

**FISH SPECIES DIVERSITY, FISHING GEARS AND CRAFTS  
FROM THE BURIGANGA RIVER, DHAKA**

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**Abstract:** Fish species, fishing gear and crafts in the most polluted river Buriganga were inventoried. During December, 2012 to November, 2013, a total of 56 fish species belonging to 20 families and 9 orders were recorded. Cypriniformes observed to be the most dominant order with 18 species (32%). The highest fish diversity was recorded during monsoon season, and lowest during winter. Maximum diversity variance ( $7.616 \pm 2.76$  Sd) observed in the monsoon season for 56 species (220 individuals). Also 12 different types of gears of two categories (active and passive) and two types of crafts were observed to be used for fishing in the study area. The highest number of species of fishes ( $n = 56$ ) recorded in August and lowest ( $n = 3$ ) in April and May 2013. Strong correlation between water depth and number of fish species ( $r = 0.74$ ) and fishing activities ( $r = 0.96$ ) was observed.

**Key words:** Fish diversity, fishing gear, craft, Buriganga river.

**INTRODUCTION**

The River Buriganga running by the side of the Dhaka city, the capital of Bangladesh, which is a megacity of about 12 million people. Intensive human intervention, rapid industrialization, unplanned urbanization and population pressure around the river are main causes for its pollution (Moniruzzaman *et al.* 2009). The River Buriganga is highly polluted river of Bangladesh (Sarker 2005, Nouri *et al.* 2009). It is increasingly being polluted with the city's thousands of industrial units and sewerage lines dumping huge volumes of toxic wastes into it day and night (Islam *et al.* 2006). The Department of Environment (DoE) identified 249 factories along the River Buriganga (Sarker 2005). Most importantly, the quality of the Buriganga river water has been deteriorating. The large input of organic matter to aquatic flood plain habitats may reduce dissolved oxygen and result in the emigration or death of a great number of fishes (Winemiller 1989).

It is often claimed that freshwater ecosystems are the most endangered ecosystems in the world (Sala *et al.* 2000) affecting both species diversity and their abundance. Throughout the last century, freshwater fish are one of the

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most threatened taxonomic groups (Darwall and Vie 2005) because of their high sensitivity to the quantitative and qualitative alteration of aquatic habitat due to intensive anthropogenic activities (Laffaille *et al.* 2005, Kang *et al.* 2009, Sarkar *et al.* 2008). As a consequence, many fish species have become highly endangered, particularly in rivers. However, most of the fish 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 (Hossain *et al.* 2012a,b). Subsequently they are often used as bio-indicators for assessment of water quality, river network connectivity or flow regime (Chovance *et al.* 2003). Nowadays, fish biodiversity and management of associated habitats is a great challenge (Dudgeon *et al.* 2006). In addition, the conservation of aquatic biodiversity has gained great ecological importance over recent years (Hossain *et al.* 2012a). Several studies of Buriganga river on heavy metal concentrations in fishes (Aleya *et al.* 2013, Ahmed *et al.* 2016), water (Mohiuddin *et al.* 2011) and sediment (Saha and Hossain 2011, Mohiuddin *et al.* 2011), Ecological health (Ali *et al.* 2008), bacterial load and chemical pollution (Mihir *et al.* 2009), restoration of Buriganga (Khorshed 2008), have been centered. However, synthesis and analysis or assessments of fish biodiversity are highly limited for this river. Moreover, this study could not find out any publication on fish diversity of Buriganga river using different web based search engine. Therefore, this study attempted to collect information and documentation on fish diversity and state of Buriganga river ecology.

### MATERIAL AND METHODS

*Study area:* The River Buriganga is situated at the south-western periphery of Dhaka city. The average depth is 25 feet (7.6 m) and maximum depth is 58 feet (18 m). Study was carried out approximately 18.5 km in the river. The study was restricted to three main parts of the site: Bangladesh- China friendship bridge (Postoghola bridge) to Babu bazar bridge = A site, Babu bazar bridge to Basilla bridge = B and Basilla bridge to Amin bazar bridge = C. Study area started from Posthogola bridge point (90°26'12"E and 23°40'25"N) and ending Amin bazar bridge (90°20'12"E and 23°46'25"N) (Fig. 1). Geographical position confirmed by GPS meter Model: Magellan GPS 320.

