



Research Article

First Report on Assessment of Aquatic Biodiversity in Gajner Beel (Wetland) Ecosystem in Northwestern Bangladesh: Recommendations for Its Sustainable Management

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Abstract | The wetland ecosystem (Gajner beel), which is home to a diverse range of aquatic species such as fishes, plants, arthropods, mollusks, amphibians, reptiles, and aquatic birds to ensures the stability and resilience of aquatic ecosystems by maintaining balanced food webs and ecological processes. Thus, the aim of this study was to assess the aquatic biodiversity of the Gajner beel wetland ecosystem located in the northwestern region of Bangladesh. Additionally, the research intended to identify the underlying factors responsible for threatening or reducing in numbers of native fish species. A number of 52 individuals were found in the Gajner beel wetland ecosystem, where 48 were observed as indigenous, 03 were Indian major carps and 01 was exotic species. Total 29 plants, 4 arthropods, 3 mollusks, 5 amphibians, 5 reptiles and 11 aquatic birds were identified from the studied area. Among 52 fishes, 8 species were recorded as threatened and 11.80% were vulnerable, 11.80% were endangered, 2.00% were critically endangered and major proportions (56.90%) were least concern. In this study, the maximum length (L_{max}) of 23 species were measured and among them *Amblypharyngodon mola* was 8.5 cm and *Pethia phutunio* was 4.7 cm, which were recorded as maximum length to compare with the Fishbase. However, reduction of water level, overfishing and habitat destruction are key responsible for the degradation of the beel fisheries. This study underscores the rich biodiversity of the Gajner beel wetland ecosystem, documenting 52 fish species, including threatened populations, alongside diverse flora and fauna, while highlighting that reduced water levels, overfishing, and habitat destruction are the primary drivers of fisheries degradation, emphasizing the urgent need for conservation efforts to protect this ecologically significant wetland.

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Keywords | Aquatic biodiversity, Gajner beel, Indigenous species, Maximum length, Threatened species, Endangered



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Introduction

Biodiversity is crucial for maintaining the balance of ecosystems, supporting life on Earth, and providing essential services that sustain human well-being and economic prosperity. Article II (1992) of the Convention on Biological Diversity (CBD), biological diversity encompasses the variety of life forms within and among species, as well as across ecosystems. Wetlands, in particular, play a vital role in sustaining this biodiversity, especially in regions like Bangladesh, which is endowed with a rich array of aquatic habitats due to its unique geographical and climatic conditions. Situated in the Ganges-Brahmaputra delta, the largest deltaic plain in the world, Bangladesh is characterized by extensive floodplains, numerous rivers, and a vast network of wetlands, including beels (floodplain depressions and lakes). The fisheries industry holds significant importance in the economy of Bangladesh, which is predominantly reliant on agriculture. Their contributions are noteworthy in the areas of nutrition, employment creation, and foreign exchange revenue. The agricultural industry is of significant importance as it provides 60% of the nation's animal protein consumption, contributes 3.509% to the Gross Domestic Product (GDP), and accounts for 1.23% of export earnings. Additionally, it should be noted that the fisheries sector is accountable for offering full-time employment to roughly 1.4 million individuals and part-time employment to approximately 11 million people, as reported by the Department of Fisheries (DoF, 2020).

Wetlands are among the most productive and biologically diverse ecosystems on Earth, providing critical ecological services such as water purification, flood control, and habitat for a wide range of flora and fauna. According to Goudie (2004), a wetland is an area of land located in close proximity to a river or stream, extending from the water body's banks to the surrounding valley walls, and susceptible to flooding during times of high discharge. Bangladesh boasts a remarkable range of fish species, particularly within its plentiful and diverse inland water bodies, which include beels (floodplain depressions and lakes), ponds, rivers, canals, ditches, and paddy fields. These aquatic environments serve as a habitat for over 267 species of freshwater fish, as reported by Ahmed *et al.* (2007). According to the Department of Fisheries (DoF, 2013) in Bangladesh, there are an estimated

4,500 beels in the country. These bodies of water contributed a total of 104,871 metric tons to the inland fish production in 2014–2015, which accounts for approximately 2.22% of the total. According to Azher *et al.* (2007), the combined expanse of beels in Bangladesh is approximately 114,161 hectares, accounting for approximately 27% of the nation's inland freshwater reserves.

One notable wetland in Bangladesh is the Gajner beel, situated in Sujanagar Upazilla, Pabna, in the northwestern region of the country. The Gajner beel, connected to the Padma River, works as a dynamic feeding and spawning ground for numerous species of freshwater fish (Mazid *et al.*, 2007). Several important indigenous fish species, such as *Esomus danricus*, *Nandus nandus*, *Heteropneustes fossilis*, *Botia lohachata*, *Botia dario*, *Channa orientalis*, *Macrognathus pancalus*, *Ompok pabda*, *Puntius ticto*, *Pethia phutunio*, *Trichogaster lalius*, and *Trichogaster fasciata* are specifically targeted by small-scale fishers in the Gajner beel (Craig *et al.*, 2004). Additionally, during the monsoon season, juvenile Hilsa are also found in this wetland (Mazid *et al.*, 2007). The livelihoods of approximately 0.5 million populaces residing in the nearby communities unswervingly or ramblingly depend on this marshland.

