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FISH DIVERSITY AND ITS THREATENED STATUS OF THE DHARLA RIVER IN BANGLADESH

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ABSTRACT

Fish diversity of a riverine ecosystem became reduced due to different manmade and natural calamities. This study investigated the present fish biodiversity status of the Dharla River located (25.8103° N, 89.6487° E) in the northern part of Bangladesh from January to December 2018. In this study, the existing fish biodiversity status of the Dharla River was estimated in terms of diversity indices and threatened status (both global and local). Data was collected from the three sampling sites of the river using different fishing gears and three selected fish markets located in the Kurigram district of Bangladesh. A total of 76 fish species were identified belonging to 8 orders, 26 families and 57 genera. The Cyprinidae was the most dominant family represented by 14 species followed by the Danionidae (13 species), Bagridae (8 species) and few minor families. Apart from the indigenous species, nine exotic fish species were also recorded. The Shannon-Weaver diversity (*H*), Pielous evenness (*e*) and Margalef richness (*D*) indices ranged from 3.00 to 3.71, 0.62 to 0.94 and 3.94 to 7.95, respectively. Out of 76 indigenous species, 28 species (37%) were identified as threatened in Bangladesh, which included critically endangered (4), vulnerable (9) and endangered (15) species. Indiscriminate fishing through poisoning and destructive fishing gears were identified as the major threats to fish biodiversity of the Dharla River. Thus, the river serves as considerable support for threatened indigenous fishes. Therefore, necessary steps are needed to stop destructive fishing, establish permanent fish sanctuaries and proper monitoring for maintaining sustainable biodiversity in the Dharla River.

How to Cite

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INTRODUCTION

The freshwater ecosystem is the world's richest ecosystem containing about 41.24% of known fish species (Gökçe, 2019). Bangladesh is enriched with 24,140 km of rivers, 114,161 ha of natural depressions or beels, 5,488 ha of oxbow lakes, 68,800 ha of reservoirs and some 2.7 million ha of floodplains in terms of inland water resources (DoF, 2019). Also, Bangladesh is considered a riverine country, including 310 rivers with their tributaries (BBS, 2018) flowing throughout the country.

The diverse vast inland water bodies supported 265 indigenous freshwater fish species of Bangladesh (Rahman, 2005). Furthermore, Bangladesh is positioned fifth in the production of freshwater fishes and rivers serve as brood banks for this purpose (DoF, 2019). However, rapid population increase in Bangladesh declined the freshwater fish very hastily from the river ecosystem (Galib et al., 2009). Overexploitation of natural fishes occurred to meet the food protein demand of the people. Unplanned management of the river water for agriculture and industrial activities led to the extinction of freshwater fish species from the rivers (IUCN 2015). Unplanned construction of roads, sluice gates, dams and bridges blocked many migratory routes and caused the devastation of fish habitat, nursery and breeding grounds (IUCN 2015). Conversion of inundated land to cropland (Chakraborty and Nur, 2009), invasion of exotic species, aquatic pollution, unplanned exploitation, discharges from industries and municipal sewerage, and global climate change led to the threat of many indigenous species (Rao et al., 2014; Siddik et al., 2014; Sharker et al., 2015). IUCN (2015) declared 64 fish species in Bangladesh as threatened among 253 assessed species, whereas the number of threatened species was 54 in 2000.

The Dharla River is one of the transboundary rivers flowing in northern Bangladesh. It originates from Kupup or Bitang Lake in southeastern Sikkim in the eastern Himalayas, known as the Jaldhaka River, and flows through Bhutan and the Kalimpong, Jalpaiguri and Cooch Behar districts of West Bengal, India. The Dharla River enters into Bangladesh through the Lalmonirhat district and joins together with the Jaldhaka River then flows with the Dharla River until it empties into the Brahmaputra River near the Kurigram district (Chowdhury, 2012).

A scientific understanding of management is very important in order to conserve fish biodiversity and ensure sustainability in natural water bodies (Hanif et al., 2015). For sustainable management of a riverine ecosystem, diversity indices reveal more information on scarcity and commonness in their community, rather than the simple relationship of the species present in specific water bodies (Hanif et al., 2015). Although several studies have been conducted on assessing fish biodiversity of different rivers in Bangladesh (Imteazzaman and Galib, 2013; Hanif et al., 2015; Galib, 2015; Siddique et al., 2016; Parvez et al., 2017; Parvez et al., 2019), studies on the fish diversity of the Dharla River remained untouched till now. Therefore, the present study aimed to conduct an assessment of indices based on fish biodiversity of the Dharla River with their threatened status.

