Ann. Bangladesh Agric. (2021) 25 (2) : 47-60 *ISSN 1025-482X (Print)*
www.doi.org/10.3329/aba.v25i2.62412 *2521-5477 (Online)*

ICHTHYOFAUNA OF THE KATAMADARI RIVER, BANGLADESH: COMPOSITION, CONSERVATION STATUS AND THREATS

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Abstract

This research was carried out in the Katamadari River, which is located in the northern part of Bangladesh, to acquire information regarding the contemporary status of ichthyofaunal variation and their conservation. Over the course of a year from June 2020 to May 2021, a combined approach was adopted to collect data, which included collecting fish samples from fishers and fish traders as well as administering a survey. A total of 62 fish species were identified in the river, including three exotic species, and two prawn species. Out of ten observed orders, Cypriniformes, Siluriformes, and Perciformes were found to be the most dominant, consisting of 19, 16, and 14 fish species respectively. Fishes from Cyprinidae family were revealed to be the most abundant, accounting for about 27.5% of the total fish composition. Besides, among the thirteen common fish groups, catfish's contribution was the highest followed by perches, carps, and barbs and minnows. However, almost a quarter of all fish species were under threatened category: seven vulnerable, eight endangered, and two critically endangered. Approximately 50% of the total fish species were examined to be rare and very rare. The current study also documented a range of anthropogenic as well as natural threats to the aquatic biodiversity of the river, all of which have devastating impacts.

Keywords: Fish diversity, Katamadari river, fish abundance, threats, fisheries management.

Introduction

Bangladesh, a Southeast Asian country, is home to a diverse range of waterbodies, including rivers, canals, lakes, oxbow lakes, *haors* (floodplains), *beels* (lake-like wetlands with static water), estuaries, and extensive sea waters (Shamsuzzaman *et al.*, 2017; Himu *et al.*, 2020). These fresh, brackish, and marine waterbodies sustain approximately 800 fish species, placing Bangladesh third in Asia after China and India in terms of fish diversity (Hussain and Mazid, 2001; Rahman *et al.*, 2012; Barman *et al.*, 2021) Rajshahi, northwestern Bangladesh. A total of 80 species of fish under 9 orders and 24 families were recorded. Cypriniformes were most dominant order constituting 35% of the total fish population followed by Siluriformes (32.50%. However, due to anthropogenic stressors especially overexploitation, habitat degradation, and pollution, the country's wild fish population has been declining over the years (Bashar *et al.*, 2020; Hossain *et*

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al., 2016; Talukder *et al.*, 2021)Siluriformes (18.75%, resulting in a significant reduction in the contribution of inland capture fisheries to total fish production, from 63 percent in 1982-83 to 28 percent in 2018-19 (DoF, 2019). In addition, a total of 64 freshwater fish species have been categorized as threatened by IUCN Bangladesh, with 9 critically endangered, 30 endangered, and 25 vulnerable among them (IUCN Bangladesh, 2015). Therefore, studies on fish diversity have received renewed interest from both academic and policy sectors in recent years, as sustainable management and conservation of these aquatic species require reliable and authentic information on current status and regulating factors.

Bangladesh has over two hundred rivers that flow into the Bay of Bengal, constituting a labyrinth of about 24,000 km of riverine waterways (Islam, 2018). Rivers and their tributaries provide refuge to a majority (approximately 230 species) of the country's 265 freshwater fish species (Rahman, 2005), acting as their feeding, spawning and nursing ground (Parvez *et al.*, 2019). Over the last few decades, numerous studies have been carried out to catalog the various fish species in country's rivers, reporting a multitude of fish species available there (Galib *et al.*, 2013; Hossain *et al.*, 2016, 2017; Mondol *et al.*, 2015; Sultana *et al.*, 2016; Mia *et al.*, 2019; Talukder *et al.*, 2021)Siluriformes (18.75%.

In the Fulbaria upazila (sub-district) of Mymensingh district, Bangladesh, there are four major rivers: Banar, Khiru, Katamadari, and Nageshwari (Sultana *et al.*, 2019). These rivers are vital not just for aquatic species, but also for the livelihood, economy, and food supply of the people residing in the surrounding areas. The Katamadari river is about 40 kilometers long, originating from Muktagachha and flowing through Fulbaria until joining the Khiru river at Trishal. Recently, Sultana *et al.*, (2018) and Akter *et al.* (2020) documented fish diversity in the Banar river and Khiru River, respectively. However, no information on the hydrological and fish species data of Katamadari River is currently available in the literature. Therefore, the current study aimed to investigate the Katamadari River's fish faunal variety and identify important threats, concerns as well as mitigation strategies, for sustainable exploitation and better management of the river's aquatic resources.

Materials and Methods

Study area and duration

The research was carried out along the Katamadari River in the Fulbaria upazila of Mymensingh district (Fig. 1). The study was conducted over the span of a year, from June 2020 to May 2021, to collect data on fish assemblages and major stressors for aquatic fauna.

Data collection tools and methods

Fish sample collection

Fish samples were collected every month from fishermen from four villages surrounding the study area who had previously been contacted and fish sellers from nearby fish markets who buy fish from the fishermen of the studied villages. Collected fresh fish were preserved with 10% formalin and later transported to the laboratory of Department of Aquatic Resource Management, Sylhet Agricultural University,

