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Environment and fish fauna of the Atrai River: global and local conservation perspective

Nipa Chaki[1] • Sayka Jahan[2] • Md. Foyzul Hassan Fahad[1] • Shams Muhammad Galib[1] • ABM Mohsin[1]

[1] *Aquatic Biodiversity Lab, Department of Fisheries, Faculty of Agriculture, University of Rajshahi, Rajshahi-6205, Bangladesh*

[2] *Department of Environmental Science and Technology, Jessore University of Science and Technology, Jessore-7408, Bangladesh*

Correspondence: Shams Muhammad Galib, Department of Fisheries, Faculty of Agriculture, University of Rajshahi; Email: thegalib@gmail.com

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Abstract

The fish fauna of the Atrai River were studied for a period of two years from January 2011 to December 2012. Sampling was carried out by several fishing nets and traps on fortnight basis. A total of 74 fish species belonging to 27 families and 52 genera were recorded. Cyprinidae was the most dominant family contributing 18 species in 9 genera. Two alien species were found- *Hypophthalmichthys molitrix* and *Hypostomus plecostomus*. Thirty locally threatened species (Vulnerable 13.51%, Endangered 18.92% and Critically Endangered 8.11%) were recorded. But, no globally threatened species was found. Relative abundance of majority 36.49% species was rare. Global population trend of 24.32% recorded fish species was Declining. The highest number of species (42) was recorded in the November 2011. Whereas, the lowest the number of fish species (12) recorded in June and August 2011. Very high correlation was found between fish species and physical environmental parameters (air temperature, water temperature, and water transparency). This study concluded that Atrai River could be an excellent place for natural conservation of fish species. Nevertheless, efforts to maintain a sustainable fishing pressure, removal of existing alien species and avoiding further introduction of such species are recommended.

Keywords: Freshwater environment, Atrai River, fish diversity, fish conservation, population trend

INTRODUCTION

Bangladesh is a home to at least 265 freshwater fish species (Rahman 2005). Huge number of water bodies in various forms *viz.* pond, ditch, rivers, beels, haors, baors etc. support these large number of fish species. Atrai River is one of the major rivers in Bangladesh contributes a huge amount of fish to the people of the country. At present time, reduction in the abundance and fish species from the inland waters of Bangladesh is a burning issue in the country (Galib *et al.* 2009, Imteazzaman and Galib 2013). However, a total of 54 fish species of Bangladesh have been declared threatened by IUCN (IUCN Bangladesh 2000) but most of the wild populations have seriously declined in rivers and streams of Bangladesh due to over exploitation augmented by various ecological changes and degradation of the natural habitats (Galib *et al.* 2009, 2013a). All these findings clearly indicate the need for water body specific detailed biodiversity studies which is essential to assess the present status and for the sustainable management of a body of water (Galib *et al.* 2013a; Imteazzaman and Galib 2013). Though such type of research efforts are much common in neighbor countries like India (Dahanukar *et al.* 2012, Kharat *et al.* 2012, Baby *et al.* 2010, Jadhav *et al.* 2011, Patra 2011, Johnson and Arunachalam 2009, Heda 2009, Saha and Bordoloi 2009) but very few in Bangladesh.

Environmental parameters are very important for organisms living in a habitat. But there is no study where relationships have been shown between environmental parameters and seasonal abundance of fish in Bangladesh.

To the best knowledge of the authors only one previous research work has been conducted on fish fauna of Atrai River between August 2005 and July 2006 (Joadder 2009). This effort becomes an old one and updated study is required to know the present status of fish. Moreover, in the study by Joadder (2009) fish species were recorded from different fish landing centers and markets adjacent to Atrai River which did not ensure the accuracy of the findings. Thus the present study was carried out with a view to preparing an updated checklist of fish species focusing their relative abundance in the Atrai River, global and national conservation status, and global population trend. Also, relationship between environmental parameters and availability of fishes was established in this research.

METHODOLOGY

Study area and duration: The study was conducted at three points (site I: 88°56' E and 24°38' N; site II: 88°58' E and 24°37' N; site III: 89°01' E and 24°35' N) of the Atrai River under Atrai Upazila (sub-district) of Naogaon district, Bangladesh between (Figure 1). Fish were collected for two years on fortnight basis, from January 2011 to December 2012.

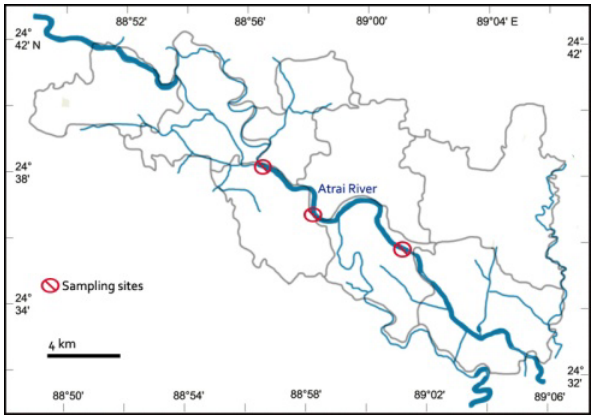

Figure 1: Sampling spots in the Atrai River

Sampling: Fish were caught by a variety of fishing nets (cast net, seine net, drag net, and lift net) and traps (locally called *Kholsun*, *Britti* and *Dohair*). All these fishing gears were operated with the help of professional fishermen.

