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Seasonal variation and community structure of fishes in the Mahananda River with special reference to conservation issues

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Abstract

This study was carried out in the Mahananda River from January to December 2013 with a view to determining the seasonal variation and community structure of fishes along with some conservation issues. Monthly sampling was carried out using traditional fishing gears and fishes were identified based on morphometric and meristic characters. A total of 4082 individuals of native fish species were captured, analyzed and classified into 62 species belonging to 46 genera, 25 families and 9 orders. Cypriniformes and Siluriformes were the dominant fish orders represented by 19 species each and the most abundant family was Cyprinidae (14 species). In addition to indigenous individuals, 9 individuals of 2 exotic fish species (*Hypophthalmichthys molitrix* and *Pangasius hypophthalmus*) were also recorded. Among three sampling sites, S-1 was the most diversified in terms of not only the number of individual fish but also the number of species present represented by mean (±SE) individuals of 151.50±25.22 and species of 25.58±3.91. Three distinct fish groups of fish families were revealed from the cluster analysis of similarity. To improve the situation, control of illegal fishing gears, establishment of sanctuaries and legal protection for threatened species are recommended.

Keywords: Mahananda River, seasonal variation, community structure, conservation, threatened fish

INTRODUCTION

Different freshwater bodies of Bangladesh are home to diversified freshwater finfish species supporting at least 265 species (Rahman 2005). Due to various anthropogenic and natural causes freshwater habitats are now squeezing every year and a considerable portion of total number of fish species are now at stake. IUCN Bangladesh (2000) has identified a total of 54 freshwater species of Bangladesh as threatened to extinct under three categories *viz.* Critically Endangered, Endangered and Vulnerable. Decreasing trend of freshwater fishes in various rivers of Bangladesh has already been reported by several researchers (Galib 2015; Joadder *et al.* 2015; Chaki *et al.* 2014; Mohsin *et al.* 2014, 2013; Galib *et al.* 2013). In a recent research Hossain (2014a) declared that 30 riverine fish species have became extinct though the researcher did not mention the methodology followed for his findings. However, all these clearly indicate the need for research in rivers of Bangladesh to reveal the present status of fishes which is a prerequisite to ensure proper management of not only the water body but also the resources within it.

The Mahananda River is a major tributary of the Ganges in Bangladesh. This river enters into Bangladesh from India through Bholahat Upazila (sub-district) of Chapai Nawabganj district and it has neither any tributary nor any distributary (Baby 2015). The length of this river within Bangladesh is about 36 km (Baby 2015). Although the Mahananda River is one of the important rivers in north-western part of Bangladesh (Hossain 2014b) but it has not been focused to such extent. Only a single research is notable that was carried out to assess the available fish species in the river by Mohsin and Haque (2009). However, in this research the researchers have

provided a check list of fish species and no statistical data were provided. So, it is not possible to understand the actual status of available fishes from this research effort. This paper will describe the present status of available fish species in the Mahananda River in terms of proportion to catch and conservation issues.

METHODOLOGY

Sampling spots and duration: Three sites of the Mahananda River were surveyed on monthly basis for a period of one year from January to December, 2013. Three sampling sites were Bholahat (S-1 or site I; 88°12'E, 24°56'N), (S-2 or site II; 88°15'E, 24°51'N), and Gomostapur (S-3 or site III; 88°15'E, 24°46'N) (Figure 1). Sampling site was around 10 km far from each other.

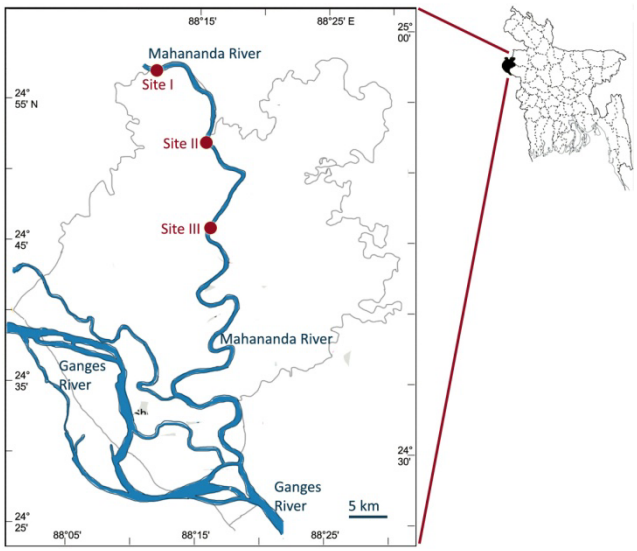

Figure 1: Map of Chapai Nawabganj district of Bangladesh including location of the Mahananda River and sampling sites (I-III)

Sampling framework: Fish were collected with a seine net (mesh 6x6 mm; 100x3 ft) and a cast net. Approximately 200 m of river segment was sampled during day (09:00-17:00 hours) and night (20:00-05:00 hours) at each sampling spot. Nine professional fishermen were employed for the purpose of sampling under the guidance of the research team. In case of cast net, 10 hauls were considered during each sampling.