MATERIALS AND METHODS

Study area and duration

The study was conducted on the Dharla River at the Kurigram district (25.8103° N, 89.6487° E) in the northern part of Bangladesh (Figure 1) from January to December 2018. The fish samples were collected twice a month from three selected sites (S-1: 25°51'50.7"N 89°36'39.0"E, S-2: 25°47'37.0"N 89°39'03.6"E, S-3: 25°51'32.4"N 89°36'01.3"E) at early morning and three markets (Buraburi Bazar-25°44'36.2"N 89°40'59.9"E, Mogalbasa Bazar-25°46'07.0"N 89°39'22.3"E, Zia Bazar-25°48'47.0"N 89°38'58.7"E) at noon in the study area. The fishermen used gill nets (mesh size 0.5-1.27 cm), cast nets (mesh size 0.4-1.1 cm), lift nets/dip nets (mesh size 0.3-1.2 cm) and different types of traditional fishing traps like conical traps, fish barrier (*Thaga*) to catch the fish. Fishes were collected and counted on the spot, and then categorized. The identified and unidentified fishes were preserved into the 10% formalin at the fish laboratory in Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur for further study.

Identification and conservation status of fishes

The collected fish from the selected study areas were identified based on their morphometric characters and meristic counts following Talwar and Jhingran (1991), Rahman (2005). Updated taxonomic framework followed Eschmeyer (2014). It is very important to know the conservation status of fish biodiversity for taking future strategies to maintain the sustainability of the riverine ecosystem. To serve this purpose, the conservation status and risk of extinction were determined according to IUCN (2015).

Data analyses

Species diversity indices, i.e. Shannon-Weaver diversity index (*H*), Margalef's richness index (*D*), Pielou's evenness (*e*), of the Dharla River were calculated by using PAST version 4.02 through the following way:

Shannon-Weaver diversity index, $H = -\Sigma P_i \ln P_i$ (Shannon and Weaver, 1949)

Margalef's richness index, $D = (s-1)/(\ln N)$ (Margalef, 1968)

Pielou's evenness index, $e = H/\ln S$ (Pielou, 1966)

where Relative abundance, $P_i = s / N$

s = number of individuals of one species
N = total number of all individuals in the sample
ln = natural logarithm.