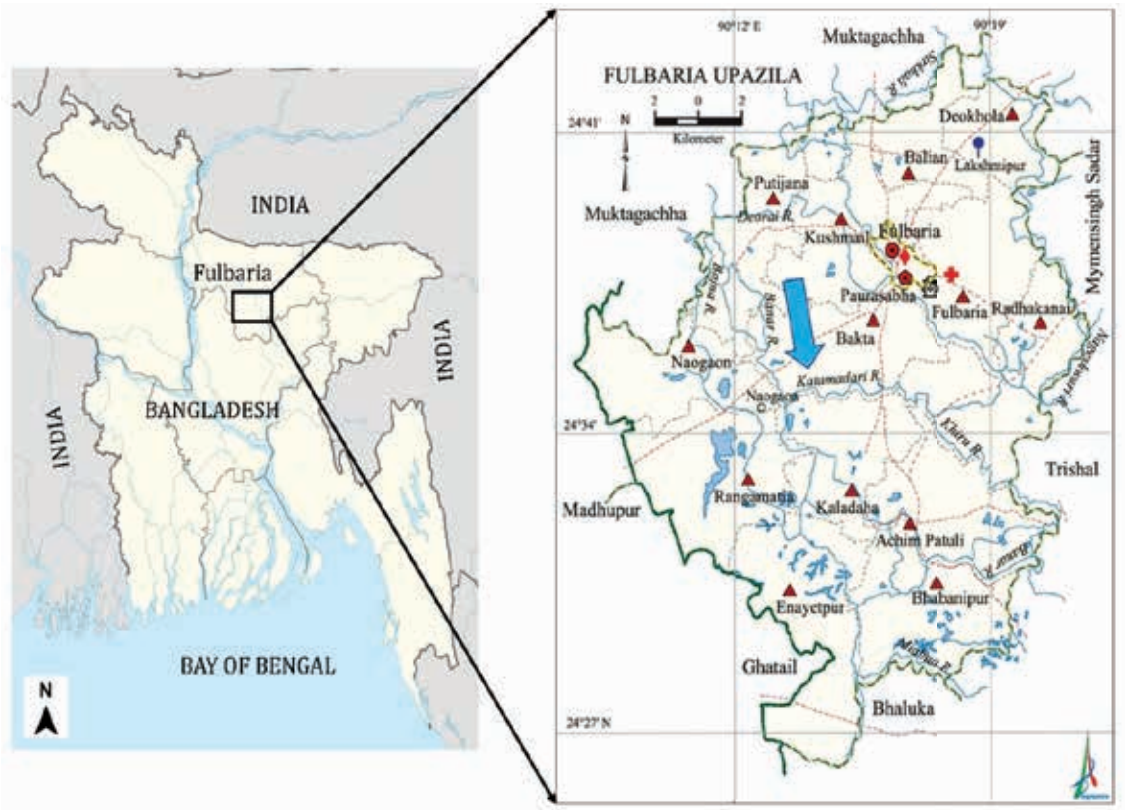

Fig. 1. Map showing the study area.

Sylhet. In the laboratory, samples were sorted and identified to species level through assessing their morphometric and meristic characteristics (Talwar and Jhingran, 1991; Rahman, 2005; FishBase, 2018). Furthermore, fish species were categorized based on availability into four groups as – throughout the year in large amounts (TYL), throughout the year in a small amount (TYS), rare (R), and very rare (VR) and also quantified the numbers of fish sample – to assess the present status of fish in the study area. Fish species availability was evaluated based on the abundance during sampling (Hossain *et al*., 2016; Talukder *et al.*, 2021) Siluriformes (18.75%).

Survey

In addition to sample collection, a survey comprising of personal interviews, focus group discussions (FGDs), and key informant interviews (KIIs) were employed to gather data for the current study. Before administering the survey, a draft semi-structured questionnaire with questions covering the name of the fish species, availability status, current risks, and possible coping mechanisms was tested at the field and modified accordingly. A total of 85 face to face interviews were conducted among the randomly selected fishermen from four nearby villages (e.g., Badihati, Naogaon, Polashihata, and Borokhila) and fish traders from two fish markets (e.g., Keshoreganj and

Shibganj). Only fishermen were selected for the individual interviews because fishing and fish trading are primarily done by them in the study area. A total of nine FGDs were carried out to cross-check the gathered information. Each group of FGDs contained 8 to 10 people, which were done at the river bank and at the local fish markets. The duration of FGDs were between 20 and 30 minutes. Moreover, fifteen knowledgeable persons such as experienced fishers, teachers, government and non-government officials, and elected representatives from the study area were interviewed as Key Informant Interviews (KII).

Data analysis

Data obtained from the study were analyzed using Microsoft Office Excel 2013 and graphical charts were generated through GraphPad Prism (Version 8.0.0).

Results and Discussion

This study recorded 62 species of ichthyofauna available in Katamadari River, including 60 finfish and 2 prawn species from 10 orders and 25 families (Table 1). The results of this study could not be compared to those of other studies in this river because fish diversity of this river had never been studied before. Previous research on fish diversity and richness of the other rivers located in the surrounding areas supports these findings. For example, Sultana *et al.* (2018) observed that Banar River of Fulbaria had a total of 62 fish species under 10 orders and 24 families. Likewise, Khiru River, the another river located at Fulbaria, also reported to have 64 fish species categorized into 11 orders and 22 families (Akter *et al.*, 2020). Besides, in another study, Talukder *et al.* (2021) documented 66 fish species from Shari-Goyain River of Sylhet, which was also in line with this study.

Cypriniformes, Siluriformes, and Perciformes were the most dominant orders, contributing for 30.65, 25.81, and 22.58% to the total fish population in Katamadari River, respectively (Fig. 2). These observations are in accordance with many studies that revealed Siluriformes, Cypriniformes, and Perciformes to be the most prevalent in freshwaters of Bangladesh (Rahman, 2005; Mondol *et al*., 2015; Hossain *et al*., 2016; Debnath *et al*., 2020; Talukder *et al*., 2021)Cyprinidae was the most dominant family constituting 31.25% of the total fish population followed by Bagridae (10.20%.

The most dominating family was Cyprinidae (27.42%), followed by Siluridae, Bagridae, Schilbeidae, and Channidae, where each accounted for approximately 6.5% of the total fish population. Each of the three families, Cobitidae, Notopteriidae, and Palaemonidae, contributed to around 5%, while Ambassidae, Osphronemidae, and Mastacembelidae each contributed to a little over 3% of the population (Fig. 3). Several other researchers reported similar results, where Cyprinidae, Siluridae, Bagridae, Schilbeidae, and Channidae were found to be prominent families in Khiru (Akter *et al*., 2020), Banar (Sultana *et al*., 2018), Shari-Goyain (Talukder *et al*., 2021), Halda (Azadi and Alam, 2013), Padma (Rahman *et al*., 2012)Rajshahi, northwestern Bangladesh. A total of 80 species of fish under 9 orders and 24 families were recorded. Cypriniformes were most dominant order constituting 35% of the total fish population followed by Siluriformes (32.50%, and Kushiara (Hossain *et a* ., 2017) rivers.

