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ASSESSMENT OF FISHERIES DIVERSITY OF MATHABHANGA RIVER IN THE SOUTH-WESTERN PART OF BANGLADESH

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ABSTRACT

Mathabhanga is an important and well-known river in the southwestern part of Bangladesh due to its role in fish production and as a vital income source for numerous fishermen. The study was carried out from August 2022 to July 2023 to reveal the existing aquatic resources and their composition, along with diversity, richness, and evenness indices. A comprehensive list of 57 distinct fish species has been documented, spanning across 8 orders, 22 families, and 42 genera. Within these, the Cypriniformes order exhibited the highest diversity in terms of both species count and observed individuals. Among the fish species inhabiting the Mathabhanga river, approximately 29.83% are considered threatened in Bangladesh, comprising 14.04% categorized as vulnerable (VU), 14.04% as endangered (EN), and 1.75% as critically endangered (CR). Overall values of the diversity index ranged from 2.45 to 3.15, richness was 3.81 to 6.17, and evenness index was 0.72 to 0.84. The investigation revealed that fish biodiversity in the Mathabhanga River has been steadily decreasing. This study suggested that fisheries should be managed through community-based fisheries management, establishing fish sanctuary, water pollution control, maintenance of fishing gear, and the implementation of the Fish Act for the sustainable management of fish biodiversity in the Mathabhanga River.

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INTRODUCTION

Bangladesh is a small Asian country of rivers located in the southern part of the continent. The country is part of the Ganges Delta, the most populous river delta region in Asia and the world (Ericson et al., 2005). It is blissful with grandiose water possessions in the form of ponds, lakes, floodplains, rivers, canals, streams, haors, bells, and a long coastline convenient for high fish production. The country possesses extensive coastal, marine, and inland fisheries resources, as well as a high potential for fisheries output. The total inland fisheries area covers 4.71 million ha, among which inland capture fisheries cover 3.86 million ha and inland culture fisheries cover 0.85 million ha (DoF, 2022). Within inland capture fisheries, a historical dominance of nearly 260 freshwater fish species has been observed in contributing to the fish production of Bangladesh (DoF, 2022). With its substantial inland, coastal, and marine water resources, Bangladesh achieved the third position in terms of inland open-water capture production and secured the fifth position in global aquaculture production (DoF, 2022). The fishing industry in Bangladesh is notable for being one of the most productive and vibrant sectors, and over the past few decades, it has become more and more important to the country's economy (Sunny et al., 2020). More than 12% of Bangladesh's almost 18 million people rely on fisheries and aquaculture-related activities as their primary or secondary source of income (Acharjee et al., 2021). Fish provide about 60% of total national daily animal protein consumption (DoF, 2019).

The Mathabhanga River is a transboundary river between Bangladesh and India. It is a tributary within the Ganges-Padma river system, which stands as one of the primary river systems in Bangladesh. The river originates by diverting from the main channel of the Ganges River, approximately 16 km downstream from the confluence (Shafa et al., 2023). The river serves as the primary source of surface water in the region, playing a crucial role in supporting agriculture, fish production, and the livelihoods of fishermen (Biswas and Panigrahi, 2014). Mathabhanga is a significant river in the southwestern part of Bangladesh and plays a great role in delivering sweet water from rainfall through Jalangi to the Sundarbans.

Due to various natural and human disturbances, the rivers in our country are steadily losing their fish biodiversity, and the Mathabhanga River is no exception to this trend. This decline poses a significant concern for the fisheries sector, both locally and globally. Understanding the natural fish species present in the Mathabhanga River is essential for conserving its biodiversity, which was the guiding principle behind this study. Currently, the gradual decline of aquatic biodiversity in natural water bodies is a pressing issue in Bangladesh, as indicated by previous studies (Galib et al., 2013; Mohsin et al., 2014; Islam et al., 2019). This study aims to assess the fish biodiversity, including threatened fish species, in the Mathabhanga River. By providing clear knowledge about the current situation of fish diversity in this river, the study will facilitate the necessary information for decision-making regarding conservation efforts. The findings will enable efficient authorities to implement proper management initiatives and develop policies aimed at conserving fish biodiversity in the Mathabhanga River.