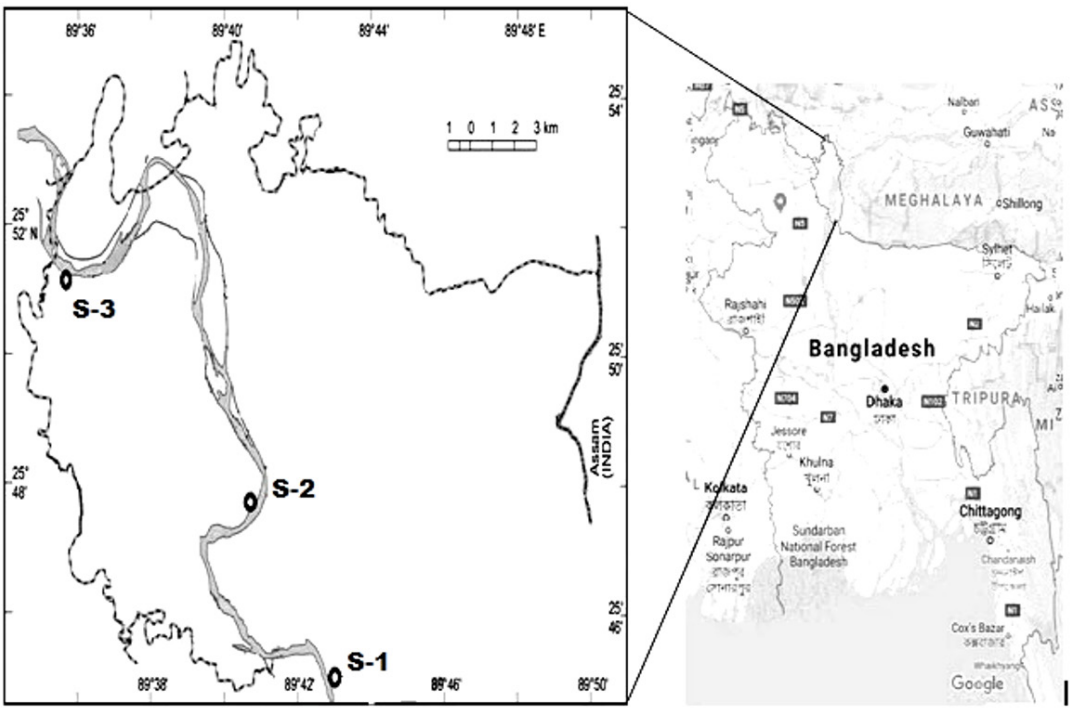

Fig 1. Location of the study area (S-1: Sampling site-1; S-2: Sampling site-2; S-3: Sampling site-3)

RESULTS

Fish species diversity and IUCN conservation status

The identified indigenous fish species are listed according to family, scientific name, English name, local name, global and local IUCN status of 2015 in Table 1. Total 76 indigenous fish species belonging to 57 genera, 26 families and 8 orders were recorded during the study period (Table 1). The family with the richest diversity in terms of species number was the Cyprinidae (14 species), followed by the Danionidae (13 species) and Bagridae (8 species). Four species were identified for each of the family Channidae, Siluridae, Sisoridae, Mastacembelidae; and three species for the Ambassidae. Cobitidae, Botiidae, Osphronemidae; Notoperidae had two species each and the rest of the families belonged to a single species (Figure 2).

Besides 76 indigenous fish species, nine exotic fish species were also found in the Dharla River; they were as follows: *Ctenopharyngodon idella, Pangasius hypophthalmus, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Barbonymus gonionotus, Clarias gariepinus, Oreochromis mossambicus, Anabas testudineus* (thai koi), *Cyprinus Carpio*.

Among the identified fishes, 28 species (37%) were considered as threatened under the categories of critically endangered (5%), endangered (20%) and vulnerable (12%), according to the Red List of IUCN (2015) (Figure 3). Of the 28 indigenous threatened species in the Dharla River, 13 species belonged to the order Cypriniformes, followed by 10 species of Siluriformes, two (02) species of Synbranchiformes and only one (01) species of Perciformes. In the present study, two species were identified in the order Osteoglossiformes and both species were detected as threatened (Figure 4).

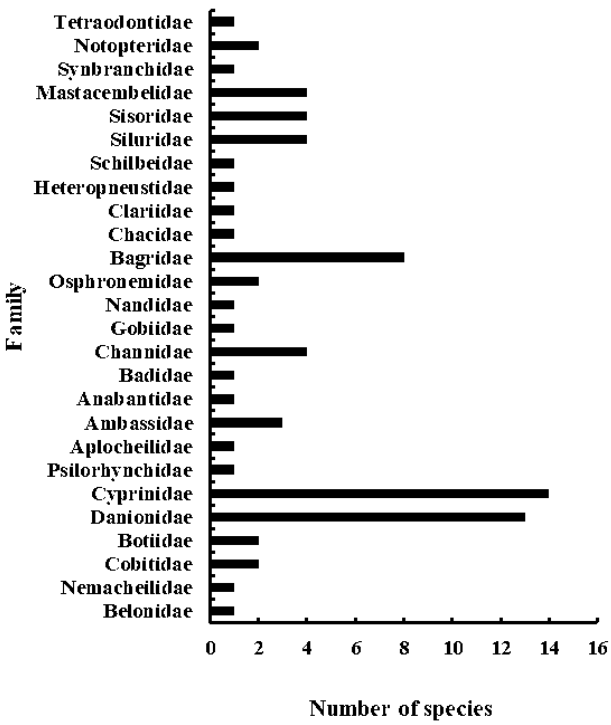

Fig 2. Number of fish species within different families collected from January to December 2018 at the Dharla River

Table 1. List of indigenous fish species found from January to December 2018 in the Dharla River (IUCN status: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated)

