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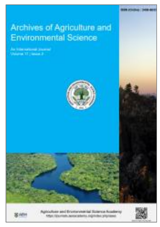

Original Research Article

Ecological assessment of Oxbow Lakes: Interplay of water quality, plankton communities, and commercial fish populations in south-western Bangladesh

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ABSTRACT

Oxbow lakes (*baors*) are semi-closed freshwater ecosystems that contribute substantially to inland fisheries and livelihoods in southwestern Bangladesh, yet their ecological productivity remains insufficiently explored. This study aimed to assess the physicochemical conditions, plankton diversity and abundance, and fish community structure of three *baors—Bukbhora*, *Jhapa*, and *Khedapara*—from July 2023 to June 2024. Monthly water quality monitoring, plankton sampling, identification, and fish community surveys were conducted to evaluate seasonal ecological patterns and production potential. Water temperature ranged from 21–33 °C, pH from 7.5–8.1, dissolved oxygen from 5.5–6.5 mg L^{-1}, alkalinity from 165–169 mg L^{-1}, and hardness from 169–179 mg L^{-1}, indicating generally favorable conditions for aquatic productivity and fish growth. Nitrite-nitrogen remained below the detection limit (<0.01 mg L^{-1}) throughout the study. Plankton analysis identified 56 genera, comprising 43 phytoplankton and 13 zooplankton taxa. Phytoplankton were dominated by Chlorophyceae, whereas copepods predominated among zooplankton. Plankton abundance showed strong seasonal variation, peaking in March, with phytoplankton consistently more abundant than zooplankton. A total of 35 commercially important fish species representing seven orders were recorded; Cypriniformes was the dominant order. Carnivorous fishes comprised 44% of the community, followed by omnivores (32%), herbivores (16%), and detritivores (8%). Overall, the *baors* exhibited favorable water quality and substantial plankton productivity that supported a diverse fish assemblage. The combined assessment of water quality, plankton dynamics, and trophic structure provides an integrated ecological baseline for prioritizing habitat restoration, seasonal fish sanctuaries, and ecosystem-based fisheries management to enhance sustainable production while conserving biodiversity.

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INTRODUCTION

Fish is a vital natural resource in Bangladesh, making substantial contributions to food security, employment, rural livelihoods, and the national economy. According to the Department of Fisheries (DoF), the fisheries sector contributed approximately 2.53% to the national gross domestic product (GDP) and 22.26% to agricultural GDP in the fiscal year 2023–24. The sector also supplies nearly 60% of the country's animal protein and provides direct or indirect livelihoods for approximately 12% of the population (Karim *et al.*, 2020; DoF, 2024). Beyond its economic importance, fisheries play a critical role in poverty reduction, food security, and livelihood sustainability, particularly across developing countries in Asia (Bremer *et al.*, 2016; ILO, 2021; Siddique *et al.*, 2022a, 2022b; Zhang *et al.*, 2022; Mahalder *et al.*, 2023; Elahi *et al.*, 2024; Talukdar *et al.*, 2025). Bangladesh possesses approximately 3.86 million ha of inland fisheries resources, encompassing rivers, floodplains, *beels*, *haors*, and other wetlands, as well as semi-closed water bodies such as oxbow lakes (*baors*). These diverse aquatic habitats provide considerable opportunities for increasing fish production through ecologically appropriate management and culture-based fisheries enhancement (Alam *et al.*, 2022).

Oxbow lakes, locally known as *baors*, are semi-closed freshwater ecosystems formed from abandoned river channels, particularly within the moribund Ganges delta of southwestern Bangladesh. More than 500 *baors* are distributed across the country, covering approximately 5,671 ha, although only a limited number are currently managed under formal culture-based practices by the DoF, fishers' cooperatives, and non-governmental organizations (DoF, 2024). These wetlands provide important habitats for fish and other aquatic organisms and support the livelihoods of surrounding communities. However, their ecological characteristics can vary considerably among locations because of differences in rainfall, water depth, hydrological connectivity, surrounding land use, and nutrient inputs from adjacent agricultural areas. Runoff from intensively cultivated croplands may introduce fertilizers, pesticides, and other contaminants into *baors*, potentially altering water quality, primary productivity, plankton communities, and fish assemblages. Understanding these ecological interactions is therefore essential for developing management strategies that enhance fish production without compromising ecosystem integrity (Islam *et al.*, 2021).

