OPEN ACCESS Journal of Animal Health and Production

Research Article

Risk Assessment and Health Status of Shing (*Heteropneustes fossilis*) and Gulsha (*Mystus cavasius*) in the Southern Region of Bangladesh

Md. Jahid Hossain[1]*, Md. Hamidur Rahman[2], Kanij Fatema Eti[3], Fatema Jahan[1], Bably Akter[1]

[1]Department of Aquaculture, Faculty of Fisheries and Ocean Sciences, Khulna Agricultural University, Khulna-9100, Bangladesh; [2]Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; [3]Department of Marine Bioresource Science, Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University, Chattogram-4225, Bangladesh.

Abstract | This study evaluated the aqua-ecological parameters of the selected habitats to prevent fish damage due to changes in water quality and assess the health status of two economically valuable fish species in the selected habitats. Data was collected every ten days between 10:00 and 12:00 AM during the study period to assess water quality. Data was collected through the questionnaire interview from 25 fish farmers and 10 fish sellers, mainly on the abundance and health status of *Heteropneustes fossilis* and *Mystus cavasius,* two small indigenous catfishes of Bangladesh. The health investigation was conducted through clinical and histopathological observations. Water quality was in good condition in the summer but deteriorated in the winter. Clinically, fish were almost normal in the summer and mildly affected in the rainy season. Histopathological changes of the skin and muscle of the fish included loss of epidermis, hemorrhage, necrosis, and vacuums during the winter season. General gill pathology of both markets included lamellar missing, hypertrophy, vacuums, hemorrhage, and necrosis in the winter season. In the case of the liver of fish, hemorrhage, vacuums, and necrosis are especially found in the winter season. Histopathologically, the organs of the fish were almost normal in the summer season and had mild pathological changes in the rainy season. The current study is a tiny addition to the coastal wetland of Bangladesh in determining the current state of the wetland and the true scenario of wild small indigenous species (SIS) health status.

Keywords | Catfish, Histology, Water quality, Wetland, SIS, Beel

Received | January 28, 2025; **Accepted** | March 13, 2025; **Published** | April 07, 2025
***Correspondence** | Md. Jahid Hossain, Department of Aquaculture, Faculty of Fisheries and Ocean Sciences Khulna Agricultural University, Khulna-9100, Bangladesh; **Email:** paveljahid1993@gmail.com
Citation | Hossain MJ, Rahman MH, Eti KF, Jahan F, Akter B (2025). Risk assessment and health status of shing (*Heteropneustes fossilis*) and gulsha (*Mystus cavasius*) in the southern region of Bangladesh. J. Anim. Health Prod. 13(2): 275-285.
DOI | https://dx.doi.org/10.17582/journal.jahp/2025/13.2.275.285
ISSN (Online) | 2308-2801

INTRODUCTION

The world's largest deltaic nation is Bangladesh (Mahmuda *et al.*, 2020; Rahman *et al.*, 2021; Tandra *et al.*, 2019). Additionally, as noted by (Baroi *et al.*, 2019; Islam *et al.*, 2020; Mahmud *et al.*, 2021) the subsector of fisheries and aquaculture is essential in mitigating the adverse effects of protein shortage. Due to Bangladesh's declining natural fisheries resources and growing human population, aquaculture is becoming an increasingly important technique for producing fish (Mahmud *et al.*, 2021; Nasrin *et al.*, 2021; Rahman *et al.*, 2021; Noor *et al.*, 2024). According to Mou *et al.* (2023) the fisheries sub-sector accounts for 1.24% of the country's total export revenue, 26.50% of its GDP from agriculture and 3.57% of its GDP overall. This massive output generates a significant amount of foreign exchange (Biswas *et al*., 2021; Murshed *et al*., 2023). The utilization of various algae and chemicals has increased in tandem with the growth of aquaculture in Bangladesh (Uddin *et al*., 2020; Rahman *et al*., 2022). Wetlands are priceless natural treasures. They are richly diverse habitats. The wetlands sustain the way of life and livelihood for millions of people worldwide. Wetlands have historically been utilized for a variety of commercial purposes, including forestry, fishing, hunting, agriculture, and recreation. The five main categories of wetlands that are commonly acknowledged are marine, estuarine, lacustrine, riverine, and palustrine, according to (Faruk *et al*., 2016). The Mayur River flows through the Beel Pabla, a riverine wetland in the Khulna region. In Bangladesh, 143 species of 265 freshwater fish are classified as small indigenous species (SIS) (Talwar et al., 1991b). Though 64 of these species are currently threatened, 9 are severely endangered, 30 are endangered, and 25 are vulnerable, all of these species were formerly determined to be present in Beel water bodies (Flowra *et al*., 2013). However, local farmers have recently shown particular interest in SIS with high nutrient content, such as koi, shing, magur, pabda, gulsha, mola, etc.

Catfish species have significant commercial and aquacultural importance in several Asian countries. These fish are considered to be particularly healthful, tasty, and delightful because of their low spine, low fat, and high digestion (Farhana, 2023). The Asian stinging catfish or fossil cat (*Heteropneustes fossilis*) is a notable air-breathing catfish that is commonly referred to as "shing" in the surrounding area of Bangladesh (Farhana, 2023). The species is well-known for its great flavor and market value, and it is also highly commended for its nutritional and medicinal characteristics (Uddin *et al*., 2019). Bangladeshi fish farmers have been drawn to *Mystus cavasius*, often known as Gulsha, due to its high market value, lucrative culture, and delicious flavor (Rahman *et al*., 2021). *M. cavasius*, small freshwater fish, are very nutrient-dense. Omega-3 and omega-6 fatty acids, as well as vitamins and minerals, are abundant in gulsha. It also reduces cholesterol, heart problems, and triglyceride levels. Its low-fat content strengthens our immune system (Paul *et al*., 2019).

In recent years, several native and non-native fish species—particularly Pangas, Tilapia, Shing, Pabda, Gulsha, and Koi—have been effectively introduced into culture systems in Bangladesh (Rahman *et al*., 2021; Nahiduzzaman *et al*., 2023). However, in natural habitats the actual scenario is different. Due to overexploitation, ecological changes, the reduction of water bodies, the use of pesticides in rice cultivation, the release of chemical effluents from industrial plants, and hydrological changes brought on by the construction of flood control infrastructure, the fish has gradually become endangered in recent years (Rahman *et al*., 2014). Moreover, fish population structure is directly and indirectly affected by any significant changes in surface water quality (Svobodova et al., 2017). Delicate food organisms can suffer harm and even die at low pollution concentrations. Thus, while fish are not directly impacted, they do experience some indirect consequences. The decrease in natural food supply or its total absence causes the fish to be in worse health, which a drop may follow in the generation of antibodies (Edward et al., 2010). This may reduce fish illness resistance (Edward et al., 2010; Andrews *et al*., 2010).