Order and Family	Scientific name	English name	Local name	Local Status (IUCN 2015)	Global status (IUCN 2015)
ORDER: BELONIFORMES					
Belonidae	*Xenentodon cancila* (Hamilton 1822)	Freshwater garfish	Kankila	LC	NE
ORDER: CYPRINIFORMES					
Nemacheilidae	*Paracanthocobitis botia* (Hamilton 1822)	Sand loach	Balichata	LC	LC
Cobitidae	*Lepidocephalichthys guntea* (Hamilton 1822)	Guntea loach	Puiya	LC	LC
	Canthophrys gongota (Hamilton 1822)	Gongota loach	Pahari gutum	NT	LC
Botiidae	*Botia lohachata* Chaudhuri 1912	Y- loach	Rani	EN	NE
	Botia Dario (Hamilton 1822)	Bengal loach	Rani	EN	LC
Danionidae	*Cabdio jaya* (Hamilton 1822)	Jaya	Jaya	LC	NE
	C. morar (Hamilton 1822)	Aspidoparia	Morari	VU	NE
	Amblypharyngodon mola (Hamilton 1822)	Molacarplet	Mola	LC	LC
	Barilius barila (Hamilton 1822)	Barred barila	Barali	DD	LC
	Opsarius barna (Hamilton 1822)	Barna baril	Bani koksa	EN	LC
	Barilius shacra (Hamilton 1822)	Shacra baril	Koksa	LC	LC
	Bengala elanga (Hamilton 1822)	Bengala barb	Along	EN	LC
	Chela cachius (Hamilton 1822)	Silver hatchlet chela	Chep chela	VU	LC
	Devario devario (Hamilton 1822)	Sind danio	Chapchela	LC	LC
	Esomus danrica (Hamilton 1822)	Flying barb	Darkina	DD	NE
	Raiamas bola (Hamilton 1822)	Trout barb	Bhol	EN	LC
	Rasbora daniconius (Hamilton 1822)	Slender rasbora	Darkina	LC	LC
	S. phulo (Hamilton 1822)	Fine Scale Razorbelly Minnow	Ful Chela	LC	NT
Cyprinidae	*Gibelion catla* (Hamilton 1822)	Catla	Katal	LC	NE
	Garra gotyla (Gray 1830)	Gotyla	Ghorpoia	EN	LC
	Chagunius chagunio (Hamilton 1822)	Chaguni	Jarua	VU	LC
	Cirrhinus reba (Hamilton 1822)	Reba carp	Korki	NT	LC
	Labeo gonius (Hamilton 1822)	Kuria labeo	Ghannya	NT	LC
	Tariqilabeo latius (Hamilton 1822)	Hill stream carp	Kala bata	EN	LC
	Labeo bata (Hamilton 1822)	Bata labeo	Bata	LC	LC
	Labeo boga (Hamilton 1822)	Boga labeo	Bhangan	CR	LC
	Labeo calbasu (Hamilton 1822)	Black rohu	Kalibaus	LC	LC
	Labeo rohita (Hamilton 1822)	Rohu carp	Rui	LC	LC
	Osteobrama cotio (Hamilton 1822)	Cotio	Dhela	VU	LC
	Puntius sophore (Hamilton 1822)	Pool barb	Jatpunti	LC	LC
	Pethia ticto (Hamilton 1822)	Ticto barb	Tit punti	VU	LC
	Systomus sarana (Hamilton 1822)	Olive barb	Sarpunti	NT	LC
Psilorhynchidae	*Psilorhynchus balitora* (Hamilton 1822)	Balitora minnow	Balitora	LC	LC

Continued.

