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Study the diversity and seasonal variations of endangered fishes, plankton and benthos in Kanchan river of Dinajpur

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Abstract

This research work was carried out from February to June, 2018 to monitor the present status of endangered fishes, productivity and overall health status of Kanchan river situated in Dinajpur district. Water and sediment samples were collected twice in a month during the study period from the selected five different sampling sites along with required information about the availability of threatened fishes. The findings noted over 28 available threatened fish species in Kanchan river including several commonly available threatened fishes (Endangered: *Acanthocobitisbotia*, *Somileptesgongota*, *Botiadario*, *Botialohachata*, *Bariliustileo*, *Barilusbengalensisetc*.; Critically endangered: *Channabarca*, *Labeonandina*, *Clupisomagaruaetc.*) which are very rear in nationwide. Common planktonic flora and fauna of this riverine ecosystem were also identified. In the river several phytoplankton (*Asterionella* sp., *Tabellaria* sp., *Clostridium* sp. etc.) and zooplankton (*Brachionus* sp.) were monitored as season specific. Abundance of plankton were analyzed statistically significant (p <0.05) in different seasons. Plankton counting detected comparatively lower (23,000 per liter) and higher (39,000 per liter) numbers in the month of February and June, respectively. The observed benthic fauna of Kanchan river possessed 22 species of macro-benthos from different groups. Monitored minimum temperature (21.5 ºC) was recorded in the month of February and it was maximum in the month of June (30.5 ºC). These results suggested that productivity indicators (availability of planktonic flora and fauna including benthos) were better in the early monsoon season than the pre-monsoon season. Similarly, better ecosystem health (temperature, dissolve oxygen and availability of plankton) was also observed in early monsoon season. Seasonal variations of water temperature and dissolved oxygen were visualized significant (p <0.05). Finally, this study findings recommended to stop all manmade interventions for the better health of this riverine ecosystem as well as to take necessary actions for conserving the commonly available endangered and critically endangered fishes of Kanchan river.

Key words: diversity, seasonal variation, endangered fish, plankton, Kanchan River

1. Introduction

Bangladesh has vast productive fresh water resources with diversified macro and micro aquatic flora and fauna. Out of 260 freshwater fishes in Bangladesh, over 140 species have been classified as 'small indigenous species (SIS)'. Currently, diversity and abundance of several SIS has tremendously reduced due to some stressors dominantly by over fishing, dryness and anthropogenic activities. IUCN-Bangladesh [5] reported that about 54 freshwater fish species are under threats of extinction and this scenario is worsening as the threatened fish species are greatly influenced by climate change oriented warming, massive bed siltation, pollution etc. Although several small fish species have now apparently disappeared and become endemic in the major parts of Bangladesh, still 16-20 different endangered fishes are locally available in different rivers of Dinajpur [1]. On the other hand, plankton is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and a means of coping with any environmental change therefore phytoplankton community structure observation may be used as a reliable tool for biological monitoring studies to assess

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the pollution status of aquatic bodies [7, 4]. The diversity of species, amount of biomass and abundance of plankton communities as well as benthos [10] can be used to determine the health of an ecosystem and evaluation tool for the health status of river ecosystem.

Therefore, this research work has been conducted to know about the current status of endangered fishes, productivity and health status of the studied river ecosystem including seasonal variations.

2. Materials and methods

2.1 Sampling sites

The research was conducted in the Kanchan river (Punarbhaba river) of Dinajpur district where five sampling points (Figure 1) were selected.