However, the wetland ecosystem's fish population has undergone a consistent decrease, mainly attributed to environmental degradation. Anthropogenic activities such as the erection of flood control embankments, drainage systems, and sluice gates, alongside the transformation of inundated regions into arable land, have led to a decline in water accessibility and the depletion of the natural habitat of indigenous fish species. Furthermore, the uncontrolled application of pesticides and insecticides, as well as the contamination resulting from household, commercial, and agrochemical debris, including run-off, have contributed to the continued loss of numerous native fish species in this particular aquatic ecosystem (Mazid and Hossain, 1995).

Destructive fishing methods and unsustainable fishing practices have also played a role in the loss of fish diversity. Furthermore, it has been found that both human activities and climate change are responsible for the degradation of the beel fisheries. The existence of indigenous fish species within this wetland ecosystem is crucial not only for preserving its

Table 1: Available literature on biodiversity in Bangladesh.

Aspects	Water body	References
Biodiversity	Shorupdah <i>beel</i> , Bangladesh	Majumder <i>et al.</i> (2017)
Biodiversity and management status	Charia <i>beel</i> , Northern Bangladesh	Chakraborty <i>et al.</i> (2021)
Causes of biodiversity depletion	Chalan <i>beel</i> , Bangladesh	Rahman (2015)
Fish biodiversity	Chapai <i>beel</i> , Bangladesh	Hossain and Pramanik (2022)
Habitat and biodiversity degradation	Chalan <i>beel</i> , Bangladesh	Hossain <i>et al.</i> (2009)
Impact of <i>beel</i> encroachment	Noagaon District, Bangladesh	Salam <i>et al.</i> (2020)
Wetland management	<i>beel</i> Bakar, Bangladesh	Khondoker <i>et al.</i> (2014)

biodiversity but also for its substantial value as a means of sustenance and revenue for the nearby populace.

Despite numerous studies on aquatic biodiversity in various water bodies (Table 1), there is a significant research gap regarding the assessment of aquatic biodiversity in the Gajner *beel* wetland ecosystem. This lack of focused research highlights the urgent need to establish protective measures to conserve this ecologically important wetland. Therefore, the primary objective of this study is to assess the aquatic biodiversity of the Gajner *beel* wetland ecosystem in northwestern Bangladesh, providing critical baseline data to inform conservation strategies.

Materials and Methods

Study area and sampling period

The study was carried out in Gajner *beel*, which is one of the largest wetlands in Bangladesh. It is situated in Sujanagar, Pabna, at coordinates Lat. 23°55'N and Long. 89°33'E, as depicted in Figure 1. Samples of aquatic plants and animals were collected during daytime from a total of 30 selected stations in Gajner *beel* over a study period from July 2020 to June 2022.

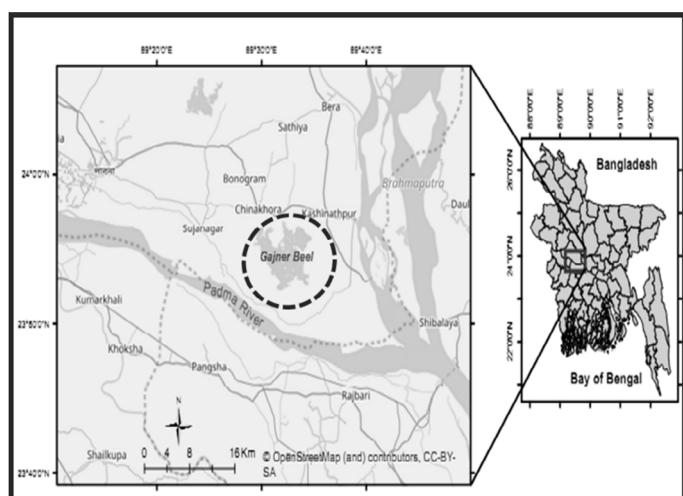


Figure 1: Study site in the Gajner *beel* (Lat. 23°55'N; Long. 89°33'E), Sujanagar, Pabna, Bangladesh.

Identification of aquatic diversity

Collected fishes were sorted up to species level in the laboratory (Department of Fisheries, University of Rajshahi, Rajshahi 6205). Fish species were identified according to the Fishbase; Freshwater Fishes of Bangladesh (Rahman, 2005), and Fisheries of Bangladesh (Shafi and Quddus, 1982). The aquatic plants were identified according to Flora of Bangladesh (Ali, 2021). The identification of plants and other species was conducted in accordance with the Encyclopedia of Flora and Fauna of Bangladesh and the IUCN Red List of Bangladesh (IUCN Bangladesh, 2015). Indigenous aquatic species, with a focus on both plants and animals, were identified based on their abundance during sampling and surveying. This was achieved through the use of questionnaires administered to local occupants and fishers. The diversity of fish was assessed through the methodology outlined by Rahman *et al.* (2012). The categorization of fish availability is as follows: TY (Throughout the year), TYS (Throughout the year in small amounts), TYL (Throughout the year in large amounts), SM (Found in small amounts during monsoon), LM (Found in large amounts during monsoon), R (Rare), VR (Very rare), and NE (Not evaluated). This study aimed to estimate the relationship between the maximum total lengths (TL) achieved by a species and the corresponding number of species that attained that TL, expressed as cumulative percentages. For the collection of relevant data, an interview technique was employed in this study. A local individual was selected as a respondent to locate fishermen's houses and gather pertinent information from them. Participatory Rural Appraisal (PRA) tools, including Focus Group Discussion (FGD) and cross-check interviews with key informants, were utilized to engage with the fishers. In order to obtain data through questionnaire interviews, a simple random sampling method was employed, involving 40 fishers from the Gajner *beel*. These interviews were conducted either at the fishermen's homes or at the

actual fishing sites within the *beel*. Additionally, the author gathered crucial information on fish catch and aquatic vegetation of the *beel* through observations of the entire study area. Participatory Rural Appraisal (PRA), which encompassed methods like Focus Group Discussion (FGD), was employed as a group-based approach to collect information from the target group, specifically the fishers. FGDs were conducted to gain an overview of specific issues, such as the composition of the existing fish catch. To ensure the reliability of the collected data, cross-check interviews were conducted with relevant individuals such as the upazila fisheries officer (UFO), district fisheries officer (DFO), scientific officers of BFRI, school teachers, local leaders, and NGO workers. The data were then coded, summarized, processed, and analyzed for interpretation purposes.