On the other hand, illness is one of the factors that affect both wild fisheries and aquaculture. Numerous diseases reduce the market value of fish by harming them, slowing down their growth, deteriorating the quality of their meat, and even killing those (Uddin *et al*., 2019). The primary reasons for the disturbance of the natural ecological habitat of aquatic fauna, which might result in fish disease, are the unregulated use of pesticides, herbicides, and inorganic fertilizers in agriculture as well as industrial discharge and sewage (Mustafa *et al*., 2024). Disease outbreaks in fish, both in captivity and in the wild, are believed to be mainly brought on by ecological imbalances, vulnerable hosts, and the presence of aggressive pathogens (Marma *et al*., 2016). Fish raised and wild alike are susceptible to a range of diseases at different periods of the year (Uddin *et al*., 2019). The illness has become a serious problem for Bangladesh's output of both farmed and wild fish (Rahman et al., 1996). Disease outbreaks are more likely to affect snakeheads and catfish on flood plains and closed water reservoirs (Hossain and Mazid, 1995). The most common symptoms of the sickness include bleeding, necrosis, pyknosis, hypertrophy, gill damage, and other abnormalities (Ahmed *et al*., 2004). The quality of the water that fish live in can have an impact on their growth and production (Dinda *et al*., 2023). Histological changes have been extensively used in many studies to investigate a range of human and animal illnesses and evaluate the effects of chemical pollutants on fish tissue. Furthermore, histology is quite beneficial since it can precisely determine the physiological state of fish at any particular time (Dinda *et al*., 2023). From the above discussion, this research is the first step in determining the catfish's health and monitoring the water quality from where they belong. It will help further research on catfish, SIS, invasive species, and the biodiversity of Beel Pabla.

MATERIALS AND METHODS

Study Area

The study consisted of both field and laboratory investigations. The field study was conducted in Beel Pabla and four different fish markets adjacent to the Beel area (Dhaiga Bazar, Arongghata Bazar, Mostofa'r Bazar, Uttar Beel Pablo Bazar, and all the sampling stations are beside those Bazars) showed in (Figure 1).

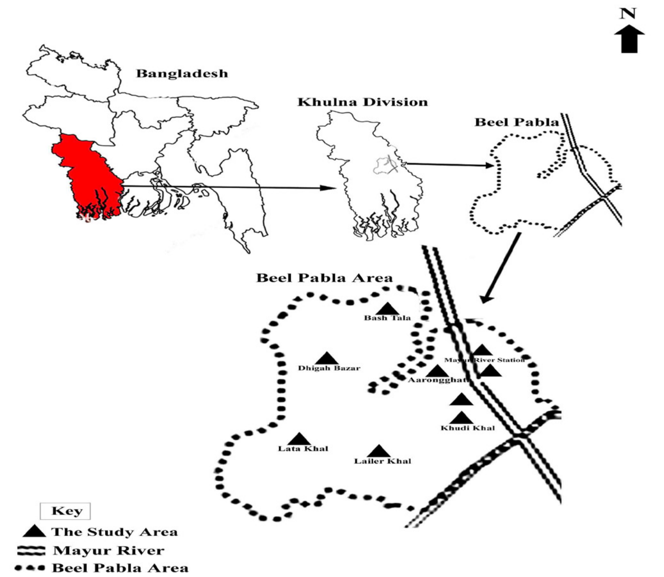

Figure 1: A map of the beel pabla showing the data collection area.

Data Collection Method

Data was collected through the questionnaire interview with 25 fish farmers and 10 fish sellers at a randomly selected system. A set of questionnaires was prepared. The questionnaire focused mainly on the abundance and health status of *H. fossilis* and *M. cavasius*. For the questionnaire interview, a set of questionnaires was developed composed of open-form questions. The data was collected at 60-day intervals.

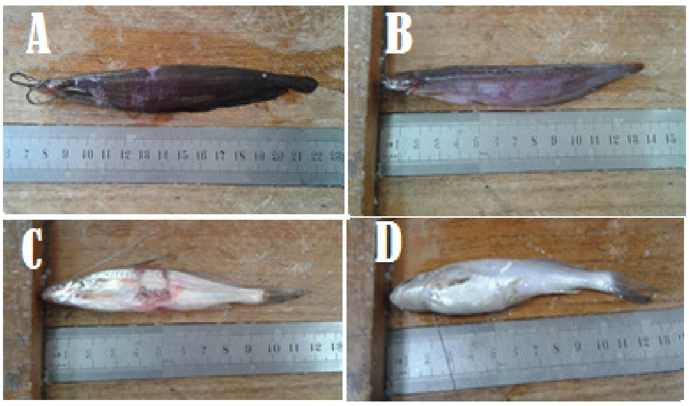

Figure 2: A) *H. fossilis* from Beel Pabla in January had many whitish lesions on an anterior portion of the body and an ulcer near the pectoral fin. **B)** *H. fossilis* in June having whitish patches of the body and loss of mucus. **C)** *M. cavasius* in January had a reddish lesion near the dorsal fin, a severe ulcer, and reddish color near the anus. **D)** *M. cavasius* in June had a swollen abdomen and loss of mucus.

Sample Collection for Health Check

Fish were collected in live conditions. Using the naked eye, the physical symptoms of the fish were examined to identify any wounds, illnesses, or strange body abnormalities (Figure 2). Samples of the gills and liver were removed for histological analysis using forceps and a sharp scalpel. Following fish dissection, a portion of the liver was removed to be examined, and the gills were removed to be examined.

Assessment of Water Quality Parameters

Using a Celsius thermometer, the Backpack Lab Marine Science Educational Test Kit (Model: HI 3899 BP) was utilized to assess salinity, pH, dissolved oxygen, temperature, ammonia, and nitrite levels. These analyses were carried out every ten days between 10:00 AM and 12:00 noon during the study period.

Methods of Histopathological Test

Using a sharp scalpel and forceps, samples of the liver and gills were taken for histological examination. Using a sterile scalpel and forceps, samples were collected and then preserved in 10% buffered formalin. The size of the samples was 1 cm^3. The preserved samples were taken out and trimmed with a scalpel. Trimmed samples were placed separately in perforated plastic holders and covered by perforated steel covers. Labeling was made with a dark pencil (2B) on perforated plastic holders. The samples were then arranged in a steel rack and processed through an automatic tissue processor (SHANDON, CITADEL 1000) for dehydration, clearing, and infiltration. The samples were then embedded with melted wax, a steel mold, and a perforated plastic holder. Proper care was taken for the placement and orientation of stomach and intestine samples in the steel molds during the embedding period. After the embedding period, the paraffin blocks were placed on a table to solidify. The blocks were then placed in a refrigerator for half an hour, and the steel molds were then separated from the paraffin blocks. Trimming was done from the side and surface of the blocks with the help of a scalpel and a microtome machine (Leica JUNG RM 2035), respectively. The blocks were then washed with tap water and distilled water repeatedly. Before the final section, sample blocks were taken and placed in a deep freeze for at least 30 minutes. The blocks were then sectioned at a thickness of 5 micrometers by using the microtome machine. The ribbons with sections were placed in a water bath (electric thermal, mountain bath) at a temperature of 40 °C. Suitable sections were selected and separated from the ribbons, which were finally picked up over glass slides. The sections were then stained with hematoxylin and eosin (H and E) stains, proceeding through various chemicals of different concentrations and time schedules. After staining, the sections were mounted with Canada balsam and covered with coverslips. The prepared sections were kept over a flat surface for 8–10 hours to fix the coverslips permanently and then examined under a compound microscope. Photomicrographs of the stained sections were taken using a photomicroscope (Novex, Holland). The author used magnification from 100x to 125x. However, we chose 120x for a better shot of the specimen.

Table 1: Water quality parameter (WQP) of wet and dry season of beel pabla waterbody.