Primary productivity is a fundamental component of aquatic ecosystem functioning and is largely driven by phytoplankton. As the principal primary producers, phytoplankton convert inorganic nutrients and light energy into organic matter and oxygen, forming the base of aquatic food webs and supporting higher trophic levels (Reynolds, 2012). Their abundance, composition, and seasonal dynamics can provide valuable information about nutrient availability, environmental conditions, and the trophic status of aquatic ecosystems (Kruk *et al.*, 2010; Visser *et al.*, 2016; Nunes *et al.*, 2018; Khan *et al.*, 2025). Changes in phytoplankton communities may consequently influence zooplankton production and the availability of food resources for planktivorous and omnivorous fishes. Thus, simultaneous assessment of phytoplankton, zooplankton, physicochemical conditions, and fish communities can provide a more comprehensive understanding of ecosystem productivity than evaluating individual environmental variables in isolation.

Fish species richness is another useful component for evaluating the ecological condition and biological value of wetland ecosystems. A diverse fish assemblage may indicate the availability of heterogeneous habitats and food resources, although species richness alone does not necessarily provide a complete measure of ecosystem health. In *baors*, fish diversity and production are influenced by environmental conditions, habitat characteristics, fishing pressure, stocking practices, and food-web dynamics. Despite their importance as fish-producing wetlands, the ecological mechanisms linking water quality, plankton productivity, and fish community structure in Bangladeshi *baors* remain insufficiently documented. Previous studies have largely focused on individual aspects of *baor* ecology, fisheries production, or fish diversity (Raju *et al.*, 2018; Rimi, *et al.*, 2022), leaving a significant gap in integrated assessments that simultaneously examine physicochemical conditions, plankton communities, seasonal productivity, and fish trophic structure.

This knowledge gap is particularly important because the production potential of *baors* may depend not only on stocking or fishing management but also on the ecological capacity of these systems to sustain natural food-web productivity. The DoF reported approximately 11,685 metric tons of fish production from *baors* in Bangladesh in 2024 (DoF, 2024), while earlier FAO/UNDP assessments indicated that production could potentially be increased through improved management and stocking practices. Nevertheless, achieving higher yields without understanding ecosystem-level constraints may increase pressure on water quality, biodiversity, and trophic stability. Therefore, establishing an ecological baseline is essential for identifying opportunities for sustainable fisheries enhancement. The novelty of the present study lies in its integrated evaluation of water quality, plankton diversity and seasonal dynamics, primary productivity, and fish community composition and trophic structure across three representative *baors* of southwestern Bangladesh. Rather than assessing fish production independently, the study links environmental conditions and lower trophic-level productivity with fish community characteristics to identify potential ecological drivers of fisheries production. Such an integrated approach can provide a scientific basis for ecosystem-based management, habitat restoration, and culture-based fisheries enhancement while maintaining biodiversity.

Accordingly, this study aimed to assess the physicochemical characteristics, primary productivity, plankton diversity and abundance, and fish community structure of three selected *baors*—*Bukbhora*, *Jhapa*, and *Khedapara*—over an annual cycle. The study further sought to characterize seasonal ecological variation and examine the relationships among environmental conditions, plankton productivity, and fish assemblages. The findings are expected to provide a baseline for developing scientifically informed management strategies to enhance fish production and conserve the ecological integrity of *baor* ecosystems in Bangladesh.

MATERIALS AND METHODS

Study area and study period

The study was conducted over a 12-month period from July 2023 to June 2024 in three oxbow lakes (*baors*), namely *Bukbhara*, *Jhapa*, and *Khedapara*, located in Jashore Sadar and Monirampur upazila of Jashore District, southwestern Bangladesh. The selected *baors* represent important freshwater ecosystems supporting fisheries production and local livelihoods. Monthly sampling was conducted throughout the study period to capture seasonal variations in environmental conditions, plankton communities, and fish assemblages.