Results

The Gajner *beel* was found to harbor a total of 52 indigenous fish species, as documented in Table 2. Among these, 13 species were identified as being threatened. Among them, 11.80% were vulnerable, 11.80% were endangered, 2.00% were critically endangered and major proportion (56.90%) were least concern according to IUCN Bangladesh (2015) (Figure 2 and Table 2). However, according to IUCN (2021), 8 species were recorded as threatened where 3.92% were vulnerable, 11.76% were near threatened and 70.59% were least concern (Figure 3).

Moreover, in this study *beel*, 7 fish species were found which is listed in rare (Table 2), where, *Gudusia chapra* was found in large amount during monsoon. Additionally, 9 species were recorded as SM (found in little bit during monsoon) in study *beel*. Generally, *Tenualosa ilisha* was also found in small amount which come from river during monsoon in Gajner *beel*.

According to the IUCN Conservation Status (BD) assessment conducted on fish species in Gajner *beel*, it turned out that the majority of species (56%) were categorized as Least Concern. Near Threatened species accounted for 2%, Vulnerable for 12%, and Endangered for 12% (as shown in Figure 2). The study revealed that the vulnerable category was the most abundant among threatened fish species, accounting for 46% of the total. This was followed by the endangered category at 46%, while the critically endangered category made up 8% of the total, as

depicted in Figure 2. It is noteworthy that within Bangladesh, 64 native freshwater fish species have been classified as threatened by IUCN (2015). Of these, 13 have been identified within Gajner *beel*, representing 20.31% of the total threatened fish species in the country. Additionally, it should be noted that the endangered species present within Gajner *beel* accounted for 26% of all identified fish species, as illustrated in Figure 3. Of the 13 fish species examined, 6 (9.37%) were classified as Vulnerable (VU), 6 (9.37%) as Endangered (EN), and only 1 species (1.57%) was categorized as Critically Endangered (CR), as shown in Table 2.

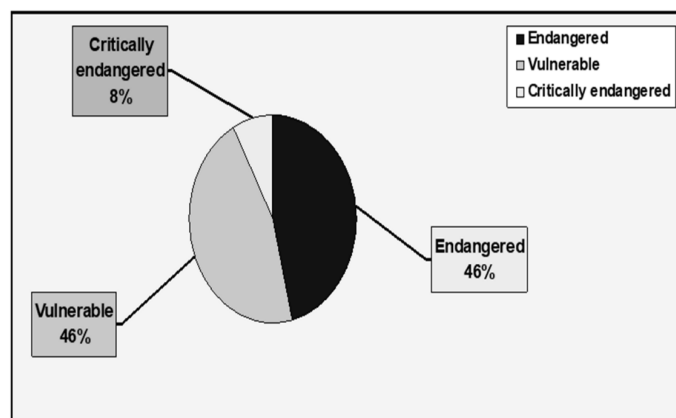
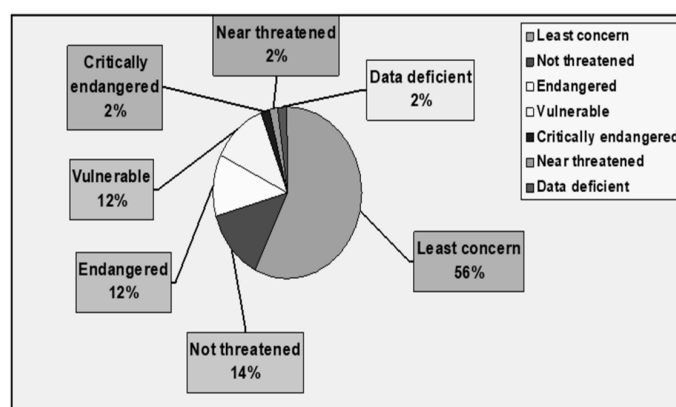


Figure 2: Status of fishes in the wetland (Gajner beel, Pabna) ecosystem according to IUCN Bangladesh (2015).

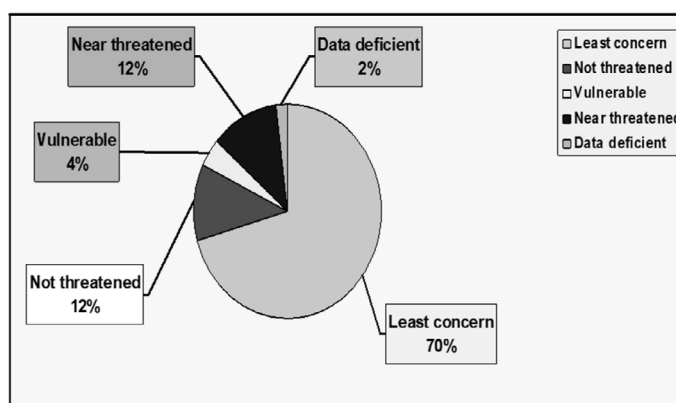


Figure 3: Status of fishes in the wetland (Gajner beel, Pabna) ecosystem according to IUCN (2021).