*Study period:* Present inventory survey was carried out during December, 2012 to November, 2013 in the Buriganga river. Survey was conducted for two days per month/fortnightly. Survey was usually made between 7.00 a.m. and 5.00 p.m.

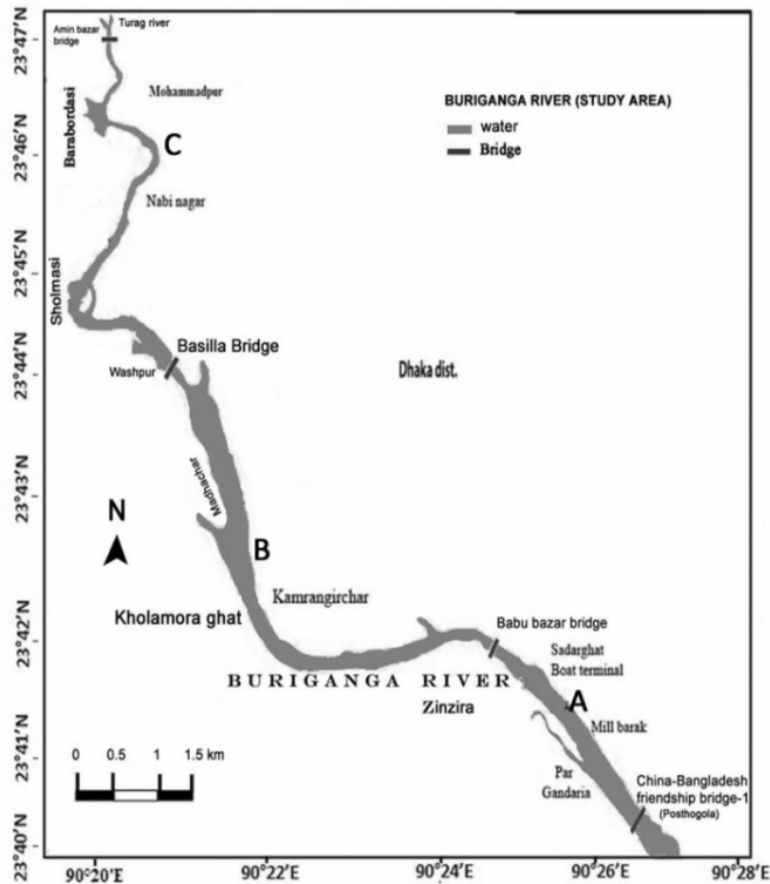


Fig. 1. Study area from China-Bangladesh friendship Bridge-1 to Amin bazar bridge in the river Buriganga.

*Survey procedure for data collection:* Boat base and questioner survey were held continuously in the river through a biological team. Team member used digital camera, measurement tape, spring balance, polythene bags, data sheet, pencil, rubber band, map and other field logistics. Detailed information on catch by species and different types of gear and craft were recorded while fishermen were harvesting fish in the river and different ages of fishermen were interviewed on the gears and also questions about the local names, mode of operation, species caught, fishing starting and ending time. Fish species, fishing gears and crafts were observed and fish samples were collected directly from the fishing sites along the river soon after they were caught to confirm their identification. Fish specimen were transported to the laboratory for the identification and preserved in 10% formalin for further observation. Fish species, gear and craft

photographs were also taken. Fish species weighed by spring balance and length size recorded by scale during the interview time of fisherman.