MATERIALS AND METHODS

Selection of the Study Area

The selection of the study area is a crucial initial step in the research process. The study area was selected based on the abundance of fisheries resources and the concentration of fish production in the Mathabhanga river of Chuadanga. The Mathabhanga River is a vast area, and hence, studying the entire area within a limited and brief research timeframe is a challenging endeavor. So some central points of the fish passing zone, such as Subalpur-Tirodhara, Darshana, and the Mathabhanga Bridge of Chuadanga, were selected for the study to extract sufficient information (Figure 1).

Period of the Study

The study was conducted for a year, from August 2022 to July 2023. Data collection was conducted every month to meet the research objectives. The data concerning the present study were collected through the survey method by those who have engaged with the fishing and marketing of fish and fisheries resources in the Mathabhanga River.

Data Collection

The data and information were collected firsthand through field visits and observations at the sampling sites. Information about fish species was gathered through interviews with various stakeholders, including boat owners of commercial fishing vessels, retailers, fish traders, local residents, fishermen, riverside settlers, and other key informants from the sampling areas. Additionally, focus group discussions were conducted at fish landing centers, fish markets, and fishing villages within the selected sampling sites. Visits to the sites were carried out at least twice a month throughout the study period.

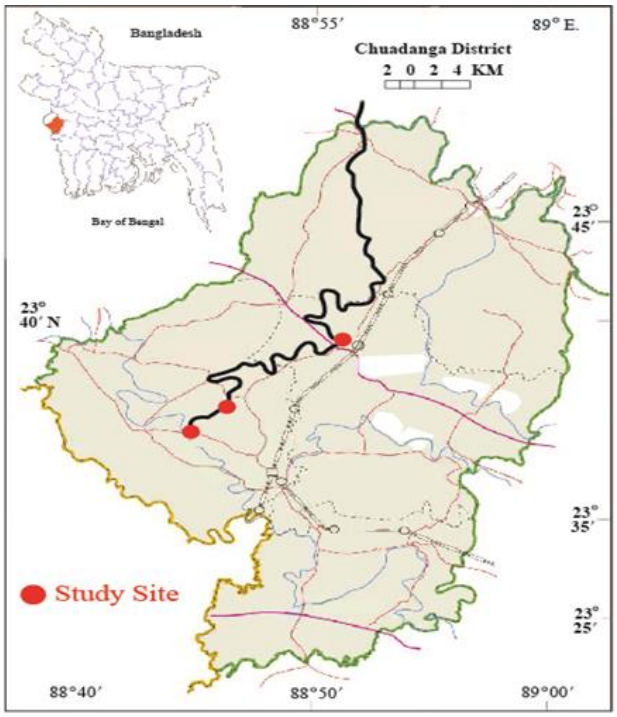

Figure 1. Location of the Study area

Fish Specimen Collection and Identification

Diverse fish species samples were procured from the catches brought in by fishermen at distinct fish landing centers within the designated sampling areas, as well as from the neighboring local fish markets. Through analyzing the morphometric and meristic characteristics, the collected fish samples were identified (Rahman, 2005). The conservation status in Bangladesh was determined following the database (IUCN, 2015).

Data Analysis

For assessing the range of fish species within the research locale, data was compiled every month. The collected data was analyzed by the computer software Microsoft Excel 2013. This study computed diversity, evenness, and richness indices to comprehend the diversity status and resource abundance, employing the subsequent formulas:

1. Shannon-Weaver diversity index, H= – Σ Pi Ln Pi (Shannon and Weaver, 1949)
2. Margalef's richness index, D = s-1/Ln N (Margalef, 1968),
3. Evenness index, e = H/ln S (Pielou, 1966)

Where **H** stands for the diversity index, **Pi** stands for the relative abundance (s/N), and **s** stands for the number of individuals for each species. **N** is the total number of individuals, **D** is the richness index, **S** is the total number of species, **e** is the similarity or evenness index, and **Ln** is the natural logarithm.

RESULTS

A total of 57 fish species under 8 orders and 22 families were recorded during the study period from the sampling sites. Additionally, 13 species of fisheries items under the classes gastropoda, bivalvia, crustacea, amphibia, and reptilia were also recorded. Among the fish, Cypriniformes emerged as the most prominent order in terms of both abundance and diversity. Siluriformes and Perciformes secured the second and third positions, respectively, in terms of fish abundance. Among the total 57 fish species, 19 are in the order Cypriniformes, 17 are in the order Siluriformes, and 8 are in the order Perciformes, which covers more than 70% of the species in the study. The order Channiformes and Synbranchiformes both contain 4 species, and the order Clupeiformes and Osteoglossiformes both contain 2 species, respectively. The order Beloniformes, which encompasses just one species, exhibited the lowest species count.