Table 2: Available fish species in the Wetland (Gajner beel, Pabna) ecosystem, Bangladesh.

S. No.	Species name	Common name	Local name	Availability in the Gajner beel	IUCN Bangladesh Status	IUCN world-wide
1	<i>Ailia coila</i>	Gangetic ailia	Baspata	SM	LC	NT
2	<i>Amblypharyngodon mola</i>	Mola carplet	Mola	TYL	LC	LC
3	<i>Anabas testudineus</i>	Climbing perch	Koi	TYL	LC	DD
4	<i>Aplocheilichthys panchax</i>	Blue panchax	Kanpona	R	LC	LC
5	<i>Badis badis</i>	Badis	Napte koi	R	NT	LC
6	<i>Botia dario</i>	Bengal loach	Rani	TYS	EN	LC
7	<i>Botia lohachata</i>	Reticulate loach	Bou	R	EN	NE
8	<i>Cabdio morar</i>	Morari	Pioly	R	VU	LC
9	<i>Chanda nama</i>	Elongateglass-perchlet	Chanda	TYL	LC	LC
10	<i>Channa marulius</i>	Great snakehead	Gozar	TYS	EN	LC
11	<i>Channa orientalis</i>	Walking snakehead	Cheng	TYL	LC	LC
12	<i>Channa punctatus</i>	Spotted snakehead	Taki	TYL	LC	LC
13	<i>Channa striatus</i>	Striped snakehead	Shol	TYL	LC	LC
14	<i>Cirrhinus cirrhosis</i>	Mrigal carp	Mrigal	TYS	NT	VU
15	<i>Cirrhinus reba</i>	Reba carp	Raik	TYS	NT	LC
16	<i>Clarias batrachus</i>	Walking catfish	Magur	R	LC	LC
17	<i>Esomus danrica</i>	Flying barb	Darkina	TYS	LC	LC
18	<i>Gibelion catla</i>	Catla	Katal	TYS	LC	LC
19	<i>Glossogobius giuris</i>	Tank goby	Bele	TYL	LC	LC
20	<i>Gudusia chapra</i>	Indian River Shad	Chapila	LM	VU	LC
21	<i>Heteropneustes fossilis</i>	Stinging catfish	Shing	TYL	LC	LC
22	<i>Labeo bata</i>	Bata	Bata	TYS	LC	LC
23	<i>Labeo calbasu</i>	Orangefin labeo	Kal baush	TYS	LC	LC
24	<i>Labeo rohita</i>	Roho labeo	Rui	TYS	LC	LC
25	<i>Lepidocephalichthys guntea</i>	Guntea loach	Gutum	TYL	LC	LC
26	<i>Macrogathus aculeatus</i>	Lesser spiny eel	Tara baim	TYL	NT	NE
27	<i>Macrogathus pancalus</i>	Barred spiny eel	Guchi	TYL	LC	LC
28	<i>Mastacembelus armatus</i>	Zig-zag eel	Sal baim	TYS	EN	NE
29	<i>Monopterus albus</i>	Cuchia	Kuchia	R	VU	VU
30	<i>Mystus vittatus</i>	Gangetic mystus	Golsha-tengra	TYS	NT	LC
31	<i>Mystus tengara</i>	Tengara catfish	Choto tengra	TYL	LC	LC
32	<i>Nandus nandus</i>	Gangetic leaffish	Bheda	TYL	NT	LC
33	<i>Chitala chitala</i>	Clown knifefish	Chital	SM	EN	NT
34	<i>Notopterus notopterus</i>	Bronze featherback	Foli	SM	VU	LC
35	<i>Ompok pabda</i>	Pabdah catfish	Madhu pabda	TYL	EN	NT
36	<i>Ompok pabo</i>	Pabo catfish	Pabda catfish	TYS	CR	NT
37	<i>Oreochromis niloticus</i>	Nile tilapia	Nilontica	TYS	NE	NE
38	<i>Parambassis ranga</i>	Indian glassy fish	Lal chanda	TYL	LC	LC
39	<i>Parambassis lala</i>	Highfin glassy perchlet	Choto chanda	TYL	LC	NE
40	<i>Pethia conchonius</i>	Rosy barb	Kanchan puti	SM	LC	LC
41	<i>Pethia phutunio</i>	Spotted sail barb	Phutani punti	SM	DD	NT
42	<i>Pethia ticto</i>	Ticto barb	Titputi	TYS	VU	LC
43	<i>Puntius sophore</i>	Pool barb	Jatputi	TYL	LC	LC
44	<i>Rhinomugil corsula</i>	Corsula	Korsula	SM	LC	LC

Table continued on next page.....