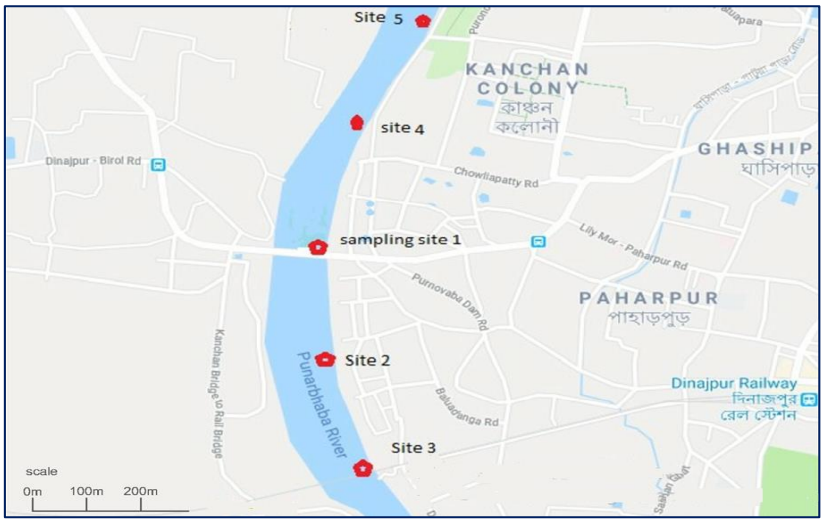

Figure 1. Sampling points from where samples and data were collected and recorded respectively. Here, Site 1: Latitude-25˚37′35.4″N, Longitude-88˚37′44.2″E; Site 2: Latitude-25˚37′35.4″N, Longitude-88˚37′8.3″E; Site 3: Latitude-25˚37′22″N, Longitude-88˚37′13.6″E; Site 4: Latitude- 25˚37′51.5″N, Longitude-88˚37′11.1″E; Site 5: Latitude-25˚38′14.7″N, Longitude-88˚37′20.5″E.

2.2 Sampling dates

This study was done on the following dates: 1 February, 2018; 16 February, 2018; 4 March, 2018; 20 March, 2018; 6 April, 2018; 22 April, 2018; 8 May, 2018; 24 May, 2018; 9 June 2018; 25 June, 2018.

2.3 Sample and data collection

Samplings were done twice per month from February to June, 2018. From every sampling point, water temperature and dissolved oxygen (DO) were measured by digital thermometer and digital DO meter (PDO model 519) respectively whereas, pH was recorded by digital pH meter.

Besides, plankton containing water samples were collected with the help of plankton net and preserved in small plastic bottles with required amount of ethanol (ethanol: plankton containing water sample=1:9). For benthos, sediment-samples were collected with the help of Ekmen Drager. Both the plankton and sediment samples were taken to the laboratory after inserting in to the ice-box. At the same time, detailed information about the available endangered fish species were noted from the sampling site associated fishermen.

2.4 Analysis of plankton and benthos

The water and sediment samples were preserved as well as analyzed in the laboratory of Fisheries Biology and Genetics Department of Hajee Mohammad Danesh Science and Technology University (HSTU). Electron microscope was used to identify the both phytoplankton and zooplankton samples. Particularly, qualitative and quantitative study of planktons were performed using Sedgewick- Rafter chamber. Fish samples were identified in the same laboratory following fish-identifying laboratory manual.

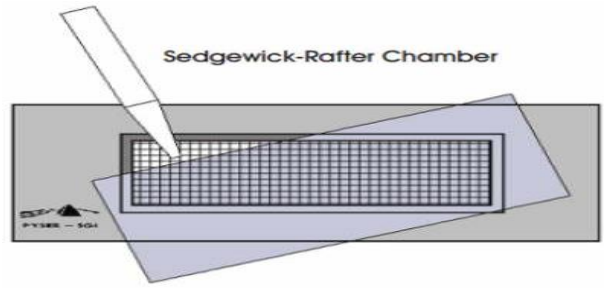

Figure 2. Sedgewick- Rafter chamber

The used rafter-chamber (Figure 2) was 50 mm long, 20 mm wide and 1 mm deep. The total area of the bottom was approximately 1000 square mm and total volume was 1000 cubic mm.

For plankton counting and recording, we used a prescribed format which contained almost all the available plankton names (both phytoplankton and zooplankton) suitable for identifying and recording.