WQP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Average	16.17e	22.18d	31.59b	36.00a	37.40a	31.90b	29.73b	28.61bc	27.64c	28.03bc	22.53d	17.80e
SD	1.88	1.25	2.07	0.83	1.42	1.36	1.54	0.59	2.37	1.01	2.23	1.98
Ph												
Average	7.83b	7.99a	7.92b	7.99a	7.85b	8.10a	7.95b	8.00a	8.63a	8.40a	7.80b	5.95c
SD	1.46	0.78	0.63	0.22	0.88	0.69	1.13	0.18	0.51	0.65	0.69	0.24
Dissolve Oxygen												
Average	1.59d	1.66c	1.73c	1.95b	2.27a	2.18a	2.40a	2.32a	2.00b	1.97b	1.64c	1.61d
SD	0.48	0.30	0.45	0.06	0.46	0.22	0.29	0.65	0.54	0.35	0.33	0.43
Phosphate												
Average	8.50c	10.67b	10.40b	11.50b	12.63a	10.83b	13.30a	6.00d	5.47d	7.58c	8.97c	8.00c
SD	0.26	1.45	0.85	1.51	0.57	1.10	0.54	0.10	0.59	1.59	0.50	0.90
Ammonia												
Average	0.63c	0.65c	0.75b	0.80b	0.60c	0.92a	0.43e	0.33e	0.40e	0.58c	0.50d	0.53d
SD	0.15	0.13	0.15	0.05	0.04	0.06	0.32	0.15	0.30	0.38	0.40	0.31

The small letters **a-e** indicated a significant difference among different months.

Data Analysis

The information gathered throughout the experiment was entered and stored on a computer. The experiment's data was analyzed using Microsoft Office XL 2010. All the analyses were carried out by one-way analysis of variance (ANOVA). All the data are expressed as mean standard deviation (SD) the means at a 5% level of significance.

RESULTS AND DISCUSSION

Water Quality Fom Beel Pabla During Wet and Dry Seasons

Successful aquaculture operations require high-quality water, as water quality factors (temperature, DO, and pH) directly impact the health, growth, and feed utilization of farmed fish (Karim *et al*., 2022). The lowest recorded average temperature in January was 16.15 °C, and the highest recorded average temperature in May was 37.48 °C. In the wet and dry seasons, the average temperature was 32.35 °C and 22.75 °C, respectively (Table 1). The average temperature in the Mayur River of Beel Pabla was 22.59°C during the dry season and 31.65 °C during the wet season, according to Hashan and Moniruzzaman (2022). The months with the highest temperatures align with the period of rainfall (April–September), whereas the winter season (December–February) is characterized by lower temperatures and less precipitation, as reported by the climate knowledge portal, in Bangladesh (Bal *et al*., 2021). April to October has been taken as the wet season and November to March as the dry season (Hashan and Moniruzzaman, 2022). The lowest recorded temperature, however, was 17 °C in January. According to Akter *et al*. (2009) the winter temperatures at Kailla Beel, Mymensingh, were lower. The results of the current experiment and Alim (2005) measurements of the water's temperature ranged from 17.30 to 33.50 °C, which were nearly identical. Caesar *et al*. (2021) stated that a temperature range of 23 to 30 degrees Celsius is appropriate for catfish cultivation; beyond this range, processing efficiency can be reduced, which raises the toxicity of an aquatic organism pollutant. The average pH values during the wet and dry seasons were 8.44 and 7.80 respectively. Similar results were shown by Hashan and Moniruzzaman (2022), with an average pH of 7.44 in the wet season and 7.40 in the dry season, respectively. This study's pH range falls between 6.0 and 8.5, which is the range in which tropical fish species can be cultured. Fresh water with a pH between 6.5 and 9.0 at dawn is ideal for fish productivity (Chhatawal, 1998). According to Gosh (2006), Thai sharputi and silver carp on a private fish farm in Mymensingh were impacted (both clinically and histologically) in December and January, when the pH was at its lowest point (6.5). To perform functions like swimming, growth, and reproduction, aquatic creatures require oxygen to burn their fuel, which is food, and vice versa. Thus, the cycle of activity, feed conversion, and growth rate of aquatic organisms are determined by the availability of oxygen (Caesar *et al*., 2021). Limiting oxygen can cause cellular respiration to become dysregulated, which can then cause major issues with mitochondrial ATP synthesis (oxidative phosphorylation). These oxygen-limiting circumstances also increase the generation of free radicals formed from oxygen, which is referred to as Reactive Oxygen Species (ROS) (Bal *et al*., 2022b). The highest average dissolved oxygen (DO) was 2.40 mg/l in July, and the lowest average was 1.59 mg/l in January. Good growth of flora and animals is favored by dissolved oxygen concentrations of more than 5.00 mg/l

Table 2: Histopathology of different organs of fishes from beel pabla of different seasons.

Research station	Fish Species	Organs	Winter season	Summer season	Rainy season
Beel Pabla	Heteropneustes fossilis	Skin muscle	'e' lost, 'd' with 'h', 'n' and 'v'	'e' normal, 'd' split, 'n', 'h' and 'v'	'e' and 'd' almost Normal
		Gill	'gl' missing, 'hy' and 'v'	'gl' missing	Almost normal
		Liver	'h', 'n' and 'v'	Almost normal	Mild 'v'
	Mystus cavasius	Skin muscle	'e' partly lost, 'd' and 'm' with 'n', 'v'	'e' and 'd' are almost normal except for having 'v'	'e' lost and 'd' separated from 'm' with 'v'
		Gill	'gl' missing, 'hy' and 'n'	Almost normal	Normal with 'h'
		Liver	'v'	Almost normal	More or less normal with 'h'

Abbreviations: **e:** epidermis; **d:** dermis; **h:** haemorrhage; **n:** necrosis; **gl:** gill lamellar, **Hy:** hypertrophy; **v:** vaccums and **m:** muscle.

(Das, 2000). The dissolved oxygen concentrations in Seetadwar Lake (Tewari and Mishra, 2005; Rawat and Sharma, 2005; Surve *et al*., 2005) varied from 3.41 to 6.21 mg/l. According to Hashan and Moniruzzaman (2022), the highest average DO was 2.40 mg/l in July 2019 and the lowest average was 1.53 mg/l in January 2020. DoE (Department of Environment, Bangladesh) states the line that the DO limit should exceed 5 mg/l. Because of dilution, the average DO rises slightly from 1.54 to 2.55 mg/l during the wet season. However, the state that the intensive lower DO value is caused mainly by the peak level value of BOD (Biological Oxygen Demand) stated by Hashan and Moniruzzaman (2022). Between March and July, the levels are significantly higher, with minor oscillations in the middle of the year. Consequently, eutrophication occurred across Bel Pabla's waterbodies. An increased phosphate level in the waterbody can also be caused by sewage discharges, runoff, and fertilizer application in nearby croplands. Phosphate in Mayur River water ranged from 5.51 to 12.64 mg/l; average readings for the dry and rainy seasons were 8.61 and 8.85, respectively. The standard limit is 0.6 and 6 mg/l, respectively, for surface water, according to the DoE and the EPA (Hashan and Moniruzzaman, 2022). The wintertime maximum ammonia readings from Pabla Beel were 0.9 ppm, while the lowest reading was 0.3 ppm. According to Akter *et al*. (2009), wintertime saw higher ammonia levels. According to Ahmed *et al*. (2009), wintertime observations of higher ammonia values, lower temperature values, and dissolved oxygen (DO) values may contribute to a rise in fish disease incidence. Ammonia levels varied; according to Lianthuamluaia *et al*. (2013), the lowest value was 0.026 mg/L recorded in August 2012, while the highest value was 0.182 mg/L recorded in January 2013. The author states that the elevated ammonia levels observed in winter may be attributed to the decomposition of organic matter that has accumulated from the catchment area during the rainy seasons.