Water quality assessment

Water quality parameters were monitored monthly at each selected *baor*. Water temperature (°C), transparency (cm), dissolved oxygen (mg L^{-1}), pH, alkalinity (mg L^{-1} as $CaCO_3$), hardness (mg L^{-1} as $CaCO_3$), and carbon dioxide (mg L^{-1}) were measured following standard limnological procedures. Water temperature was measured in situ using a Celsius thermometer. Water transparency was determined using a 20-cm-diameter Secchi disc following the conventional Secchi-disk method. The pH was measured directly at the sampling site using a digital pH meter (Jenway, Model 3020 CORNING 445). Dissolved oxygen was measured in situ using a digital DO meter (YSI, Model 58). Carbon dioxide concentration was determined using a HACH FF2 water-analysis kit following the manufacturer's procedure, using sodium hydroxide as the titrant. Alkalinity was determined using the same HACH kit by titration with sulfuric acid using phenolphthalein and bromocresol methyl red indicators. Total hardness was determined using the HACH FF2 kit using ManVer 2 reagent and EDTA titration. These measurements followed established procedures for freshwater quality assessment (APHA, 2017).

Plankton sampling

Plankton samples were collected monthly from three sampling stations representing different environmental and anthropogenic conditions within the selected *baors*. All stations were sampled consecutively on the same day during each monthly visit to minimize temporal variation among sampling locations. At each station, five surface-water replicates were collected at approximately 1–2 m intervals to account for small-scale spatial heterogeneity. Approximately 10 L of water was collected for each replicate from 10–12 cm below the water surface. The collected water was filtered through a 25-μm-mesh plankton net. Overall, 10 L $\times$ 5 replicates at each station approximately 50 L of water were filtered at each station during each sampling event. A mechanical flow meter (HYDRO-BIOS, Model 438110) was used to monitor water flow during filtration (Khan *et al.*, 2025). The plankton concentrate obtained after filtration was reduced to approximately 25 mL and transferred into clean, labelled sample bottles. Samples were immediately preserved in 10% ethanol and transported to the laboratory for subsequent identification and enumeration. The sampling and preservation procedures followed established approaches for quantitative plankton assessment (APHA, 2017; Santhanam *et al.*, 2019).

Plankton identification and abundance estimation

Preserved plankton samples were examined under a biological microscope (AmScope B100 Binocular Biological Microscope) at 40$\times$ and 100$\times$ magnification. Phytoplankton were identified to the genus level using the taxonomic characteristics described by Santhanam *et al.* (2019), while zooplankton were identified following the procedures and taxonomic descriptions of Bhuyan *et al.* (2020). Plankton abundance was determined using a Sedgewick–Rafter counting cell (Model SKU: M7.32). A well-mixed subsample was transferred to the counting chamber, allowed to settle, and examined microscopically. Plankton were counted following standard Sedgewick–Rafter enumeration procedures (APHA, 2017; Menden-Deuer *et al.*, 2020). Abundance was expressed as cells L^{-1}. Colonial and filamentous forms were counted as single units according to the adopted counting protocol.

Fish sampling and identification

Fish specimens were collected monthly from the three selected *baors* through multiple fishermen catches obtained from different locations within each waterbody. This approach was used to obtain representative coverage of the fish assemblages and reduce potential sampling bias associated with a single fishing location or gear. Representative specimens were photographed using a digital camera for subsequent documentation and identification. Fish species were identified based on their external morphological, morphometric, and meristic characteristics following Fricke *et al.* (2022) and the taxonomic information available in FishBase (Froese & Pauly, 2024). Valid scientific names and taxonomic classifications were cross-checked against Eschmeyer's Catalog of Fishes (Fricke *et al.*, 2022). The conservation status of each species was determined using the IUCN Red List of Threatened Species (IUCN, 2022), while national conservation status was assessed according to the IUCN Bangladesh Red List (IUCN Bangladesh, 2015). The recorded fish species were classified according to taxonomic order. Based on their principal feeding habits, species were further categorized into carnivorous, herbivorous, omnivorous, and detritivorous groups using published dietary information and FishBase (Froese & Pauly, 2024).

Data analysis

All physicochemical, plankton, and fish-community data were systematically organized and tabulated using Microsoft Excel (Microsoft Office 2019). Descriptive statistics were used to summarize monthly and site-wise variations in water quality parameters and plankton abundance. Plankton taxa were summarized according to major taxonomic groups, while fish species were summarized by taxonomic order, feeding behavior, and conservation status. Seasonal patterns in environmental conditions and plankton abundance were examined to characterize temporal variation among the studied *baors*.