A compilation of current fish species along with their taxonomic classification (order and family), local name, English name, scientific name, present availability, and IUCN (2015) status in Bangladesh is presented in Table 1.

Table 1. Fish diversity of Mathabhanga River with present status conservation status

SL No.	Local Name	English Name	Scientific Name	Present Status	IUCN Conservation Status in Bangladesh
			Order: Beloniformes		
			Family: Belonidae		
1.	Kakila	Freshwater garfish	*Xentodon cancila*	LA	LC
			Order: Cypriniformes		
			Family: Cyprinidae		
2.	Rui	Rohu carp/Indian major carp	*Labeo rohita*	RA	LC
3.	Catla	Indian Major carp	*Catla catla*	RA	LC
4.	Kalibaus	Black rohu	*Labeo calbasu*	CA	LC
5.	Silver Carp	Silver carp	*Hypopthalmichthys molitrix*	RA	LC
6.	Mrigal	Indian Major carp	*Cirrhinus cirrhosus*	LA	NT
7.	Raik	Reba carp	*Cirrhinus reba*	CA	NT
8.	Bata	Bata Labeo	*L. bata*	CA	LC
9.	Chela	Silver Hatchet	*Chela cachius*	CA	VU
10.	Chaep chela	Indian glass barb	*Chela laubuca*	MA	LC
11.	Mola	Mola carplet	*Amblypharyngodon mola*	RA	NT
12.	Darkina	Flying barb	*Esomus danricus*	CA	NT
13.	Titputi	Ticto barb	*Puntius ticto*	CA	VU
14.	Jatputi	Punti/Pool barb	*Puntius sophore*	CA	LC
15.	Sarputi	Olive barb	*Puntius sarana*	RA	NT
16.	Jaya	Jaya	*Aspidoparia jaya*	LA	LC
17.	Dhela	Cotio	*Cyprinus cotio*	LA	NT
18.	Vanti punti	Barb	*Puntius stigma*	MA	LC
19.	Bourani	Bengal loach	*Botia dario*	RA	EN
20.	Gutum	Peppeered loach	*Lepidocephalichthys guntea*	MA	LC
			Order: Siluriformes		
			Family: Bagridae		
21.	Ayre	Long whiskered catfish	*Sperata aor*	RA	VU
22.	Rita	Rita	*Rita rita*	RA	EN
23.	Guijja Ayre	Giant river Catfish	*Sperata seenghala*	RA	VU
24.	Tengra	Tengara catfish	*Mystus tengara*	CA	LC
25.	Gulsha tengra	Gangetic mystus	*Mystus cavasius*	MA	NT
26.	Battia tengra	Striped dwarf catfish	*Mystus vittatus*	CA	LC
			Family: Clariidae		
27.	Magur	Walking catfish	*Clarias batrachus*	RA	LC