Specimen preservation and identification: Fish were preserved in 5-7% buffered formalin and identified using following literatures- Rahman (1989 and 2005) and Talwar and Jhingran (1991). After identification, fish were classified following Nelson (2006). Collected fish were deposited at the Aquatic Biodiversity Lab, Department of Fisheries, University of Rajshahi, Rajshahi, Bangladesh.

Relative abundance of fish: To measure the relative abundance of fishes, we followed Jadhav *et al.* (2011) with slight modification *i.e*. abundant (76-100% of the total catch), common (51-75% of the total catch), moderate (26-50% of the total catch), low (11-25% of the total catch) and rare (1-10% of the total catch).

Global and local conservation status, and population trend: Global conservation status and population trend were detected following IUCN (2014); whereas following IUCN Bangladesh (2000), conservation status of recorded fish in Bangladesh was noted.

Study of aquatic environmental parameters: Important water quality parameters were measured using standard techniques to understand the state of aquatic environment. A HACH Kit Box (Model FF-2; USA) was used for the evaluation of dissolved oxygen (DO), free carbon dioxide, alkalinity, and pH. These parameters were measured according to Hach (1991). Air and water temperature was measured by means of a thermometer and a Secchi disc was used to measure the transparency level of water.

Data analysis: Statistical analyses were carried out using Microsoft Excel 2007 and Statistical Packages for Social Sciences (SPSS) version 15.00.

RESULTS AND DISCUSSION

Fish species diversity: A total of 74 fish species have been recorded belonging to 27 families and 52 genera (Table 1). Cyprinidae was the most dominant family contributing 18 species in 9 genera. Image 1 represents some of the fish species collected from the Atrai River.

Number of recorded species (74) was found lower than that of the number of fish species by Joadder (2009) who recorded 78 fin fish species from the same river. However, almost all the common exotic aquaculture species of Bangladesh (*Oreochromis mossambicus*, *O. niloticus*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Cyprinus carpio communis, Cyprinus carpio specularis, Puntius gonionotus*, and *Clarias gariepinus*) were recorded in his study, but did not found in the present study except *H. molitrix*. This variation is mostly due to difference in the way of conducting study. Joadder (2009) surveyed fish markets and landing centers where fishes from both the Atrai River and nearby aquaculture ponds are landed. Lower number of fish species (63) was recorded by *Galib et al.*

(2013a) in the Choto Jamuna River, a tributary of the Atrai River reflecting that fishes were more abundant in the main stream of river. Sixty nine fish species were reported in the river Padma by Mohsin *et al.* (2013). In a coastal river, the Andharmanik, 54 species fish species were recorded by Mohsin *et al.* (2014). Galib *et al.* (2009) recorded 81 fish species in the Chalan Beel, the largest wetland of Bangladesh located in nearby areas of study areas.

Table 1: List of freshwater fishes from Atrai River

Family/Species	***Conservation status***		***Relative abundance***	***Global pop. trend[2]***
	Bangladesh[1]	***Global[2]***		
Belonidae (Needlefishes)				
Xenentodon cancila (Hamilton, 1822)	NO	LC	L	U
Clupeidae (Herrings: Shads, Sprats, Sardines, Pilchards, and Menhadens)				
Gudusia chapra (Hamilton, 1822)	NO	LC	A	D
Corica soborna Hamilton, 1822	NO	LC	M	U
Engraulidae (Anchovies)				
Setipinna phasa (Hamilton, 1822)	NO	LC	R	D
Cyprinidae (Minnows and Carps)				
Amblypharyngodon mola (Hamilton, 1822)	NO	LC	A	S
Catla catla (Hamilton, 1822)	NO	LC	R	U
Cirrhinus mrigala (Bloch, 1795)	NO	LC	R	S
Cirrhinus reba (Hamilton, 1822)	VU	LC	L	S
Esomus danricus (Hamilton, 1822)	NO	LC	C	S
Hypophthalmichthys molitrix (Valenciennes, 1844)	EX	NT	R	D
Labeo bata (Hamilton, 1822)	EN	LC	C	U
Labeo calbasu (Hamilton, 1822)	EN	LC	L	U
Labeo gonius (Hamilton, 1822)	EN	LC	R	U
Labeo rohita (Hamilton, 1822)	NO	LC	L	U
Puntius sarana (Hamilton, 1822)	CR	LC	L	U
Puntius phutunio (Hamilton, 1822)	NO	LC	R	U
Puntius sophore (Hamilton, 1822)	NO	LC	A	U
Puntius chola (Hamilton, 1822)	NO	LC	C	U
Puntius ticto (Hamilton, 1822)	VU	LC	L	U
Osteobrama cotio (Hamilton, 1822)	EN	LC	R	U
Salmostoma bacaila (Hamilton, 1822)	NO	LC	C	S
Salmophasia phulo (Hamilton, 1822)	NO	LC	C	U
Cobitidae (Loaches)				
Acanthocobitis botia (Hamilton, 1822)	NO	LC	R	D
Botia dario (Hamilton, 1822)	EN	LC	R	U
Botia lohachata Chaudhuri, 1912	EN	NA	R	NA
Lepidocephalus guntea (Hamilton, 1822)	NO	LC	L	S
Somileptus gongota (Hamilton, 1822)	NO	LC	R	U
Ambassidae/Chandidae (Asiatic Glassfishes)				
Chanda nama Hamilton, 1822	VU	LC	A	D
Chanda ranga Hamilton, 1822	VU	LC	A	S
Chanda lala Hamilton, 1822	NO	NT	R	D
Anabantidae (Climbing Goumaries)				
Anabas testudineus (Bloch, 1792)	NO	DD	L	U
Channidae (Snakeheads)				
Channa punctata (Bloch, 1793)	NO	LC	C	U
Channa orientalis Bloch & Schneider, 1801	VU	NA	R	NA
Channa striata (Bloch, 1793)	NO	LC	C	U
Channa marulius (Hamilton, 1822)	EN	LC	R	U
Gobiidae (Gobies)				
Glossogobius giuris (Hamilton, 1822)	NO	LC	C	U
Nandidae (Asian Leaffishes)				
Badis badis (Hamilton, 1822)	EN	LC	R	U
Nandus nandus (Hamilton, 1822)	VU	LC	R	U