RESULTS AND DISCUSSION

Physicochemical characteristics of water

The physicochemical characteristics of water in all three study sites—*Bukbhora*, *Jhapa*, and *Khedapara baors* of Jashore Sadar and Monirampur upazilas-were generally within the acceptable standards for Bangladesh (Figures 1, 2, and 3). Water quality in all three *baors* remained within ranges suitable for freshwater fish production. The relatively stable pH, moderate dissolved oxygen, and high alkalinity indicate good buffering capacity and adequate oxygen conditions. Seasonal variation in temperature and transparency was likely related to monsoon-driven dilution, increased suspended sediment, and subsequent stabilization after the monsoon. Similar relationships between water clarity, nutrient dynamics, and plankton communities have been reported in shallow oxbow and tropical lakes (Yaqoob *et al.*, 2021; Kondowe *et al.*, 2022). Fluctuations in dissolved oxygen observed in the present study may be attributed to seasonal variations in photosynthetic activity and respiratory demand of aquatic organisms (Bulbul, 2022). Similar favorable physicochemical conditions have been reported from Hail Haor (Hasan *et al.*, 2023), supporting the suitability of oxbow lakes for fisheries production. Overall, the studied *baors* showed more stable water conditions than these systems, possibly due to their semi-closed nature and moderate uptake of nutrients by aquatic organisms.