		Family: Siluridae			
28.	Boal	Freshwater shark	*Wallago attu*	MA	VU
29.	Pabda	Pabda catfish	*Ompok pabo*	CA	CR
30.	Kani pabda	Butter catfish	*Ompok bimaculatus*	RA	EN
		Family: Schilbeidae			
31.	Bacha	Batchwa Vacha	*Eutropiichthys vacha*	CA	LC
32.	Ghaura	Garua bacha	*Clupisoma garua*	CA	EN
33.	Kajuli/ Baspata	Gangetic Ailia	*Ailia coila*	CA	LC
34.	Batasi	Indian potashi	*Pseudeutropius atherinoides*	LA	LC
		Family: Sisoridae			
35.	Pulpu/ Gang Tangra	*Sisorid catfish*	*Gagata youssoufi*	RA	NT
		Family: Heteropneustidae			
36.	Shing/ Jiol	Stinging Catfish	*Heteropneustes fossilis*	CA	LC
		Family: Pangasiidae			
37.	Pangus	Pungas	*Pangasius pangasius*	RA	EN
		Order: Channiformes			
		Family: Channidae			
38.	Taki	Spotted snakehead	*Channa punctatus*	CA	LC
39.	Cheng	Walking snakehead	*C. orientalis*	LA	LC
40.	Shol	Snakehead murrel	*C. striata*	RA	LC
41.	Gojar	Great snakehead	*C. marulius*	MA	EN
		Order: Perciformes			
		Family: Anabantidae			
42.	Koi	Climbing perch	*Anabas testudineus*	RA	LC
		Family: Mugilidae			
43.	Khorsulla	Corsula mullet	*Rhinomugil corsula*	CA	LC
		Family: Osphronemidae			
44.	Khalisha	Banded Gourami	*Trichogaster fasciata*	LA	LC
		Family: Ambassidae			
45.	Chanda	Elongated Glass Perchlet	*Chanda nama*	CA	LC
46.	Poisha chanda/ Lal chanda	Highfin glassy perchlet	*C. lala*	RA	LC
		Family: Nandidae			
47.	Vheda	Mud Perch	*Nandus nandus*	LA	NT
		Family: Cichlidae			
48.	Tilapia	Tilapia	*Oreochromis mossambicus*	RA	LC
		Family: Gobiidae			
49.	Bele	Tank goby	*Glossogobius giuris*	CA	LC
		Order: Clupeiformes			
		Family: Clupeidae			
50.	Khoira/ Chapila	Indian river shad	*Gudusia chapra*	MA	VU
51.	Kachki	Ganges river sprat	*Coricaso borna*	LA	LC
		Order: Synbranchiformes			
		Family: Mastacembelidae			
52.	Baim	Zig-zag-eel	*Mastacembelus armatus*	LA	EN
53.	Tara Baim	Lesser spiny eel	*Macrognathus aculeatus*	RA	NT
54.	Panchal/Guchi	Barred spiny eel	*Mastacembelus pancalus*	CA	LC
		Family: Synbranchidae			
55.	Kuchia	Mud eel	*Monopterus cuchia*	LA	VU
		Order: Osteoglossiformes			
		Family: Notopteridae			
56.	Chital	Humped Featherback	*Chitala chitala*	LA	EN
57.	Foli	Freshwater knife fish	*Notopterus notopterus*	CA	VU

Note: *CA=Commonly Available, MA=Moderately Available, LA=Less Available, RA=Rarely Available* LC=Least concern, NT=Near Threatened, CR=Critically endangered, EN=Endangered, VU=Vulnerable

Order-wise Percentage of Mathabhanga River Fish Species

Among the identifying fish groups, Cypriniformes was found to be the most dominant order, consisting of 35.19% of the total fish population, followed by Siluriformes (31.48%), and Perciformes (14.81%). Channiformes and Synbranchiformes comprised 7.41%. Osteoglossiformes and Cleupeiformes account for 3.70% of the total species, while the contribution of Beloniformes was 1.85% (Figure 2).

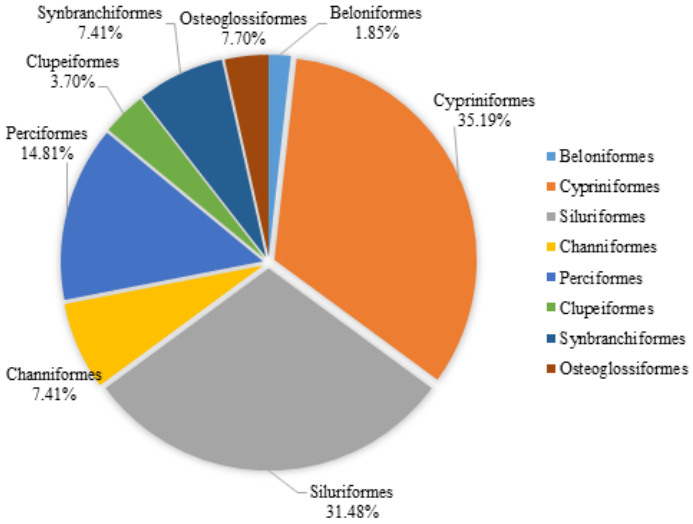

Figure 2. Percentage of fish species diversity under different orders found in the Mathabhanga River

Family-wise Percentage of Mathabhanga River Fish Species

57 fish species belonging to 22 taxonomic families were recorded during the study period. The family Cyprinidae emerged as the most dominant. A total of 17 fish species were documented from the Cyprinidae family, constituting 30% of the entire fish population. Bagridae (11%) were the second leading family, containing 6 species, followed by 4 species of Channidae (7%) and Schilbeidae (7%), 3 species of Siluridae (5%) and Mastacembelidae (5%), 2 species of Cobitidae (4%), Ambasidae (4%) and Clupeidae (4%) and 1 species of each family found under Belonidae, Clariidae, Sisoridae, Heteropneustidae, Pangasiidae, Anabantiidae, Mugilidae, Osphronemidae, Nandidae, Cichlidae, Gobiidae, and Synbranchidae contributing each of 2% of the total fish population (Figure 3).