S. No.	Species name	Common name	Local name	Availability in the Gajner beel	IUCN Bangladesh Status	IUCN world-wide
45	<i>Salmostoma bacaila</i>	Large razorbelly minnow	Chela	TYL	LC	LC
46	<i>Systomus sarana</i>	Olive barb	Sarputi	SM	NT	LC
47	<i>Tetraodon cutcutia</i>	Ocellated pufferfish	Potka	R	LC	LC
48	<i>Trichogaster fasciata</i>	Banded gourami	Kholisha	TYL	LC	LC
49	<i>Trichogaster lalius</i>	Dwarf gourami	Lal kholisha	TYL	LC	LC
50	<i>Wallago attu</i>	Wallago	Boal	SM	VU	NT
51	<i>Xenentodon cancila</i>	Freshwater garfish	Kakila	TYL	LC	NE
52	<i>Tenuulosa ilisha</i>	Hilsa shad	Ilish	SM	LC	LC

LC: Least concern, VU: Vulnerable, EN: Endangered, CR: Critically endangered, NT: Near threatened, DD: Data deficient, NE: Not evaluated, 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, and NE: not evaluated.

In addition, from the survey and focus group discussion (FGD) among fishers, fish farmers, traders, researchers, Government and NGO personnel, the reduction of water level is the major cause for declining the fishes in the Gajner beel followed by overfishing, habitat destruction and use of destructive fishing gears (Figure 4).

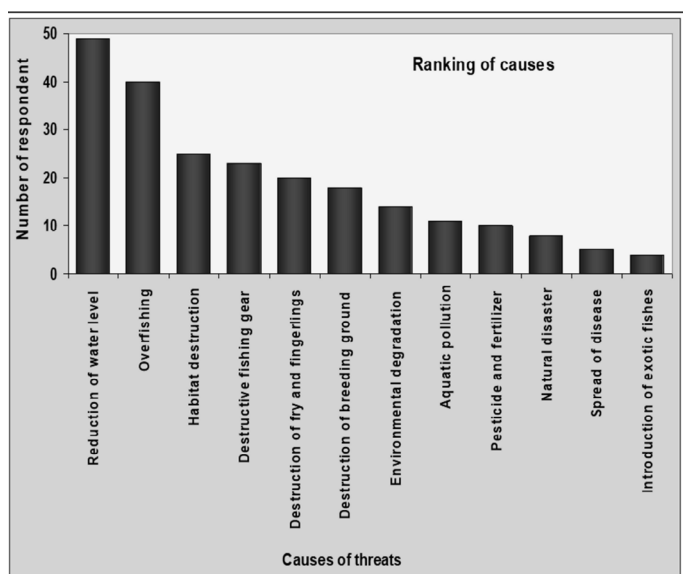


Figure 4: Principle causes for declining the fish biodiversity in the Gajner beel, Pabna, Bangladesh.

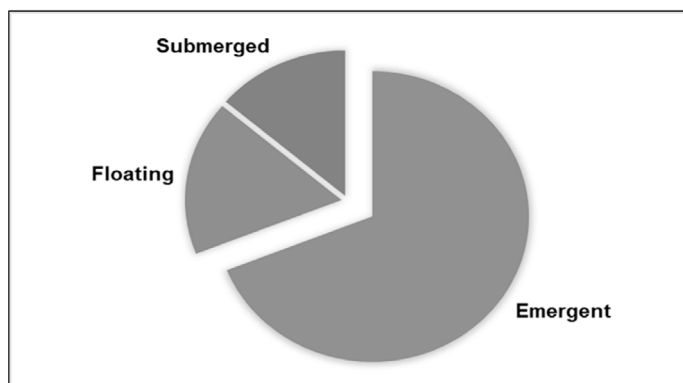


Figure 5: Type of aquatic plants observed in Gajner beel, Bangladesh.

A total of 29 aquatic plants were identified from the Gajner beel wetland ecosystem, Bangladesh (Table 3). Among them 20 species were categorized as emergent, 5 species as floating, and 4 species as submerged (Figure 5). Further, a total of 4 arthropods, 3 mollusks, 5 amphibians, 5 reptiles, and 11 aquatic birds were identified from Gajner beel wetland (Tables 4 and 5).

Discussion

Bangladesh boasts a remarkable wealth of fish diversity, and one prime example of this can be found in the Gajner beel ecosystem situated in northwestern Bangladesh. The primary intent of the current study is to perform a thorough evaluation of the aquatic biodiversity present in the wetland region. The study aims to shed light on the current status of various components, including fish, flora, fauna, other fisheries items, and avian species, while also investigating the causes underlying the decline of these populations.

The Gajner beel ecosystem revealed a remarkable presence of 52 indigenous fish species, with 13 of them classified as threatened. Comparatively, Sultana *et al.* (2019) recorded 56 fish species in Bhawal beel, Mymensingh, while Karim *et al.* (2020) documented 38 fish species from Ruhul beel and Bamonji beel under Chalon beel, northwestern Bangladesh, representing 24 genera, 17 families, and 8 orders (7 fish and 1 prawn). Chakraborty and Mirza (2007) reported a total of 70 fish species in Gharia beel, and Eshan *et al.* (2000) identified 40 fish specimens, including three exotic species, in Chanda beel, while Hossain and Pramanik (2022) identified 48 fish species in Chapai beel. Interestingly, Majumder *et al.* (2017) recorded 52 species in Shorupdah beel, Jessore, which is similar

Table 3: List of Aquatic plants observed in the Gajner beel wetland, Bangladesh with their types.