Plankton number was calculated by following equation:

Number of plankton, $N = \frac{A*c}{F*V*L} * 1000$ (plankton cell/per liter)

Here,

F= Number of the SR cell field

C=Volume of final concentration of sample

A= Total number of plankton counted

L= Volume of original water

V= Volume of SR cell (1 cubic meter)

N= Number of plankton cell per litter

2.5 Statistical data analysis

Data were analyzed by repeated by repeated measures analysis of variance (ANOVA) with 'treatment' as the main factor and 'sampling date' as repeated factor followed by Tukey's test to discern the differences among treatment means. Statistical significance was set at $p < 0.05$. Statistical analyses were performed using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL). Values were presented as means ± standard deviation (SD).

3. Results

3.1 Present status of endangered fishes of kanchan river (Punarbhaba river)

The natural water bodies of the Northwest part of Bangladesh were blessed with small indigenous fish species. Although, the availability of SIS of fish are declining due to various man-made and natural stressors nationally, most of the threatened fishes of Bangladesh are available in different natural waters of Dinajpur district. The list of recorded available endangered fish of Kanchan river (Punarbhaba river) is represented by Table 1. According to the information provided by the fishermen, over 28 threatened fishes are currently available in Kanchan river (Table 1) from where some are abundant in the studied river although these fishes are rarely available nationwide. A precious study performed by Amin et al. (2010) also reported that some vulnerable and endangered indigenous fishes were locally abundant in the natural waters of the Northwest part of Bangladesh including the natural waters of Dinajpur district. These abundant threatened fishes in Kanchan river are balichata gutum (*Acanthocobitis botia*), pahari gutum (*Somileptes gongota*), rani (*Botiadario*), putul rani (*Botia lohachata*), Khorki/Tilakoksha (*Barilius tileo*), Joya (*Barilus bengalensis*) etc. According to our observation and collected information from the fishermen, it can be said that during winter season (December-January) the studied river possessed very minimum water when rural people prepared Katha (fish shelter with tree branches) and at the pre-monsoon season (February-March) they caught fish indiscriminately and got more fishes. After that, fish availability is reduced and that was gradually increased again in the early-monsoon season (June-July) and comparatively large amount of fishes were obtained in monsoon season (August-October).

More importantly, several critically endangered fishes such as: tilashol (*Channa barca*), nandina (*Labeo nandina*), ghaura (*Clupisoma garua*) *etc.* are reported to be available in the Kanchan river of Dinajpur district.

3.2 Available plankton and benthos in the studied river

After analyzing the planktonic flora and fauna (Table 2 and Table 3) it has been found that comparative lower number of both phytoplankton (<12,000 per liter) and zooplanktons (<4,000 per liter) were detected in pre-monsoon season (February-March) and relatively higher number of planktonic flora (>16 nos.) and fauna (>4 nos.) were determined

Table 1. List of threatened species found in Kanchan River

Local Name	Scientific Name	Status
Balichata gutum	*Acanthocobitis botia*	Endangered
Paharigutum	*Somileptes gongota*	Endangered
Rani	*Botia dario*	Endangered
Rani	*Botia dayi*	Endangered
Putul rani	*Botia lohachata*	Endangered
Golshatengra	*Mustus cavasius*	Vulnerable
Tengra	*Batasio tengra*	Endangered
Ghaura	*Clupisoma garua*	Critically endangered
Bhol	*Raiamas bola*	Endangered
Tara baim	*Macrognathus aculiatus*	Endangered
Sal baim	*Mastacembelus armatus*	Endangered
Sarpunti/Puta	*Barbodes sarana*	Endangered
Tit punti	*Puntius ticto*	Vulnerable
Chela	*Chela laubuca*	Endangered
Foli	*Notopterus notopterus*	Vulnerable
Bhangan bata	*Labeo bata*	Endangered
Bhagna	*Cirrhinus reba*	Vulnerable
Khorki/Tilakoksha	*Barilius tileo*	Endangered
Juary/Joya	*Barilus bengalensis*	Endangered
Chapila	*Gudusia chapra*	Vulnerable
Gofi chela/Nipati	*Dario fangila*	Vulnerable
Nandina	*Labeo nandina*	Critically endangered
Chital	*Chitala chitala*	Endangered
Tila shol	*Channa barca*	Critically endangered
Gajar	*Channa marulius*	Endangered
Rita	*Rita rita*	Endangered
Pabda	*Ompok pabda*	Endangered
Boal	*Wallago attu*	Vulnerable
Pangas	*Pangasius pangasius*	Endangered
kuchia	*Monopterus cuchia*	Vulnerable