Species identification and preservation: Collected fish specimens were identified and counted at the sampling sites. All the fish specimens were identified based on morphometric and meristic characters following Rahman (1989 and 2005) and Talwar and Jhingran (1991). Identified species were classified based on the classification system of Nelson (2006). Scientific names and authorities follow those of Froese and Pauly (2015). However, fish specimens, those were difficult to identify on the spot, were preserved in 10% formalin solution and brought to the Aquatic Biodiversity Lab of the Department of Fisheries, University of Rajshahi, Bangladesh for proper identification.

Cluster analysis: Similarity values were calculated from the density data of various species at all the sampling sites. Bray-Curtis similarity analysis (Harper 1999) was performed in this regard to show level of similarity between different fish families.

Determination of conservation status and population trends: Global conservation status categories (Near Threatened, Least Concern, Vulnerable etc.) and global population trend (Decreasing, Stable etc.) are based on the online classification database developed by the International Union for the Conservation of Nature and Natural Resources (IUCN 2015). National conservation categories are based on book 'Redbook of the Threatened Fishes of Bangladesh' published by IUCN Bangladesh (2000). Local population status of fish species was determined by interviewing the professional fishermen in the study areas. A total of 75 fishermen, 25 from each sampling site, were asked to state the present status of each species compared to the status of concerned species 20 years ago. They were not asked to provide statistical data but to rank each species as: Decreasing or Increasing or Stable or Unknown, just like the population trends categories of IUCN. The rank of species came out from the majority of fishermen was considered only. All the fishermen had a fishing experience of at least 20 years in the river Mahananda and they were selected randomly for interview. This method was also used by Galib (2015).

RESULTS AND DISCUSSION

Status of fish fauna in the Mahananda River

A total of 4082 fish individuals were captured and analyzed during January to December, 2013. These individuals were classified into 62 indigenous fish species belonging to 46 genera, 25 families and 9 orders (Table 1). Cypriniformes and Siluriformes were two dominant orders represented by 19 species each followed by Perciformes (15 species). Among the families, 14 species were belonging to Cyprinidae followed by Bagridae (6 species). Two exotic fish species, *Hypophthalmichthys molitrix* and *Pangasius hypophthalmus*, were collected, represented by nine individuals from the river. A total of 56 fish species were reported in an earlier study conducted in the Mahananda River by Mohsin and Islam (2009) which is lower than that of the present findings. However, there was a significant difference in sampling method between present survey and study carried out by Mohsin and Haque (2009) and thus variation in results can be expected.

Table 1: Native fish species in the Mahananda River with conservation status, population trend and number of individual caught at different sampling sites during January to December 2013

Systematic position and fish species	*Conservation status*		*Population trend*		*Number of individual recorded*			
	Global	*Local*	*Global*	*Local*	*S-1*	*S-2*	*S-3*	*All*
Beloniformes								
Belonidae (Needlefishes)								
Xenentodon cancila (Hamilton, 1822)	LC	NO	UN	DE	24	8	6	38
Clupeiformes								
Clupeidae (Herrings, shads, sprats, and others)								
Gudusia chapra (Hamilton, 1822)	LC	NO	DE	ST	84	63	36	183
Corica soborna Hamilton, 1822	LC	NO	UN	DE	128	86	22	236
Engraulidae (Anchovies)								
Setipinna phasa (Hamilton, 1822)	LC	NO	DE	DE	12	8	4	24
Cypriniformes								
Balitoridae (River loaches)								
Acanthocobitis botia (Hamilton, 1822)	LC	DD	DE	UN	5	4	3	12
Cobitidae (Loaches)								
Botia dario (Hamilton, 1822)	LC	EN	UN	DE	5	3		8
Botia lohachata Chaudhuri, 1912	NE	EN	NE	DE	27			27
Lepidocephalichthys guntea (Hamilton, 1822)	LC	NO	UN	DE	29	25	12	66
Somileptus gongota (Hamilton, 1822)	NE	NO	NE	DE	7			7
Cyprinidae (Minnows or Carps)								
Amblypharyngodon mola (Hamilton, 1822)	LC	NO	ST	ST	78	96	63	237
Cabdio morar (Hamilton, 1822)	LC	DD	UN	ST	23	23	15	61
Cirrhinus reba (Hamilton, 1822)	LC	VU	ST	ST	18	8	3	29
Cirrhinus cirrhosus (Bloch, 1795)	VU	NO	DE	DE	2			2
Gibelion catla (Hamilton, 1822)	LC	NO	UN	DE	1			1
Labeo bata (Hamilton, 1822)	LC	EN	UN	DE	10	2	2	14
Labeo calbasu (Hamilton, 1822)	LC	EN	UN	DE	10	3	5	18
Labeo rohita (Hamilton, 1822)	LC	NO	UN	DE	2			2
Osteobrama cotio (Hamilton, 1822)	LC	EN	UN	DE	5	5	2	12
Puntius sarana (Hamilton, 1822)	LC	CR	UN	DE	3	1		4
Puntius sophore (Hamilton, 1822)	LC	NO	UN	ST	392	341	317	1050
Puntius ticto (Hamilton, 1822)	LC	VU	UN	DE	29	29	18	76
Salmophasia bacaila (Hamilton, 1822)	LC	NO	ST	ST	146	127	61	334
Salmophasia phulo (Hamilton, 1822)	LC	NO	UN	ST	94	64	87	245
Cyprinodontiformes								
Aplocheilidae (Asian Rivulines)								
Aplocheilus panchax (Hamilton, 1822)	LC	NO	UN	UN	13	18	13	44
Osteoglossiformes								
Osteoglossidae (Osteoglossids or Bonytongues)								
Chitala chitala (Hamilton, 1822)	NT	EN	DE	DE	2			2
Notopterus notopterus (Pallas, 1769)	LC	VU	UN	DE	5	2	3	10
Perciformes								
Ambassidae (Asiatic Glassfishes)								
Chanda nama Hamilton, 1822	LC	VU	DE	ST	70	43	33	146
Parambassis lala (Hamilton, 1822)	NT	NE	DE	DE	3	1		4
Parambassis ranga (Hamilton, 1822)	LC	VU	ST	ST	81	73	71	225
Anabantidae (Climbing Gouramies)								
Anabas testudineus (Bloch, 1792)	DD	NO	UN	DE	4	2		6
Channidae (Snakeheads)								
Channa punctata (Bloch, 1793)	LC	NO	UN	ST	2	1	1	4
Channa striata (Bloch, 1793)	LC	NO	UN	DE	6	4	2	12

