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Original Article

Exploring shellfish diversity, utilisation and conservation threats in the Chalan Beel, Bangladesh

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Abstract
Shellfish are important components of aquatic ecosystems, including freshwater wetlands. In this study, we examined shellfish species diversity and their utilisation by humans in the largest wetland of Bangladesh, the Chalan Beel. Through systematic, standardised field surveys, we recorded 19 shellfish species, including 14 molluscs and five arthropods. The global conservation status of the recorded species was retrieved from the IUCN Red List database, and all were classified as Least Concern. Among the 19 recorded species, the majority—11 species—are used for human consumption, followed by use as animal feed (e.g. for fish, shrimp and poultry) (eight species), as fish bait (eight species), in traditional medicine (eight species), as ornamental species in aquariums (two species) and in freshwater pearl culture (one species). Six threats to shellfish populations have been identified: (i) harvesting for commercial trade, (ii) use of illegal fishing gear, (iii) construction of irrigation canals, (iv) destructive 'katha' fishing methods, (v) changes in land use and (vi) duck farming in the wetland. The findings of this study will serve as baseline data for future research. To ensure a sustainable supply of shellfish for human consumption and animal feed, we recommend focusing on shellfish aquaculture rather than harvesting from the wild. This approach may be particularly beneficial for mollusc populations. We also advocate for the formulation of conservation regulations for shellfishes in the country.

Keywords: arthropods; bivalves; Chalan Beel; freshwater shellfishes; molluscs; wetland

1 | INTRODUCTION

Shellfish are an important component of global food production, commonly including shell-bearing molluscs (e.g. snails, oysters and mussels) and arthropods (e.g. shrimp, lobsters and crabs) (Venugopal and Gopakumar 2017; Azra *et al.* 2021). Shellfish aquaculture constitutes a major share of global aquaculture production (Azra *et al.* 2021). Beyond their economic value, shellfish are ecologically significant and play numerous roles in aquatic ecosystems (Gutiérrez *et al.* 2003; Patel and Kurhe 2023). For instance, molluscs are well-known as sentinel organisms used to monitor habitat health, particularly in assessing environmental pollution (Baroudi *et al.* 2020). Mussels contribute to the aquatic food web by filtering water and converting inaccessible nutrients into food for their predators (e.g. fish, amphibians, reptiles and birds), making them vital to ecosystem dynamics (Bril *et al.* 2014).

Research on marine shellfish, particularly regarding their role as seafood and in aquaculture, has received considerable attention (e.g. Dumbauld *et al.* 2009; Stewart-Sinclair *et al.* 2020; Senovilla-Herrero *et al.* 2024). However, freshwater shellfish can also serve as a basis for

economic activities, as they are widely recognised for various uses, including as human food and poultry feed (Patel and Kurhe 2023). Shellfishes have high importance in achieving the United Nation's Sustainable Development Goals (SDGs) because of their roles for sustainability and preservation of aquatic ecosystems (SDG 14) and for water management (SDG 6) (Mesquita *et al.* 2024).

Bangladesh, a small developing country in South Asia, is home to a large number of shellfish species (Anisuzzaman *et al.* 2016). Currently, the species diversity of shellfish is not well documented, as research efforts have primarily focused on fish species (e.g. Chaki *et al.* 2014; Galib *et al.* 2016; Shalehin *et al.* 2020). Nonetheless, Anisuzzaman *et al.* (2016) reported a total of 362 mollusc species, comprising 336 marine and 26 freshwater species. Additionally, Antu *et al.* (2022) documented 148 species of bivalves and 318 species of gastropods in the country. However, habitat-specific data on aquatic biodiversity, primarily shellfishes, are largely unavailable. Only a few notable studies on shellfish populations have been conducted. For instance, Antu *et al.* (2022) recorded bivalves and gastropods from Sonadia Island, while Gain and Das (2014) documented 14 shellfish species from the Passur River in southern Bangladesh. These studies, however, are limited to coastal or marine habitats, highlighting a clear lack of research in the country's freshwater environments. Therefore, we conducted this study to explore shellfish diversity, their utilisation and associated threats in the largest wetland of Bangladesh, the Chalan Beel.