According to Ahmed *et al*. (2009), seasonal variations in water quality indicators, including pH, temperature, dissolved oxygen, total alkalinity, total hardness, and ammonia, are crucial for the growth of pathogens that cause disease in fish. According to Hossain and Paul (1993), fish with weak immune systems might gradually become more ill-prone in colder climates. According to Barua (1994), at least 31 fish species have been impacted by EUS in Bangladesh; the fish species most significantly impacted during the winter months are *Channa, Puntius, Mystus*, and *Mastacembelus*. The majority of ailments, according to the water bodies that envelop living beings, mostly happen in the winter. Both the water level and quality declined dramatically over this period. Fish in January and February showed significant clinical symptoms. *H. fossilis* was reported to exhibit a weak body, physical abnormalities, mucus loss, numerous whitish and reddish lesions, and ulcers throughout this time (Uddin *et al*., 2019). Severe reddish lesions and mild injury were observed at various parts of the body from *M. cavasius* in January, and abrasion and white spots were found from fish in February at different culture ponds. While normal, healthy *M. cavasius* was observed in April (Uddin *et al*., 2020). Khalil *et al*. (2014) observed that the maximum numbers of parasites were collected from the host species in January and the minimum in February. However, from the above discussion, it can be assumed that the winter period is critical for both culture and capture fisheries due to water pollution, climate change, parasites, and bacterial infestation.

Seasonally Clinical and Histological Observations of *H. fossilis* and *M. cavasius*

In the case of *H. fossilis* weak body, many whitish lesions on an anterior portion of the body and an ulcer near the pectoral fin were observed in the winter season (Table 2). In the case of *M. cavasius, a reddish* lesion near the dorsal fin, a severe ulcer, and a reddish color near the anus were found in the winter season (Table 2). In the case of *H. fossilis, a rough* body with almost no mucus and whitish lesions was recorded in the summer. In the case of *M. cavasius,* healthy and normal appearances were observed in the summer. Clinically, *H. fossilis* had whitish patches of the body and a loss of mucus. During the winter season, the fish exhibited histopathological changes in the skin and muscle (Figure

3 and 4), including epidermal loss, hemorrhaging, necrosis, and the presence of vacuoles. Gill pathology in both *H. fossilis* (Figure 5) *M. cavasius* (Figure 6) showed lamellar damage, hypertrophy, vacuoles, hemorrhaging, and necrosis during winter. The liver also displayed signs of hemorrhaging, vacuoles, and necrosis in colder months.

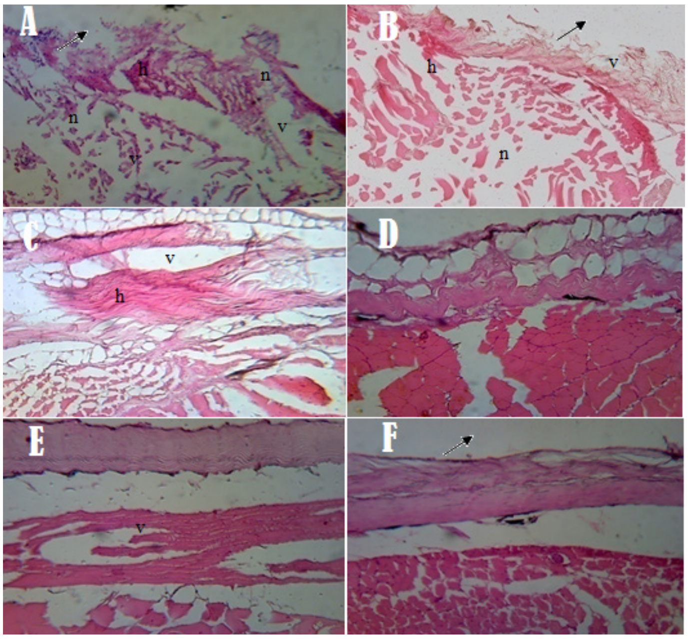

Figure 3: (A) Section of skin and muscle of *H. fossilis* in January having epidermis lost ( ), dermis with hemorrhage (h), necrosis (n), vacuums (v), and muscle also necrosis (n) with wide vacuums (v). **(B)**Cross-section of skin and muscle of *H. fossilis* having epidermis partly missing ( ), dermis with necrosis (n) and hemorrhage (h), and muscle had wide vacuums (v) in January. **(C)**Photomicrograph of skin and muscle of *H. fossilis* in April showing epidermis normal, dermis split and necrosis (n) with hemorrhage (h), vacuums (v). **(D)**Section of skin and muscle of *H. fossilis* with epidermis and dermis almost normal in April. **(E)** Cross-section of skin and muscle of *H. fossilis* in June having epidermis and dermis almost normal and muscle with vacuums (v). **(F)**Photomicrograph of skin and muscle of *H. fossilis* in June with epidermis partly lost, dermis separated from muscle. H and E × 120.

In contrast, during the summer, the fish organs appeared nearly normal, with only mild pathological alterations observed during the rainy season (Figure 7 and 8). Alam *et al.* (2020) reported that loss of balance, skin lesions, mucus discharge, hemorrhages, body and tail erosion, congestion, and enlargement with hemorrhage of the internal organs, such as the abdomen and body cavity, are clinical signs of a diseased catfish. In the case of *M. cavasius, a swollen* abdomen and loss of mucus were found in the rainy season. However, mild lesions near the adipose fin and reduced mucus were observed in the rainy season. In December and January, *C. striatus* from the BAU fish pond exhibited rough skin, scale loss, and deep white lesions all over its body, according to Ahmed et al. (2012).

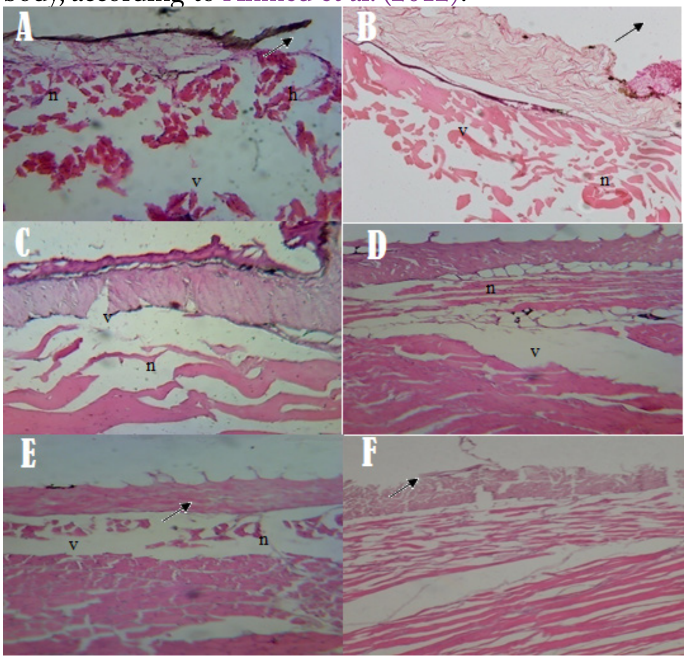

Figure 4: (A) Section of skin and muscle of *Mystus cavasius* in January showing epidermis totally and dermis partly lost ( ), muscle with necrosis (n), vacuums (v), and hemorrhage (h). **(B)**Cross-section of skin and muscle of *Mystus cavasius* in January with epidermis lost ( ), dermis normal, and muscle with necrosis (n) and vacuums (v). **(C)** Photomicrograph of skin and muscle of *Mystus cavasius* in April having epidermis and dermis almost normal except vacuums (v) and necrosis (n). **(D)**Section of skin and muscle of *Mystus cavasius* with epidermis and dermis almost normal except vacuums (v) and necrosis (n) in April. **(E)** Cross-section of skin and muscle of *Mystus cavasius* in June having epidermis lost ( ), dermis separated from muscle with vacuums (v), and necrosis (n). **(F)**Photomicrograph of skin and muscle of *Mystus cavasius* in June with epidermis totally and dermis partly lost ( ). H and E × 120.