continued...

Table 1: Continued

Systematic position and fish species	*Conservation status*		*Population trend*		*Number of individual recorded*			
	*Global**	*Local***	*Global**	*Local*	*S-1*	*S-2*	*S-3*	*All*
Gobiidae (Gobies)								
Glossogobius giuris (Hamilton, 1822)	LC	NO	UN	DE	46	12	6	64
Mastacembelidae (Spiny eels)								
Macrognathus aculeatus (Bloch, 1786)	NE	NE	NE	ST	13	5	1	19
Mastacembelus armatus (Lacepède, 1800)	LC	EN	UN	DE	3	1	1	5
Mastacembelus pancalus (Hamilton, 1822)	LC	NO	UN	DE	4	7	1	12
Mugilidae (Mullets)								
Rhinomugil corsula (Hamilton, 1822)	LC	NO	UN	DE	3	4	8	15
Nandidae (Asian Leaffishes)								
Badis badis (Hamilton, 1822)	LC	EN	UN	DE	3	2	1	6
Osphronemidae (Gouramies)								
Trichogaster chuna (Hamilton, 1822)	LC	NO	UN	DE	4	1	2	7
Trichogaster fasciata Bloch and Schneider, 1801	LC	NO	UN	DE	63	11	24	98
Trichogaster lalius (Hamilton, 1822)	LC	NO	UN	DE	16	6	6	28
Siluriformes								
Bagridae (Bagrid Catfishes)								
Mystus cavasius (Hamilton, 1822)	LC	VU	DE	ST	144	85	103	332
Mystus tengara (Hamilton, 1822)	LC	NO	UN	ST	41	33	31	105
Mystus vittatus (Bloch, 1794)	LC	NO	DE	DE	4	2	3	9
Rita rita (Hamilton, 1822)	LC	CR	DE	DE	5	1	1	7
Sperata aor (Hamilton, 1822)	LC	VU	ST	DE	2	1		3
Sperata seenghala (Sykes, 1839)	LC	EN	UN	DE	5	3	6	14
Clariidae (Airbreathing Catfishes)								
Clarias batrachus (Linneaeus, 1758)	LC	NO	UN	DE	1		1	2
Heteropneustidae (Airsac Catfishes)								
Heteropneustes fossilis (Bloch, 1794)	LC	NO	ST	DE	1			1
Pangasiidae (Shark Catfishes)								
Pangasius pangasius (Hamilton, 1822)	LC	CR	DE	DE	4	2	1	7
Schilbeidae (Schilbeid Catfishes)								
Ailia coila (Hamilton, 1822)	TH	NO	DE	DE	37	11	8	56
Clupisoma garua (Hamilton, 1822)	LC	CR	DE	ST	12	5	6	23
Eutropiichthys vacha (Hamilton, 1822)	LC	CR	DE	DE	8	2	4	14
Neotropius atherinoides (Bloch, 1794)	LC	NO	UN	DE	36	10	15	61
Siluridae (Sheatfishes)						2	1	3
Ompok bimaculatus (Bloch, 1794)	NT	EN	UN	DE	5			5
Ompok pabda (Hamilton, 1822)	NT	EN	DE	DE	2			2
Wallago attu (Bloch & Schneider, 1801)	NT	NO	DE	DE	5	1	3	9
Sisoridae/Bagariidae (Sisorid Catfishes)								
Bagarius bagarius (Hamilton, 1822)	NT	CR	DE	DE			1	1
Gagata cenia (Hamilton, 1822)	LC	NO	UN	UN	7	8	4	19
Glyptothorax telchitta (Hamilton, 1822)	LC	DD	UN	UN	2			2
Synbranchiformes								
Synbranchidae (Swamp eels)								
Monopterus cuchia (Hamilton, 1822)	LC	VU	UN	DE			1	1
Tetraodontiformes								
Tetraodontidae (Puffers)								
Tetraodon cutcutia (Hamilton, 1822)	LC	NO	UN	DE	7	3	3	13