in early-monsoon season (May-June) meaning that the studied riverine ecosystem remained more productive in early monsoon season (Table 4) that may be due to start of rainfall. In this study, commonly available phytoplankton in pre-monsoon season were *Cyclotella* sp., *Pediastrum* sp., *Ulotrix* sp., *Oscillatoria* sp., *Navicula* sp., *Fragillaria* sp., *Chlorella* sp., and the common zooplanktons *Cyclops* sp., *Daphnia* sp., *Nauplius* sp. were determined. On the other hand, available phytoplanktonic flora in early monsoon season were *Cyclotella* sp., *Pediastrum* sp., *Ulotrix* sp., *Oscillatoria* sp., *Navicula* sp., *Fragillaria* sp., *Chlorella* sp., *Spirogyra* sp., *Ceratium* sp., *Biddulphia* sp., *Dinophysis* sp., *Cosmodismus* sp., *Spirunila* sp., *Scenedesmus* sp., *Merispodia* sp., *Surirella* sp., *Melosira* sp. etc. and planktonic fauna were *Daphnia* sp., *Cyclops* sp., *Nauplius* sp., *Brachiomysis* sp., *Bosmina* sp., *Pseudosida* sp., *Diaphanosoma* sp. etc.

In the study conducted in the riverine ecosystem in 2017 was also detected most of the above mentioned planktonic flora in the riverine ecosystem [4].

It is important to note that a few plankton were observed season specific in the studied river. For example, *Asterionella* sp., *Tabellaria* sp., *Clostridium* sp., etc. planktonic flora and *Brachionus* sp. (planktonic fauna) were observed only in the month of July which might be due to increased water temperature.

Table 2. Major groups of available phytoplankton in Kanchan river

Bacillariophyta	***Euglenophyta***	***Cyanophyta***	***Charophyta***	***Chlorophyta***
Cyclotella	*Euglena*	*Microcystis*	*Closterium*	*Pediastrum*
Diatoma	*Phacus*	*Oscillatoria*	*Spirogyra*	*Chlorella*
Navicula		*Anabaena*	*Cosmarium*	*Scenedesmus*
Nitzschia		*Nostoc*	*Zygnema*	*Microspora*
Synedra				
Tabellaria				

Table 3. Major groups of available zooplankton in Kanchan river

Copepoda	Cladocera	Rotifera	Crustacean larvae
Cyclops	*Daphnia*	*Brachionus*	Nauplius
Diaptomus	*Dyaphanosoma*	*Keratella*	
	Moina	*Notholka*	
		Asplanka	

Table 4. Planktonic diversity and abundance in different temperature of Kanchan river detected in study period.

Month (Temperature)	Phytoplankton	Zooplankton	Number/liter
February (21.5ºC)	*Cyclotella, Pediastrum, Ulotrix, Oscillatoria, Navicula, Fragillaria, Chlorella.*	*Cyclops, Daphnia,Nauplius.*	23,000
March (26.2ºC)	*Cyclotella, Pediastrum, Ulotrix, Oscillatoria, Navicula, Fragillaria, Chlorella, Spirogyra,Ceratium, Biddulphia, Dinophysis.*	*Cyclops, Daphnia, Nauplius.*	24,000
April (27.4 ºC)	*Cyclotella, Pediastrum,Ulotrix, Oscillatoria, Navicula, Fragillaria, Chlorella, Spirogyra,Ceratium, Biddulphia, Dinophysis, Cosmodismus, Spirunila, Scenedesmus, Merispodia, Surirella, Melosira.*	*Daphnia, Cyclops, Nauplius, Brachiomysis, Diaptomus, Topodiaptomus Bosmina, Pseudosida.*	25,000
May (28.3 ºC)	*Cyclotella, Pediastrum, Ulotrix, Oscillatoria, Navicula, Fragillaria, Chlorella, Spirogyra,Ceratium, Dinophysis, Cosmodismus, Spirunila, Scenedesmus, Merispodia, Surirella, Melosira, Synedra, Micrasteria.*	*Daphnia, Cyclops, Nauplius, Brachiomysis, Bosmina, Pseudosida, Diaphanosoma.*	35,000
June (30.5 ºC)	*Ceratium, Biddulphia, Dinophysis, Asterionella, Cosmodismus, Cyclotella, Microcystis, Spirunila, Pediastrum,Ulotrix, Scenedesmus, Merispodia,Oscillatoria, Surirella. Tabellaria, Melosira, Navicula, Synedra,Chlorella, Micrasteria, Synedra, Fragillaria, Clostridium.*	*Cyclops, Diaptomus, Topodiaptomus, Bosmina, Daphnia, Pseudosida, Diaphanosom. Notholca, Nauplius, Brachionus.*	39,000