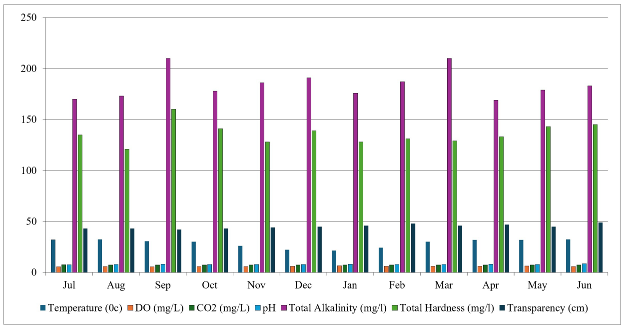

Figure 1. *Physicochemical parameters of Bukbhora baor.*

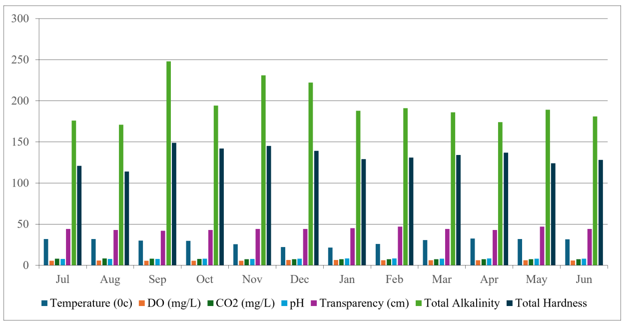

Figure 2. *Physicochemical parameters of Jhapa baor.*

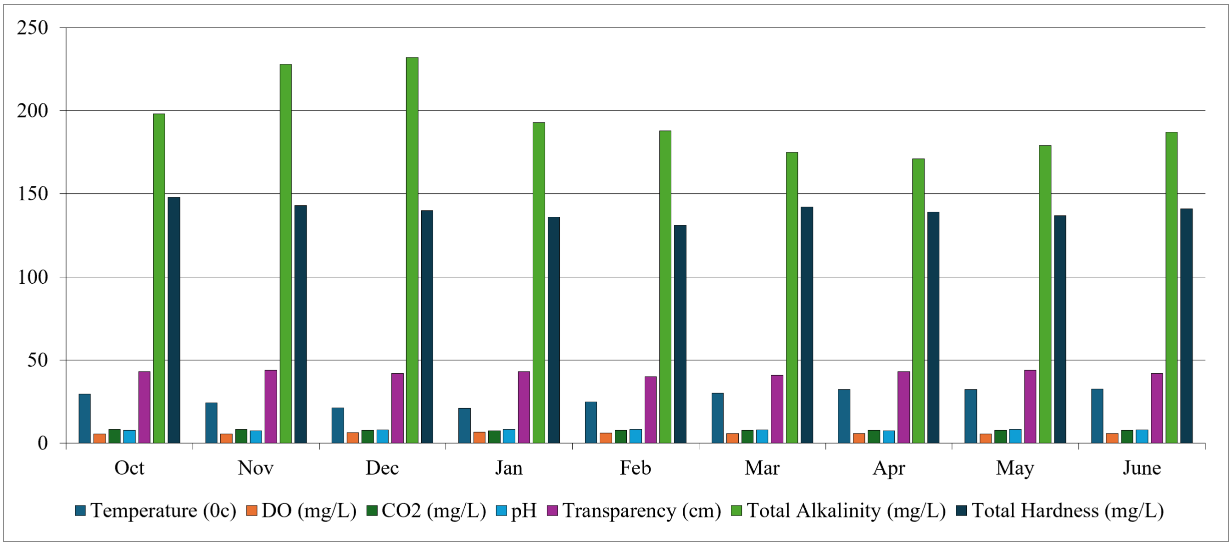

Figure 3. *Physicochemical parameters of Khedapara baor.*

Assessment of plankton community dynamics

Plankton composition

A total of 56 plankton genera were recorded from the three *baors*, comprising 43 phytoplankton genera and 13 zooplankton genera (Table 1). The phytoplankton community comprised seven taxonomic groups, with Chlorophyceae being the most diverse, represented by 14 genera, followed by Bacillariophyceae (9), Cyanophyceae (8), Zygnematophyceae (7), Euglenophyceae (3), Trebouxiophyceae (1), and Dinophyceae (1). The zooplankton community comprised 13 genera belonging to three major taxonomic groups: Rotifera, Cladocera, and Copepoda. Copepoda was the most diverse group, with five genera, followed by Rotifera and Cladocera, with four genera each. Overall, phytoplankton accounted for a greater proportion of the recorded plankton diversity, with 43 genera compared with 13 genera of zooplankton.

Table 1. Taxonomic composition of phytoplankton and zooplankton recorded from the studied *baors*.

Plankton group	Taxonomic class/group	Genera recorded	Number of genera
Phytoplankton	Bacillariophyceae	*Diatoma, Navicula, Nitzschia, Chaetoceros, Cyclotella, Gyrosigma, Synedra, Bacillaria, Fragilaria*	9
	Chlorophyceae	*Eudorina, Pleodorina, Oedogonium, Ankistrodesmus, Oocystis, Chlamydomonas, Coelastrum, Ulothrix, Volvox, Pediastrum, Microspora, Scenedesmus, Crucigenia, Actinastrum*	14
	Cyanophyceae	*Oscillatoria, Gomphosphaeria, Anabaena, Microcystis, Anacystis, Polycystis, Spirulina, Merismopedia*	8
	Zygnematophyceae	*Spirogyra, Zygnema, Staurastrum, Closterium, Euastrum, Desmidium, Mougeotia*	7
	Euglenophyceae	*Euglena, Phacus, Trachelomonas*	3
	Trebouxiophyceae	*Chlorella*	1
	Dinophyceae	*Ceratium*	1
Total phytoplankton			43
Zooplankton	Rotifera	*Brachionus, Keratella, Filinia, Asplanchna*	4
	Cladocera	*Moina, Daphnia, Bosmina, Diaphanosoma*	4
	Copepoda	*Cyclops, Mesocyclops, Macrocyclops, Diaptomus, Pseudodiaptomus*	5
Total zooplankton			13

Plankton abundance in Baors

Plankton abundance was highest in March, suggesting a pre-monsoon increase in productivity (Figure 4). This increase may have been supported by greater light availability, limited dilution, and the accumulation of nutrients during the dry period. Phytoplankton were more abundant than zooplankton throughout the study, indicating sustained primary production. The dominance of Chlorophyceae suggests relatively productive and nutrient-rich conditions. Similar patterns have been reported in oxbow and tropical lakes (Yaqoob *et al.*, 2021; Kondowe *et al.*, 2022; Krasznai *et al.*, 2024). Khan *et al.* (2025) also reported a dominance of Chlorophyceae in Kaptai Lake, although the seasonal peak differed from that observed in the present study. This difference may be related to the contrasting hydrological characteristics of large reservoirs and small, semi-closed *baors*, particularly in terms of water exchange, flushing, and nutrient retention. Copepoda were the dominant zooplankton group, followed by Rotifera and Cladocera, indicating an active link between primary producers and higher trophic levels. The increase in copepod abundance during March may have been associated with greater phytoplankton availability under relatively stable pre-monsoon conditions. A similar dominance of copepods was reported by Kondowe *et al.* (2022) in Lake Kanyaboli, whereas Khan *et al.* (2025) found Rotifera to be dominant in Kaptai Lake. Differences among these systems may be explained by variation in water residence time, fish predation, aquatic vegetation, and nutrient availability.