** based on IUCN (2015); **based on IUCN Bangladesh (2000)*
Conservation status: CR, Critically Endangered; DD, Data Deficient; EN, Endangered; LC, Least Concern; NE, Not Evaluated; NO, Not Threatened; NT, Near Threatened; TH, Threatened; VU, Vulnerable
Population trends: DE, Decreasing; ST, Stable; UN, Unknown

The number of recorded fish species was quite similar to the findings of several other researchers who have studied the fish fauna of riverine ecosystem of Bangladesh in last decade. In river Padma, where the Mahananda Rivers joins finally at Chapai Nawabganj Sadar sub-district, occurrence of a total of 69 and 71 fish species were recorded by Mohsin *et al.* (2013) and Joadder *et al.* (2015) and almost all the recorded species were same in all these studies except for some variations. In another study by Samad *et al.* (2010) reported 57 small indigenous fish species (SIS) from the Padma River which is close to the number of species recorded in present research. As almost all the rivers, expect those in hilly districts of south-eastern part of Bangladesh, belong to three main river systems- the Ganges, Brahmaputra and Meghna (Hossain 2014b); and as the land area of country is not too large so similarity of fish species availability can be expected in freshwater rivers.

In the Choto Jamuna River of adjacent Naogaon district, 63 fish species under 11 genera, 13 families and 9 orders were reported by Galib *et al.* (2013) which is very much similar to the present research findings. Another study that was carried out in the Atrai River of same district (Naogaon) revealed the presence of 74 fish species including 8 exotic species. Presence of similar fish species was also noticed in this case too. All these represents that there was closeness in species availability in all these rivers and this is due to geographical location of sampling sites.

Variation was found while comparing the findings of the present study with fish diversity of Andharmanik River, a river located at a distant district of Patuakhali of southern part of Bangladesh. Although the number of species in both rivers did not vary to a great extent but species composition was found different (Mohsin *et al.* 2014).

Seasonal variation of fish fauna

Seasonal variation in number of individuals caught and species are shown in Figure 2. Sampling site S-1 was the most diversified sampling spot in terms of not only the number of individual fish caught but also the number of species present represented by mean (±SE) individuals of 151.50±25.22 and mean(±SE) species of 25.58±3.91. The lowest number of fish species and number of individual fish were recorded in sampling site S-3 with mean(±SE) value of 15.25±2.28 and 85.08±16.06 respectively. At sampling spot S-2, mean(±SE) number of fish species and number of individuals recorded were found as 18.33±2.92 and 104.83±20.95 respectively. Decreasing trend of number of fish species and individuals along downstream of river Brahmaputra was reported by Galib (2015) which justifies the variation in species and individuals harvested at different sampling sites in this research.

The highest number of species was recorded in December at two sampling sites, 50 species at S-1 and 38 species at S-2; whereas, the highest number of fish species recorded at S-3 was 27 and it was recorded in November (Figure 2). Among all the sampling locations, the lowest number of species (4) was found at S-2 and S-3 in May and April respectively. On the other hand, the highest number of individual fish (313) caught at S-1 in August and the lowest was 9 at S-2 in April. Galib *et al.* (2013) recorded presence of the highest number of fish species in the Choto Jamuna River in February, November and December. All these are winter months in Bangladesh and water level of any water bodies starts to decrease during this time and large number and amount of catch is generally made by the fishermen in almost all the water bodies of country. Similar trend of monthly occurrence of fish species in different water bodies of Bangladesh was also revealed through several other studies (Mohsin *et al.* 2013; Joadder *et al*. 2015).

Apart from the indigenous fish individuals, nine specimens of two exotic fish species (6 individuals of *H. molitrix* and 3 individuals *P. hypothalamus*) were also caught at sampling site S-2 and S-3. It is believed that these species were escaped from nearby adjacent aquaculture ponds during heavy rain. Entrance of alien species into the river ecosystem in the same way has already been reported in Bangladesh (Galib *et al.* 2009; Mohsin *et al.* 2014).

The high number of individuals was found in the catches made from July to September. During these three months mean (±SD) individual caught was found 611.67±49. Heavy rain during this period is common in Bangladesh and almost all the water bodies remain full of water this time. The highest number of catch was made in August (668 individuals). As majority of the fish freshwater species in Bangladesh breed during monsoon- presence of large number of individual fishes as well as species in the fishing gears are commonly occurred.

Catch, those were made between October and December represents a major part of total harvest. During this time water level in almost all the water bodies goes down, especially those are in northern part of Bangladesh. The lowest catch was made from February to May. This is largely due to insufficient water in the river during this period. Water level reduced to a great extent during this time, and some parts of the river dried up completely led to a situation when fishing became a tough job to do.