Order and Family	Scientific name	English name	Local name	Local Status (IUCN 2015)	Global status (IUCN 2015)
ORDER: CYPRINODONTIFORMES					
Aplocheilidae	*Aplocheilus panchax* (Hamilton 1822)	Panchax minnow	Kanpona	LC	LC
ORDER: PERCIFORMES					
Ambassidae	*Chanda nama* (Hamilton 1822)	Elongate glass per-chlet	Chanda	LC	LC
	Pseudambassis ranga (Hamilton 1822)	Indian glossy fish	Rangachanda	LC	LC
	Pseudambassis lala (Hamilton 1822)	Highfin glassy per-chlet	Lalchanda	LC	NE
Anabantidae	*Anabas testudineus* (Bloch 1792)	Climbing perch	Koi	LC	DD
Badidae	*Badis badis* (Hamilton 1822)	Badis	Napit Koi	NT	LC
Channidae	*Channa marulius* (Hamilton 1822)	Great snake head	Gajar	EN	LC
	Channa punctatus (Bloch 1793)	Spotted snake head	Taki	LC	LC
	Channa striatus (Bloch 1793)	Snake head murrel	Shol	LC	LC
	Channa orientalis Bloch & Schneider 1801	Walking snakehead	Cheng	LC	LC
Gobiidae	*Glossogobius giuris* (Hamilton 1822)	Tank gobi	Baila	LC	LC
Nandidae	*Nandus nandus* (Hamilton 1822)	Mottled Nandus	Veda	NT	LC
Osphronemidae	*Trichogaster fasciata* Bloch & Schneider 1801	Banded gourami	Kholisha	LC	LC
	Trichogaster lalius (Hamilton 1822)	Dwarf gourami	Lalkhailsha	LC	LC
ORDER: SILURIFORMES					
Bagridae	*Batasio tengana* (Hamilton 1822)	Dwarf catfish	Tengra	EN	LC
	Hemibagrus menoda (Hamilton 1822)	Menoda catfish	Gang tengra	NT	LC
	Mystus bleekeri (Day 1877)	Day's mystus	Gulshatengra	LC	LC
	Mystus cavasius (Hamilton 1822)	Gangetic mystus	Kabashi tengra	NT	LC
	Mystus tengara (Hamilton 1822)	Stripped dwarf catfish	Bujritengra	NT	LC
	Mystus vittatus (Bloch 1794)	Stripped river catfish	Tengra	NT	LC
	Rita rita (Hamilton 1822)	Rita	Rita	EN	LC
	Sperata aor (Hamilton 1822)	Long-whiskered catfish	Ayre	VU	LC
Chacidae	*Chaca chaca* (Hamilton 1822)	Squarehead catfish	Chaka	EN	LC
Clariidae	*Clarias batrachus* (Hamilton 1822)	Walking catfish	Magur	LC	LC
Heteropneustidae	*Heteropneustes fossilis* (Bloch 1794)	Stinging catfish	Shing	LC	LC
Schilbeidae	*Ailia coila* (Hamilton 1822)	Gangetic ailia	Baspata	LC	NT
Siluridae	*Clupisoma garua* (Hamilton 1822)	Vacha	Bacha	EN	NE
	Ompok pabda (Hamilton 1822)	Two stripe pabda catfish	Madhupabda	EN	NT
	O. pabo (Hamilton 1822)	Pabo catfish	Kala pabda	CR	NT
	Wallago attu (Hamilton 1822)	Freshwater shark	Boal	VU	NT
Sisoridae	*Bagarius bagarius* (Hamilton 1822)	Devil catfish	Baghair	CR	NT
	Gagata gagata (Hamilton 1822)	Gangetic gagata	Gang tengra	LC	LC
	Sisor rabdophorus (Hamilton 1822)	Sisor catfish	Sai sore	CR	LC
	Conta conta (Hamilton 1822)	Conta catfish	Hara machh	NT	NE

Continued.

Order and Family	Scientific name	English name	Local name	Local Status (IUCN 2015)	Global status (IUCN 2015)
ORDER: SYNBRANCHIFORMES					
Mastacembelidae	*Macrognathus aral* (Bloch & Schneider 1801)	One-stripe Spiny Eel	Tara baim	DD	LC
	M. pancalus (Hamilton 1822)	Stripped spiny eel	Guchibaim	LC	LC
	M. aculeatus (Bloch 1786)	Spotted spiny eel	Tara baim	NT	NE
	Mastacembelus armatus (Lacepede 1800)	Tire track spiny eel	Sal baim	EN	NE
Synbranchidae	*Monopterus cuchia* (Hamilton 1822)	Freshwater mud eel	Kuchia	VU	VU
ORDER: OSTEOGLOSSIFORMES					
Notopteridae	*Chitala chitala* (Hamilton 1822)	Clown knife fish	Chital	EN	NT
	Notopterus notopterus (Pallas 1769)	Bronge feather back	Foli	VU	LC
ORDER: TETRAODONTIFORMES					
Tetraodontidae	*Leiodona cutcutia* (Hamilton 1822)	Ocellated puffer fish	Tepa	LC	LC