Fish biodiversity

A total of 35 commercially important fish species belonging to seven orders were recorded, indicating that the studied *baors* support considerable fish diversity. This richness was lower than the 43 species reported from Jhapa *Baor* by Rimi *et al.* (2022). The difference may be related to variation in sampling duration, fishing gear, hydrological connectivity, and fishing pressure among the study sites. Akhi *et al.* (2020) reported that fish assemblages in the Karatoya River were influenced by environmental factors such as alkalinity, dissolved oxygen, and conductivity. The present study similarly suggests that favorable water quality and adequate plankton availability may contribute to maintaining diverse fish communities, including cyprinids, catfishes, snakeheads, perches, and spiny eels in the studied *baors*.

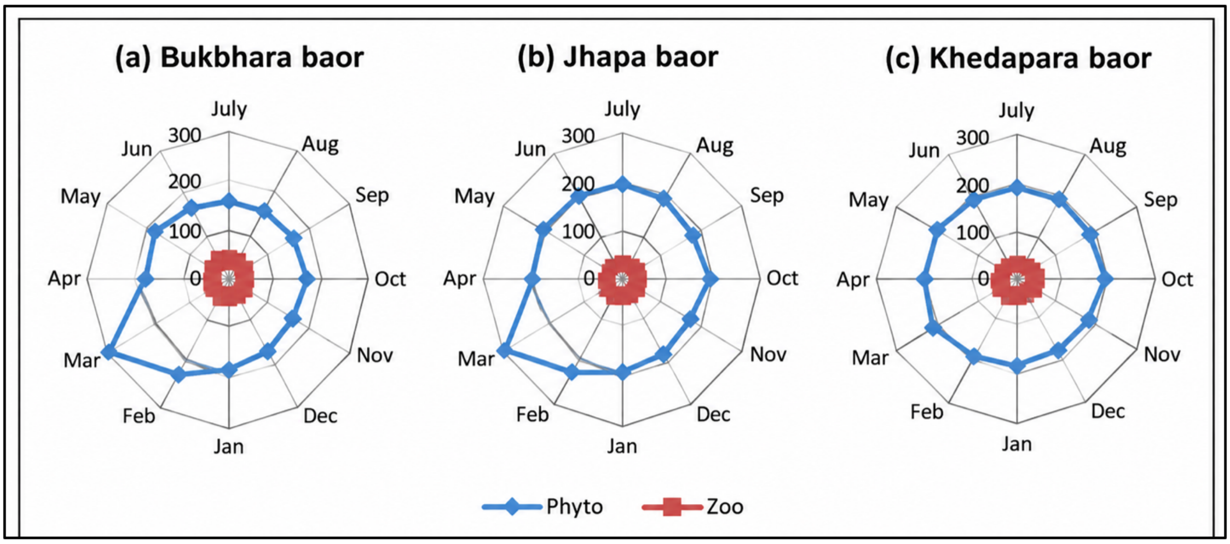

Figure 4. *Plankton abundance ($\times 10^2$) in baors.*

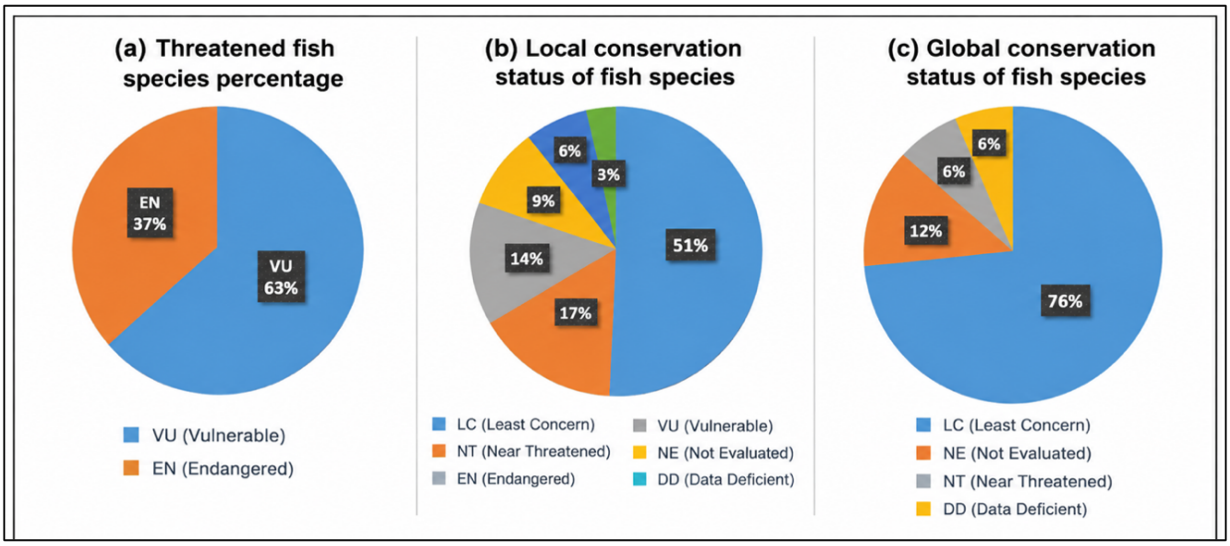

Figure 5. *Threatened fish species and conservation status of fish species.*

Conservation status

Sixty-four of Bangladesh's native freshwater fish species have been classified as threatened, according to IUCN Red List Assessment 2015 Bangladesh. In the *baors*, eight fish species with a potential for commercial sale have been identified as threatened. Five species (63%) were found to be vulnerable (VU), three (37%) to be endangered (EN), and no one is critically endangered (CR) (Figure 5). The local conservation status of fish species was least concern (51%), followed by near threatened (17%), vulnerable (14%), endangered (9%), not evaluated (6%), and data deficient category (3%) (Figure 5). Most of the recorded fish species were classified as Least Concern, but the presence of Vulnerable and Endangered species highlights the conservation value of the studied *baors*. Similar findings have been reported from Jhapa *Baor* (Rimi *et al.*, 2022) and other wetlands of Bangladesh (Parvez *et al.*, 2019). In contrast, Hoque *et al.* (2021) reported a higher proportion of threatened species in Hakaluki *Haor*, whereas Hoque *et al.* (2022) found that Least Concern species predominated in Vailadhora *Beel*, indicating spatial variability in conservation status across wetland systems.

Order-wise fish composition

Cypriniformes was the most diverse order, followed by Perciformes and Siluriformes (Table 2). This composition may reflect the availability of plankton, littoral and benthic habitats, as well as the influence of carp stocking in the *baors*. Similar patterns have been reported in freshwater ecosystems of Bangladesh, where environmental conditions and habitat diversity influence fish assemblages (Akhi *et al.*, 2020; Rimi *et al.*, 2022; Nahiduzzaman *et al.*, 2023). The lower species richness compared with Jhapa *baor* may be associated with differences in fishing pressure, hydrological connectivity, and habitat complexity among the studied systems.