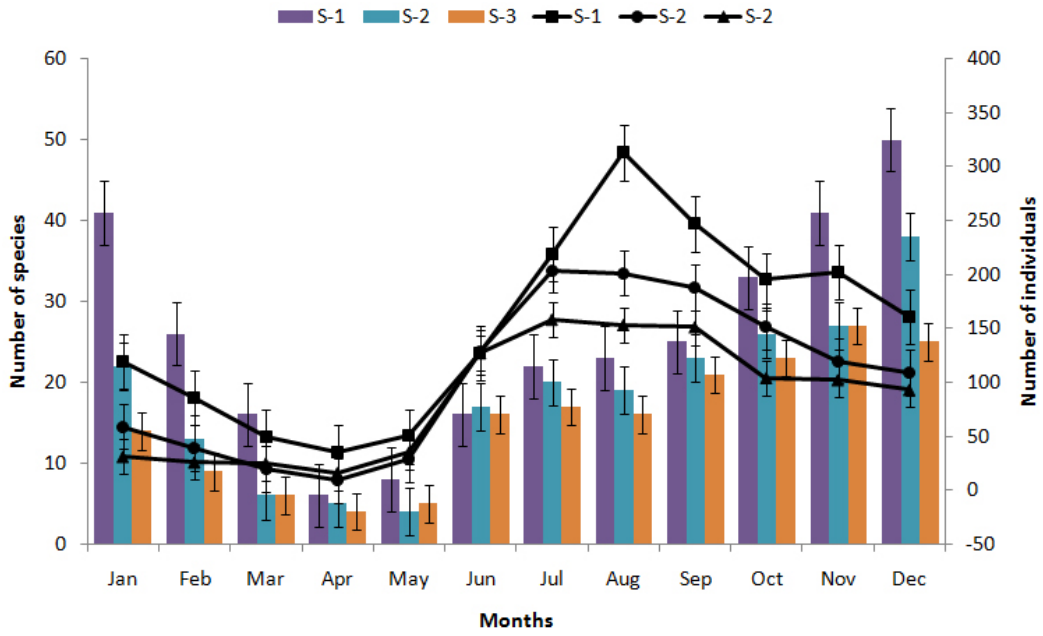

Figure 2: Seasonal variation in number of individuals (lines) and fish species (columns) at different sampling sites in the Mahananda River during January to December 2013

Community structure of fishes

A similarity cluster analysis of Bray-Curtis demonstrated that there were divisions in fish community structure at the sampling sites and three significantly different groups were detected (Figure 3). Group A represented six families (F-2, F-5, F-9, F-16, F-17 and F-21); whereas, group B composed of four families (F-10, F-15, F-18, F-20). Group C represented the largest parts of families (48% of the total families) of recorded fishes (Figure 3).

The most abundant fish species in the Mahananda River was *P. sophore*, represented by 1050 individuals with relative abundance (RA) of 25.72% of the total individuals of indigenous fish species. Next to this barb, *S. bacaila* (334 individuals, 8.18% RA) and *M. cavasius* (332 individuals, 8.13% RA) were two dominant native fish species. *P. sophore* is an abundant and widespread SIS in Bangladesh and very common in catches. In a study carried out to assess the fish biodiversity in the Halti Beel of Bangladesh, Imteazzaman and Galib (2013) found this species (*P. sophore*) as the most dominant species represented by 1234 individuals (8.03 RA). Imteazzaman and Galib (2013) also reported that *M. cavasius* and *S. bacaila* ranked 5th (6.08% RA) and 13th (2.98% RA) respectively in terms of number or proportion of individuals in the total catch. All these species were belonging to SIS group and reflected their common availability in natural water bodies of Bangladesh. Presence of large number of SIS in natural waters of Bangladesh has already been reported by several researchers (Galib *et al.* 2010; Samad *et al.* 2010; Kostori *et al.* 2011).

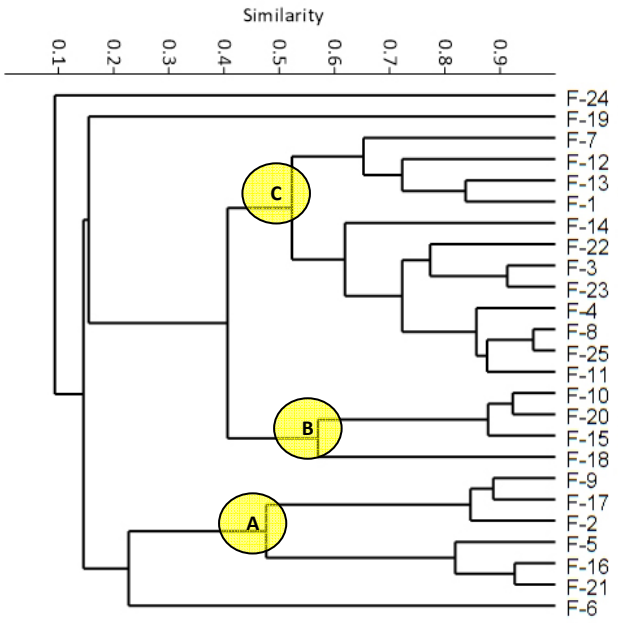

Figure 3: Bray-Curtis cluster analysis of similarity of different families of indigenous fishes based on number of individuals belonging to each family at three sampling sites during January to December, 2013 (F-1, Belonidae; F-2, Clupeidae; F-3, Engraulidae; F-4, Balitoridae; F-5, Cobitidae; F-6, Cyprinidae; F-7, Aplocheilidae; F-8, Osteoglossidae; F-9, Ambassidae; F-10, Anabantidae; F-11, Channidae; F-12, Gobiidae; F-13, Mastacembelidae; F-14, Mugilidae; F-15, Nandidae; F-16, Osphronemidae; F-17, Bagridae; F-18, Clariidae; F-19, Heteropneustidae; F-20, Pangasiidae; F-21, Schilbeidae; F-22, Siluridae; F-23, Sisoridae; F-24, Synbranchidae; and F-25, Tetraodontidae)

