Fish and Plankton Biodiversity in the Kishoreganj Haor, Kishoreganj, Bangladesh

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Abstract

Haor is a wetland environment considered as a rich diversified fisheries resource with important role on ecology, economy and social structure. The present study was conducted to evaluate the diversity of fish and plankton communities in the Kishoregonj haor, Kishoreganj, Bangladesh. Fish samples were collected from the fishers and fish landing station for taxonomic study from July 2017 to December 2018. Fish were identified through direct observation and using morphometric and meristic characteristics. A total of 23 genera of phytoplankton belonging to 4 classes were identified. A total 8 genera of Bacillariaophyceae, 9 genera of Chlorophyceae, 3 genera of Cyanophyceae and 3 genera of Euglenophyceae class were listed from the study area. In total 3 groups of zooplankton were identified, i.e. Phylum-Rotifera, Order-Cladocera and Sub-class-Copepoda in Kishoreganj haor. In the present study, a total of 79 species of fishes belonging to 27 families under 9 orders were recorded. Cypriniformes was found as the most dominant order comprising 31 species followed by Siluriformes (21) and Perciformes (15). The result of this study showed that the fish and plankton diversity indices in the Kishoreganj haor are good even some fish species are gradually decreasing.

Introduction

Haor is a productive wetland ecosystem with a high environmental, economic and social value that is characterized by being a bowl-shaped depression covered by water almost six months in a year starting from the monsoon (Sarma et al. 2010). Haor ecosystem covers about 25% of the Northeastern part of Bangladesh. In addition, it is a mosaic of wetland habitats including rivers, streams and irrigation canals, large areas of seasonally flood plains and hundreds of haors and beels (Hussain et al., 2007). In seven districts of Bangladesh: Sylhet, Moulavibazar, Habiganj and Sunamganj in northeast, Netrokona and Kishoreganj in north central and Brahmanbaria in central eastern region of Bangladesh, a number of 423 haors comprising a surface area of about 8000 km² are present (Miah, 2013). The three sides of haor region are surrounded by mountain ranges of India, with Meghalaya in north, Tripura and Mizoram in south, and Manipur and Assam in east.

The haor region is crisscrossed by numerous rivers coming down from the hills of India with huge amount of runoff water during monsoon, which ultimately falls into Meghna basin (Ahmed, 2012; Rabby et al., 2011). Usually water body in the haor region remains at zero level from January to March and then starts to increase and go down again during August (Sarma, 2010; Noween et al., 2015). Mostly, in June and July, the water level reaches the highest point (Salauddin and
Islam, 2011). In addition, the rainfall in the haor region is comparatively higher than the other region of country. The average annual rainfall in the haor areas is 4130 mm, which is almost twice higher than the country’s average annual rainfall (Nowreen et al., 2015). The physical settings and hydrology of the haor region created countless opportunities as well as constraints for the inhabitants (Hanif et al., 2015).

Haor contains diverse types of floral and faunal diversity especially reptiles, birds, fish species, amphibians etc., which play an important role in the existence of haor ecosystem (Choudhury, 2016). According to Pandit et al. (2015) over 84 species of fish were reported to be commonly caught by local fishermen in the haor region. Islam et al. (2008) recorded 108 species under 29 families of 10 orders from the haor region. Hence, the haor region plays important role for fish production, maintaining biodiversity, meeting local and regional demand (Salauddin and Islam, 2011). However, the Kishoreganj haor region is also known for its richest SIS (Small Indigenous Fish Species) biodiversity, consisting of 30 species belonging to 7 orders and 15 families (Rownok et al., 2014).

Primary productivity is essential for fish species growth and distribution in natural water bodies. Primary production is mainly depending on nutrient concentration in aquatic environment. The variation in nutrient concentrations caused by changes in water flow and upwelling regimes of rivers is the cause of fluctuations of primary productivity (Lotze and Worm, 2002). The primary productivity describes the biological wealth of the water body, constituting a vital link in the food chain. Haor is considered to have an exceptionally higher primary productivity than other wetland habitat types (Muzaffar and Ahmed, 2007). In any aquatic ecosystem the phytoplankton works as the backbone of food chain that keeps the animals alive in aquatic environments. The phytoplankton communities of haor is very much linked with production of zooplankton and fish (Muzaffar and Ahmed, 2007). Muzaffar and Ahmed (2007) found 107 genera of phytoplankton in haor region and representing six classes. Azher et al. (2006) listed 75 plankton species (60 phytoplankton and 15 zooplankton) where Chlorophyceae and Copepoda was the most dominant groups in the Kishoreganj haor region. Fish diversity is an important index to conserve the fisheries resources in a particular region of a country. Very limited research works are available on protection of this fishery resource in Bangladesh. Therefore, the present study was conducted to assess the plankton and fish diversity in the Kishoreganj haor.