Table 1: Continued.

Family/Species	*Conservation status*		*Conservation status*	*Global pop. trend*[2]
	Bangladesh[1]	*Global*[2]		
Osphronemidae (Gouramies)				
Colisa fasciata (Bloch & Schneider, 1801)	NO	LC	M	U
Colisa lalia (Hamilton, 1822)	NO	LC	R	U
Trichogaster chuna (Hamilton, 1822)	NO	LC	R	U
Amblycipitidae (Torrent Catfishes)				
Amblyceps mangois (Hamilton, 1822)	NO	LC	R	U
Bagridae (Bagrid Catfishes)				
Mystus cavasius (Hamilton, 1822)	VU	LC	A	D
Mystus seenghala (Sykes, 1839)	EN	LC	A	U
Mystus aor (Hamilton, 1822)	VU	LC	M	S
Mystus tengara (Hamilton, 1822)	NO	LC	A	U
Mystus vittatus (Bloch, 1794)	NO	LC	M	D
Hemibagrus menoda (Hamilton, 1822)	NO	LC	L	U
Rita rita (Hamilton, 1822)	CR	LC	M	D
Chacidae (Squarehead, Angler, or Frogmouth Catfishes)				
Chaca chaca (Hamilton, 1822)	EN	LC	R	D
Clariidae (Airbreathing Catfishes)				
Clarias batrachus (Linneaeus, 1758)	NO	LC	L	U
Heteropneustidae (Airsac Catfishes)				
Heteropneustes fossilis (Bloch, 1794)	NO	LC	L	S
Loricariidae (Suckermouth Armored Catfishes)				
Hypostomus plecostomus (Linnaeus, 1758)	EX	NA	R	NA
Pangasiidae (Shark Catfishes)				
Pangasius pangasius (Hamilton, 1822)	CR	LC	L	D
Schilbeidae/Schilbidae (Schilbeid Catfishes)				
Ailia coila (Hamilton, 1822)	NO	NT	M	D
Eutropiichthys vacha (Hamilton, 1822)	CR	LC	M	D
Pseudeutropius atherinoides (Bloch, 1794)	NO	LC	C	U
Clupisoma garua (Hamilton, 1822)	CR	LC	L	D
Siluridae (Sheatfishes)				
Ompok pabda (Hamilton, 1822)	EN	NT	L	D
Ompok bimaculatus (Bloch, 1794)	EN	NT	A	U
Wallago attu (Bloch & Schneider, 1801)	NO	NT	A	D
Sisoridae (Sisorid Catfishes)				
Bagarius bagarius (Hamilton, 1822)	CR	NT	R	D
Gagata cenia (Hamilton, 1822)	NO	LC	R	U
Hara hara (Hamilton, 1822)	NO	LC	R	U
Glyptothorax telchitta (Hamilton, 1822)	NO	LC	R	U
Mastacembelidae (Spiny Eels)				
Mastacembelus pancalus (Hamilton, 1822)	NO	LC	L	U
Mastacembelus armatus (Lacepède, 1800)	EN	LC	C	U
Macrognathus aculeatus (Bloch, 1786)	NA	NA	C	NA
Synbranchidae (Swamp Eels)				
Monopterus cuchia (Hamilton, 1822)	VU	LC	L	U
Notopteridae (Featherfin Knifefishes or Old World Knifefishes)				
Chitala chitala (Hamilton, 1822)	EN	NT	R	D
Notopterus notopterus (Pallas, 1769)	VU	LC	M	U
Aplocheilidae (Asian Rivulines)				
Aplocheilus panchax (Hamilton, 1822)	NO	LC	L	U
Mugilidae (Mullets)				
Rhinomugil corsula (Hamilton, 1822)	NO	LC	R	U
Tetraodontidae (Puffers)				
Tetraodon cutcutia Hamilton, 1822	NO	LC	L	U