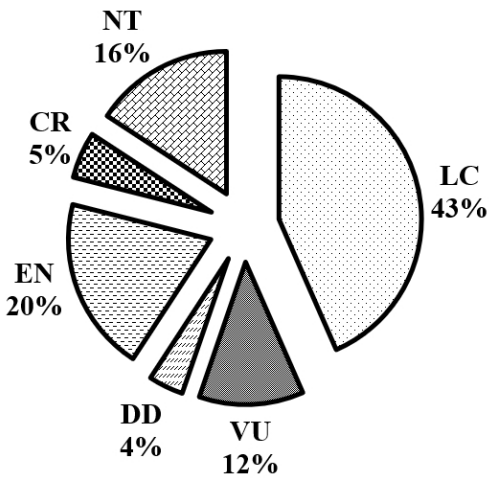

Fig 3. Threatened status of identified fishes at the Dharla River in Bangladesh collected from January to December 2018 (CR- Critically Endangered, EN- Endangered, VU- Vulnerable, NT- Near Threatened, LC- Least Concern, DD- Data Deficient)

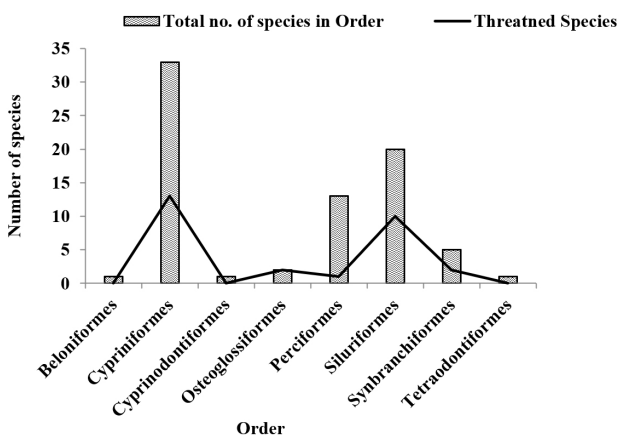

Fig 4. Order-wise threatened fish species diversity in the Dharla River

Diversity, richness and evenness indices

The values of different diversity indices are represented in Table 2. The Shannon-Weaver diversity (*H*), Pielou's evenness (*e*) and Margalef's richness (*D*) index of the Dharla River during the study period ranged from 3.00 (July) to 3.71 (January), 0.62 (September) to 0.94 (June) and 3.94 (July) to 7.95 (January), respectively. The higher value of Shannon-Weaver diversity and Margalef's richness indices were found between October and February, whereas Pielou's evenness was higher between May and August (Table 2).

DISCUSSION

Freshwater biodiversity of inland waters constitutes a valuable natural resource (Hiddink et al., 2008). Fish biodiversity of inland open waters is highly diversified (Hussain, 2010). Biodiversity and its conservation are regarded as a major issue for biologists towards sustainable use (Kar et al., 2006). The Dharla River is no exception.

The Dharla River is located in the northern part of Bangladesh and a total of 76 indigenous fish species were recorded from this river by the present study. In northern Bangladesh, Bhuiyan et al. (2008) identified 73 fish species in the Padma River near Rajshahi, and Parvez et al. (2014) identified 84 species from three major rivers, i.e. the Dhepa, the Punarbahaba and the Atrai, in the Dinajpur district. However, the scenario was opposite to the previous record. For example, Islam and Hossain (1983) and Hossain and Haque (2005) recorded 110 and 134 species of fish, respectively, from the Padma River. The number of fish species was higher than in the present study. The lower number of fish species of the present study compared to the previous assessment is evidence of the gradual loss of biodiversity in the study area.

Table 2. Total number of species and total number of individuals recorded with Shannon-Weaver diversity (*H*), Pielous evenness (*e*) and Margalef richness (*D*) values during the study period

Month	Number of species	Total number of Individuals	Shannon-Weaver Diversity (*H*)	Pielous Even-ness (*e*)	Margalef Richness (*D*)
January	54	788	3.71	0.75	7.95
February	52	743	3.66	0.75	7.72
March	47	541	3.64	0.81	7.31
April	26	250	3.11	0.86	4.53
May	22	232	3.08	0.91	4.39
June	22	196	3.03	0.94	3.98
July	22	206	3.00	0.92	3.94
August	27	200	3.20	0.91	4.91
September	37	342	3.13	0.62	6.17
October	37	405	3.49	0.89	6.00
November	38	616	3.51	0.88	5.76
December	35	608	3.48	0.93	5.30

Resembling the present study, the Cypriniformes was illustrated as the most dominant fish order in the Padma River of northwestern Bangladesh by Rahman et al. (2012). This finding was also similar to the previous study by Parvez et al. (2019) from three rivers, i.e. the Dhepa, the Punarbahaba and the Atrai, in the Dinajpur district in Bangladesh. This finding is also consistent with the study of Parvez et al. (2017) in the Dhepa River fish sanctuary. Hasan et al. (2013) also found the Cyprinidae as the dominant fish family in Baikka beel followed by the family Bagridae, Siluridae and Channidae.