Materials and Methods

Study Area

This experiment was performed in the Kishoreganj haor (Figure 1). The area was selected considering its unique geographic location, richness of fishery resources and primary productivity and for species diversity. Total surface area of Karimganj upazila (Kishoreganj) is 200.52 km², located in between 24º22’ and 24º32’ north latitudes and 90º48’ and 91º01’ east longitudes. It is bounded by Tarail and Itna upazilas in north, Nikli, Katiadi and Kishoregonj Sadar upazilas in south, Nikli and Mithamoin upazilas in east, Kishoreganj Sadar upazila in west. In Karimganj, there is a renowned fish landing station called “Chamra Bondor”. Most of fish caught in the Kishorgong haor region has been landed to this station.

Collection of Data

Samples of fish were collected from the fishermen’ catches landed at different stations in the study area.
and from fish markets as well. Monthly sampling was carried out from July 2017 to December 2018. Plankton samples were collected personally by monthly field visits to the study area. Historical fishing data were collected by means of interviews conducted with boat owners of commercial fishing vessels, retailers, fish traders, local people, sport fishers, riverside settlers and from the sampling area. Additional historical data was also acquired from various relevant scientific articles, reports, maps website, library, Bangladesh Fisheries Research Institute, Department of Fisheries of Bangladesh and some local NGO offices.

**Fish Identification**

Most of the collected fish species were identified on the spot with the help of prepared freshwater fisheries resources list, related books and IUCN red list 2015. Fish samples were also brought to the laboratory for double confirmation to identify the fish species. The fish specimens were identified based on the morphometric and meristic appearances according to Rahman (2005), Talwar and Jhingran (1991).

**Plankton Sampling**

Monthly plankton samples from July 2017 to December 2018 were collected from 8 different locations in the Kishoreganj haor. Sampling was performed by using a plankton net with a mesh size of 25µm and a cod end to retain the organisms. The net was towed horizontally, and the plankton samples were collected from the sub-surface layer (0.2-0.5 m) of the water column. Immediately after collection, all samples were preserved in 5% buffered formalin and stored in 250 ml labeled plastic bottles. Then, the sample bottles were brought to the laboratory of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh, Bangladesh for qualitative analysis under microscope.

**Identification of Plankton**

Collected planktons were sorted out with the help of fine brushes, needle, forceps and an inverted microscope (OPTIA B-350 Italy). Plankton sample was picked up with plastic dropper from plastic bottle. Then sample kept on glass slide for identification. Identification of plankton was done according to Bellinger (1992). Zooplanktons were identified following the keys given by Bhouyain and Asmat (1992).

**Fish and Plankton Diversity Analysis**

In this study, the Shannon-Weaver diversity index (1949) was calculated for evaluating the status of fish diversity using the following formulae:

\[
H' = - \sum_{i=1}^{R} p_i \ln p_i
\]

Where, \(H'\) is the diversity index, \(p\) is the proportion \((n/N)\) of individuals in one particular species \(n\) to the total number of individuals found \(N\), and \(R\) is the total number of species.

**Results**

**Fisheries Resources**

During the study period, a total of 79 fish species belonging to 27 families under 9 orders were collected from Chamra Bondor fish landing station, Karimganj, Kishoreganj, Bangladesh. Cypriniformes was the most dominant family with 31 species followed by Siluriformes (21 species), Perciformes (16 species), Clupeiformes (4 species), Anguilliformes (2 species), Beloniformes (2 species), Synbranchiformes (1 species), Tetraodontiformes (1 species) and Cyprinodontiformes (1 species) (Table 1 and Figure 2).