[1]as per IUCN Bangladesh (2000), [2]as per IUCN (2014). Conservation status: CR, Critically Endangered; DD, Data Deficient; EN, Endangered; EX, Exotic; LC, Least Concern; NA, has not been assessed for IUCN Redlist; NO, Not Threatened; NT, Near Threatened; VU, Vulnerable. Relative abundance: A, Abundant; C, Common; L, Low; M, Moderate; R, Rare. Global population trend: D, Decreasing; NA, has not been assessed; S, Stable; U, Unknown

Conservation status and population trend: A total of 30 fish species have been recorded from the present study considered threatened by IUCN Bangladesh (2000). These fishes were belonging to following categories - Vulnerable 13.51%, Endangered 18.92% and Critically Endangered 8.11% (Figure 2) whereas the total number of threatened species in Bangladesh is 54 (IUCN Bangladesh 2000). Of the total recorded species, 2.70% were exotic or introduced species in Bangladesh; these were *H. molitrix* and *Hypostomus plecostomus*.

Among the two alien species recorded, *H. molitrix* was introduced in Bangladesh for the purpose of aquaculture in 1969 from Hong Kong (Galib and Mohsin 2011, Rahman 2007). It is speculated that this popular aquaculture species has already been established itself into the natural waters of Bangladesh (Rahman 2007) and the present record indicates justification of such assumption. This species is commonly found all over the country and also a popular species not only in aquaculture ponds but also in integrated fish culture in rice fields (Galib *et al.* 2013b). However, this was not the first record of *H. molitrix* in the natural waters of Bangladesh. This species is also found in the Andharmanik River (Mohsin *et al.* 2014), Bookbhara Baor (Mohsin *et al.* 2009), Chalan Beel (Galib *et al.* 2009), Choto Jamuna River (Galib *et al.* 2013a), Halti Beel (Imteazzaman and Galib 2013), Padma River (Mohsin *et al.* 2013).

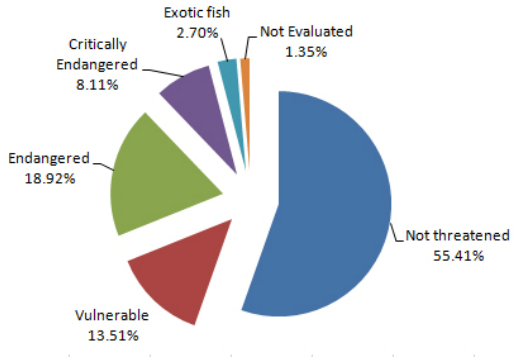

Figure 2: Conservation status of recorded fishes in Bangladesh

It is believed that during heavy flood this species has been escaped from adjacent culture ponds into Atrai River. It is essential to monitor the status of exotic fishes continuously to commence appropriate management steps in time. Similar comments were also made by Imteazzaman and Galib (2013) and Galib *et al.* (2013a) while working in a *beel* (wetland) and a river adjacent to the River Atrai.

H. plecostomus, a common aquarium fish species of Bangladesh (Galib and Mohsin 2010, Galib *et al.* 2013c) was also found to be established in the Atrai River. Nowadays, occurrence of small to large *H. plecostomus* in the catch of fishermen was common, especially during dry season. Like *H. molitrix* this record of *H. plecostomus* in nature was not the first in Bangladesh; prior to this study this species was also reported from several lakes and ponds of the country where they establish themselves like other native population through natural breeding (Galib and Mohsin 2010, Rahman 2007).

Global conservation status of the fishes is shown in Figure 3. Majority fishes were belonging to Least Concern category (82.43%) followed by Near Threatened (10.81%) and so on.

Based on the database of IUCN (2014), the global population trend of recorded fish species is presented in Figure 4. According to database, population trend of majority of the fishes (58.11%) recorded in the present study was Unknown. Almost one-fourth (24.32%) of the fishes were belonging to the Decreasing category.

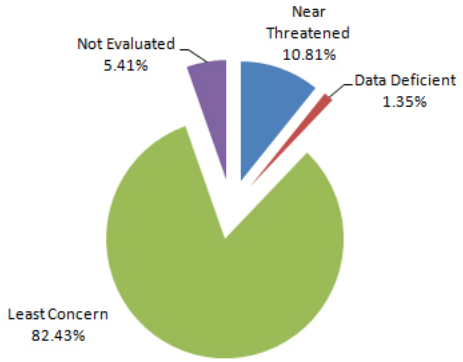

Figure 3: Global conservation status of fishes of the Atrai River

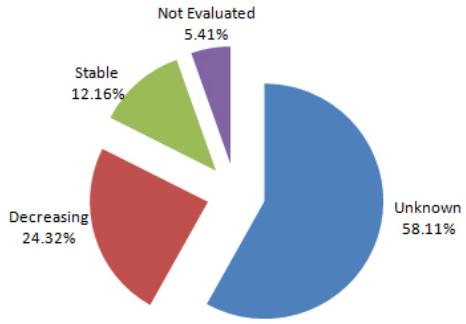

Figure 4: Global population trend of fishes of the Atrai River

Relative and seasonal abundance of fish species: Of the total 74 species, relative abundance of majority of the fishes (36.49%) was recorded as Rare (Table 1, Figure 5). Relative abundance of the fishes reflects the current scenario of fishes in open water bodies of Bangladesh. Because due to several causes like overfishing, fishing by illegal gears, and indiscriminate fishing of fry to brood fish have led abundance of indigenous fish population at

stake. The present findings might be of help to implement appropriate conservation management in time. Status of majority of the fishes (27%) was common in the Chalan Beel, and only 9% of the species were rare (Galib *et al.* 2009).