According to Hossain *et al.* (2009), fish that had wintertime were afflicted by deep dermal ulcers, rough skin, body discoloration, and scale loss. However, in December and January, the fish displayed reddish lesions, dark or faded color, and decreased mucus on the exterior. *H. fossilis* and *M. cavasius* appeared nearly typical in both marketplaces during the summer. Ahmed *et al.* (2004) investigated three small native fish species using clinical, parasitological, and histopathological findings. They discovered that a large number of the fish were impacted between December and January. Fish were clinically determined to be less affected in February and March, according to Chakma et al. (2002). Numerous authors, including Ahmed *et al.* (2004) and Ahmed *et al.* (2009), found similar findings. According to Akter *et al.* (2009), in April and May, the skin and muscular structure of *A. testudineus* were nearly normal. Except for a few vacuums and bleeding in every fish on both farms in February and March, the epidermis and dermis nearly recovered to normal. In March, skin and muscle recovered to nearly normal structure, according to Ahmed *et al.* (2009). Autumn brings with it relatively fewer pathological alterations, except for the epidermis and dermis, which arrange them essentially regularly. However, in all the species under investigation, necrotic muscles and vacuums were seen in September and October. September and October showed partial loss of epidermis, necrosis in the muscles, and hemorrhage.

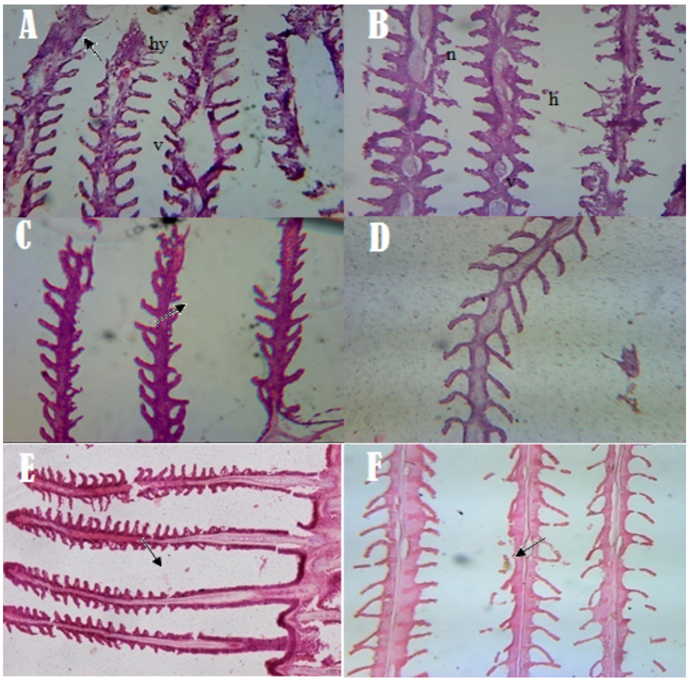

Figure 5: (A) Section of the gill of *H. fossilis* in January had lamellar missing ( ), hypertrophy (hy), and vacuums (v). **(B)**Cross-section of the gill of *H. fossilis* with hemorrhage (h), necrosis (n), and vacuums (v) in January. **(C)**Photomicrograph of the gill of *H. fossilis* in April with lamellar missing ( ). (D)Section of the gill of *H. fossilis* in April with almost normal structure. **(E)**Cross-section of the gill of *H. fossilis* in June had almost normal structure except lamellar missing. **(F)**Photomicrograph of the gill of *H. fossilis* in June with few lamellar missing ( ) H and E × 120.

According to Uddin *et al.* (2019), the frequent pathology of *H. fossilis* gills in January and February included hypertrophy of the epithelium with partially absent primary and secondary gill lamellae, the presence of parasites, necrosis, and clubbing of secondary gill lamellae. Cyst and lamellar missing were noticed in the gill of *M. cavasius* in January, whereas almost normal gill was found in fish in April (Uddin *et al.*, 2020). The liver of *H. fossilis* was severely affected in January and February from the investigated farms compared with March and April observed by Uddin *et al.* (2019). Akter (2006) observed vacuoles, hepatic necrosis, fungal granuloma, and pyknotic cells in the liver of *H. fossilis* and *M. tengara*. Uddin *et al.* (2020) reported that the liver of *M. cavasius* from different cultured ponds had severe necrosis, vacuums, and hemorrhages in all the investigated fish farms during January and February. Khatun *et al.* (2011) also reported similar findings. According to research findings by Ahmed et al. (2012), vacuums, melanocytes, and protozoan cysts were discovered in the skin and muscles of large carp in November. Hossain et al. (2009) also noted that in certain tiny native species, the dermis was partially destroyed and the muscle and dermis were badly necrotic during the winter.

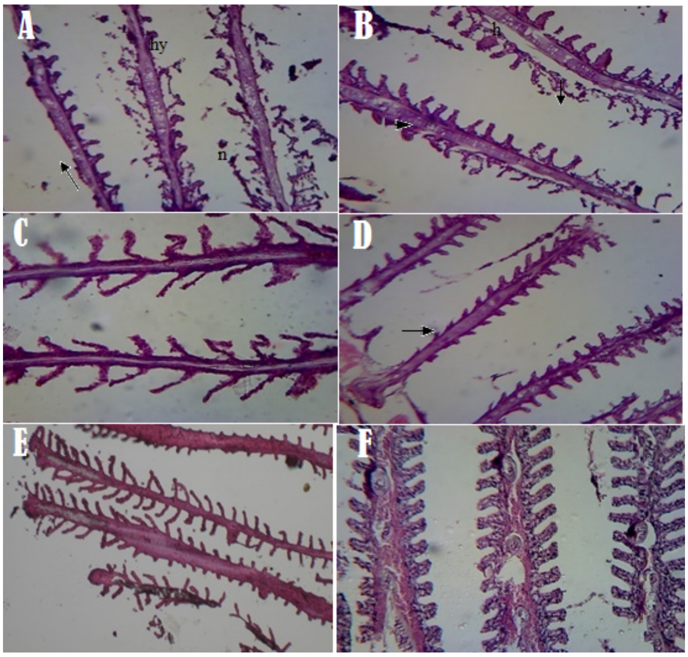

Figure 6: (A) Section of the gill of *Mystus cavasius* in January showing lamellar missing ( ), hypertrophy (hy), and necrosis (n). **(B)**Cross-section of the gill of *Mystus cavasius* with lamellar missing ( ) and hemorrhage (h) in January. **(C)**Photomicrograph of an almost normal gill of *Mystus cavasius* in April. **(D)**Section of the gill of *Mystus cavasius* in April has lamellar missing. **(E)**A cross-section of the gill of *Mystus cavasius* in June showed a normal structure with hemorrhage. **(F)**Photomicrograph of an almost normal gill of *Mystus cavasius* in June. H and E × 120.

