	1.20
Beloniformes	1	0.13
Decapoda	2	0.26
Clupeiformes	1	0.13
Total	56	

#### 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. Ali *et al.* (2014)<sup>[2]</sup> found a total of 53 species in the river Chitra at Jessore district of Bangladesh. Galib *et al.* (2013)<sup>[6]</sup> 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 Talma River is much lower. For example, Rahman *et al.* (2012)<sup>[17]</sup> 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 Alam *et al.* (2013)<sup>[11]</sup>. In the river Tista, Khan *et al.* (2013)<sup>[10]</sup> 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 (Galib *et al.*, 2013)<sup>[6]</sup>, the river Mahananda (Mohsin *et al.*, 2009)<sup>[12]</sup>, the river Tista (Khan *et al.*, 2013)<sup>[10]</sup> and the river Padma (Rahman *et al.*, 2012)<sup>[17]</sup>. In case of the river Halda, though Cypriniformes was the most abundant family like other rivers, the second most dominant order was Perciformes unlike Siluriformes. Siluriformes was third dominant order in Halda River. Above findings are usual because these three Orders (Cypriniformes, Siluriformes and Perciformes) are the most dominant groups in freshwater bodies of Bangladesh (Rahman, 2005)<sup>[16]</sup>.

The higher number of fish individuals and species were recorded in winter months (September, October, March) than other months (Table 2). This is probably due to lower water depth in this time. During the winter months, water depth reached to its minimum level for insufficient rainfall. Therefore, fishermen can use their fishing gears more

effectively and harvest more fishes. Higher diversity and abundance of fishes in winter season were also reported for the river Choto Jamuna situated in the north-west part of Bangladesh (Galib *et al.*, 2013)<sup>[6]</sup>. On the contrary, the lowest number of individuals and species were recorded in the month of June. In Bangladesh, heavy rainfall occurs during this time which makes fishing difficult as water level reached its maximum and river becomes more violent.

The value of Shannon-Weaver diversity index,  $H$  increases when both the number of species and evenness,  $e$  increases. For a given number of species, the value of  $H$  is maximized when all species are equally abundant. However, quantifying biodiversity is a complicated task. The value of  $H$  usually falls between the values 1.5 and 3.5, and it rarely surpasses the value 4.5. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species (Bibi and Ali, 2013)<sup>[4]</sup>. In the present study, the value of  $H$  was found highest ( $H = 1.59$ ) in the month of October and it was the lowest in June ( $H = 1.06$ ).

By the initiative of International Union for the Conservation of Nature (IUCN), a comprehensive inventory of biological species was made based on their extinction risk and global conservation status which is known as the IUCN Red List of Threatened Species or IUCN Red List. One of the aims of this initiative is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction. The IUCN Red List has nine groups which are extinct (EX), extinct in the wild (EW), critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), data deficient (DD) and not evaluated (NE). The IUCN Red List also used a term ‘threatened’ is a grouping of three categories: CR, EN and VU. A total of 54 native freshwater fish species of Bangladesh have been declared as threatened species by IUCN (2000)<sup>[9]</sup>. In Talma River, 32% of fish species were found threatened. Among these fishes, 12.5% were vulnerable, 16.07% were endangered and 3.57% were critically endangered. Galib *et al.* (2013)<sup>[6]</sup> reported 41.27% of fish species in the river Choto Jamuna as threatened. Mohsin *et al.* (2009)<sup>[12]</sup> observed 33.92% of fish species in Mahananda River were threatened. In another study, 42.5% fish species were recorded as threatened in the river Padma (Ramman *et al.*, 2012)<sup>[17]</sup>. There are two sanctuaries established in the river Talma by the Government of Bangladesh under Department of Fisheries (DoF) to increase abundance and diversity of fishes. Threatened fish species observed in Talma River was found relatively lower than the percentage of threatened fishes among all freshwater species of global aquatic ecosystem (39%) (IUCN, 1998)<sup>[8]</sup> and also lower than the above mention studies of different rivers which may indicate that these two sanctuaries are contributing in increasing of fish biodiversity and keeping lower percentage of threatened species in the study area. From the investigation of present study, it was found that many factors are responsible for decreasing biodiversity of fishes in Talma River including habitat loss, siltation in river basins, over-exploitation and indiscriminate killing of juvenile fish due to unregulated fishing pressure, water pollution caused by industrial and domestic wastes, pesticides and agrochemicals, destruction of breeding and nursery grounds due to construction of dam for flood control and other purposes.

#### 5. Conclusion

During the study periods a variety of freshwater fish species (56) were recorded at Talma River belonging to 37 genera, 21

families and eight orders. The research revealed that a total of 32.14% fish species were threatened in the study area. Among the threatened species 12.5% were vulnerable, 16.07% endangered and 3.57% critically endangered. The month-wise values of Shannon-Weaver diversity ( $H$ ), Margalef's richness ( $D$ ) and Pielou's ( $e$ ) evenness were found to 1.42, 6.64 and 0.86, respectively. The study also revealed that at present, loss of biodiversity is alarming and the earliest effective management is essential to deal with this issue. Several reasons including degradation of natural habitats, excess exploitation using illegal fishing gears and techniques, use of toxins in agricultural land, lower level of water, construction of rubber dam were responsible for this loss. Abundance of threatened fish species (32.14%) among the total catch strongly reflecting its potentiality to an excellent site for natural conservation. However, the study also formulates the future potentialities and recommendation for development, conservation and better management of the fish biodiversity in the study area. It is recommended that natural habitat of fish and other aquatic resources should not be disturbed, poisonous or toxic substances should not apply in the adjacent area and government should take some important step to improved the natural habitat through excavating and dredging of bottom mud and establish fish pass and sanctuaries as well as increasing people awareness to conserve biodiversity in the Talma River.

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