Beyond these, plankton counting findings showed that relative lower (23,000 per liter) and higher numbers (39,000 per liter) of plankton availability was recorded in the month of February and June respectively (Table 4) indicating that both diversity and abundances of planktonic flora and fauna were importantly influenced by seasonal variation specifically for thermal change. The relationship (Figure 3) between the thermal change and planktonic abundances were observed positive in the sampling months and the variation of planktonic abundances were visualized statistically significant ($p < 0.05$) in different months. From these findings we can say that the studied riverine ecosystem was more productive in early monsoon season than pre monsoon season.

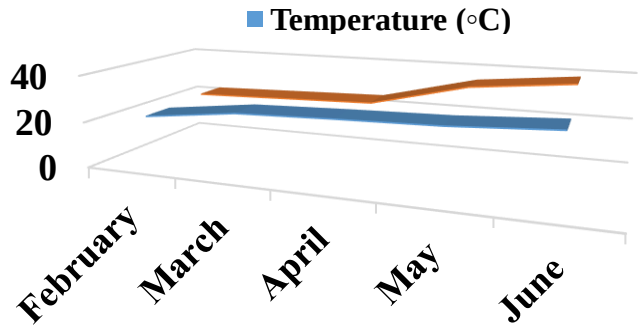

Figure 3. The relationship between thermal change and planktonic abundances in Kanchan river during different sampling months

Benthic invertebrates are very important component of the aquatic food chain proving about 60% of the total natural food items for aquatic animals. They also play an important role in sediment-water interaction through their burrowing and feeding activities. However, the study of benthic fauna of Kanchan river showed that the riverine ecosystem of Kanchan river contained 22 species of macro-benthos (Table 5) from different groups. Another several

published reports [2, 6] mentioned that macrobenthos were the basic components of the aquatic chains of rivers and ubiquitous in all aquatic ecosystems and showed sensitivity towards aquatic pollution.

Table 5. List of benthos found at Kanchon river

Local Name	**Scientific Name**
Shamuk	*Pilaglobosa*
Lamba shamuk	*Melanoides tuberculata*
Gol shamuk	*Planorbis sp.*
Choto shamuk	*Viviparous bengalensis*
Jinuk	*Lamellidens marginalis*
Gol jinuk	*Corbicula sp.*
Musculium	*Musculium sp.*
Unio	*Unio sp.*
Kecho	*Pheretima sp.*
Tubifex	*Tubifex tubifex*
Branchiura	*Branchiura sp.*
Chironomus	*Chironomus sp.*
Jok	*Hirudinea sp.*
Pelopia	*Pelopia sp.*
Shamuk	*Pilavirens*
Chotogul shamuk	*Paludomus conica*
Pasanu shamuk	*Indo planorbis*
Patla shamuk	*Limnaea sp.*
Pasanugul shamuk	*Macrochla myssequax*
Badamichoto shamuk	*Belamya bengalensis*
Pasanu durakata shamuk	*Bellamya dissimilis*
Pasanu lamba shamuk	*Broitia costula*

3.3 Temperature and dissolved oxygen levels of Kanchan river

Recorded average temperature and dissolve oxygen from the study area are given in table 4. According to the obtained data, minimum temperature (21.5 ºC) was noted in the month of February whereas it was maximum in the month of June (30.5 ºC). Besides, gradual increasing of the river water temperature was found from March to June (early monsoon) meaning that water temperature is normally increased according to the seasonal change and there was no abrupt thermal changes occurred. In July, comparatively maximum temperature was recorded as 30.5 ºC which was seemed to be higher than the expected level (Table 6, Figure 4).