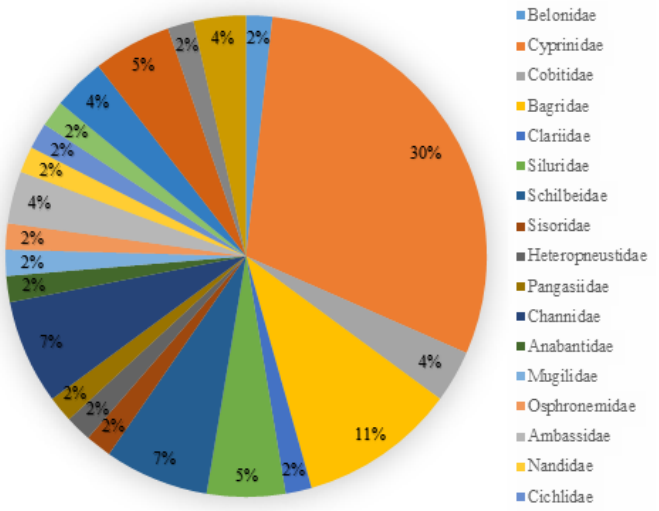

Figure 3. Percentage of fish species diversity under different Families found in the Mathabhanga River

Status of Fish According to the IUCN Red List 2015 in the Mathabhanga River

Among the 57 species in the study period, 30 were recorded as least concern (LC), 10 as near threatened (NT), 8 as vulnerable (VU), 8 as endangered (EN), and 1 as critically endangered (CR). In percentage among the five categories of available 57 species of fish, the least concerned (LC) species contains 52.63%, the near-threatened (NT) species contains 17.54%, both vulnerable (VU) and endangered (EN) species contain 14.04%, and the critically endangered (CR) species contains 1.75% of the total fish population (Figure 4).

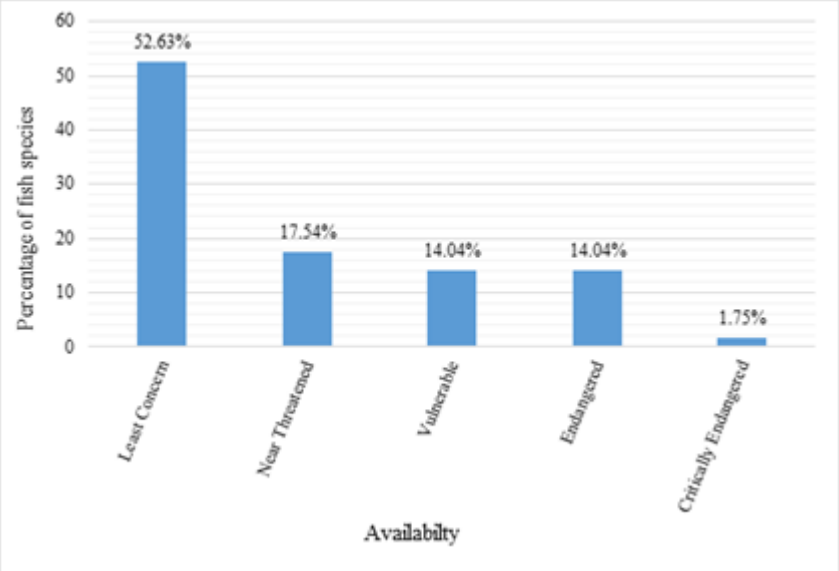

Figure 4. Percentage of fish status according to IUCN Red List 2015 in the Mathabhanga River

Diversity, Richness, and Evenness Indices

Table 2 presents the month-wise data for the Shannon-Weaver diversity index (*H*), Margalef's richness index (*D*), and Pielou's evenness index (*e*). Across all the samples examined in the current survey, the Shannon-Weaver diversity index (*H*) ranged between 2.45 and 3.15, Margalef's richness index (*D*) exhibited variations from 3.81 to 6.17, and Pielou's evenness index (*e*) showed a range from 0.72 to 0.84. *H* values show that the highest number of fish faunal diversity was in the month of October 2022, and the lowest number was in April 2023. *D* values indicate that the richness of fish species was the highest in January 2023 and the lowest in April 2023. *The e* value shows that the evenness of fish species was the highest in August 2022 and the lowest in March 2023.