Several fish population including loaches (Cobitidae), Gouramies (Osphronemidae), Sisorid catfishes (Sisoridae) were declining in the study area and rapid conservation of these fish species is essential. Similar findings also reported by Mohsin *et al.* (2014). They have found that Gourami population was in similar condition in the Andharmanik River in Patuakhali district.

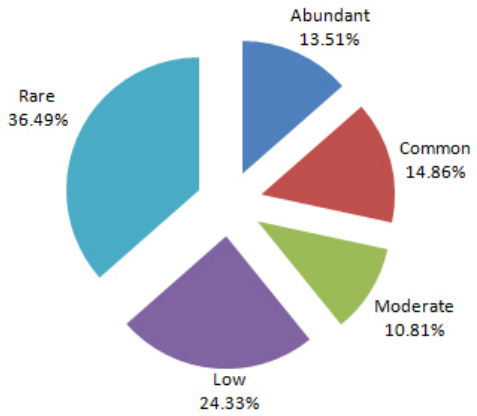

Figure 5: Relative abundance of fishes in the Atrai River

Seasonal abundance of fishes in the river Atrai is shown in Figure 6. The highest number of species (42) was recorded in the November 2011. Whereas, the lowest the number of fish species (12) recorded in June and August 2011.

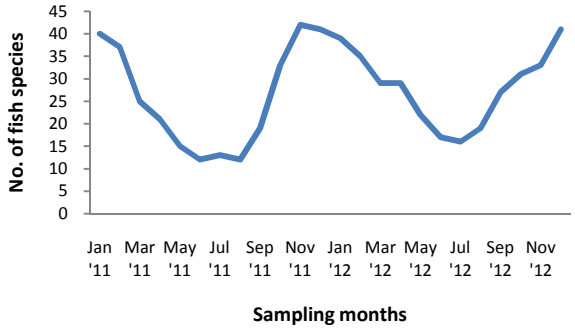

Figure 6: Seasonal abundance of fishes in the Atrai River

In a tidal river, the Andharmanik, Mohsin *et al.* (2014) reported quite similar findings; they have recorded the highest number of fish species (45) in the month of November whereas minimum 19 fish species was found in May. In the river Padma, a far greater number of fish species (67) has been reported by Mohsin *et al.* (2013) in the months of May, June, August, September, and December.

State of aquatic environment: There was a minor difference between air and water temperature (Table 2). The highest air temperature (33.15±0.87 °C) was recorded in the month of August 2012; whereas, the lowest air temperature (17.20±3.53 °C) was in December 2012. Mean air temperature was 23.92±4.20 °C. On the other hand, the highest and lowest water temperature were recorded in the month of October 2012 (30.90±0.50 °C) and December 2012 (17.20±2.27 °C) respectively. Water transparency changed in course of time. The highest transparency was found 36.40±3.52 cm in September 2011 and the lowest value of water transparency was recorded 14.90±3.42 cm in January 2012 (Table 2).

The physical condition of water is greatly influenced with all these factors; these are the determinant of the productivity of any aquatic habitat. Mean water temperature (24.73±4.31 °C) was favorable for almost all the fishes in the temperate zone (Rath 2000). Water transparency was found suitable for primary productivity as Rahman (1992) mentioned that less than 40 cm water transparency is favorable for enhancing the primary productivity of a water body.

The highest pH (8.10±0.29) was measured in December 2012. Whereas, the lowest pH was found 6.75±0.22 (March 2012). Dissolved oxygen level reached its peak (9.57±0.56 mg/l) in the month of September 2012 and downed to the lowest level (4.83±0.29 mg/l) in January 2011 (Table 2). The lowest free CO_2 was recorded 13.10±0.98 mg/l in August 2011 and the highest value (16.30±1.82 mg/l) was recorded in May 2012. The highest and the lowest alkalinity values were found as 149.20±18.02 mg/l (April 2012) and 85.68±16.42 mg/l (September 2012) respectively (Table 2).

pH was found to be varied between suitable range (6.5-8.5) for fish, as per FAO (1997). Rath (2000) also made similar comment. Rahman *et al.* (2006) recorded pH of 7.55-8.03 in the Rajdhala Beel which are very close to the values determined in the present study. Similar results were also recorded by other researchers (Hossain *et al.* 1997, Saha and Hossain 2002). Mean dissolved oxygen content (7.25±1.39 mg/l) can be considered good for growth of fish species (Rath 2000). Mean alkalinity (114.37±20.41 mg/l) was in suitable range for water productivity. Rath (2000) reported that calcareous water with alkalinity more than 50 mg/l is most productive. Alikunhi (1957) has reported that for a highly productive water body the alkalinity would be over 100 mg/l.