![Figure 2. Species richness of different fish orders in the Kishoreganj haor during 2017-2018.](image-url)
Table 1. Monthly variations in habitation rate of sea cucumbers

| Order                  | Family               | Scientific name       | Local name      | English name          | Present status | IUCN status | No. of Species | Diversity index (H') |
|------------------------|----------------------|-----------------------|-----------------|-----------------------|----------------|--------------|-------------------|-----------------------|
| ANGUILLIFORMES         | ANGUILLIDAE          | Anguilla bengalensis  | Bamos, Bau baim | Giant Mottled Eel     | RA             | VU           | 2                | 1.1                   |
| SYNBRANCHIFORMES       | OPHICHTHIDAE         | Pisodonophis boro     | Nol baim        | Rice-paddy Eel        | CA             | NO           |                  |                       |
|                        | SYBRANCHIDAE         | Monopterus cuchia     | Kuiccha         | Cuchia/Gangetic Mudeel| RA             | VU           | 1                | 1.5                   |
| TETRAODONTIFORMES      | TETRAODONTIDAE       | Tetraodon cutcutia     | Potka           | Pufferfish            | MA             | NO           | 1                | 2.9                   |
| BELONIFORMES           | BELONIIDAE           | Xenentodon cancila     | Kaikka          | Freshwater            | MA             | NO           | 2                | 2.8                   |
| HEMIRAMPHIDAE          | Hyphoeramphus limbatus| Subol kaikka          |                 | Congaturi             | RA             | NO           |                  | 1.2                   |
| CYPRINODONTIFORMES     | CYPRINODONTIDAE      | Aplocheilus panchax    | Kanipona        | Panchax Minnow        | MA             | NO           | 1                | 3.2                   |
| CYPRINIFORMES          | CYPRINIDAE           | Securicula gora        | Naukka chela    | Gora Chela            | RA             | NO           | 31               | 1.2                   |
|                        |                      | Salmostoma phulo      | Chela           | Finescaled Razorbelly Minnow | MA             | NO           |                  | 2.7                   |
|                        |                      | Salmostoma bacalia    | Chela           | Large Razorbelly Minnow | MA             | NO           |                  | 2.8                   |
|                        |                      | Esomus danricus        | Darkina         | Flying Barb            | RA             | DD           |                  | 1.3                   |
|                        |                      | ParLuciosoma daniconius| Darkina       | Blackline Rasbora     | RA             | DD           |                  | 1.4                   |
|                        |                      | Barilius bendelisis    | Nunchora        | Hamilton's Barila     | RA             | EN           |                  | 1.1                   |
|                        |                      | Danio devario          | Kash khauri     | Devario Danio         | CA             | NO           |                  | 4.1                   |
|                        |                      | Amblypharyngodon mola  | Mola            | Pale Carplet Coto     | CA             | NO           |                  | 4.2                   |
|                        |                      | Osteobrama cotio       | Gilachki        | Carp Coto             | RA             | EN           |                  | 1.2                   |
|                        |                      | Labeo gonius           | Ghonia          | Labeo                 | RA             | EN           |                  | 1.3                   |
|                        |                      | Labeo calbasu          | Kalbaush        | Labeo                 | RA             | EN           |                  | 1.9                   |
|                        |                      | Labeo rohita           | Rou/rui         | Rohu                  | MA             | NO           |                  | 3.0                   |
|                        |                      | Labeo angra            | Karish, Dirua   | Angra Labeo           | RA             | NO           |                  | 1.4                   |
|                        |                      | Labeo boggut           | Nania           | Boggut Labeo          | RA             | DD           |                  | 1.5                   |
|                        |                      | Cirrhinus cirrhosus    | Mrigal          | Mrigal Carp           | MA             | NO           |                  | 3.2                   |
|                        |                      | Puntius sarana         | Deshi sarpunti, | Olive Barb            | RA             | CR           |                  | 1.7                   |
| Common Name                       | Scientific Name     | English Name         | Status | IUCN | CA | MA | NO | RA | Not listed |