Fisheries Items of Mathabhanga River

Fisheries items are those aquatic organisms that have economic importance and can be cultured with fish. There were 13 species of fisheries items recorded during the study period (Table. 3). Among the fisheries items are 5 species of mollusk, 4 species of arthropods, and 4 species of chordates. The fisheries items were very commonly found in the study area. Only *Macrobrachium rosenbergii* was less available, and *Trionyx gangeticus* was rarely available.

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

Month	No. of Species	No. of Individuals	*H*	*D*	*e*
August, 2022	35	1142	2.99	4.83	0.84
September, 2022	38	1208	2.98	5.21	0.82
October, 2022	44	1358	3.15	5.96	0.83
November, 2022	43	1063	3.12	6.02	0.83
December, 2022	43	1140	3.05	5.97	0.81
January, 2023	44	1061	3.01	6.17	0.80
February, 2023	39	947	2.74	5.54	0.75
March, 2023	31	879	2.47	4.43	0.72
April, 2023	27	905	2.45	3.81	0.74
May, 2023	29	899	2.55	4.12	0.76
June, 2023	29	887	2.58	4.13	0.77
July, 2023	28	926	2.57	3.95	0.77

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

Table 3. A Checklist of other fisheries items in the Mathabhanga river

SL.	Local Name	English Name	Scientific Name	Seasonal Availability
		Phylum: Mollusca		
		Class: Gastropoda		
1.	Shamuk	Apple Snail	*Pila globosa*	Very common
2.	Shamuk	Snail	*P. virens*	Moderately available
3.	Guli Shamuk	River snail	*Bellamya bengalensis*	Very common
4.	Pechano Shamuk	Screw Snail	*Melanoides tuberculatus*	Common
		Class: Bivalvia		
5.	Jhinuk	Freshwater Mussel	*Unio sp.*	Common
		Phylum: Arthropoda		
		Class: Crustacea		
6.	Gura chingri	Prawn	*Macrobrachium lamarrei*	Very common
7.	Chingri	Prawn	*M. dayanum*	Moderately available
8.	Golda Chingri	Freshwater Prawn	*M. rosenbergii*	Less available
9.	Kakra	Crab	*Cancer sp.*	Very common
		Phylum: Chordata		
		Class: Amphibia		
10.	Sona Bang	Bull frog	*Rana hexadactyla*	Common
11.	Kola Bang	Frog	*R. tigrina*	Very common
		Class: Reptilia		
12.	Kachim	Tortoise	*Trionyx gangeticus*	Rarely available
13.	Dhora Saap	Water snake	*Natrix piscator*	Common

DISCUSSION

Fish play an important role in the socio-economics and culture of Bangladesh. The geophysical location, along with the tropical climate, enriches the country with an enormous number of high-potential fisheries resources. Throughout history, inland open water has served as a prominent source of fish production in the country. Back in the 1960s, approximately 90% of the national fish production was derived from inland open-water fisheries (DoF, 1997), a figure that later stood at 57.10% during the fiscal year 2020–21 (DoF, 2022). Bangladesh achieved fish production self-sufficiency with a per capita fish consumption of 62.58 g/day compared to the goal of 60 g/day (DoF, 2019). The present study was determined to ascertain the present status of fisheries resources in the Mathabhanga river and evaluate the nutritional values of some selected fish species. Evaluations of fish biodiversity within the context of Bangladesh have often focused on the country's major rivers. While various studies have examined the fish diversity of these larger rivers, there has been a limited body of work about the fish diversity of smaller rivers. Mathabhanga is a small river in the southwestern part of Bangladesh. There is very limited work conducted on the fisheries resources of this river, and so there is no proper information about the resources. A total of 57 species of fish fauna were recorded in the present study. Several authors have reported different fish species compositions for different areas of Bangladesh. Shafa et al. (2023) found a total of 26 species in the river Mathabhanga. A total of 53 species were discovered by Ali et al. (2014) in the river Chitra in the Jashore district of Bangladesh. A total of 63 fish species were identified by Galib et al. (2013) in the river Choto Jamuna in Naogaon district. The species diversity of the Mathabhanga River is much lower in comparison with the large rivers of Bangladesh. As an illustration, Rahman et al. (2012) identified a comprehensive total of 80 fish species within the Padma River situated in the Chapai Nawabganj district. In a separate study, Joadder et al. (2015) documented the presence of 71 fish species spanning across 10 orders, 26 families, and 54 genera in the River Padma. Similarly, Alam et al. (2013) presented findings from the upper Halda River, reporting the existence of 63 fish species categorized within 9 orders, 24 families, and 51 genera.