Table 2: State of aquatic environmental parameters (mean±SD) during the period of study

Month	*Air temperature (^{0}C)*	*Water temperature (^{0}C)*	*Water transparency (cm)*	*pH*	*DO (mg/l)*	*Free CO_2 (mg/l)*	*Alkalinity (mg/l)*
2011							
Jan	18.40±1.04	18.80±1.64	15.80±3.42	7.42±0.14	4.83±0.29	14.47±0.70	120.33±21.08
Feb	20.40±1.67	20.20±1.30	16.20±3.70	7.67±0.76	5.77±0.93	14.90±2.46	96.00±19.92
Mar	21.20±1.04	23.10±1.20	16.50±2.90	7.50±0.20	5.82±0.90	15.00±1.30	102.45±17.95
Apr	21.80±1.34	23.60±1.40	17.30±3.10	7.48±0.34	6.10±0.30	15.40±1.50	141.20±18.10
May	23.40±1.74	24.80±1.67	19.10±2.80	7.70±0.45	6.80±0.75	16.20±1.80	123.3±21.45
Jun	24.60±1.14	26.10±1.54	24.24±3.40	7.65±0.31	7.20±0.43	15.60±1.43	110.4±15.20
Jul	29.10±1.08	27.69±1.20	28.50±3.60	7.10±0.18	7.80±0.70	14.30±1.20	106.6±17.30
Aug	31.15±0.87	29.10±1.80	30.47±3.64	7.58±0.54	8.20±0.55	13.10±0.98	95.98±28.21
Sep	27.20±1.04	30.10±1.02	36.40±3.52	7.17±0.14	9.37±0.76	13.73±1.56	99.67±24.42
Oct	25.10±0.74	30.50±0.50	29.20±2.77	7.58±0.14	9.10±0.46	14.80±3.93	118.67±34.30
Nov	24.60±1.14	23.80±1.30	26.00±3.39	7.58±0.14	8.20±0.52	15.40±0.87	95.00±09.54
Dec	18.20±3.63	18.20±3.27	17.20±1.92	8.10±0.29	6.67±0.29	14.70±3.08	123.33±24.09
2012							
Jan	18.70±1.20	17.70±1.53	14.90±3.42	7.42±0.14	5.85±1.05	14.47±0.70	122.33±14.1
Feb	20.90±1.47	20.40±1.30	15.20±3.70	7.67±0.76	5.77±0.93	14.90±2.46	96.0±19.92
Mar	21.90±1.04	23.50±1.20	16.80±2.90	6.75±0.22	5.42±0.80	15.10±1.33	108.45±16.95
Apr	22.01±1.24	23.90±1.44	17.70±3.10	7.38±0.34	6.30±0.10	15.55±1.51	149.2±18.02
May	23.10±1.54	25.00±1.57	19.50±2.80	7.70±0.35	6.92±0.77	16.30±1.82	173.3±21.45
Jun	24.20±1.34	26.40±1.56	24.64±3.40	7.50±0.21	7.24±0.46	15.90±1.47	119.4±15.20
Jul	29.40±1.08	27.90±1.10	28.95±2.60	7.15±0.18	7.85±0.70	14.50±1.28	108.6±16.20
Aug	33.15±0.87	29.50±1.89	31.47±3.64	7.20±0.44	8.25±0.45	13.25±0.99	91.98±27.21
Sep	28.20±1.04	30.40±1.02	33.40±1.52	7.27±0.24	9.57±0.56	13.83±1.59	85.68±16.42
Oct	25.28±0.74	30.90±0.50	29.29±2.72	7.80±0.34	9.50±0.46	14.97±3.93	128.67±34.30
Nov	24.80±1.44	24.80±1.30	26.00±1.39	7.81±0.14	8.60±0.42	15.80±0.89	99.05±08.54
Dec	17.20±3.53	17.20±2.27	17.00±1.92	8.00±0.25	6.87±0.19	14.70±2.08	129.33±24.09
Mean	23.92±4.20	24.73±4.31	22.99±6.74	7.51±0.30	7.25±1.39	14.87±0.84	114.37±20.41

Relationship between environmental parameters and seasonal abundance of fishes: Table 3 shows the correlation between seasonal abundance of fishes and environmental parameters. Very high correlation was found between fish species and physical environmental parameters (air temperature, water temperature, and water transparency). No previous study was found to be conducted on the Atrai River where relationship between fish and environmental parameters was established, so it is not possible to compare present findings with the previous one.