Table 2. Systematic list of fish species collected from *baors* with taxonomic authority and conservation status.

Order	Scientific Name	Local Name	Common/Group Name	IUCN Conservation Status (BD)	IUCN Conservation Status (GB)
Cypriniformes	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Silver carp	Carps	NT	NT
	Hypophthalmichthys nobilis (Richardson, 1845)	Bighead carp	Carps	DD	DD
	Catla catla (Hamilton, 1822)	Catla	Carps	LC	LC
	Labeo rohita (Hamilton, 1822)	Rui	Carps	LC	LC
	Cirrhinus mrigala (Hamilton, 1822)	Mrigal	Carps	NT	LC
	Labeo calbasu (Hamilton, 1822)	Kalibaush	Carps	LC	LC
	Cyprinus carpio Linnaeus, 1758	Common carp	Carps	VU	VU
	Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	Carps	NE	NE
	Mylopharyngodon piceus (Richardson, 1846)	Black carp	Carps	LC	LC
	Amblypharyngodon mola (Hamilton, 1822)	Mola	Minnow	LC	LC
	Osteobrama cotio (Hamilton, 1822)	Dhela	Minnow	LC	LC
	Chela cachius (Hamilton, 1822)	Chela	Minnow	VU	LC
	Puntius sophore (Hamilton, 1822)	Punti	Barb	VU	LC
Siluriformes	*Mystus vittatus* (Bloch, 1794)	Tengra	Catfish	LC	LC
	Mystus tengra (Hamilton, 1822)	Gulsha tengra	Catfish	LC	LC
	Ompok pabda (Hamilton, 1822)	Pabda	Catfish	EN	NT
	Sperata aor (Hamilton, 1822)	Ayre	Catfish	VU	LC
	Clarias batrachus (Linnaeus, 1758)	Magur	Catfish	LC	LC
	Heteropneustes fossilis (Bloch, 1794)	Shing	Catfish	LC	LC
Perciformes	*Chanda ranga* (Hamilton, 1822)	Ranga chanda	Perches	LC	LC
	Chanda nama (Hamilton, 1822)	Nama chanda	Perches	LC	LC
	Anabas testudineus (Bloch, 1792)	Koi	Climbing perch	LC	DD
	Trichogaster fasciata Bloch & Schneider, 1801	Kholisha	Perches	LC	LC
	Channa striata (Bloch, 1793)	Shol	Snakehead	NT	LC
	Channa marulius (Hamilton, 1822)	Gozar	Snakehead	EN	LC
	Channa punctata (Bloch, 1793)	Taki	Snakehead	LC	NE
	Nandus nandus (Hamilton, 1822)	Meni	Perches	NE	NE
	Glossogobius giuris (Hamilton, 1822)	Bele	Perches	LC	LC
Synbranchiformes	*Mastacembelus armatus* (Lacepède, 1800)	Baim	Spiny eel	EN	NE
	Macrognathus aculeatus (Bloch, 1786)	Tara baim	Spiny eel	NT	LC
	Macrognathus pancalus Hamilton, 1822	Guchi baim	Spiny eel	LC	LC
Osteoglossiformes	*Notopterus notopterus* (Pallas, 1769)	Foli	Featherback	VU	LC
Clupeiformes	*Gudusia chapra* (Hamilton, 1822)	Chapila	River shad	NT	LC
Beloniformies	*Xenentodon cancila* (Hamilton, 1822)	Kakila	Garfish	LC	LC
	Hyporhamphus limbatus (Valenciennes, 1847)	Ek thuita	Halfbeak	NT	LC