In the current study, the order Cypriniformes emerged as the dominant and most diverse group, encompassing both the highest count of species and individuals. The orders Siluriformes and Perciformes held the subsequent positions, ranking as the second and third most prominent categories, respectively. Similar results were also recorded for several other Bangladeshi rivers, including the Choto Jamuna (Galib et al., 2013) and the Tista (Khan et al., 2013). Despite Cypriniformes being the most prevalent order in the river Halda, unlike other rivers, Perciformes was the second most prevalent order, not Siluriformes (Alam et al., 2013). The outcomes observed above are characteristic and consistent, as these three orders (Cypriniformes, Siluriformes, and Perciformes) are widely prevalent in the freshwater ecosystems of Bangladesh (Rahman, 2005). The most dominant family recorded in the present study was Cyprinidae, which was similar to the Padma River of the Rajshahi district and the Upper Halda river of the Chittagong district, respectively (Joadder et al., 2015; Alam et al., 2013). In the present study, there were 11 fisheries items recorded from the river Mathabhanga. Shafa et al. (2023) recorded seven fishery items from this river. Nahar et al. (2011) reported 15 fisheries items from the river Mahananda. According to the IUCN (2015), among the recorded fish species, 52.63% were found to be least concerning (LC), 17.54% were near threatened (NT), 14.04% were both vulnerable (VU) and endangered (EN), and 1.75% were critically endangered (CR). Galib et al. (2013) documented the presence of 41.27% threatened fish species within the Choto Jamuna River, comprising 15.87% vulnerable (VU), 15.87% endangered (EN), and 9.52% critically endangered (CR) categories. This percentage is higher compared to the findings of the current study. Similarly, Joadder et al. (2015) reported 39.43% of threatened fish species in the River Padma, including 13% vulnerable (VU), 18% endangered (EN), and 8% critically endangered (CR) species among the total fish species, differing from the present study. The diversity (H), richness (D), and evenness (e) of fish species in the study area were assessed every month. When both the number of species and evenness, e, increase, the value of the Shannon-Weaver diversity index, H, increases. When all species exhibit equal abundance, the value of H reaches its maximum for a given number of species. However, quantifying biodiversity is a challenging task. The highest estimated values of H, D, and e were 3.15, 6.17, and 0.84, and the lowest values were 2.45, 3.81, and 0.72. Shafa et al. (2023) found the highest values of H, D, and e were 2.99, 4.45, and 0.94, and the lowest values were 2.60, 2.80, and 0.92 in the river Mathabhanga. Rahman (2015) also reported the Shannon-Weaver diversity (H), Margalef richness (D), and evenness (e) values for the Talma River in Northern Bangladesh from March to October. They discovered that the highest values (H = 1.51, D =7.41, e = 0.73) and the lowest values (H = 1.37, D =6.97, e = 0.66)

CONCLUSION

Bangladesh is blessed with the world's richest and most diverse inland aquatic ecosystem, which has a wide variety of aquatic resources. But over the years, due to natural and manmade causes, aquatic biodiversity, especially the species diversity of fish and other aquatic organisms in the open water, particularly in the river, has been declining sharply. The current research has determined that the Mathabhanga river is renowned for harbouring aquatic life and represents an initial effort to assess the variety of open-water fish species. The total count of fish species documented throughout the study period provides a promising indication of abundant fish populations in this river. However, the outcomes of this investigation may not comprehensively represent the extensive spectrum of open-water fish diversity. The Mathabhanga river faces notable challenges from factors like climate change, loss of habitats, invasive species, excessive fishing, sedimentation, urban development, pollution, and human intrusion. These factors have significantly impacted the diversity of fish species. Furthermore, water quality is progressively declining, leading to a gradual decrease in the presence of fish species and other aquatic biodiversity. The identification of endangered fish species within the study area underscores the considerable peril posed to the existing conservation status of freshwater fish in Bangladesh.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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