Table 3: Correlation among seasonal abundance of fish and environmental parameters (Pearson correlation)

Parameters	*Air temp.*	*Water temp.*	*Water transparency*	*pH*	*DO*	*CO_2*	*Alkalinity*
Fish abundance	-0.683**	-0.641**	-0.466**	0.384	-0.268	0.071	0.031
Air temp.		0.871**	0.866**	-0.440*	0.706**	-0.464*	-0.418*
Water temp.			0.884**	-0.368	0.808**	-0.259	-0.224
Water transparency				-0.280	0.922**	-0.479*	-0.420*
pH					0.004	0.334	0.270
DO						-0.304	-0.285
CO_2							0.559**

*** Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

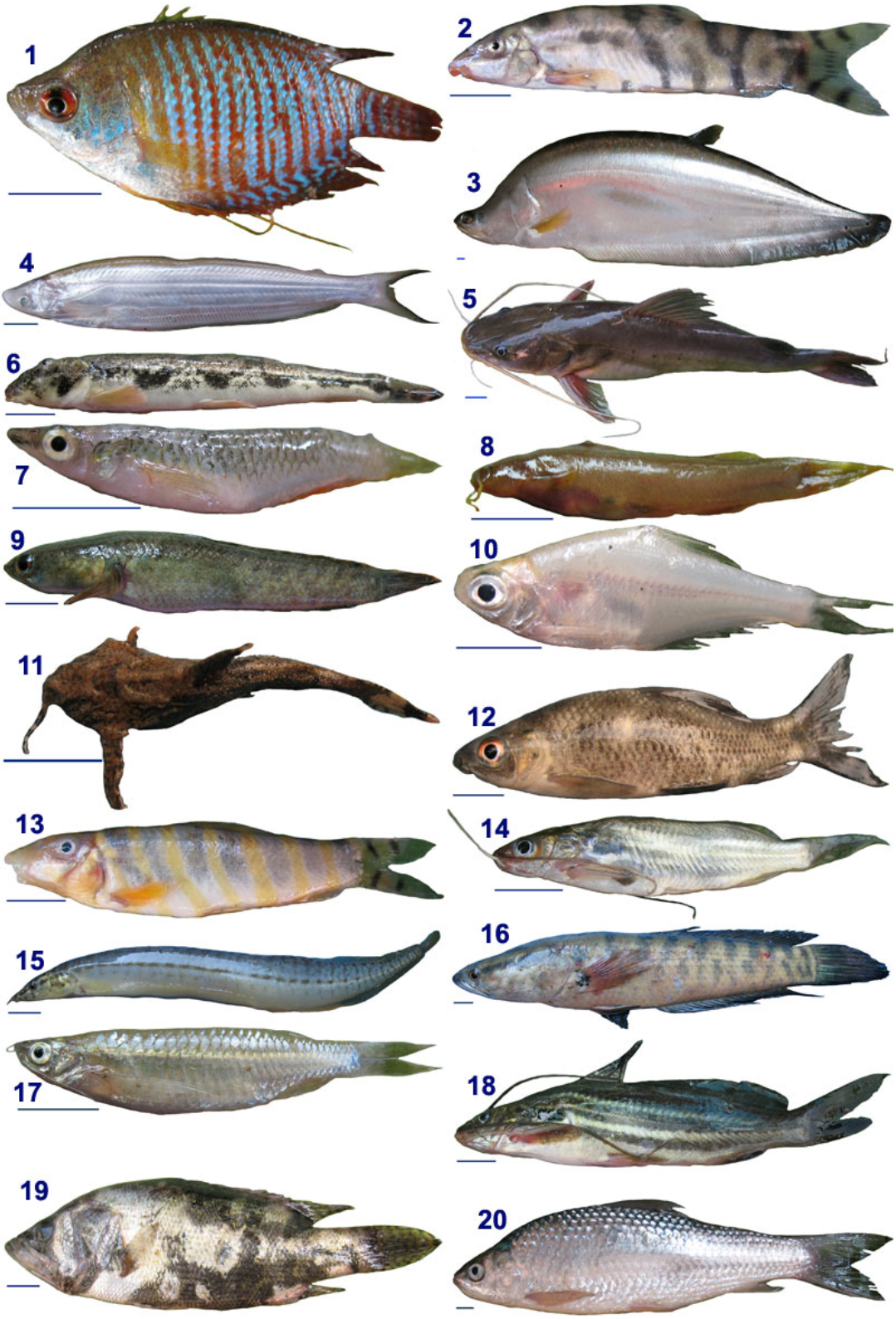

Image 1: Some fishes of the Atrai River. Line below each species indicates scale of 1 cm (1) *Colisa lalia*, (2) *Botia lohachata*, (3) *Chitala chitala*, (4) *Ailia coila*, (5) *Hemibagrus menoda*, (6) *Somileptus gongota*, (7) *Aplocheilus panchax*, (8) *Amblyceps mangois*, (9) *Channa orientalis*, (10) *Osteobrama cotio*, (11) *Hara hara*, (12) *Labeo calbasu*, (13) *Botia dario*, (14) *Mystus tengara*, (15) *Mastacembelus pancalus*, (16) *Channa striata*, (17) *Esomus danricus*, (18) *Mystus vittatus*, (19) *Nandus nandus*, and (20) *Labeo bata*.

CONCLUSION

In conclusion, still there was a rich diversity of fishes in the Atrai River, though anthropogenic effects were much higher especially fishing pressure. The fish fauna were less threatened by alien fish species, though two exotic fish species were recorded. A major part of the total fishes were considered threatened species in Bangladesh. Environmental parameters were also more or less suitable for aquatic species. Thus, the Atrai River can be considered a refuge for conservation of threatened freshwater fishes of Bangladesh. The conservation efforts should ensure that the current status of fish fauna is maintained by minimizing anthropogenic impacts, especially the fishing pressure and introduction of alien invasive species.