Table 6. Average temperature (ºC) and dissolve oxygen (mg/l) recorded from different sampling points of the study area. Means with different letters in different months were significantly different (p <0.05)

Month	**Average temperature (°C) of five sampling sites**	**Average dissolve oxygen (mg/l) of five sampling sites**
February	21.50±0.98^{a}	5.38±0.12^{d}
March	26.20±0.44	5.41±0.09^{d}
April	27.40±0.18	5.03±0.49
May	28.30±0.22^{b}	4.74±0.92^{c}
June	30.50±0.26^{b}	4.48±0.04^{c}

By observing the dissolve oxygen (mg/l) level of the Kanchan river we found that similar to water temperature, comparative lower DO level was observed in the late winter season whereas comparatively higher DO level was reported (Table 4, Figure 5) in the early monsoon season indicated a positive relation between river water temperature and dissolve oxygen. Both average temperature and dissolved oxygen were significantly (p < 0.05) varied among different sampling months.

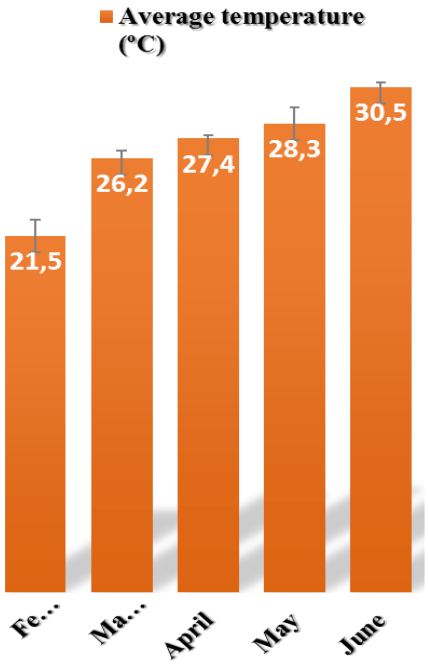

Figure 4. Observed average temperature (ºC) in Kanchan river during the study period

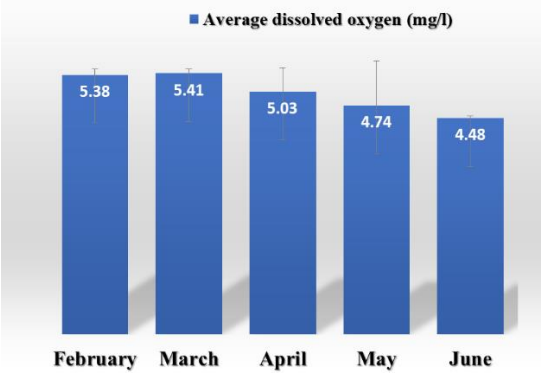

Figure 5. Average dissolve oxygen (mg/l) in Kanchan river during the study period

It is important to report that the condition of Kanchon river is deteriorating day by day due to both natural and man-made activities. River neighbors throwing waste materials inside the river even the local drainage system is connected with the river which might worsening the health ecosystem of this river as well as reducing fish availability..

4. Conclusions and discussion

Finally, it can be concluded that similar to current national trend the availability of the threatened fishes are reducing gradually in Kanchan river although some of endangered and critically endangered fishes are still commonly available. The monitored productivity indicators (availability of planktonic flora and fauna including benthos) showed better condition in early monsoon season than pre-monsoon season. Similarly, better ecosystem health (temperature and dissolve oxygen) is observed in early monsoon season. Therefore, it is our holy responsibility to aware river associated people and other relevant authorities to prohibit all manmade interventions that destroying riverine ecosystem-health along with take necessary actions to conserve the ichthyodiversity of this river particularly for protecting commonly available endangered and critically endangered fishes.

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