In the current study, there were nine (9) reported exotic fish in the Dharla River, which was quite higher than that of Alam et al. (2013) who found three exotic fish species in the Halda River. Galib et al. (2013) recorded two exotic species in the Choto Jamuna River, Saha and Hossain (2002) found six exotic species in Saldu beel, Parvez et al. (2017) identified seven (7) exotic fishes from the Dhepa River fish sanctuary. However, the present findings of this study are consistent with those of Parvez et al. (2014) who recorded 12 exotic species in three rivers of the Dinajpur district. The recorded species were very popular in the aquaculture of Bangladesh and also in the Kurigram district from where the fish samples were collected. Due to heavy floods in 2017 in the study area, these species escaped from the aquaculture ponds. These alien species can create a threat to our indigenous species (Mijkherjee et al., 2002). Parallel observations were also made by different researchers (Rixon et al., 2005). To overcome such potential impact on native biodiversity, no alien fish species should be introduced without studying the details of life history and potential impact on the natural ecosystem, with a strong monitoring system. Besides, no predatory exotic fish species should be introduced in the indigenous ecosystem and people should be motivated to cultivate alternative indigenous fish species. The authorities should develop national guidelines and protocols for introducing alien species in the endemic ecosystem with proper legislative control (Hossain et al., 2018).

IUCN (2015) recognized an increase of 18.5% of threatened fish between 2000 to 2015 in Bangladesh due to different anthropological causes. IUCN (2015) also identified 64 threatened species (25.3%) in Bangladesh, which is quite different to the present (37%) study. Due to assessing a large number of species (253) by IUCN, the percentages of threatened species was probably reduced. Besides, Galib et al. (2013) identified a large number of fish species (41.72%) as threatened from the River Choto Jamuna of the northern part of Bangladesh. In addition, 32.8% of threatened fish species were identified in the northwestern part of Bangladesh from the study by Parvez et al. (2019).

It is interesting to note that 28 threatened species were found in the Dharla River, which is very similar to the studies of Galib et al. (2009) in Chalan Beel, Mohsin et al. (2013) in the Padma River, Imteazzaman and Galib (2013) in Halti Beel, and Galib (2015) in the Brahmaputra River, Bangladesh who found 28, 26, 22 and 24 threatened indigenous species, respectively. Yet Mohsin et al. (2014) reported a small number of threatened fishes (10) from the Andharmanik River of southern Bangladesh, which

is quite different to this study. The threatened ranks of indigenous species were Endangered (20%), Vulnerable (12%) and Critically Endangered (5%). These findings are broadly supported by Parvez et al. (2017) and Galib (2015).

The maximum number of fish species and the total number of individuals were found between September and March. It seems that water level became lower compared to other months which allowed fishermen to operate fishing gear more effectively and resulting in increased catch from the Dharla River. Likewise, lower levels of water form difficulty in niche segregation and fishes facing intra- and inter-specific competition, so fishes become more susceptible to catch by fishermen (Shaikh et al., 2011). A similar observation was found by Galib et al. (2013) in the Choto Jamuna River of the northwest region in Bangladesh. Nath and Deka (2012) also observed the richest fish diversity in the winter months.