S. No.	Family	English name	Local name	Scientific name	Type
1	Nymphaeaceae	Water lily	Shapla, shaluk	<i>Nymphaea nouchali</i>	Emergent
2	Nymphaeaceae	White water lily	Sada shapla	<i>Nymphaea pubescens</i>	Emergent
3	Nymphaeaceae	Red water lily	Rokto komol	<i>Nymphaea rubra</i>	Emergent
4	Nelumbonaceae	Lotus	Padma	<i>Nelumbo nucifera</i>	Emergent
5	Convolvulaceae	Water spinach	Kolmi	<i>Ipomoea aquatica</i>	Emergent
6	Pontederiaceae	Water hyacinth	Kochuripana	<i>Eichhornia crassipes</i>	Floating
7	Pontederiaceae	Leaf pondweed	Boronukha	<i>Monochoria hastata</i>	Emergent
8	Marsileaceae	4-leaved clover	Shushni	<i>Marsilea quadrifolia</i>	Emergent
9	Oxalidaceae	Indian sord	Amrool	<i>Oxalis corniculata</i>	Emergent
10	Polygonaceae	Polygonum	Bishkatali	<i>Polygonum glabrum</i>	Emergent
11	Onagraceae	Water primrose	Keshordam	<i>Ludwigia adscendens</i>	Emergent
12	Menyanthaceae	Crested floating-heart	Chandmala, Kumudini	<i>Nymphoides cristatum</i>	Emergent
13	Amaranthaceae	Alligator weed	Maloncho	<i>Alternanthera philoxeroides</i>	Emergent
14	Asteraceae	Hingcha	Helencha	<i>Enhydra fluctuans</i>	Emergent
15	Hydrocharitaceae	Duck lettuce	Panikola	<i>Ottelia alismoides</i>	Submerged
16	Hydrocharitaceae	Water thyme	Jhanjhi	<i>Hydrilla verticillata</i>	Submerged
17	Araceae	Water lettuce	Topapana	<i>Pistia stratiotes</i>	Floating
18	Araceae	Taro	Kochu	<i>Colocasia esculenta</i>	Emergent
19	Lamnaceae	Minute duckweed	Khudi pana	<i>Lemna minor</i>	Floating
20	Lamnaceae	Mosquito fern	Kutipana	<i>Azolla pinnata</i>	Floating
21	Salviniaceae	Floating fern	Tilok pana	<i>Salvinia natans</i>	Floating
22	Commelinaceae	Benghal dayflower	Kanai bashi	<i>Commelina benghalensis</i>	Emergent
23	Convolvulaceae	Pink morning glory	Dholkolmi	<i>Ipomea carnea</i>	Emergent
24	Poaceae	Southern cut grass	Arail	<i>Leersia hexandra</i>	Emergent
25	Poaceae	Asian waterweed	Dol	<i>Hygroryza aristata</i>	Emergent
26	Ceratophyllaceae	Coontail	Kata jhanji	<i>Ceratophyllum demersum</i>	Submerged
27	Hydrocharitaceae	Brittle naiad	Najas	<i>Najas najas</i>	Submerged
28	Alismataceae	Arrowhead	Chhotokut	<i>Sagittaria sagittifolia</i>	Emergent
29	Cyperaceae	Bog bulrush	Soktochechra	<i>Scirpus mucronatus</i>	Emergent

Table 4: Available other fisheries item observed in Gajner beel (wetland), Pabna, Bangladesh.

Group	Family	Common name	Local name	Scientific name
Arthropods	Palaemonidae	Monsoon river prawn	Golda chingri	<i>Macrobrachium malcolmsonii</i>
	Palaemonidae	Kaira river prawn	Chingri	<i>M. dayanum</i>
	Palaemonidae	Kuncho river prawn	Gura chingri	<i>M. lamarrei</i>
	Palaemonidae	Brown crab	Kakra	<i>Cancer pagurus</i>
Mollusks	Ampullariidae	Apple snail	Appel shamuk	<i>Pila globosa</i>
	Vivipariadae	-	Jhinuk	<i>Viviparus bengalensis</i>
	Eulamellibranchidae	Freshwater mussel	Jhinuk	<i>Lamellidens marginalis</i>
Amphibian	Ranidae	Indian bullfrog	Sona bang	<i>Rana tigrina</i>
	Ranidae	Indian greenfrog	Kola bang	<i>Rana hexadactyla</i>
	Ranidae	Indian bullfrog	Mini kolabang	<i>Hoplobatrachus tigrinus</i>
	Ranidae	Indian skipperfrog	Kotkoti bang	<i>Euphlyctis cyanophlyctis</i>
	Bufonidae	Asian common toad	Kuno bang	<i>Bufo melanostictus</i>
Reptiles	Emydidae	Crowned river turtle	Kachim	<i>Hardella thurjii</i>
	Trionychidae	Indian flapshell turtle	Kachim	<i>Lissemys punctata</i>
	Geoemydidae	Indian eyed turtle	Kachim	<i>Morenia petersi</i>
	Colubridae	Checkered keelback	Dhora sap	<i>Natrix piscator</i>
	Colubridae	Red-necked keelback	laldhora	<i>Rhabdophis sub miniata</i>

Table 5: Available birds observed in Gajner beel wetland, Pabna, Bangladesh.