2 | METHODOLOGY

2.1 Study area

This study was conducted in Chalan Beel, the largest wetland of Bangladesh (Galib *et al.* 2018; Nurullah 2023). The Chalan Beel is widely known as a key source of fish and agricultural crops in Bangladesh (Kashmi *et al.* 2025). This ecosystem also supports other key species like a range of aquatic birds and turtles (Galib *et al.* 2018; Kashmi *et al.* 2025). Unfortunately, this habitat is under threat from different anthropogenic activities including overexploitation, flow modification and habitat shrinkage (Hossain *et al.* 2009; Galib *et al.* 2018; Kashmi *et al.* 2025).

2.2 Determination of shellfish species diversity

We visited six locations (S1 – S6) of the Chalan Beel monthly from January to December 2024. Among these locations, three were located in Singra Upazila (= subdistrict) of Natore district (S1 – S3) and three in Tarash Upazila of Sirajganj district (S4 – S6). At each location, on every sampling day, we extensively surveyed for shellfishes using a combination of hand scoop net and fishing nets for two hours between 09:00 and 12:00 hours. In addition, we also examined on-going fishing activities as shellfishes are also caught in fishing nets. A dip net (diameter: 30 cm, mesh 0.5 cm) was used to collect shellfishes from the sampling sites. Five sweeps, each for a two-minute duration over approximately an area of 5 m^2 area were performed at each sampling site.

Samples of shellfish were identified at the sampling sites. They were brought to the laboratory only if identification could not be confirmed on-site. Collected samples were identified examining the external characteristics of shellfish specimens following standard literature (e.g. Verma 1971; NHM nd).

Shellfish abundance was categorised into four types: (i) Very Common (VC; >100 individuals recorded at each sampling site during each sampling), (ii) Common (C; 20 – 99 individuals recorded at each sampling site), (iii) Few (F; 1 – 19 individuals recorded at each sampling site), and (iv) Rare (R; <5 individuals recorded, but not at every sampling site or during every sampling effort). The IUCN redlist status is based on IUCN (2025).

2.3 Utilisation of shellfishes and threat identification

We conducted questionnaire-based interviews with fishermen (n = 30), agriculture farmers (n = 30) and boatmen (n = 20) of Chalan Beel to collect data on human utilisation of shellfish. Respondents were also asked to identify threats to shellfish abundance in the wetland. In addition, through direct observation during the sampling period, both actual and potential threats to shellfishes were identified.

3 | RESULTS

3.1 Shellfish diversity, availability and conservation status

A total of 19 shellfish species belonging to nine families were recorded in this study, including 14 molluscs and five arthropod species (Table 1). The majority (six species) were classified as rare, whereas five species were considered very common (Table 1). Molluscs are primarily abundant from the monsoon (July – September) to post-monsoon (October – December) period (Table 1). The only crab species (*Cancer pagurus*) recorded in the wetland was mostly available from spring to summer (Table 1). All of the shellfish species belonged to the Least Concern category (Table 1).

3.2 Utilisations of shellfishes

Among the 19 recorded shellfish species, the majority—11 species—have been used for human consumption, followed by use as animal feed (e.g. for fish and poultry) (eight species), as fish bait (eight species), in traditional medicine (eight species), as ornamental species in aquariums (two species) and in freshwater pearl culture (one species) (Figure 1; Table 1).

3.3 Threats to shellfishes

This study identified six actual or potential threats to the

shellfish populations of Chalan Beel (Table 2). These include harvesting shellfishes for commercial trades, use of illegal fishing gears, construction of irrigation canals, destructive 'katha' fishing method, changes in land use and duck faming in the wetland (Table 2).

FIGURE 1 Harvested freshwater crab (left) and apple snail (above) for human or animal consumption from the Chalan Beel– the largest wetland of Bangladesh.