According to Ahmed *et al.* (2010), *A. testudineus* showed signs of necrosis, bleeding, fungal hyphae, and partial loss of the epidermis and dermis in December and January. Ahmed et al. (2012) reported that in *O. niloticus*, the secondary gill lamellae were lost in December and January, along with gill hypertrophy, hyperplasia, clubbing, and bleeding in the primary gill lamellae. According to the research results of Ahmed et al. (2012), throughout December and January, *A. testudineus* from two distinct farms in the Mymensingh area showed signs of hypertrophy, hyperplasia, and necrosis. It is reported by Karim *et al.* (2022) that due to exposure to pollutants, histopathological changes like hemorrhage, nuclear alteration, hyperplasia and hypertrophy, necrosis, pyknosis, vacuole, and lipid droplets were seen in the livers of catfish.

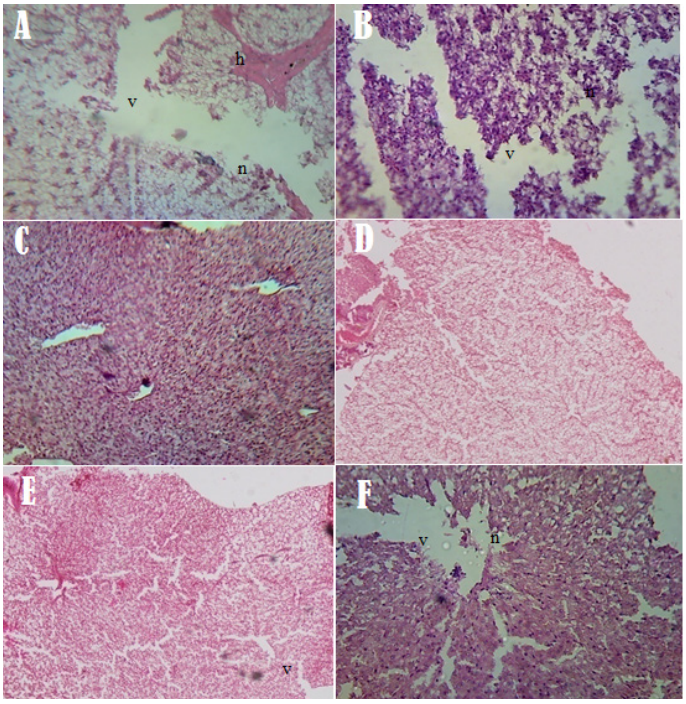

Figure 7: (A) Section of liver of *H. fossilis* in January having haemorrhage (h), necrosis (n), and vacuums (v). **(B)** Cross-section of liver of *H. fossilis* with necrosis (n) and vacuums (v) in January. **(C)**Photomicrograph of almost normal liver of *H. fossilis* in April from. **(D)**Section of liver of *H. fossilis* in April showing almost normal structure. **(E)** Cross-section of liver of *H. fossilis* with mild vacuums (v) in June. **(F)**Photomicrograph of liver of *H. fossilis* in June having necrosis (n) and vacuums (v). H and E × 120.

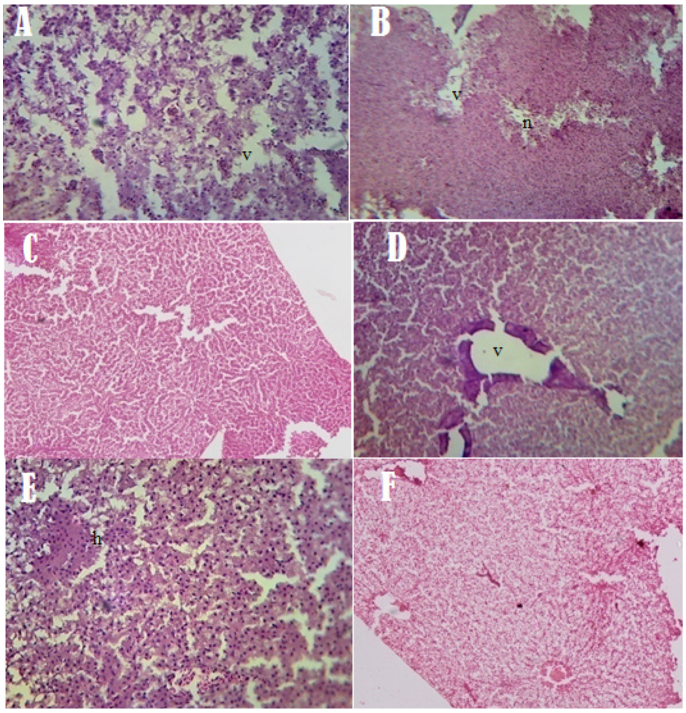

Figure 8: (A) Section of liver of *Mystus cavasius* in January having vacuums (v). **(B)**Cross-section of liver of *Mystus cavasius* with necrosis (n) and vacuums (v) in January. **(C)**Photomicrograph of liver of *Mystus cavasius* in April showing almost normal structure. **(D)**Section of liver of *Mystus cavasius* in April having more or less normal with vacuums (v). **(E)**A cross-section of the liver of *Mystus cavasius* in June showed more or less normal with hemorrhage (h). **(F)**Photomicrograph of almost normal liver of *Mystus cavasius* in June. H and E × 120.

CONCLUSIONS AND RECOMMENDATIONS

The country faces a serious threat from biodiversity loss, particularly the decline in species diversity, and the number of native fish species in various inland water bodies is decreasing each year. Current study suggests that fish are more affected during the colder months of January and February, both clinically and histopathologically, with most fish appearing healthy in March and April. Since fish are particularly vulnerable to unfavorable ambient temperatures and other biological factors during winter, extra caution is necessary. Stricter safety measures should be implemented in winter to prevent infections. Further research is needed to improve the health status of species such as shing (*H. fossilis*) and gulsha (*M. cavasius*) and reduce the risk of disease. Collaboration between the public and private sectors is essential for conserving this valuable wetland. Additionally, stocking high-quality fry of native species and ensuring proper waste disposal could enhance the number and diversity of healthy fish in Beel Pabla's waterbody.

ACKNOWLEDGEMENTS

The authors thank Md Yunus Ali (farmer), and Md Gias Uddin Ahmed (Research Supervisor) for the support given during the data collection process.

NOVELTY STATEMENT

Aquaculture in Beel Pabla has great potential. However, no prior studies have focused on *H. fossilis* and *M. canvass* in Beel Pabla. This study evaluated two valuable fish species, *H. fossilis,* and *M. cavasius*, to see how water quality affected their health in particular settings. Fish growers and sellers were interviewed to get information on fish health, and water quality data was gathered every ten days. Summertime water quality was determined to be good, while wintertime deterioration affected fish health. Fish showed mild health concerns during the rainy season, more serious damage during the winter, including liver, gill, and skin problems, and generally good health throughout the summer. The study highlights the significance of water quality monitoring for fish health protection, especially in Bangladesh's coastal wetlands.

AUTHOR'S CONTRIBUTIONS

Md. Jahid Hossain and Fatema Jahan: contributed equally to the research's advancement.
Md. Hamidur Rahman: wrote the manuscript.
Kaniz Fatema Eti: helped with the manuscript's translation and data analysis.

Conflict of Interest

There is no conflict of interest to be declared.

REFERENCES

Ahmed N, Alam MF, Hasan MR (2010). The economics of sutchi catfish (*Pangasianodon hypophthalmus*) aquaculture under three farming systems in rural Bangladesh. J. Aquacult. Res., 41: 1668–1683. https://doi.org/10.1111/j.1365-2109.2010.02549.x

Ahmed GU, Hague N, Perveen R, Sultana S (2004). Disease investigation of small indigenous fishes from Kailla beel in the Mymensingh area. J. Bangladesh Agric. Univ., 2(2): 305-311.