|----------------------------------|---------------------|----------------------|--------|-----|----|----|----|----|------------|
| Puntius guganio                  | Puntius guganio     | Thai sarpunti        |        |     |    |    |    |    | 3.0        |
| Puntius phutunio                 | Puntius phutunio    | Titpunti             |        |     |    |    |    |    | 4.1        |
| Puntius conchonius               | Puntius conchonius  | Teri punti           |        |     |    |    |    |    | 3.5        |
| Puntius ticto                    | Puntius ticto       | Tita punti           |        |     |    |    |    |    | 3.0        |
| Puntius sophore                  | Puntius sophore     | Jat punti            |        |     |    |    |    |    | 4.2        |
| Puntius terio                    | Puntius terio       | Teri punti           |        |     |    |    |    |    | 4.0        |
| Catla catla                      | Catla catla         | Katal                |        |     |    |    |    |    | 3.6        |
| Hypophthalmichthys molitrix      | Hypophthalmichthys molitrix | Silver carp        |        |     |    |    |    |    | 1.5        |
| Cyprinus carpio                  | Cyprinus carpio     | Carpu                |        |     |    |    |    |    | 1.7        |
| Nemachilus botia                 | Nemachilus botia    | Gutum                |        |     |    |    |    |    | 3.1        |
| Nemachilus zonalternaans         | Nemachilus zonalternaans | Gutum              |        |     |    |    |    |    | 3.2        |
| Botia dario                      | Botia dario         | Bou mach             |        |     |    |    |    |    | 1.9        |
| Lepidocephalus guntea            | Lepidocephalus guntea | Gutum              |        |     |    |    |    |    | 3.3        |
| Lepidocephalichthys annandali   | Lepidocephalichthys annandali | Gutum      |        |     |    |    |    |    | 2.0        |
| Clarias batrachus                | Clarias batrachus   | Magur                |        |     |    |    |    |    | 21.0       |
| Wallago attu                     | Wallago attu        | Boal                 |        |     |    |    |    |    | 4.2        |
| Ompok bimaculatus                | Ompok bimaculatus   | Pabda                |        |     |    |    |    |    | 3.5        |
| Ompok pabda                      | Ompok pabda         | Lali paibba          |        |     |    |    |    |    | 2.5        |
| Heteropneustes fossilis          | Heteropneustes fossilis | Shingi            |        |     |    |    |    |    | 4.3        |
| Silonia silondia                 | Silonia silondia    | Shilon               |        |     |    |    |    |    | 3.2        |
| Allia coila                      | Allia coila         | Kajuli               |        |     |    |    |    |    | 3.5        |
| Pseudeutropius atherinoides      | Pseudeutropius atherinoides | Batai               |        |     |    |    |    |    | 1.3        |
| Eutropiichthys vacha             | Eutropiichthys vacha | Bacha               |        |     |    |    |    |    | 4.0        |
| Eutropiichthys murius            | Eutropiichthys murius | Bacha, Muri         |        |     |    |    |    |    | 3.4        |
| Clupisoma garua                  | Clupisoma garua     | Ghaura               |        |     |    |    |    |    | 3.1        |
| Rita rita                        | Rita rita           | Rida                 |        |     |    |    |    |    | 1.9        |
| Aorichthys aor                   | Aorichthys aor      | Ayer                 |        |     |    |    |    |    | 3.7        |
| Aorichthys seenghala             | Aorichthys seenghala | Kata                |        |     |    |    |    |    | 2.8        |
| Hemibagrus menoda                | Hemibagrus menoda   | Gang magur           |        |     |    |    |    |    | 2.6        |
| Mystus cavusius                  | Mystus cavusius     | Gulsha               |        |     |    |    |    |    | 4.0        |
| Mystus bleekeri                  | Mystus bleekeri     | Gulsha               |        |     |    |    |    |    | 4.1        |
| Mystus tengara                   | Mystus tengara      | Bajari tengra        |        |     |    |    |    |    | 4.2        |
| Family            | Common Name                  | Scientific Name                  | Status | Average |
|-------------------|------------------------------|----------------------------------|--------|---------|
| GenAqua           |                              | GenAqua 4(1): 39-48 (2020)       | CA     | 2.8±1.0 |

| **GenAqua**       |                              | Commonly available species, MA= Moderately available species, RA= Rarely available species, DD= Data Deficient, NO= Not Threatened, VU= Vulnerable, EN= Endangered, CR= Critically Endangered. |
Fish Availability in the Kishoreganj Haor

Comparing the present status of fish diversity with past status, it is clearly indicated that the number of fish species declined due to anthropologic factors (Figure 3).