REFERENCES

Alikunhi KH (1957) Fish culture in India. Farm Bulletin No. 20. Indian Council of Agricultural Research, New Delhi, India. 144 pp.

Baby F, Tharian J, Ali A and Raghavan R (2010) A checklist of freshwater fishes of the New Amarambalam Reserve Forest (NARF), Kerala, India. Journal of Threatened Taxa 2(12): 1330-1333.

Dahanukar N, Paingankar M, Raut RN and Kharat SS (2012) Fish fauna of Indrayani River, northern Western Ghats, India. Journal of Threatened Taxa 4(1): 2310–2317.

FAO (1997) Simple method for aquaculture management for freshwater fish culture ponds and water practices. Food and Agriculture Organization of the United Nations, Rome, Italy. 233 pp.

Galib SM and Mohsin ABM (2010) Exotic ornamental fishes of Bangladesh. Bangladesh Journal of Progressive Science & 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 GmbH & Co. KG, Germany, 167 pp.

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

Galib SM, Mohsin ABM, Chaki N, Fahad MFH and Haque SMM (2013b) An Overview of the Traditional Rice-Prawn-Fish Farming in Kalia of Narail District, Bangladesh. Journal of Fisheries 1(1): 1-6. DOI: 10.17017/jfish.v1i1.2013.1

Galib SM, Imam MA, Rahman MA, Mohsin ABM, Fahad MFH and Chaki N (2013c) A study on aquarium fish business in Jessore district, Bangladesh. Trends in Fisheries Research 2(3): 11-14.

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.

Hach C (1999) Freshwater aquaculture manual, Test Kit Model FF-2. HACH Company World Headquarters, Colorado, USA. 28 pp.

Heda NK (2009) Fish diversity studies of two rivers of the northeastern Godavari basin, India. Journal of Threatened Taxa 1(10): 514-518.

Imteazzaman AM and Galib SM (2013) Fish Fauna of Halti Beel, Bangladesh. International Journal of Current Research 5(1): 287-290.

IUCN (2014) IUCN Red List of Threatened Species. Version 2014.2. <www.iucnredlist.org>. Downloaded on 28 May 2014.

IUCN Bangladesh (2000) Red book of threatened fishes of Bangladesh, IUCN- The world conservation union. xii+116 pp.

Hossain MS, Mazid MA, Rahman S, Ehshan MA, Razzaque A and Islam MR (1997) Limnological observations on Basukhali-Salimpur-Kola-Barnal (BSKB) beel. part I: physico-chemical parameters. Bangladesh Journal of Zoology 22(2): 161-164.

Jadhav BV, Kharat SS, Raut RN, Paingankar M and Dahanukar N (2011) Freshwater fish fauna of Koyna River, northern Western Ghats, India. Journal of Threatened Taxa 3(1): 1449-1455.

Joadder AR (2009) A comprehensive study on the availability of fishes and non-fishes in Atrai River of Naogaon district: A case study in northern part of Bangladesh. Journal of Fisheries International 4(2): 19-22.

Johnson JA and Arunachalam M (2009) Diversity, distribution and assemblage structure of fishes in streams of southern Western Ghats, India. Journal of Threatened Taxa 1(10): 507-513.

Kharat SS, Paingankar M and Dahanukar N (2012) Freshwater fish fauna of Krishna River at Wai, northern Western Ghats, India. Journal of Threatened Taxa 4(6): 2644-2652.

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, Hasan MM and Galib SM (2009) Fish diversity of community based fisheries managed oxbow lake (Bookbhara Baor) in Jessore, Bangladesh. Journal of Science Foundation 7(1): 121-125.

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

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

Patra AK (2011) Catfish (Teleostei: Siluriformes) diversity in Karala River of Jalpaiguri District, West Bengal, India. Journal of Threatened Taxa 3(3): 1610-1614.

Rahman AKA (1989) Freshwater Fishes of Bangladesh, first edition. Zoological Society of Bangladesh, University of Dhaka, Dhaka, Bangladesh, 364 pp.

Rahman AKA (2005) Freshwater Fishes of Bangladesh, second edition. Zoological Society of Bangladesh, University of Dhaka, Dhaka, Bangladesh, 263 pp.

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

Rahman MM, Jewel MAS, Sarker MA and Mondol MR (2006) Study on water quality paramaters and plankton population of Rajdhala Beel at Netrokona, Bangladesh. Progressive Agriculture 17(2): 177-184.

Rahman MS (1992) Water quality management in aquaculture. BRAC Prokashana, Dhaka, Bangladesh. pp. 83-84.

Rath RK (2000) Freshwater aquaculture, 2nd edition. Scientific Publishers, Jodhpur, India. 445 pp.

Saha BK and Hossain MA (2002) Saldu Beel fishery of Tangail. Bangladesh Journal of Zoology 30(2): 187-194.

Saha S and Bordoloi S (2009) Ichthyofaunal diversity of two beels of Goalpara District, Assam, India. Journal of Threatened Taxa 1(4): 240-242.

Talwar PK and Jhingran AG (1991) Inland Fishes of India and Adjacent Countries Vol. 1 and 2. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi-Calcutta, 1158 pp.