The dominant fish order was found Cypriniformes (2205 individuals, 54.02% RA) followed by Siluriformes (675 individuals, 16.54% RA), Perciformes (651 individuals, 15.95% RA), Clupeiformes (443 individuals, 10.85% RA) and so on. Cypriniform fishes are very common in water bodies of Bangladesh and being reported to form the largest portion of catch in several researches (Galib *et al.* 2013; Imteazzaman and Galib 2013).

Comparison of fish assemblages

The present findings was compared with the findings of Mohsin and Haque (2009) and presented in Figure 4. In both of the studies, more or less similar fish fauna were recorded that can be classified into similar orders. Equal number of indigenous fish species was recorded in both of the studies for five fish orders *i.e.* Beloniformes, Cypriniformes, Cyprinodontiformes, Synbranchiformes and Tetraodontiformes and they were represented by 1, 19, 1, 1 and 1 species respectively. However, slight increase in the number of fish species in present research was recorded for three fish orders- Osteoglossiformes, Perciformes and Siluriformes (Figure 4). Number of exotic fish species was also found higher in the present study than that of Mohsin and Haque (2009) who have recorded only *H. molitrix* in the Mahananda River. In this study in addition to *H. molitrix*, *P. hypophthalmus* (locally called Thai pangus) was also recorded from the river.

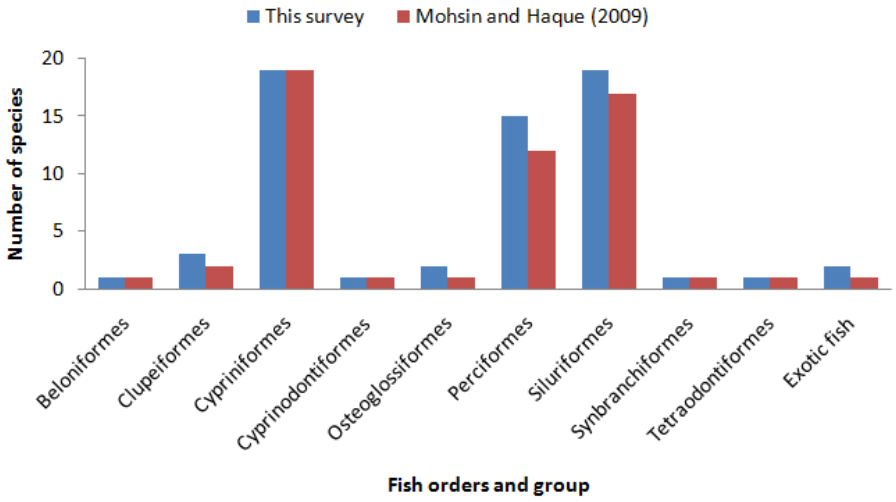

Figure 4: Comparison of number of fish species in the Mahananda River belonging to different orders and exotic fish between present study (2013) and Mohsin and Haque (2009)

Conservation status and population trends of fish species

Conservation status and population trends are shown in Table 1. Global conservation status of majority of the collected fish species (50; 80.65%) were belonging to Least Concern category of IUCN. One globally Threatened species, *A. coila* and one globally Vulnerable species, *C. cirrhosus* were also recorded from the sampling sites. *C. cirrhosus* was represented by only two individuals caught at S-1. Whereas, *A. coila* was harvested from all three sampling spots and represented by 56 individuals. There were six species which considered Near Threatened globally also found from the river. Galib (2015) reported that majority (82%) of the fish species available in the Brahmapurta River in Bangladesh were belonging to Lest Concern category of IUCN. Slightly lower percentage (72%) of species of fishes in the Padma River was found Least Concern (Joadder *et al.* 2015).

On the other hand, in case of local conservation status a total of 32 species (51.61% of the total species) were belonging to Not Threatened category. However, over two-fifth (40.32%, 25 species) of the recorded fish species were treated as threatened to extinct species in freshwater habitats of Bangladesh. Local conservation status of these species were Vulnerable (12.90%, 8 species), Endangered (17.74%, 11 species) and Critically Endangered (9.68%, 6 species). The total number of threatened to extinct freshwater fish species is 54 (IUCN Bangladesh 2000) and nearly half of these species were available in the Mahananda River which justified itself for being a suitable place for natural conservation of threatened aquatic biota. Similar potentiality was also reported by several researchers while working with similar issues in various natural waters of Bangladesh (e.g. Galib *et al.* 2013; Imteazzaman and Galib 2013; Mohsin *et al.* 2013).