Table 1. List of fish species observed in the Katamadari River of Bangladesh

Order	Family	Local name	Scientific name	Group name	Availability*	Conservation status**
Beloniformes	Belonidae	Kakila	*Xenentodon cancila*	Gars	TYL	LC
	Hemirhamphidae	Ekthuita	*Hyporhampus limbatus*	Gars	R	LC
Clupeiformes	Clupeidae	Chapila	*Gudusia chapra*	Clupeids	R	VU
Cypriniformes	Cobitidae	Gutum	*Lepidocephalichthys guntea*	Loaches	TYL	LC
		Rani	*Botio dario*	Loaches	VR	EN
	Cyprinidae	Catla	*Catla catla*	Carps	TYS	LC
		Rohu	*Labeo rohita*	Carps	TYL	LC
		Mrigal	*Cirrhinus cirrhosus*	Carps	TYS	NT
		Common carp	*Cyprinus carpio*	Carps	TYS	NE
		Gonia	*Labeo gonius*	Carps	VR	NT
		Grass carp	*Ctenopharyngodon idella*	Carps	TYL	NE
		Kalibaush	*Labeo calbasu*	Carps	VR	LC
		Silver carp	*Hypophthalmicthys molitrix*	Carps	TYS	NE
		Bata	*Labeo bata*	Carps	TYS	LC
		Chela	*Chela cachius*	Barbs and minnows	TYS	VU
		Mola	*Amblypharyngodon mola*	Barbs and minnows	TYL	LC
		Darkina	*Esomus danricus*	Barbs and minnows	TYL	LC
		Dhela	*Osteobrama cotio*	Barbs and minnows	TYL	NT
		Tit punti	*Puntius ticto*	Barbs and minnows	TYL	VU
		Jat punti	*Puntius sophore*	Barbs and minnows	TYL	LC
		Shar punti	*Puntius sarana*	Barbs and minnows	TYS	LC
		Raj punti	*Puntius gonionotus*	Barbs and minnows	R	NE
Cyprinodontiformes	Aplocheilidae	Kanpona	*Aplocheilus panchax*	Killi fishes	TYS	LC
Osteoglossiformes	Notopteriidae	Foli	*Notopterus notopterus*	Featherbacks	R	VU
		Chitol	*Notopterus chitala*	Featherbacks	VR	EN
Perciformes	Ambassidae	Lamba chanda	*Chanda nama*	Perches	TYS	LC
		Kata chanda	Chanda baculis	Perches	TYS	NT
		Gol chanda	*Parambassis ranga*	Perches	R	LC
	Anabantidae	Koi	*Anabas testudineus*	Perches	TYS	LC
	Channidae	Taki	*Channa punctatus*	Snakeheads	TYS	LC
		Cheng	*Channa orientalis*	Snakeheads	R	LC
		Shol	*Channa striatus*	Snakeheads	TYS	LC
		Gozar	*Channa marulius*	Snakeheads	VR	EN

Table 1. Continued.

Order	Family	Local name	Scientific name	Group name	Availability*	Conservation status**
	Cichlidae	Tilapia	*Oreochromis mossambicus*	Perches	R	DD
	Gobiidae	Bele	*Glossogobius giuris*	Perches	TYS	LC
	Nandidae	Meni	*Nandus nandus*	Perches	R	NT
	Osphronemidae	Boro khalisha	*Colisa fasciatus*	Perches	R	NT
		Choto khalisha	*Colisa chuno*	Perches	TYS	NT
		Lal khalisha	*Colisa lalia*	Perches	VR	NT
Siluriformes	Bagridae	Gulsha	*Mystus cavasius*	Catfishes	TYS	NT
		Bujuri	*Mystus tengra*	Catfishes	VR	LC
		Tengra	*Mystus vittatus*	Catfishes	TYL	LC
		Ayre	*Mystus aor*	Catfishes	VR	VU
	Clariidae	Magur	*Clarius batrachus*	Catfishes	R	LC
	Heteropneustidae	Shing	*Heteropneustes fossilis*	Catfishes	R	LC
	Pangasiidae	Pangus	*Pangasius pangasius*	Catfishes	VR	EN
	Schilbeidae	Batasi	*Pseudeutropius atherinoides*	Catfishes	R	NT
		Garua	*Clupisoma garua*	Catfishes	VR	EN
		Bacha	*Eutropiichthys vacha*	Catfishes	VR	LC
		Kajuli	*Ailia coila*	Catfishes	R	LC
	Sisoridae	Baghair	*Bagarius bagarius*	Catfishes	VR	CR
	Siluridae	Boal	*Wallago attu*	Catfishes	R	VU
		Pabda	*Ompok pabo*	Catfishes	TYS	CR
		Kani pabda	*Ompok bimaculatus*	Catfishes	R	EN
		Madhu pabda	*Ompok pabda*	Catfishes	VR	EN
Synbranchiformes	Mastacembelidae	Boro Baim	*Mastacembelus armatus*	Eels	R	EN
		Guchi	*Macrognathus pancalus*	Eels	TYS	LC
		Tara Baim	*Macrognathus aculeatus*	Eels	TYS	NT
	Synbranchidae	Kuchia	*Monopterus cuchia*	Eels	R	VU
Tetraodontiformes	Tetraodontidae	Potka	*Tetraodon cutcutia*	Puffer fishes	TYS	LC
Decapoda	Palaemonidae	Kalo Icha	*Macrobrachium malcolmsonii*	Prawn	TYS	NT
		Sada Icha	*Macrobrachium sp.*	Prawn	TYS	NT

Note: * R – rare, VR – very Rare, TYS – throughout the year in small amounts, and TYL – throughout the year in large amounts.