S. No.	Family	Common name	Local name	Scientific name
1	Ciconiidae	Painted Stork	Ranga Manikjor, Sona Jongha	<i>Mycteria leucocephala</i>
2	Anatidae	Mallard	Nilmatha Hash, Nilshir	<i>Anas platyrhynchos</i>
3	Podicipedidae	Little Grebe	Choto Duburi, Dubdubi, Duburi	<i>Tachybaptus ruficollis</i>
4	Rallidae	Water Rail	Panta Jhilli	<i>Rallus aquaticus</i>
5	Rallidae	White-breasted Waterhen	Dahuk, Dholabook dahuk	<i>Amaurornis phoenicurus</i>
6	Ciconiidae	Asian Openbill	Samkhol	<i>Anastomus oscitans</i>
7	Ardeidae	Indian Pond Heron	Deshi Kanibok, Kani Bok	<i>Ardeola grayii</i>
8	Ardeidae	Great White Egret	Boro Boga, Jathua Bok,	<i>Ardea alba</i>
9	Ardeidae	Indian Cormorant	Desi Pankouri	<i>Phalacrocorax fuscicollis</i>
10	Jacaniidae	Bronze-winged Jacana	Dol Pipi, Jol Pipi	<i>Metopidius indicus</i>
11	Alcedinidae	Common Kingfisher	Chhoto Maachranga	<i>Alcedo atthis</i>

to the findings of the current study. Based on these comparisons, it can be inferred that Gajner beel is more diverse than Chapai beel and Chanda beel but less diverse than Bhawal beel, Gharial beel and Hatil beel in terms of fish diversity.

In terms of aquatic biodiversity, the Gajner beel wetland ecosystem exhibited the presence of 29 aquatic plant species, 4 arthropods, 3 mollusks, 5 amphibians, and 5 reptiles. Chakraborty and Mirza (2007) conducted a comparative study and reported the presence of 13 species of marginal and submerged vegetation, 4 species of prawns, 1 species of crabs, and 5 individuals of reptiles in Gharial beel. Majumder et al. (2017) reported the presence of aquatic plants, prawns, mollusks, arthropods, amphibians and reptile were in 10, 5, 4, 3, 2 and 1, respectively in Shorupdah beel, Jessore. According to Rahman et al. (1999) study, Eshulia beel was found to host a variety of aquatic species, including 3 species of prawns, 5 species of mollusks, 6 species of arthropods (aquatic insects), 3 species of amphibians, and 2 species of reptiles. Based on these comparisons, it can be deduced that Gajner beel exhibits a notable level of diversity among the other studies conducted. Furthermore, the avian diversity in the Gajner beel ecosystem was represented by a total of 11 dominant species from 8 different families. However, due to limited information available in the literature, it is challenging to make direct comparisons with our current study.

In the present study, out of the total 52 indigenous fish species observed in Gajner beel, 11.80% were categorized as vulnerable, 11.80% as endangered, 2.00% as critically endangered, and the majority (56.90%) fell under the classification of least concern,

as per the IUCN Bangladesh (2015) classification. Comparatively, according to the findings of Hossain and Pramanik (2022), the majority of fish species in Chapai beel were classified as least concern (66%), followed by near threatened (19%), vulnerable (10%), and endangered (5%) based on the IUCN (2015) categorization. Furthermore, among the 52 indigenous fish species found in Gajner beel, 13 species were identified as threatened. Similarly, Majumder (2017) documented 64 native species as threatened in Shorupdah beel based on the IUCN Bangladesh (2015) classification.

Research conducted by Chakraborty and Nur (2009) in Medha beel, situated in the northern region of Bangladesh, revealed that 9 commercially significant aquatic species are critically endangered, 39 species are endangered, and 19 species are vulnerable. Sultana et al. (2019) have reported the existence of 13 endangered species among a total of 56 species found in Bhawal beel. The aforementioned findings underscore the conservation importance of Gajner beel, given its role as a habitat for a wide array of fish species.

In current study, we observed 21 species in TYL (Throughout the Year in Large amount), whereas 14 species in TYS (Throughout the Year in Small amount), and 7 species were recorded as rare species. After that only one species *Gudusia chapra* was recorded in large amount during monsoon. Though *Tenualosa ilisha* are spawning in the river and stay here until "Jatka" and then migrate to the Bay of Bengal. However, in our present study we found a number of specimens from this wetland ecosystem during monsoon. Though there is no prior study dealing with those specific availability fish species data restrain the comparison

with other study. The estimation of fish species and their maximum size is crucial for the implementation of sustainable management practices in aquatic environments (Rahman *et al.*, 2012). Moreover, the maximum length (L_{max}) is crucial parameter for fish species. Asymptotic length and size at sexual maturity (L_m) are depends on maximum length (L_{max}). In our present study we observed maximum length (L_{max}) of 23 species where 2 species recorded maximum length were *Amblypharyngodon mola* 8.5 cm and *Pethia phutunio* 4.7 cm to compare with fish base (Table 6).

In the present study, the fish biodiversity is declining due to reduction of water level, overfishing, habitat destruction, destructive fishing gear etc. (Figure 5). According to the respondents the main threats are reduction of water level and overfishing. On the contrary, According to Sultana *et al.* (2019), the primary factors that pose a threat to fish diversity in Bhawal *beel* have been identified as overfishing, employment of illegal fishing techniques such as current *jal* and *katha* fishing, siltation, fishing by dewatering, and environmental degradation. According to Chakraborty and Mirza (2007) findings,

the alterations in the aquatic ecosystems of Gharial *beel*, which were brought about by the construction of flood control barrages, erosion of soil, sludge, drainage structures, and agrochemicals, along with habitat degradation, pollution, and the utilization of destructive fishing gears, were the main factors that led to the reduction in fish diversity. The present study is in alignment with the findings reported by Ali (1991), Khan (1993), Nishat (1993), Zaman (1993), Stoddard *et al.* (2006), Chakraborty and Nur (2009), and Siddiq *et al.* (2013), which identified common causes of the decline in fish diversity.