Global population trends of majority of the fish species (58.06%, 36 species) was found as Unknown. However, this trend of over one-fourth of the total fish species recorded from the Mahananda River was reported Decreasing, as per IUCN (2015). Both of these statuses are not satisfactory for effective and sustainable management of aquatic resources because in order to initiate a successful management program, important information like population trends must be known. Similar global population trends of fishes were also

reported by various researchers during their work on fish biodiversity in different water bodies of Bangladesh (Chaki *et al.* 2014; Galib 2015).

Results generated through interviews and ranking by the experienced fishermen revealed that population trend of over two-third (70.97%, 44 species) fish species in the Mahananda River was Decreasing followed by Stable (22.58%, 14 species) and Unknown (6.45%, 4 species) (Table 1).

Current threats

During last couple of decades, rivers and wetlands in Bangladesh have been drastically modified for development of communication systems and agricultural uses with the construction of roads, bridges, and dams. Similar observation was also made by Hossain (2014b) who mentioned that almost all the dams or embankments affect directly successful breeding and feeding migration of indigenous fish species in Bangladesh. Lack of sufficient water during dry season in the Mahananda was observed from the current survey. It was observed that medium to large fishing boats of fishermen lied idle on the shallow water of the Mahananda River during dry months, especially from mid January to April. Local fishermen believed that the once mighty river has largely dried up in recent years due to withdrawal of its water upstream, throwing themselves out of work. Insufficient rain in last two decades in Bangladesh has been recognized as one of the drivers of modifying water bodies (Hossain 2014b). Modification of rivers for agricultural purposes is not only a threat in Bangladesh but also in many other countries of the world. Similar scenario was also reported from India (Nath and Deka 2012) and South Korea (Jang *et al.* 2003). Installment of effective fish passes and modification of road transport systems with less-hampering structures (e.g. large bridges) are required to enable movement of aquatic organisms within nearby water bodies during flood and dry season. This measure is especially required because most native fish species are migratory and rely on seasonal flooding or rain for spawning.

Use of illegal fishing nets, especially a species type of gill net locally called current *jal* was another threat to fish biodiversity of the Mahananda River. Although, use of this fishing net has been declared banned by the government in country but many fishermen use them in absence of concerned officials. There are rules and regulations regarding the use of fishing gears, regulation of mesh size of net, time of fishing and size of catch in country but unfortunately they are not implemented always leading to a loss of fish diversity. Similar problem was also reported by Nath and Deka (2012) from India.

During dry period, it was also observed that people grew paddy in dried areas near river banks and applied various chemicals in their fields to control harmful insects and to enhance the rice production. This clearly poses a threat to aquatic biodiversity of the river.

Occurrence of exotic fishes also a potential threat to native aquatic biodiversity. Large numbers of exotic fish have been introduced in Bangladesh for various purposes chiefly for aquaculture. It is widely known that introduced fish species can severely affect native ecosystems through various mechanisms (Ross 1991) but there is limited information regarding the status of introduced fishes in natural waters of Bangladesh. It was revealed from both the survey and fishermen's interview that occurrence of *H. molitrix* is common in the catches. However, *P. hopophthalmus* is an aggressive predatory fish species and can be a serious threat to native aquatic biota; especially to those who are small in size. This species was introduced in Bangladesh in 1990 from Thailand and now being used as popular ornamental and aquaculture species (Galib and Mohsin 2010). Permanent establishment of *H. molitrix* in natural waters of Bangladesh has already been reported (Rahman 2007; Galib and Mohsin 2011). Some negative impacts of two recorded exotic species have already been stated by Hossain (2014b). He mentioned that *H. molitrix* can compete with indigenous *Catla catla* for food and habitat; on the other hand, *P. hypophthalmus* is being reported to feed on SIS and led to disappearance of these species, especially in closed waters.

CONCLUSION

Immediate conservation steps should be taken to conserve the existing fish species of the Mahananda River. Strict implementation of rules and regulation to control use of illegal fishing gears in river is strongly recommended. Establishment of sanctuary in the river is also suggested where there will be no fishing activities. Establishment of legal protection for certain threatened species can be a solution to save the decreasing aquatic biodiversity, especially those are rated Critically Endangered in Bangladesh

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REFERENCES

Baby SN (2015) Mahananda River. Banglapedia the national encyclopedia of Bangladesh. Retrieved on 15 July 2015. http://en.banglapedia.org/index.php?title=Mahananda_River

Chaki N, Jahan S, Fahad MFH, Galib SM and Mohsin ABM (2014) Environment and fish fauna of the Atrai River: global and local conservation perspective. Journal of Fisheries 2(3): 163-172. DOI: 10.17017/jfish.v2i3.2014.46

Froese R and Pauly D (Eds) (2015) List of Freshwater Fishes reported from Bangladesh. FishBase, World Wide Web electronic publication. www.fishbase.org, version (10/2015)

Galib SM (2015) Fish fauna of the Brahmaputra River, Bangladesh: richness, threats and conservation needs. Journal of Fisheries 3(3): 285-292. DOI: 10.17017/jfish.v3i3.2015.120

Galib SM and Mohsin ABM (2010) Exotic ornamental fishes of Bangladesh. Bangladesh Journal of Progressive Science and Technology 8(2): 255-258.