Ahmed GU, Akter MN, Nipa SA, Hossain MM (2009). Investigation on the health condition of freshwater eel, Monopterus cuchia from Ailee beel, Mymensingh, Bangladesh. J. Bangladesh Agric. Univ., 7: 419-424. https://doi.org/10.3329/jbau.v7i2.4755

Ahmed GU, Yesmin S (2012). Investigation of the health condition of some snakeheads from the Mymensingh region. J. Bangladesh Agric. Univ., 12: 719-724.

Ahmed GU, Khatun T, Belal Hossain M, Shamsuddin M 2012: Health condition of farmed titalpia (Oreochromis niloticus). Journal of Biological Science 12(5) 287-293.

Akter MN, Ahmed GU, Hossain MS (2009). Seasonal variation of gill pathology of a climbing perch in lake fisheries of Bangladesh. Int. J. Anim. Fish. Sci., 2(3): 208-213.

Akter N (2006). Study on health condition of freshwater eels from Ailee beel, Mymensingh, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 58.

Alam MR, Sharmin S, Islam SM, Alam MA, Ehiguese FO, Pattadar SN, Shahjahan M (2020). Salinity intrusion affects the early development of freshwater aquaculture species pabda, Ompok pabda. Aquacult. Rep., 18: 100476. https://doi.org/10.1016/j.aqrep.2020.100476

Alim MA (2005). Developing a polyculture technique for farmer's consumption and cash crop. PhD Dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. pp. 287.

Andrews C, Exell A, Carrington N (2010). Manual of Fish Health: Everything You Need to Know about Aquarium Fish, Their Environment and Disease Prevention. Rev. 2nd ed., Firefly Books, Buffalo, N.Y.

Bal A, Panda F, Pati SG, Das K, Agrawal PK, Paital B (2021). Low salinity induced challenges in the hardy fish Heteropneustes fossilis; future perspective of aquaculture in near coastal zones. Aquaculture, 543: 737007. https://doi.org/10.1016/j.aquaculture.2021.737007

Bal A, Pati SG, Panda F, Paital B (2022b). Dehydration induced hypoxia and its role on mitochondrial respiratory enzymes and oxidative stress responses in liver of Asian stinging catfish Heteropneustes fossilis. Comp. Biochem. Physiol. Part C Toxicol. Pharmacol., 256: 109300. https://doi.org/10.1016/j.cbpc.2022.109300

Baroi B, Rahman MH, Rohani MF, Hossain MS (2019). Effect of dietary vitamin C on growth and survival of GIFT Tilapia. J. Agric. Rural Dev., 11(2):37-42.

Barua G (1994). The status of epizootic ulcerative syndrome of fish of Bangladesh. ODA Regional Seminar on Epizootic Ulcerative Syndrome at Aquatic Animal Health Research Institute, Bangkok, Thailand., 25-27: 13-20.

Biswas C, Soma SS, Rohani MF, Rahman MH, Bashar A, Hossain MS (2021). Assessment of heavy metals in farmed shrimp, Penaeus monodon sampled from Khulna, Bangladesh: An inimical to food safety aspects. Heliyon, 7(3): 7e06587. https://doi.org/10.1016/j.heliyon.2021.e06587

Caesar NR, Yanuhar U, Raharjo DKWP, Junirahma NS (2021). Monitoring of water quality in the catfish (Clarias sp.) farming in Tuban Regency. The 3rd International Conference on Fisheries and Marine Sciences. IOP Conf. Series: Earth Environ. Sci., 718: 012061. https://doi.org/10.1088/1755-1315/718/1/012061

Chakma AP (2002). Histopathological observation on the effect of potassium permanganate in curing diseased small indigenous fishes. M.S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 54.

Chhatawal GR (1998). Anmol Publication Privet Limited, New Delhi, India. Encycl. Environ. Biol., 2: 287–301.

Das AK (2000). Limno-Chemistry of Some Andhra Pradesh Reservoirs. J. Inland Fish. Soc. India, 32: 37-44.

Dinda T, Heri BS, Anang K (2023). Histopathology of Liver and Kidney of the River Catfish (Mystus nemurus) as a Bioindicator of Satui River Water Quality, South Kalimantan, Indonesia. Egyptian Journal Aquat. Biol. Fish. Zool., 27(5): 1505 – 1524. https://doi.org/10.21608/ejabf.2023.325814

Faruk HSM, Rahman MM, Mahmood MI, Hossain MS, Hasan S, Hossain Z, Shahadat O, Atikullah SM, Ahmed A, Shahrior S, Adib R (2016). Classification of Wetlands of Bangladesh (Vol.1 Main report). Prosoil foundation consultant. Department of Bangladesh Haor and wetlands development. 1: 1-6.

Farhana I (2023). Culture potentialities and challenges of Asian stinging Catfish / Shing fish culture in Bangladesh, Aquaculture news at Seafood Network, Bangladesh, sept.23, 2023. https://seafoodnetworkbd.com/culture-potentialities-and-challenges-of-asian-stinging-catfish-shing-fish-culture-in-bangladesh

Flowra FA, Islam MA, Jahan SN, Hussain MA, Alam MM (2013). Status and decline are causes of fish diversity in Baral River, Natore, Bangladesh. AACL Bioflux., 6(4): 352-357.

Edward J. Noga MS, DVM (2010). Fish Disease Diagnosis and Treatment. Wiley-Blackwell. Second edition, pp: 69-79

Goni O, Alam MM, Khalil SMI, Bari SM, Hamom A, Parven M, Abdullah-Al-Mamun M (2020). Identification of pathogenic bacteria from diseased stringing catfish *Heteropneustis fossils* with their sensitivity to antibiotics. Int. J. Fish. Aquat. Stud., 8(1): 291-301.

Gosh K (2006). Investigation of the health status of Juvenile exotic carp from various farming conditions, MS Thesis, Department of Aquaculture, Bangladesh Agricultural

University, Mymensingh, pp. 48.

Hashan MM, Moniruzzaman SM (2022). Temporal and Spatial Variation of Water Quality of Mayur River, Khulna, Bangladesh. J. Eng. Sci., 13(1): 89-96. https://doi.org/10.3329/jes.v13i1.60566

Hossain MS, Mazid MA (1995). A manual on the development of floodplain fisheries. Fisheries Research Institute, Mymensingh. 9-27.

Hossain MS, Paul SK (1993). Study of fish disease into the floodplain. In research progress report (June-September 1993). Fisheries Research Institute, Third Fisheries Project, Santahar, Bogra, October 1993. 7(2): 46-52.

Hossain MS, Ahmed GU, Tazri Z, Haque MA (2009). Clinical and pathological investigation disease in some small indigenous species (SIS) from fish markets of Mymensingh. Int. Biores., 7: 1-6.