This study is the first attempt to assess the aquatic biodiversity of the Gajner *beel* ecosystem, as no prior research has been conducted on this topic. The results of this study are of great importance to fishery managers, fish biologists, and conservationists, as they offer a crucial resource for implementing proactive management strategies and developing regulations that support the sustainable management of the remaining fish species in the Gajner *beel* wetland and its surrounding ecosystem.

Table 6: Descriptive statistics of total length and body weight for available fish species in the Gajner *beel*, Bangladesh.

S. No.	Species name	Observed value (cm)				L_{max} (cm)	Reference
		L_{min}	L_{max}	W_{min}	W_{max}		
1	<i>Amblypharyngodon mola</i>	3.8	8.5	0.34	7.04	8.1	Nawer <i>et al.</i> (2018)
2	<i>Anabas testudineus</i>	7.4	16.4	7.89	89	25	Talwar and Jhingran (1991)
3	<i>Botia dario</i>	7.5	9.4	6.22	12.91	15.1	Rahman (1989)
4	<i>Chanda nama</i>	2.6	7.2	0.16	3.73	11	Menon <i>et al.</i> (1999)
5	<i>Channa orientalis</i>	7.9	19.0	4.61	8.55	33	Menon <i>et al.</i> (1999)
6	<i>Channa punctatus</i>	1.7	23.0	1.93	126.9	31	Talwar and Jhingran (1991)
7	<i>Channa striatus</i>	9.5	46.0	5.97	889	100	Davidson (1975)
8	<i>Heteropneustes fossilis</i>	6.3	26.8	1.34	140.69	41.2	Renjithkumar <i>et al.</i> (2021)
9	<i>Glossogobius giuris</i>	3.2	15.0	0.33	25.39	50	Eccles (1992)
10	<i>Lepidocephalichthys guntea</i>	2	10.5	0.99	10.6	15	Talwar and Jhingran (1991)
11	<i>Macrognaathus aculeatus</i>	9.7	28.0	2.23	95.02	38	Smith (1945)
12	<i>Macrognaathus pancalus</i>	6	18.8	0.53	29.45	18.9	Baitha <i>et al.</i> (2018)
13	<i>Mastacembelus armatus</i>	7.9	43.0	0.9	194	90	Sokheng <i>et al.</i> (1999)
14	<i>Mystus vittatus</i>	5.3	11.8	1.74	9.1	21	Talwar and Jhingran (1991)
15	<i>Mystus tengara</i>	3.9	12.7	0.02	18.02	18	Talwar and Jhingran (1991)
16	<i>Nandus nandus</i>	4.2	17.4	0.98	110.58	20	Talwar and Jhingran (1991)
17	<i>Ompok pabo</i>	7.8	22.2	2.56	58.89	25	Vidthayanon (2005)
18	<i>Pethia phutunio</i>	4.7	7.9	2.43	35	3.9	Hossain <i>et al.</i> (2017)
19	<i>Puntius sophore</i>	4.2	11.4	0.75	25.13	20	Vidthayanon (2005)
20	<i>Salmostoma bacaila</i>	4.4	9.7	0.42	7.08	18	Menon (1999)
21	<i>Trichogaster fasciata</i>	2.6	9.5	0.25	63.45	12	Menon (1999)
22	<i>Trichogaster lalius</i>	3.9	9.0	1.18	9.87	9.5	Islam <i>et al.</i> (2017)
23	<i>Xenentodon cancila</i>	8	25.0	0.89	41.84	40	Talwar and Jhingran (1991)

Conclusions and Recommendations

The study on the Gajner beel wetland ecosystem in northwestern Bangladesh highlights its rich aquatic biodiversity, encompassing 52 fish species, including 48 indigenous, 3 Indian major carps, and 1 exotic species, alongside diverse flora and fauna such as plants, arthropods, mollusks, amphibians, reptiles, and aquatic birds. Notably, 8 fish species were identified as threatened, with 11.80% classified as vulnerable, 11.80% as endangered, 2.00% as critically endangered, and 56.90% as least concern. The study also documented the maximum lengths of 23 fish species, providing valuable data for comparison with global databases like Fishbase. However, the ecosystem faces significant threats, including reduced water levels, overfishing, and habitat destruction, which are driving the degradation of fisheries and biodiversity loss. These findings underscore the urgent need for targeted conservation efforts to mitigate these threats and preserve the ecological stability and resilience of the Gajner beel wetland. Protecting this ecosystem is crucial not only for maintaining biodiversity but also for ensuring the sustainability of local fisheries and the livelihoods dependent on them.

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Novelty Statement

Revealing the aquatic harmony of the Gajner *beel* wetland ecosystem in Bangladesh, this study not only provides a comprehensive inventory of its diverse inhabitants but also highlights the urgent need for sustainable management policies in the face of escalating threats, offering a crucial blueprint for the preservation of this vital biodiversity.

Author's Contribution

Md. Motiour Rahman Khan: Conceptualization, and writing original draft.

Nur-E-Farjana Ilah and Obaidur Rahman: Data analysis

Taiba Akter Laboni: Data analysis and manuscript writing.

Mst. Shahinur Khatun: Data analysis and writing.

Md. Joynal Abedin: Draft of manuscript checking.

Md. Akhtarul Islam: Data collection and analyzed the data.

Kamruzzaman: Manuscript writing.

Md. Yeamin Hossain: Edited the whole manuscript.

Conflict of interest

The authors affirm that they have no known financial or interpersonal conflicts that would have seemed to have an impact on the research presented in this study.

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