**Conservation status of fish species in Bangladesh; LC – least concern, NT – near threatened, NE – Not evaluated, DD – data deficient, VU – vulnerable, EN – endangered, and CR – critically endangered (IUCN Bangladesh, 2015).

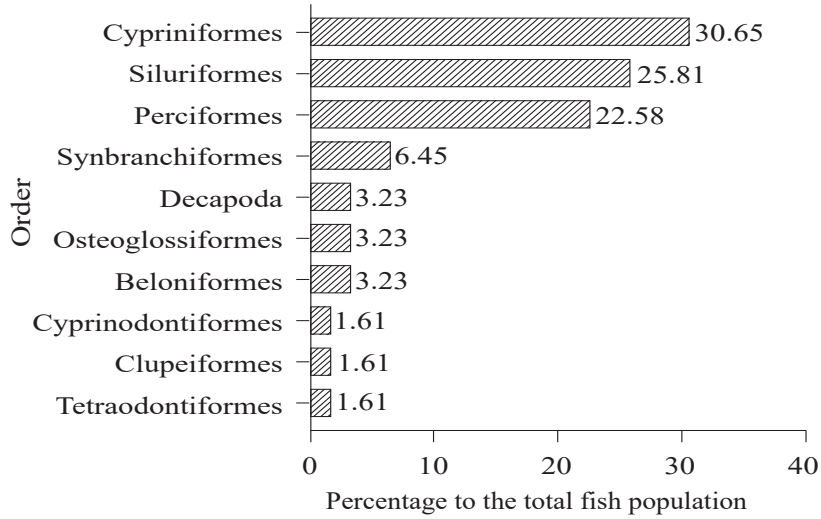

Fig. 2. Composition of fish species available in the Katamadari River under different orders.

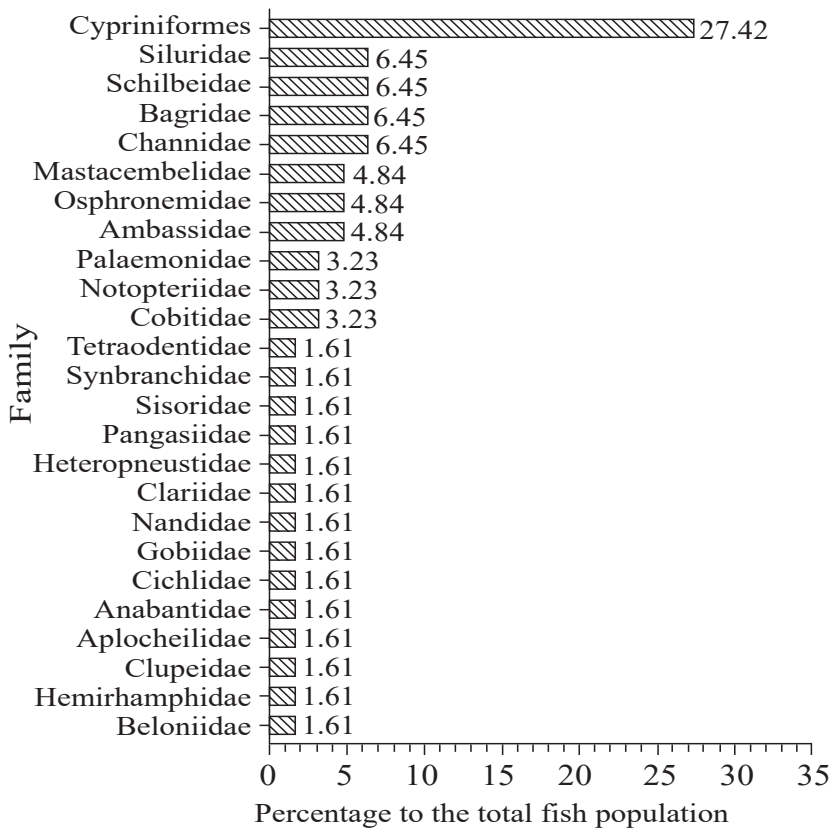

Fig. 3. Contribution of families to the fish population in the Katamadari River.

Catfishes (25.81%) were the most predominant group, followed by perches (16.13%), carps (14.52), barbs, and minnows (12.90%), out of thirteen identified common groups in the Katamadari River. Snakeheads and Eels were estimated to represent nearly 6.5% each in total fish population (Fig. 4). Catfishes, barbs and minnows, Perches, Carps, Eels, and Snakeheads were among the fourteen prevalent fish groups found in Shari-Goyain River (Talukder *et al.*, 2021), which aligns with observations of this investigation.

Over one quarter and one fifth of the identified fish species in the river observed to be rare (R) and very rare (VR). Whist, more than one third of the total fish population found to be available throughout the year in a small amount (TYS) and only about sixteen percent examined to be available in large amount throughout the year (TYL) (Fig. 5). In Padma and Rupsha River, Rahman *et al*. (2012)Rajshahi, northwestern Bangladesh. A total of 80 species of fish under 9 orders and 24 families were recorded. Cypriniformes were most dominant order constituting 35% of the total fish population followed by Siluriformes (32.50% and Hossain *et al*. (2016)Siluriformes (18.75% reported almost half of the fish population as rare or very rare, which is analogous to the findings of the current study. Thus, results of this study underscored the necessity for prompt interventions to protect fish diversity of the Katamadari River.