Galib SM and Mohsin ABM (2011) Cultured and ornamental exotic fishes of Bangladesh: past and present. LAP-Lambert Academic Publishing, Germany. 167 pp.

Galib SM, Naser SMA, Mohsin ABM, Chaki N and Fahad MFH (2013) Fish diversity of the River Choto Jamuna, Bangladesh: Present status and conservation needs. International Journal of Biodiversity and Conservation 5(6): 389-395. DOI: 10.5897/IJBC2013. 0552

Galib SM, Samad MA, Mohsin ABM, Flowra FA and Alam MT (2009) Present status of fishes in the Chalan Beel- the largest beel (wetland) of Bangladesh. International Journal of Animal and Fisheries Science 2(3): 214-218.

Harper DAT (ed.) (1999) Numerical Palaeobiology. John Wiley & Sons, New York.

Hossain MAR (2014a) Habitat and fish diversity: Bangladesh perspective, pp 1-26. In: Wahab MA, Shah MS, Hossain MAR, Barman BK and Hoq ME (eds.), Advances in Fisheries Research in Bangladesh: I. Proc. of 5th Fisheries Conference & Research Fair 2012. 18-19 January 2012, Bangladesh Agricultural Research Council, Dhaka, Bangladesh Fisheries Research Forum, Dhaka, Bangladesh. 246 pp.

Hossain MAR (2014b) An overview of fisheries sector of Bangladesh. Research in Agriculture, Livestock and Fisheries 1(1): 109-126.

Imteazzaman AM and Galib SM (2013) Fish Fauna of Halti Beel, Bangladesh. International Journal of Current Research 5(1): 187-190.

IUCN (2015) The IUCN Red List of Threatened Species. Version 2015-3. Downloaded on 02 August 2015.

IUCN Bangladesh (2000) Red book of threatened fishes of Bangladesh. IUCN- The world conservation Union. 116 pp.

Jang M, Lucas MC and Joo G (2003) The fish fauna of mountain streams in South Korean national parks and its significance to conservation of regional freshwater fish biodiversity. Biological Conservation 114(1): 115-126. DOI: 10.1016/S0006-3207(03)00016-8

Joadder MAR, Galib SM, Haque SMM and Chaki N (2015) Fishes of the river Padma, Bangladesh: Current trend and conservation status. Journal of Fisheries 3(2): 259-266. DOI: 10.17017/jfish.v3i2.2015.111

Kostori FA, Parween S and Islam MN (2011) Availability of small indigenous species (SIS) of fish in the Chalan Beel - the largest wetland of Bangladesh. University Journal of Zoology, Rajshahi University 30: 67-72. DOI: 10.3329/ujzru.v30i0.10756

Mohsin ABM and Haque E (2009) Diversity of fishes of Mahananda River at Chapai Nawabganj district. Research Journal of Biological Sciences 4(7): 828-831.

Mohsin ABM, Haque SMM, Galib SM, Fahad MFH, Chaki N, Islam MN and Rahman MM (2013) Seasonal abundance of fin fishes in the Padma River at Rajshahi district, Bangladesh. World Journal of Fish and Marine Sciences 5(6): 680-685. DOI: 10.5829/idosi.wjfms.2013.05.05.75109

Mohsin ABM, Yeasmin F, Galib SM, Alam B and Haque SMM (2014) Fish fauna of the Andharmanik River in Patuakhali, Bangladesh. Middle-East Journal of Scientific Research 21(5): 802-807. DOI: 10.5829/idosi.mejsr.2014.21.05.8415

Nath B and Deka C (2012) A study on fish diversity, conservation status and anthropogenic stress of Chandubi tectonic lake, Assam, India. Journal of Bio Innovation 1(6): 48-55.

Nelson JS (2006) Fishes of the World, fourth edition, John Wiley & Sons, Inc. 601 pp.

Rahman AKA (1989) Freshwater fishes of Bangladesh, first edition. Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka 1000, Bangladesh. 364 pp.

Rahman AKA (2005) Freshwater Fishes of Bangladesh, 2nd edition, Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka 1000, Bangladesh. 263 pp.

Rahman AKA (2007) Exotic fishes and their impact on environment. 16th Annual General Meeting and National Conference 2007, Zoological Society of Bangladesh, 30 March, Dhaka, Bangladesh, pp. 26-39.

Ross ST (1991) Mechanisms structuring stream fish assemblages: are there lessons from introduced species. Environmental Biology of Fish 30(4): 359-368. DOI: 10.1007/BF02027979

Samad MA, Asaduzzaman M, Galib SM, Kamal MM and Haque MR (2010) Availability and Consumer Preference of Small Indigenous Species (SIS) of the River Padma at Rajshahi, Bangladesh. International Journal of BioResearch 1(5): 27-31.

Talwar PK and Jhingran AG (1991) In land fishes of India and adjacent countries, Vol. 1 and 2. Oxford & IBH Publishing Company Pvt. Ltd, New Delhi, India. 1158 pp.

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