TABLE 1 Shellfishes of the Chalan Beel, the largest wetland of Bangladesh along with their abundance, conservation status and human uses.

Class and family	Scientific name	Common / local name	Availability	Peak abundance	IUCN redlist status	Uses
Gastropoda (Molluscs)						
Pilidae	*Pila globosa*	Shamuk	VC	M to Post-M	LC	FB, HF, TM
	Pila theobaldi	Shamuk	VC	M to Post-M	LC	FB, HF, TM
Viviparidae	*Bellamya bengalensis*	Choto shamuk	VC	M to Post-M	LC	AF, FB, TM
	Idiopoma dissimilis	Choto shamuk	F	M to Post-M	LC	AF, FB, TM
Lymnaiidae	*Lymnaea acuminata*	Pond snail	F	M to Post-M	LC	AF
	Lymnaea luteola	Pond snail	R	M to Post-M	LC	AF
	Lymnaea stagnalis	Pond snail	R	M to Post-M	LC	AF
Planorbidae	*Indoplanorbis exustus*	Coiled slug	F	M to Post-M	LC	AF
	Gyraulus convexiusculus	Coiled slug	R	M to Post-M	LC	AF
Helicidae	*Hellix* sp.	Garden snail	F	M to Post-M	LC	HF, TM
Thiaridae	*Melanoides tuberculata*	Snail	R	M to Post-M	LC	AF
Bivalvia (Molluscs)						
Unionidae	*Lamellidens marginalis*	Jhinuk	VC	Pre-M to M	LC	HF, PC, TM
	Parreysia pernodulosa	Jhinuk	F	Pre-M to M	LC	AT, HF, TM
	Parreysia daccaensis	Jhinuk	R	Pre-M to M	LC	AT, HF, TM
Malacostraca (Arthropods)						
Palaemonidae	*Macrobrachium malcolmsonii*	River prawn	F	Pre-M to M	LC	FB, HF
	Macrobrachium dayanum	Beel chingri	C	Pre-M to M	LC	FB, HF
	Macrobrachium lamarrei	Gura chingri	VC	Pre-M to M	LC	FB, HF
	Macrobrachium dolichodactylus	Chingri	R	Pre-M to M	LC	FB, HF
Cancridae	*Cancer pagurus*	Edible crab	C	Sp to Sm	LC	HF

Availability: C, common; F, few; R, Rare; VC, very common
Peak abundance: M, monsoon; Sm, summer; Sp, Spring
Uses: AF, animal (fish and poultry) feed; AT, aquarium trade; FB, Fish bait; HF, human food; PC, pearl culture; TM, traditional medicine

TABLE 2 Threats to shellfish population in the Chalan Beel, the largest wetland of Bangladesh.

Threats	Remarks
Trade of snails and crabs	In recent years, snails and crabs have been extensively harvested during the post-monsoon period, especially in November and December, by ethnic minorities from distant districts (e.g. Dinajpur) and groups of local people. Currently, no official data is available to quantify the amount of shellfish being harvested from the study area.
Use of illegal fishing gears	Lately, the use of illegal fishing gear has increased significantly in the Chalan Beel. The introduction of a harmful fishing net, locally known as china duari, is capable of capturing a wide range of aquatic biodiversity, including fish, molluscs, arthropods and reptiles (e.g. snakes and turtles). Almost every fisherman in the Chalan Beel is currently using this net.
'Katha' fishing	This traditional, non-selective fishing method involves creating temporary habitats for fish and other aquatic species using aquatic plants (e.g. water hyacinth), tree branches or bamboo poles. When people drain the water using shallow pumps to harvest fish (i.e. the target species), a large number of shellfish species are also inadvertently caught or killed.
Construction of irrigation canals	Over the past decade, several canals have been constructed across different parts of the Chalan Beel to facilitate floodwater drainage and support irrigation. This development has had significant negative impacts on aquatic life, including shellfish species. We recorded mass mortality of fish and shellfish in areas where water was drained within a few days, leaving aquatic organisms stranded in dry zones, where they subsequently died, were preyed upon or were harvested by humans.
Changes in land-use	Wetland areas have been converted into aquaculture ponds, which has negatively impacted aquatic life. In addition, the intensification of agriculture, expansion of human settlements and construction of roads and bridges also pose serious threats to aquatic life of the Chalan Beel including its shellfish populations.
Duck farming in the wetland	Over the past decade, duck farming in the wetland has become very popular. We recorded more than 100 such farms, each with over 200 ducks, in the Singra and Tarash areas of the Chalan Beel. These ducks rely entirely on natural food sources in the wetland, primarily shellfish. Apart from direct predation, duck faecal matter may negatively affect the shellfish population.