In addition, as per IUCN Bangladesh, (2015), approximately 27 and 21% of the total available fish species belonged to threatened and near threatened (NT) category, respectively (Fig. 6). Among the 17 threatened fish species from the river (Fig. 6), 8 species were found as endangered

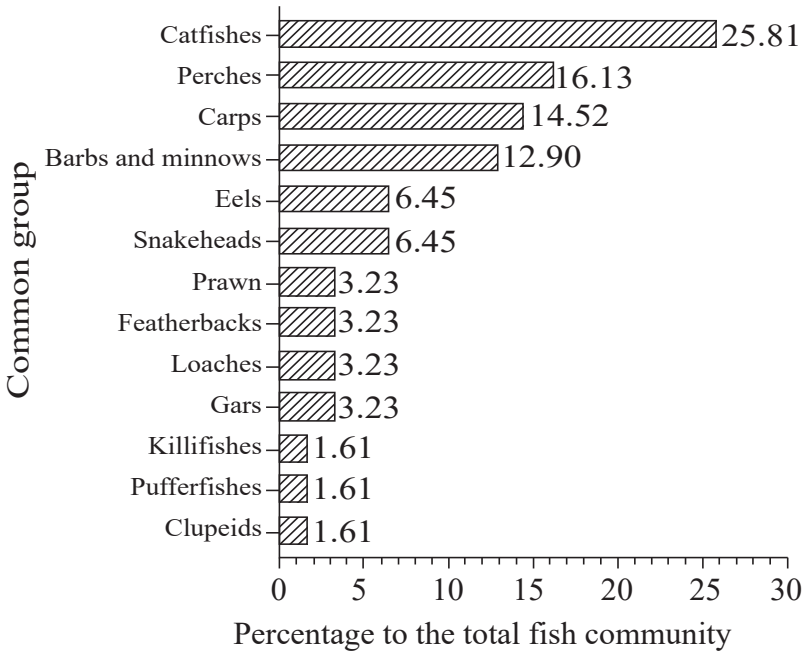

Fig. 4. Distribution of common fish groups found in the Katamadari River.

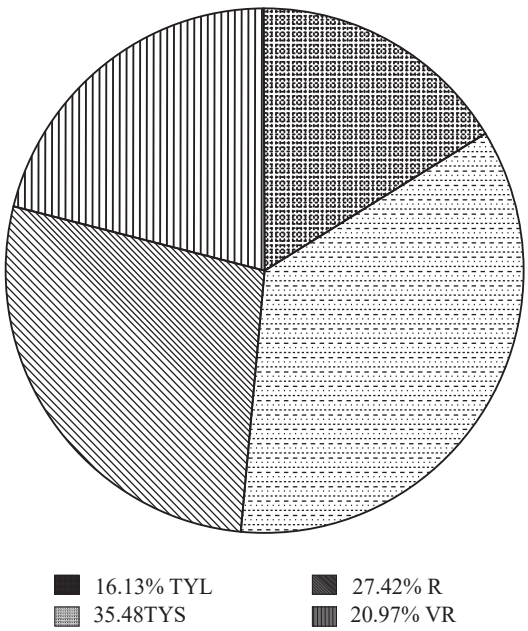

Fig. 5. Abundance of the fish species recorded from the Katamadari River.

(EN), 7 species as vulnerable (VU) and only 2 species as critically endangered (CR) (IUCN Bangladesh, 2015). Though, around 44% of the total fish population were recorded in the least concern (LC) group. Moreover, Figure 6 depicts the global conservation status of the listed fish species from Katamadari River. The majority of total fish species were mentioned in the LC category (72.58%), followed by NT (12.90%), data deficient (DD; 11.29%) and not evaluated (NE; 3.23%) (IUCN Bangladesh, 2015).

From the study area, a total of 17 threatened species were found among them 7 vulnerable, 8 endangered and 2 critically endangered (Fig. 7). Three alien (exotic) fish species were recorded in Katamadari River: Common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*) and silver carp

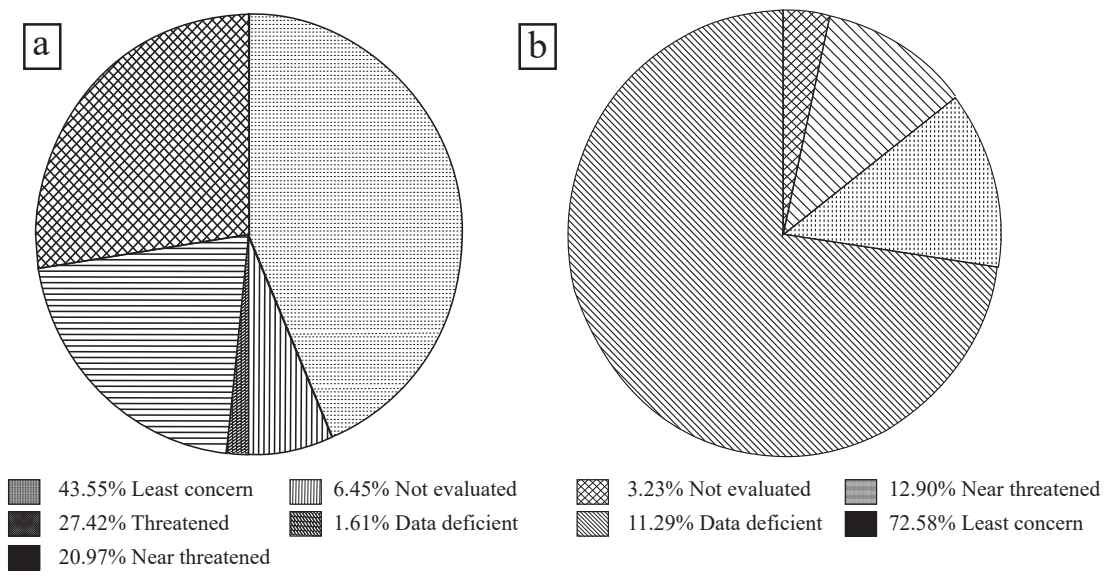

Fig. 6. Conservation status of the fish species recorded from the Katamadari River in (a) Bangladesh and (b) World (IUCN Bangladesh, 2015).