NE, not evaluated; DD, data deficient; LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered; CR, critically endangered; R, river; R-E, river–estuary; E-R, estuary–river; R-B, river–brackish; BD, Bangladesh; GB, global.

Feeding behavior

Carnivorous species represented the largest feeding group, followed by omnivores, herbivores, and detritivores (Table 3). This distribution indicates that the fish communities use a range of food resources, including plankton, small fishes, benthic organisms, and detrital material. The relatively high proportion of carnivores may be associated with the availability of prey organisms, while the presence of many omnivorous species suggests flexible feeding strategies. These findings are consistent with previous studies showing links between plankton availability, habitat conditions, and fish-community structure (Akhi *et al.*, 2020; Kondowe *et al.*, 2022; Khan *et al.*, 2025). Maintaining these communities will require continued water-quality monitoring, protection of littoral habitats, and appropriate management of fishing activities, particularly during fish recruitment periods.

Table 3. Feeding behavior of commercially important fish species

Feeding behavior	Relative composition (%)
Carnivorous	44
Omnivorous	32
Herbivorous	16
Detritivorous	8
Total	100

Conclusion

This study concluded that all the three studied *baors* showed generally suitable water conditions for fish and other aquatic organisms. A total of 56 plankton genera were identified, including 43 phytoplankton and 13 zooplankton genera. Phytoplankton were more abundant than zooplankton throughout the study and showed clear seasonal changes, with the highest abundance recorded in March. The presence of 35 fish species belonging to seven orders also indicates the importance of these *baors* as fish habitats. Taken together, the results show that the studied *baors* have good natural conditions and sufficient biological resources to support diverse fish communities. At the same time, maintaining these conditions is important for sustaining fish production in the long term. Regular monitoring of water quality and plankton, protection of important fish habitats, control of excessive fishing pressure, and establishment of fish sanctuaries should therefore be considered in future management plans.

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DECLARATIONS

Author contribution statement: Conceptualization: M.S.I. and A.T.; Methodology: M.S.I.; Software and validation: M.S.I. and A.T.; Formal analysis and investigation: M.S.I., A.T. and M.R.I; Resources: M.S.I.; Data curation: A.T.; Writing—original draft preparation: A.T.; Writing—review and editing: M.S.I, A.T., M.R.I., A.N and A.B.; Visualization: A.T.; Supervision: A.N.; Project administration: M.S.I., A.T. and M.R.I.; Funding acquisition: A.B. All authors have read and agreed to the published version of the manuscript.

Authors' Contributions: All authors contributed equally to this work.

Conflicts of interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Ethics approval: This study was conducted in view of the institutional ethical guidelines and does not harm the human participants.

Consent for publication: All co-authors gave their consent to publish this paper in AAES.

Data availability: The data that support the findings of this study are available on request from the corresponding author.

Supplementary data: No supplementary data is available for the paper.

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