4 | DISCUSSION

This study reveals shellfish diversity of the largest wetland of Bangladesh along with their availability, conservation status, utilisation and threats. The findings of this study may be helpful in formulating appropriate policies for sustainable management of the wetland.

4.1 Shellfish diversity, availability and conservation status

Shellfishes are important to the aquatic ecosystem, primarily due to their roles as scavengers, cleaners and nutrient suppliers (Gutiérrez *et al.* 2003; Patel and Kurhe 2023). The recorded number of shellfish species in the Chalan Beel was higher than that of a major coastal river in the country (i.e. the Passur River), indicating that the Chalan Beel still supports rich aquatic biodiversity, including shellfishes. In a study by Jahan and Kobra (2023), only five species of shellfish were recorded in the Chalan Beel. However, it was not possible to comment on the differences in findings between studies due to the lack of methodological details provided by Jahan and Kobra (2023).

Although all the recorded species were classified as Least Concern, it is important to note that this status reflects IUCN global assessments (IUCN 2025) and may not represent their local or national conservation status. Therefore, the shellfish population in the study area should be continuously monitored to determine national population trends and conservation status, as has been done for fish species (IUCN Bangladesh 2015). Shellfish were abundant during the monsoon (= rainy season) and post-monsoon periods, which coincide with the time when most shellfish are most active in the wetland ecosystem—particularly molluscs such as *Pila globosa* (Shampa *et al.* 2025).

4.2 Utilisation of shellfishes

In the study wetland, shellfish are harvested primarily for human consumption or as animal feed. Members of the family Palaemonidae, locally known as chingri (shrimps), are highly popular among people as food, both in fresh and dried forms, and have strong market demand (Nahiduzzaman *et al.* 2020). Snails, mussels and crabs are consumed by humans (Rahman *et al.* 2018; Koodathil *et al.* 2025) and also used as feed for ducks, mud crabs and shrimps in aquaculture ponds (Rahman *et al.* 2020; Gabito and Baltar 2023). In Bangladesh, snails, mussels and crabs are not widely popular and are primarily consumed by communities outside the mainstream population (Rahman *et al.* 2020). While marine shellfish are considered delicacies and expensive food items—rich in essential nutrients such as amino acids, digestible proteins, bioactive peptides, long-chain polyunsaturated fatty acids, astaxanthin and other carotenoids, vitamin B_{12} and other

vitamins and minerals (e.g. zinc, copper, inorganic phosphate, potassium, selenium, sodium and iodine) (Venugopal and Gopakumar 2017)—freshwater shellfish have largely remained overlooked in most cases.

4.3 Threats to shellfishes

This study revealed that shellfish populations are vulnerable to several threats in the study wetland. Globally, freshwater ecosystems—including wetlands—are considered among the most threatened (Dudgeon *et al.* 2006; Reid *et al.* 2019; Sayer *et al.* 2025). The trade of snails and crabs for human and animal consumption is a common practice both in Bangladesh and abroad (Nahid *et al.* 2014; Rahman *et al.* 2018; Koodathil *et al.* 2025). However, indiscriminate harvesting of shellfish from wetlands may lead to several consequences, including disruption of ecological balance, changes in soil fertility and alterations in water chemistry (Yang *et al.* 2020). Currently, the impacts of shellfish harvesting on the Chalan Beel ecosystem remain unclear due to a lack of comprehensive studies.