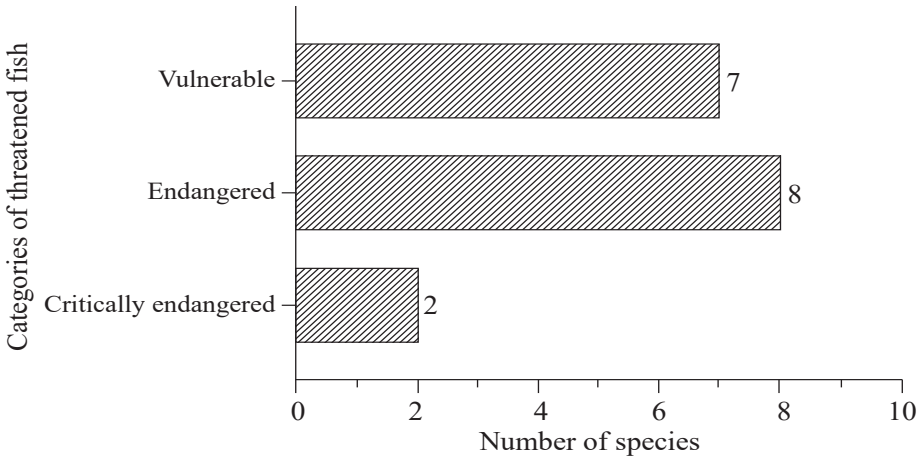

Fig. 7. Number of threatened fish species available in the Katamadari River.

(*Hypophthalmicthys molitrix*) (Table 1). These alien species, introduced in the country by the government of Bangladesh over the years for the purpose of aquaculture (Khaleque, 2002), are now harvested round the year from the studied river. Similarly, Galib (2015) and Bashar *et al*. (2020) reported the presence of four alien species in Brahmaputra River, including mirror carp, silver carp, bighead carp and sucker mouth catfish. Many alien species are invasive, posing a threat to the ecosystem and the biota that live there (Sarkar *et al.*, 2012). Alien fishes compete with native fishes for food and habitat. They may prey on local fish, bring new diseases and parasites, aid in the generation of hybrids, and contribute to the genetic erosion of indigenous species as well as the destruction of the aquatic ecosystem's physiochemical nature. The potential threat has the ability to harm not only the quality or degree of biodiversity, but also the socioeconomic aspects of the human group that relies on aquatic ecosystems for survival (Cagauan, 2007; Jiang *et al*., 2021).

During the data collection, participants were inquired regarding the threats to the Katamadari River's fish diversity. Respondents reported a range of threats and hazards for aquatic fauna of the river. Among them, overfishing, habitat destruction and illegal fishing, reduced water flow and brush pile (*Katha*) fishing were more notable (Fig. 8). In addition, construction of various infrastructures dams and bridges created problems in fish migration, which ultimately caused habitat fragmentation. Similiarly, Parvez *et al.* (2019) stated that dams and fences in the river caused habitat fragmentation and loss, leading to the extinction of native fish species. Pollution caused by runoff from agrochemicals and pesticides used in agricultural land and direct discharge of sewage have also been stated as causes of fish diversity loss by respondents of the study area. Due to this fact, fish species such as *Monopterus cuchia, Ompok pabo, Wallago attu, Clupisoma garua, Mystus aor, Bagarius bagarius, Gudusia chapra, and Notopterus chitala* become more susceptible day by day.

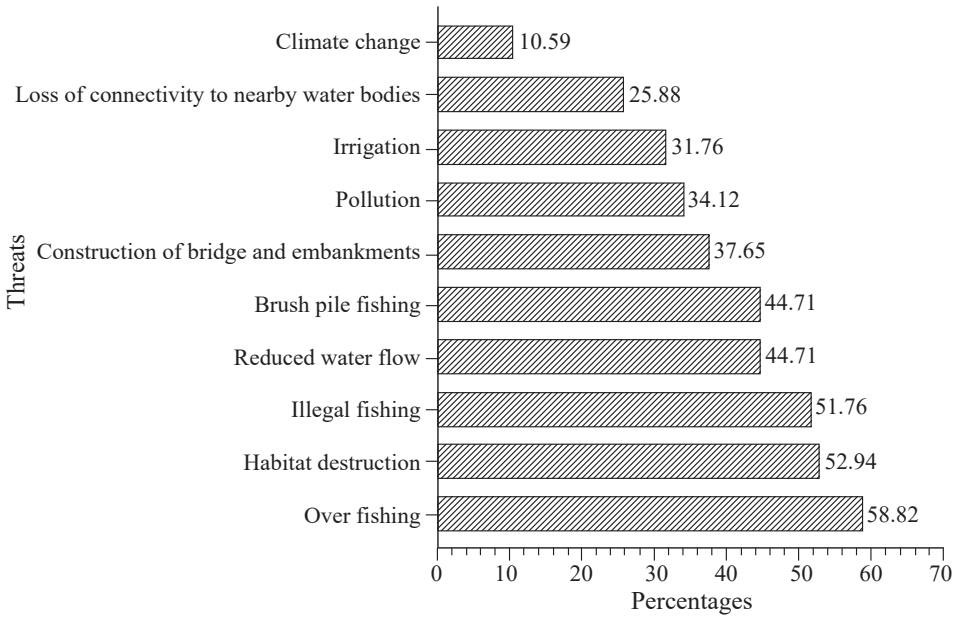

Fig. 8. Threats to the fish biodiversity of Katamdari River mentioned by respondents.

Decline and loss of fish species has been extensively documented in Bangladesh (Rahman *et al*., 2012; Galib *et al*., 2013; Mondol *et al*., 2015; Hossain *et al*., 2016; Sultana *et al*., 2018; Akter *et al.*, 2020; Talukder *et al.*, 2021) Siluriformes (18.75% and India (Mijkherjee *et al*., 2002; Chakraborty *et al*., 2006; Sarkar *et al*., 2008) as a result of aforementioned threats. Overfishing and catching of brood and juvenile fish identified as one of major causes of reduction of fish species in the rivers across the world including Bangladesh (Lakra *et al*., 2010; Rahman *et al*., 2012) species diversity; distribution and different indices of fish biodiversity management were studied in a Central India river (River Betwa, a tributary of River Ganga basin approved under India's first river linking plan.