Islam MM, Rohani MF, Rahman MH, Tandra TS, Alam M, Hossain MS (2020). Suitability and efficacy of potato as a prebiotic compound on the growth performance of rohu (*Labeo rohita*). J. Agric. Food Environ., 1: 20-25. https://doi.org/10.47440/JAFE.2020.1104

Karim MA, Rohani MF, Hasan AM, Farhad FB, Alam MM, Khalil SMI, Islam SM (2022). Health status monitoring of *Mystus cavasius* through histological aberrations of liver and kidney due to the deterioration of water Physico-chemical parameters in Surma River. Environ. Chem. Ecotoxicol., 4: 148-154. https://doi.org/10.1016/j.enceco.2022.04.001

Khatun H, Hossain MD, Jahan SN, Khanom DA (2011). Bacterial Infestation in Different Fish at Rajshahi. J. Sci. Found., 9(1): 77- 84. https://doi.org/10.3329/jsf.v9i1-2.14650

Khalil SMI, Chandra K J, Das DR (2014). Effects of Endoparasitism of *Heteropneustes fossilis* on condition factor, gonad and blood composition of host. Res. Agric. Livestock Fish., 1(1): 159-167. https://doi.org/10.3329/ralf.v1i1.22379

Khalil SMI, Mamun MAA, Bari SM, Haque MN (2014). Endoparasitic infestation in channa punctatus (bloch, 1793) was collected from different water bodies in sylhet. J. Syl. Agril. Univ., 1(1):59-64.

Lianthuamluaia A, Landge T, Purushothaman CS, Deshmukhe G, Ramteke KK (2013). Assessment of seasonal variations of water quality Parameters of savitri reservoir, oladpur, raigad District, Maharashtra. Int. J. Life Sci., 8(4): 1337-1342.

Mahmud MT, Rahman MM, Shathi AA, Rahman MH, Islam MS (2021). Growth variation of tilapia (Oreochromis niloticus) with variation of environmental parameters. J. Agric. Food Environ., 2(2): 75-79. https://doi.org/10.47440/JAFE.2021.2213

Mahmuda M, Rahman MH, Bashar A, Rohani MF, Hossain MS (2020). Heavy metal contamination in tilapia, Oreochromis niloticus collected from different fish markets of Mymensingh District. J. Agric. Food Environ., 1(4): 1-5.

Marma K, Ahmed GU, Paul SK (2016). Disease investigation of small indigenous fish species *Channa punctatus* of three fish markets in Mymensingh, Bangladesh. Asian Aust. J. Biosci. Biotechnol., 1(2): 268-273. https://doi.org/10.3329/aajbb.v1i2.61574

Mou AT, Uddin MT, Rahman MH (2023). Empirical assessment of species vulnerability for biodiversity conservation: A case study on Chalan beel of Bangladesh. Heliyon, 9: e15251. https://doi.org/10.1016/j.heliyon.2023.e15251

Murshed S, Rahman MH, Mahruf B, Najmunnahar, Mostakima S, Hossain MS (2023). Impact of silica nanoparticles on the digestibility and growth efficiency of rohu (*Labeo rohita*). J. Agric. Food Environ., 4(4): 24-30. https://doi.org/10.47440/JAFE.2023.4405

Mustafa SA, Abdulmotalib, Rudainy JA, Salman NM (2024). Effect of environmental pollutants on fish health: An overview. Egypt. J. Aquat. Res., 50(2): 225-233. https://doi.org/10.1016/j.ejar.2024.02.006

Nahiduzzaman MD, Shahidul I, Shayla SM, Moshiur R, Robiul A, Kohinoor AHM (2023). Determination of suitable species combination of two small Indigenous fish species (SIS) pabda (*Ompok pabda*) and gulsha (*Mystus cavasius*) with rohu (*Labeo rohita*) in farmers' pond. Res. Agric. Livestock Fish., 10(2): 219–228. https://doi.org/10.3329/ralf.v10i2.68785

Nasrin S, Rahman MH, Awal MR, Das M, Hossain MS, Sarker F (2021). Effect of feeding frequency on the growth of GIFT (Oreochromis niloticus). Int. J. Fish. Aquat. Stud., 9(2): 98-107. https://doi.org/10.22271/fish.2021.v9.i2b.2446

Noor MNJ, Romjan AS, Hossain MS, Habib MAB, Mahruf B, Rahman MH (2024). Low-cost spirulina manufacturing technique by using the supernatant of digested rotten ladies finger (Abelmoschus esculentus). J. Agric. Food Environ., 5(1): 30-36. https://doi.org/10.47440/JAFE.2024.5106

Paul B, Bhowmick, Sadrupa, Chanda, Soumen, Singh, Puja, Sridhar, Narashiman, Giri, Shiba (2019). Nutrition Facts: *Ompok bimaculatus* (pabda). E-Pamphlet, ICAR- CIFA extension series- 50. ICAR-Central Institute of Freshwater Aquaculture, Kausalyaganga. Odisha. http://www. cifa.nic.in/ si te s/default/files/Pabda_Pamphlet.pdf#overlay-context=node/322

Rahman MH, Mahmud MT, Hossain MS, Mou AT, Sarker F, Rahman UO (2021). Variation of production performance of Gulsha (*Mystus cavasius*) monoculture with the variation of water and soil quality parameters. J. Agric. Food Environ., 2(4):59-64. https://doi.org/10.47440/JAFE.2021.2410

Rahman MH, Khan ANMAI, Habib MAB, Hossain MS (2022). Evaluation of Sugar Mill By-product Molasses as a Low-Cost Culture Media for Microalgae. Aquacult. Stud., 22(4): 776. https://doi.org/10.4194/AQUAST776

Rahman MM, Chowdhury MBR (1996). Isolation of bacterial pathogen causing ulcer disease in farmed carp fishes of Mymensingh. Bangladesh J. Fish., 19: 103-110.

Rawat MS, Sharma RC (2005). Phytoplankton population of Garhwal Himalayan Lake Deoria Tal, Uttranchal. J. Ecophysiol. Occup. Health, 5: 73-76.

Rahman S, Monir MS, Mou MH (2014). Culture potentials of stinging catfish shing (*Heteropneustes fossilis*) under different stocking densities in northern region of Bangladesh. Trends Fish. Res., 3(2): 2319-4758.

Snieszko SF (1974). The effects of environmental stress on outbreaks of infectious diseases of fishes. J. Fish Biol., 6: 197-208. https://doi.org/10.1111/j.1095-8649.1974.tb04537.x

Surve PR, Ambore NE, Pulle JS (2005). Hydrobiological studies of Kandhar dam water, district Nanded (M.S.), India. J.

Ecophysiol. Occup. Health., 5: 61-63.

Svobodova Z, Machova J, Kocour KH, Velisek J (2017). Water Quality-Disease Relationship on Commercial Fish Farms, in: Fish Diseases. pp. 167-185. https://doi.org/10.1016/B978-0-12-804564-0.00007-7

Tandra TS, Rohani MF, Rahman MH, Islam MM, Hossain MS (2019). Suitability and efficacy of potato as prebiotic on the growth performance of catla (*Catla catla*). Bangladesh. J. Fish., 31(2): 221-227.

Talwar PK, Jhingran AG (1991). Inland fishes of India and adjacent countries (Vol. 2). CRC press. pp. 543-1158.

Tewari DD, Mishra SM (2005). Limnological study during rainy season of Seetadwar Lake at Shrawasti District. Journal of Ecophysiological and Occupatinal Health., 5: 71-72.

Uddin MA, Aktar MTNAS, Halim KMA, Hasanuzzaman KM, Islam MA (2020). Health and disease status of cultured Gulsha (*Mystus Cavasius*) at Mymensingh region of Bangladesh. Res. Agricult. Livestock Fish., 7(1): 139-151. https://doi.org/10.3329/ralf.v7i1.46842

Uddin MA, Islam MA, Islam R, Yesmin R, Halim KMA, Hasanuzzaman KM (2019). Study on the health status of farmed shing (*Heteropneustes fossilis*) in Mymensingh region. Res. Agric. Livestock Fish., 6(3): 445-455. https://doi.org/10.3329/ralf.v6i3.44811