The Shannon-Weaver diversity index (*H*) ranges typically from 1.5 to 3.5 and rarely reaches 4.5. A high value of *H* represents a diverse and equally distributed community, whereas lower values represent a less diverse community (Gaines, 1999). The range of Margalef's richness index has no limit and shows a perfect linear relationship with species richness (Gamito, 2010). Pielou's evenness (*e*) is the count of individuals of each species in an area and ranges from zero to one, zero signifying no evenness and one, a complete evenness (Pielou, 1966). The lower value of the Shannon-Weaver diversity index (*H*) was observed in the months from April to August as the water level was higher, which makes fishing very difficult (Galib et al. 2013). The lower values of the Shannon-Weaver diversity index in the monsoon months also indicate environmental stress (Acharjee and Barat, 2014). The Shannon-Weaver diversity (*H*) values (3.49-3.66) and Margalef's richness (*D*) values (6.00-7.72) were higher in winter months but evenness values were lower (0.89-0.75), which indicates fish species were not evenly distributed in the water column. This is because niche segregation was hampered due to the absence of deep water levels (Samal et al., 2014). The values of diversity and richness indices in this study were found to be greater than that of Yisa et al. (2011), Innocent et al. (2012) and Galib et al. (2013), indicating comparatively richer biodiversity in the study area of the Dharla River. In the current century, riverine ecosystems faced alarming threats due to the loss of fish diversity through different anthropological and natural causes (IUCN, 2015). To maintain the ecological and socio-economic equilibrium, conservation of fish diversity is very essential (Lakra, 2010).

The Dharla River is rich in indigenous fish biodiversity and serves as a harbor for threatened fishes. In this river, fishermen use destructive fishing gears like *current jal* (small meshed monofilament net, mesh size 0.5-1.27 cm), small mesh *ber jal* (seine net, mesh size 0.5-1.0 cm) for catching juvenile fish and poison fishing, especially in the winter season (authors' personal observation). To conserve sustainable biodiversity, it is urgently needed to eliminate all destructive fishing and formulate an action plan for sustainable biodiversity conservation. Major portion of fish species in the Dharla River has been identified as threatened species in the present study, which strongly supports its potentiality for the establishment of a natural conservation site. The establishment of a seasonal and permanent fish sanctuary could serve as a gene pool of the threatened fishes in the Dharla River. The findings of this research provide insights into the necessity of conservation of the indigenous fish diversity. Therefore it is very essential to periodically update the checklist of fish diversity of specific water bodies to retrieve the information, knowledge and changing scenarios. Besides, there is a burning need to develop a strong monitoring protocol in order to evaluate the progress of reducing losses of biodiversity, uproot the causes of biodiversity losses and assess the changes of track of threatened fish populations.

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RAZNOLIKOST I STUPANJ UGROŽENOSTI RIBA RIJEKE DHARLA U BANGLADEŠU

SAŽETAK

Raznolikost riba riječnog ekosustava postala je smanjena zbog različitih nepogoda uzrokovanih čovjekom i prirodom. U ovoj studiji, u razdoblju od siječnja do prosinca 2018. godine istraživan je trenutni status biološke raznolikosti riba u rijeci Dharla koja se nalazi (25,8103 °S, 89,6487 °E) u sjevernom dijelu Bangladeša. U ovoj je studiji postojeći status biološke raznolikosti riba u rijeci Dharla procijenjen prema indeksu raznolikosti i statusa ugroženosti (kako globalnog, tako i lokalnog). Podaci za uzimanje uzoraka prikupljeni su s tri mjesta na rijeci pomoću različitih ribolovnih alata i tri odabrane ribarnice smještene u okrugu Kurigram u Bangladešu. Ukupno je identificirano 76 vrsta riba koje pripadaju u 8 redova, 26 porodica i 57 rodova. Porodica Cyprinidae koja je bila najdominantnija, bila je zastupljena s 14 vrsta, zatim Danionidae (13 vrsta), Bagridae (8 vrsta) i nekoliko manjih porodica. Osim autohtonih vrsta, zabilježeno je i devet egzotičnih vrsta riba. Indeksi raznolikosti prema Shannon-Weaveru (H), ujednačenosti Pielous (e) i bogatstva Margalefa (D) kretali

su se od 3,00 do 3,71, 0,62 do 0,94 i 3,94 do 7,95. Od 76 autohtonih vrsta, 28 vrsta (37%) identificirano je kao ugroženo u Bangladešu, što uključuje kritično ugrožene (4 vrste), ranjive (9 vrsta) i ugrožene (15 vrsta). Neselektivni ribolov trovanjem i razornim ribolovnim spravama identificirani su kao glavne prijetnje biološkoj raznolikosti riba na rijeci Dharla. Iako rijeka Dharla služi kao značajna potpora ugroženim autohtonim ribama, potrebni su određeni koraci da se zaustavi razarajući ribolov, uspostave trajna utočišta za ribe i odgovarajući nadzor za održavanje održive biološke raznolikosti.

Ključne riječi: Autohtone ribe, IUCN, Indeks biološke raznolikosti, Očuvanje

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