Qualitative Analysis of Phytoplankton

A total of 23 phytoplankton species were identified under 4 classes. A total of 8 species of Bacillariophyceae, 9 species of Chlorophyceae, 3 species of Cyanophyceae and 3 species of Euglenophyceae classes were listed from the study area (Table 2).

Qualitative Analysis of Zooplankton

A total of 3 groups of zooplankton were identified, i.e. Rotifera, Cladocera and Copepoda in Kishoreganj haor region. A total of 5 species of Rotifera, 4 species of Copepoda and 4 species of Cladocera were identified during the study period in Kishoreganj haor region. (Table 2)

Diversity Indices of Fish and Plankton

The values of diversity indices of fish were fluctuated from 1.1 to 4.3 with mean value of 2.8±1.0. Phytoplankton diversity indices were fluctuated from 2.9 to 3.2 and 1.7 to 2.6 with mean value of 3.10±0.17 and 2.10±0.41 during wet and dry seasons, respectively while zooplankton diversity indices were fluctuated from 3.1 to 3.2 and 1.6 to 1.7 with mean value of 3.13±0.58 and 1.63±0.12 during wet and dry seasons, respectively.

Discussion

Fish Diversity in the Study Area

Freshwater fisheries sector plays an important role in the economy of Bangladesh. Diversity of fishes is the key to meet ecological balance. Fisheries resources in Kishoreganj haor are characterized by a very high degree of endemism. This region is considered as home of many freshwater fish species. Among them, most of the fish are commercially important. This haor supports several rare and threatened fish species. For example, some critically endangered species like Anguilla bengalensis, Monopterus cuchia, Osteobrama cotio, Labeo gonius, Puntius sarana, Botia dario, Corica soborna, Rita rita, Bagarius bagarius, and Colisa chuna are available in Kishoreganj haor region. The diversity indices of these fish species were from 1.1 to 1.9 while the diversity index was above 4.0 for some available fish species and the average value of Kishoreganj haor was 2.8±1.0. Khanom et al. (2016) found that the average value of diversity index of fish in Shiba river of Bangladesh was 1.86 while Iqbal et al (2015) found the range of diversity index of fish in Konoskhai haor at Northeast Bangladesh was from 2.9 to 3.1. Considering the diversity index of fish, Kishoreganj haor is rich in fish. Iqbal et al (2015) listed 83 species of fishes in the Hakaluki haor belonging to 55 genera, 28 families and 10 orders where Cypriniformes was found to the most dominant order comprising 73% followed by Siluriformes (13%) and Perciformes (9%). Trina et al. (2016) found 74 fish species where 8 were critically endangered, 17 were endangered, 9 were vulnerable and 39 were not threatened in Dekhar haor under Sunamganj, which is quite similar with the present

Figure 3. Comparison between the present and past status of fish species richness in the Kishoreganj haor.
findings. Islam et al. (2008) have recorded 108 species under 29 families of 10 orders from Tanguar Haor. Moreover, Pandit et al. (2015) listed 84 fish species from Dekhar haor of Sunamganj. Most of their findings are very similar to the present study. In the present study, the abundance of nandina (L. nandina), elong (Bengala elanga), batasi (Batasio tengana), rita (Rita rita), kajoli (Ailia unctate), garua (Clupisoma garua) and shilong (Silonia silondia) were found to be very low probably due to over exploitation and habitat degradation. Fish population is decreasing due to over exploitation and other anthropologic activities; and habitats of the Meghna, Laukhati and Galachipa rivers are degraded as well as livelihood of fishermen is below standard (Rahaman et al. 2019 and 2020; Hossain et al. 2018). It is clearly indicated that the abundance of fishes is decreased sharply. Probably because, fishermen capture a large number of fish specimens by small mesh sized nets in Kishoreganj haor. The fish species diversity was also decreased by rising temperature in Kishoreganj haor region. The abundance and distribution of fish species is controlled by water quality and primary productivity in rivers of Kishoreganj. However, fish availability has also been reduced for overfishing effort and blocking fish migration route.