A set of recommendations has been formulated for sustainable utilization, better management and conservation of aquatic resources of Katamadari River by this study based on survey. Restrictions on destructive fishing practices especially during breeding season, prohibiting the use of fine-mesh nets, introduction of fish sanctuaries, limitations on the unjustified use of fertilizers and pesticides, dredging of river to improve water holding capacity and water flow of the river, arranging training program for fishermen, strengthening community-based fisheries management, strict enforcement of the existing laws, and increasing awareness of local residents and fishermen were suggested. Similar suggestions were proposed for different waterbodies of Bangladesh (Rahman *et al*., 2012; Hossain *et al*., 2016; Sultana *et al*., 2016, 2018; Akter *et al*., 2020; Bashar *et al*., 2020; Talukder *et al*., 2021) Bangladesh. Samples were collected directly from a professional fishing boat caught by different nets, traps and hooks

from January 2019 to December 2019. Together with 4 exotic species, a total of 49 species under 6 families were recorded. Though a biodiversity index of 3.65854 and a dominance index of 0.030929 represent the richness of ichthyo-diversity within the river, Synbranchiformes and Tetraodontiformes were not reported throughout the study period. Linear regression analysis showed a positive correlation between water height of the river and monthly abundance of the species found. Catch composition of catfishes and snakeheads slumped while barbs showed triumph over previous findings. A majority of fish recorded were within the least concern category according to IUCN (2015. Besides, successful implementation of the proposed measures requires coordination from all the stakeholders, including local residents, government, and non-government organizations.

The current study had a few minor flaws, such as the fact that it only covered a small portion of the Katamadari River. The number of fish samples obtained was minimal since fish samples were acquired from fishers and fish traders instead of direct samplings due to limited resource allocated for this study. Moreover, threats were appraised based on stakeholder perceptions. As a result, further in-depth investigation will be required in future for more precise information in order to develop better management strategies for this river fishery resources.

Conclusion

The current study attempted to document the aquatic faunal richness in the Katamadari River of Bangladesh, finding a total of 62 fish and 2 prawn species. Almost half of the entire fish composition was recorded to be threatened or nearly threatened which highlighted the importance of immediate conservation measures. The findings also demonstrated that numerous manmade factors, ranging from overfishing to habitat degradation, and natural causes had detrimental impacts on the fish diversity and abundance of the study area, thereby recommended a variety of mitigation strategies. Furthermore, coordination between government and non-government institutions are required for better management and conservation of these aquatic resources of the river. Finally, more investigations are warranted to understand the deep insights regarding the aquatic faunal composition emphasizing on ecological, environmental and climate factors.

Competing interest

The authors declare that they have no competing interests.

Funding

The study did not receive funding from any organizations.

Acknowledgments

Mr. Md. Ataur Rahman, former Assistant Agricultural Extension Officer of Trishal upazila, and Upazila Fisheries Officer of Fulbaria upazila, Mymensingh were of great assistance to the authors in gathering data for this study.

References

Akter, N., M. Kunda, A. H. A. Rashid, S. K. Mazumder, M. A. Sultana and D. Pandit. 2020. Fish biodiversity in the Khiru River of Bangladesh: Present status and threats. *Int. J. Nat. Soc. Sci.* 7: 30-39.

Azadi, M. A. and M. A. U. Alam. 2013. Ichthyofauna of the River Halda, Chittagong, Bangladesh. *Bangladesh J. Zool.* 41: 113-133.

Barman, S. K., M. Kunda, S. K. Mazumder, M. Nahiduzzaman, P. P. Barman and S. K. Das. 2021. Fish-diversity in the kura river of Bangladesh: Patterns and threats. *Mal. Appl. Biol*. 50(3): 1-14.

Bashar, A., M. F. Rohani, M. R. Uddin and M. S. Hossain. 2020. Ichthyo-diversity assessment of the Old Brahmaputra River, Bangladesh: present stance and way forward. *Heliyon.* 6: e05447. https://doi.org/10.1016/j.heliyon.2020.e05447.

Cagauan, A. G. 2007. Exotic aquatic species introduction in the Philippines for aquaculture-A threat to biodiversity or a boon to the economy. *J. Environ. Sci. Manag.* 10: 48-62.

Chakraborty, B. K., M. I. Miah, M. J. A. Mirja and M. A. B. Habib. 2006. Induction of gynogenesis in endangered sarpunti, *Puntius sarana* (Hamilton) and evidence for female homogamety. *Aquaculture* 258: 312-320. https://doi.org/10.1016/j.aquaculture.2006.03.037.

Debnath, P., M. A. Hussain and S. Nasren. 2020. Fish diversity of Halir Haor, Sunamganj, Bangladesh: A checklist. *Int. J. Nat. Soc. Sci.* 7: 73-80. https://doi.org/10.5281/zenodo.4383843.

DoF, 2019. Yearbook of Fisheries Statistics of Bangladesh 2018-19. Fisheries Resources Survey System (FRSS), Department of Fisheries, Bangladesh : Ministry of Fisheries and Livestock.

FishBase. 2018. List of Freshwater Fishes reported from Bangladesh [WWW Document]. World Wide Web Electron. Publ. URL www.fishbase.org (accessed 11.10.2018).

Galib, S. M. 2015. Fish fauna of the Brahmaputra River, Bangladesh: richness, threats and conservation needs. *J. Fish.* 3: 285-292. https://doi.org/10.17017/jfish.v3i3.2015.120.

Galib, S. M., A. B. M. Mohsin, M. T. Parvez, M. C. Lucas, N. Chaki, S. S. Arnob, M. I. Hossain and M. N. Islam. 2018. Municipal wastewater can result in a dramatic decline in freshwater fishes: a lesson from a developing country. *Knowl. Manag. Aquat. Ecosyst*. 419: 37.

Galib, S. M., S. M. A. Naser, A. B. M. Mohsin, N. Chaki and F. H. Fahad. 2013. Fish diversity of the River Choto Jamuna , Bangladesh: Present status and conservation needs. *Int. J. Biodivers. Conserv.* 5: 389-395. https://doi.org/10.5897/IJBC2013.0552.

Himu, S. D., M. A. Hussain, T. A. Sumon, M. A. A. Sumon, M. F. Ahmad, M. R. Talukder and M. Kunda. 2020. Socio-economic profile of fishermen: An empirical study from Sunamganj, Bangladesh. *Int. J. Nat. Soc. Sci.* 7: 94-102. https://doi.org/10.5281/zenodo.4459278.