The use of illegal fishing gear is a common problem in Bangladeshi water bodies (Akter *et al.* 2023; Alam *et al.* 2025). Since most illegal fishing gear and methods are non-selective in nature (Hossain *et al.* 2025), shellfish are also trapped and caught in these nets. Unfortunately, most fishing regulations in Bangladesh have been formulated for fish species, not for shellfish. This resembles the need for an effective policy for shellfishes as well.

Katha fishing is a widely practiced fishing activity in small rivers and wetlands of Bangladesh and is considered a threat to aquatic biodiversity (Hossain *et al.* 2025). Although finfish and shrimp are the primary targets in this fishery, molluscs and other arthropods are also trapped, harvested or killed during the process. Unfortunately, this issue has received little or insufficient attention in the country.

Among the threats to freshwater fauna, overexploitation is often the most significant factor and it intensifies the impacts of other key threats such as flow regulation, water pollution, biological invasions and land-use change (Allan *et al.* 2005; Dudgeon 2019). The habitat of the Chalan Beel has long been affected by these factors (Hossain *et al.* 2009; Galib *et al.* 2018; Kashmi *et al.* 2025). Moreover, the overall size of the Chalan Beel has drastically declined over the past decades—from 2635 km² in 1967 to 769 km² in 2010 (Islam and Kitazawa 2013). Therefore, it is expected that the cumulative impacts of the aforementioned factors will become increasingly severe in the future.

Agriculture is a priority sector in Bangladesh and is consistently given precedence over aquatic biodiversity conservation (Jones *et al.* 2021). The construction of irrigation canals to drain floodwater from wetlands, as revealed in our study, may negatively impact wetland fisheries. These canals can rapidly remove water from wetlands—often within a few days—leaving insufficient time for fish and other aquatic organisms to complete critical life cycle stages. Floodplain wetlands such as the Chalan Beel are vital habitats for the recruitment of fish and other aquatic species; therefore, such interventions can severely affect the wetland's aquatic biodiversity.

Changes in land-use patterns within aquatic ecosystems also pose significant threats to aquatic biodiversity, including shellfish (Kashmi *et al.* 2025). Parts of the Chalan Beel have been transformed into permanent agricultural fields, aquaculture ponds and human settlements (Parvez and Mohsin 2022; Kashmi *et al.* 2025). As a result, the wetland's aquatic biodiversity—including shellfish—is vulnerable to multiple threats associated with land-use changes.

Duck farming activities in the Chalan Beel may be beneficial for farmers, but they pose threats to the shellfish populations in the wetland. Ducks feed directly on shellfish. Moreover, duck faecal matter is deposited directly into the wetland water, potentially altering water quality parameters. Since snails and mussels are considered sentinel organisms, they are highly sensitive to even minor environmental changes (Baroudi *et al.* 2020). Therefore, duck farming may negatively impact shellfish populations in the wetland.

5 | CONCLUSIONS

This study documented the availability of shellfish species in the largest wetland of Bangladesh, the Chalan Beel, and highlighted their utilisation and the threats to their populations. These findings can serve as baseline data for future research and conservation efforts. To ensure a sustainable supply of shellfish for human consumption and animal feed, we recommend focusing on shellfish aquaculture rather than harvesting from the wild, which could also support sustainable resource management (Senovilla-Herrero *et al.* 2024). This approach may be particularly beneficial for mollusc populations (Stewart-Sinclair *et al.* 2020). We also advocate for the formulation of conservation regulations for shellfish, keeping in mind that fish-dependent stakeholders in Bangladesh tend to place less emphasis on conservation (Galib *et al.* 2023). Additionally, further studies are needed to assess the impacts of duck farming on the wetland ecosystem.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

AUTHORS' CONTRIBUTION

G Singha: fieldwork, data analysis and draft manuscript writing; MN Islam: conceptualisation and supervision; SM Galib: conceptualisation, supervision, critical review of the manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on a reasonable request from the corresponding author.

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