### Primary Productivity in the Kishoreganj Haor Region

Plankton plays an important role as a primary producer in haor ecosystem and it is an important source of food for fish. Phytoplankton is an important primary producer and constitutes the basis of nutrient cycle of an ecosystem (Singh et al., 2013). Plankton growth, biomass and productivity are influenced by the nutrients, light and water temperature. Phytoplankton and zooplankton abundance varies from one water system to another. In the present study, a total 23 phytoplankton genera under 4 groups was identified.
Bacillariophyceae, Chlorophyceae were the dominant and common group in the present study area. Other recorded common genera were: Navicula sp., Gyrosigma sp., Nitzschia sp., Synedra sp., Cyclotella sp., Bacillaria sp., Rhizosolenia sp., Spirogyra sp., Ulothrix sp., Volvox sp., and Euglena sp. Azher et al. (2006) listed 60 genera of phytoplankton in Kishoreganj haor region where Chlorophyceae was the major group. Ahsan et al. (2012) listed a total 19 taxa (32.76%) of phytoplankton where Chlorophyceae (7 taxa) was the most dominant group in the Meghna river. In addition, Rahaman et al. (2016) and Rahaman et al. (2018) reported data quite similar to the present study. In Kishoreganj haor region, Nitzschia sp., Synedra sp. and Oscillatoria sp. were found in wet and dry seasons. These species indicate the pollution of water in the study area (Singh et al., 2013). In addition, Microcystis sp., and Euglena sp. were also found in the study area, which indicate the eutrophic condition in the water body (Singh et al., 2013). In Kishoreganj haor, phytoplankton diversity indices were fluctuated from 2.9 to 3.2 and 1.7 to 2.6 with mean value of 3.10±0.17 and 2.10±0.41 during wet and dry seasons, respectively. It indicated that Kishoreganj haor was a productive water body during study period. Ekhator and Aliká (2016) reported the phytoplankton diversity of the Osse river, Edo State, Nigeria was ranged from 1.8 to 3.4. Similarly, Miao (2019) found the fluctuation of phytoplankton from 1.44 to 3.08 in the Backshore Wetland in Shanghai, China.

Zooplanktons do not depend directly on nutrients to survive. Zooplanktons play important roles in food chain by linking primary producers and higher trophic levels (Xu et al., 2001). In the present study, a total of 12 zooplankton genera under 3 groups (Rotifera, Cladocera and Copepoda) were identified. Rotifera (Brachionus sp., Keratella sp., Filinia sp., Asplanchna sp., and Polyarthra sp.) was the dominant group in the present study area. Other recorded common species were Brachionus sp., Keratella sp., Moina sp., Daphnia sp., Bosmina sp., and Cyclops sp.. Ahmed et al. (2003) was also found quite similar results mentioned 13 zooplankton genera in the Meghna river. In addition, 15 genera (Daphnia sp., Ceriodaphnia sp., Diaphanosoma sp., Bosmina sp., Moina sp., Cyclops sp., Diaptomus sp., Brachionus sp., Keratella sp., Filinia sp., Tiichocera sp., Filinia sp., Lecane sp. and Polyaertha sp.) of zooplankton were listed in Kishoreganj (Rahaman et al., 2005 and Azher et al., 2006). In the present study, Moina sp. and Cyclops sp. were also found in both dry and wet season, which indicate the pollution of water body in the Kishoreganj (Jha and Barat, 2003). In Kishoreganj haor, zooplankton diversity indices were fluctuated from 3.1 to 3.2 and 1.6 to 1.7 with mean value of 3.13±0.58 and 1.63±0.12 during wet and dry seasons, respectively. Ismail and Zaidin (2015) found that the zooplankton diversity indices were changed from 1.07 to 1.21 in different types of water bodies in Indonesia. These results indicated that Kishoreganj haor was rich with zooplankton during the study period.

Conclusion

Considering the data of the present study, it can be concluded that the fish and plankton diversity in Kishoreganj haor is good even though abundance of some fish species are declining day by day. The use of destructive nets, indiscriminate fishing, ban of fishing during breeding season will be the effective actions to save the biodiversity in Kishoreganj haor.

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