Hossain, M. A., M. Akter and M. M. Iqbal. 2017. Diversity of Fish Fauna in Kusiara River (Fenchungonj Upazilla), Northeast Bangladesh. *J. Aquac. Trop.* 32: 1-13.

Hossain, M. Y., M. M., Rahman, M. M. Ali, M. A. Hossen, F. Nawer, A. H. Bahkali, M. S. El-Shikah, M. M. Islam, A. M. Elgorban and Z. F. Ahmed. 2016. Check list of fish species availability in Rupsha River, Bangladesh: Threat identification and recommendation for sustainable management. *Indian J. Geo-Marine Sci.* 45: 1292-1298.

Hussain, M. G. and M. A. Mazid. 2001. Genetic improvement and conservation of carp species in Bangladesh. Bangladesh Fisheries Research Institute, Mymensingh, Bangladesh.

Islam, M. M., 2018. Boat, waters and livelihoods: A study on nomadic fishers in the Meghna river estuary of Bangladesh. Pp. 53-64. In Nishat, B., M. Sushmita and P. Ganesh (eds.) *Conserving Ilish, Securing Livelihoods: Bangladesh-India Perspectives*, Academic Foundation and The International Water Association, New Delhi, India.

IUCN Bangladesh. 2015. IUCN Red List of Bangladesh, Volume 5: freshwater fishes. IUCN, International Union for Conservation of Nature,

Bangladesh Country Office, Dhaka, Bangladesh. https://doi.org/10.1017/CBO9781107415324.004.

Jiang, X., J. Wang, W. Tang, Z. Sun and B. Pan. 2021. Non-native freshwater fish species in the Yellow River Basin: origin, distribution and potential risk. *Environ. Biol. Fishes.* 104: 253-264.

Khaleque, M. A. 2002. A book on fish culture and management of exotic fishes. Publ. by Jusi MB, Pallabi, Mymensingh, Bangladesh (in Bengali).

Lakra, W. S., U. K. Sarkar, R. S. Kumar, A. Pandey, V. K. Dubey and O. P. Gusain. 2010. Fish diversity, habitat ecology and their conservation and management issues of a tropical River in Ganga basin, India. *Environmentalist.* 30: 306-319. https://doi.org/10.1007/s10669-010-9277-6.

Mia, M. J., J. Naher, M. G. Azom, M. S. R. Sabuz, M. H. Islam and M. R. Islam. 2019. Spatiotemporal variations in finfish assemblage and diversity indices in relation to ecological indicators of the Atrai River, Dinajpur, Bangladesh. *Egypt. J. Aquat. Res.* 45: 175-182.

Mijkherjee, M., A. Praharaj and S. Das. 2002. Conservation of endangered fish stocks through artificial propagation and larval rearing technique in West Bengal, India. *Aquac. Asia* 7: 8-11.

Mondol, M. R., Y. Hossain and M. Rahman. 2015. Check-list of fish availability in the Karatoya River, Bangladesh. *World J. Zool.* 10: 17–21. https://doi.org/10.5829/idosi.wjz.2015.10.1.91149.

Parvez, I., M. A. Alam, M. M. Hassan, Y. Ara, I. Hoshan and A. S. M. Kibria. 2019. A checklist of fish species from three rivers in northwestern Bangladesh based on a seven-year survey. *J. Threat. Taxa* 11: 13786-13794. https://doi.org/10.11609/jott.4303.11.6.13786-13794.

Rahman, A. K. A. 2005. Freshwater fishes of Bangladesh. 2nd ed. Zoological Society of Bangladesh, University of Dhaka, Dhaka, Bangladesh, 263 P.

Rahman, M. M., M. Y. Hossain, F. Ahamed, S. B. Fatematuzzhura, E. M. Abdallah and J. Ohtomi. 2012. Biodiversity in the Padma Distributary of the Ganges River, Northwestern Bangladesh: Recommendations for Conservation. *World J. Zool.* 7: 328–337. https://doi.org/10.5829/idosi.wjz.2012.7.4.6634.

Sarkar, U. K., V. K. Dubey, A. K. Singh, B. K. Gupta, A. Pandey, R. K. Sani and W. S. Lakra. 2012. The recent occurrence of exotic freshwater fishes in the tributaries of river Ganga basin: abundance, distribution, risk, and conservation issues. *Environmentalist*. 32: 476-484.

Sarkar, U. K., A. K. Pathak and W. S. Lakra. 2008. Conservation of freshwater fish resources of India: new approaches, assessment and challenges. *Biodivers. Conserv.* 17: 2495–2511. https://doi.org/10.1007/s10531-008-9396-2.

Shamsuzzaman, M. M., M. M. Islam, N. J. Tania, M. A. Al-Mamun, P. P. Barman and X. Xu. 2017. Fisheries resources of Bangladesh: Present status and future direction. *Aquac. Fish*. 2: 145–156. https://doi.org/10.1016/j.aaf.2017.03.006.

Sultana, M. A., M. Kunda and S. K. Mazumder. 2019. Status and decline causes of fish diversity of Bhawal Beel, Bangladesh. *Malaysian J. Med. Biol. Res.* 6: 93-100.

Sultana, M. A., S. K. Mazumder and M. Kunda. 2016. Fishing gears and crafts used in Payra River, Bangladesh. *Eur. J. Appl. Sci.* 8: 337-346.

Sultana, M. A., S. K. Mazumder and M. Kunda. 2018. Diversity of fish fauna and fishing gears used in the River Banar, Mymensingh, Bangladesh. *Bangladesh J. Fish.* 30: 229-240.

Talukder, M. R., M. A. Hussain, M. Kunda, A. H. A. Rashid, D. Pandit and T. A. Sumon. 2021. Checklist of fish species in the Shari-Goyain River, Bangladesh: Threats and conservation measures. *Indian J. Geo Mar. Sci.* 50: 148-155.

Talwar, P. K. and A. G. Jhingran. 1991. Inland fishes of India and adjacent countries. Vol. 2. CRC Press, Rotterdam, Netherlands.