*Identification and hydrological time:* Fish identification, common and scientific names used throughout this study are in accordance with pictorial books by (Rahman 1989, Siddiqui *et al.* 2007) and gear indentified by Ahmed (1962). Hydrological year can be divided into four seasons: (i) Rising flood (pre-monsoon): May-June. (ii) Full flood (monsoon): July-September. (iii) Flood drawdown (post monsoon): October-November. (iv) dry season (winter): December-April (FAP - 17, Vol. No. 10, 1994). Bangladesh Water Development Board (BWDB) set up a water level monitoring station at Buriganga river for forecasting the flood situation of Dhaka city. This station was located at 90°26'12" E and 23°40'25" N for the daily monitoring of the water level of the Buriganga river which included a staff gages. Therefore, this study collected the daily water depth data during study period from BWDB office, 72 Green Road, Farmgate, Dhaka, Bangladesh.

*Statistical analysis:* Data analysis for fish diversity, their abundance and distribution in the river system was carried out using MS excel. Rarefaction curves, species abundance plot (rank) distribution for the collected fish has been prepared using biodiversity pro software (Ver. 2015). The fish diversity index was calculated as per Shannon-Weiner Index. Where  $H'$  = Shannon-Weiner diversity index,  $n_i$  = Number of individuals,  $N$  = Total number of species,  $D$  = Diversity. Follow the formula.

$$H' = - \sum_{i=1}^s \frac{n_i}{N} \ln \frac{n_i}{N} \quad D = 1 - \frac{\sum_{i=1}^s n_i (n_i - 1)}{N (N - 1)}$$

## RESULTS AND DISCUSSION

The main ecological and hydrological features of the Buriganga river basin depend on the flood pulse. The measurement of water depth, increased and depletion of river water in different months are shown in Fig. 2. Depth of the water level starts to rise in May due to pre-monsoon water. This initial increase in discharge is followed by very sharp rise occurring in June and drop in July but reach flood peaks in August and September. This is the result of monsoon. Depth of water normally decreases after peaks of September onwards, reaching a minimum level in March. Water depth data clearly shown that water depth lowers in the winter and pre-monsoon periods compared to monsoon period. There is no change of water depth in the Buriganga river during winter period due to reduced flow of water in this period. A total of 56 fish species belonging to 41 genera, 20 families and 9 orders have been identified and recorded with total

length, weight from the upper Buriganga river (Table 1). Water level gradually increases with maximum number of fish species during July, 2013 to November, 2013. Maximum total length 42 cm and weight 1500 gm of fish individual recorded. The fish species have been classified in terms of “Not Evaluate” “List

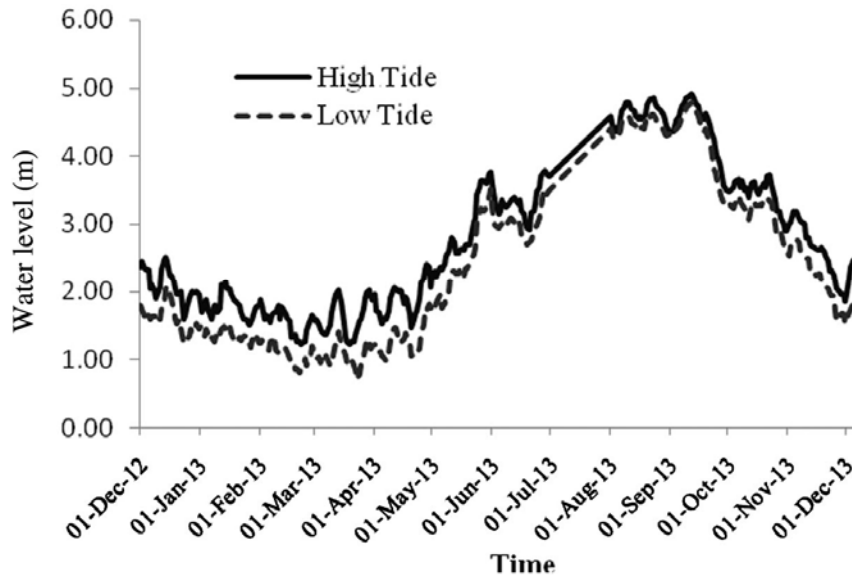


Fig. 2. Yearly water level fluctuation at Dhaka Mill Barak in the Buriganga river.

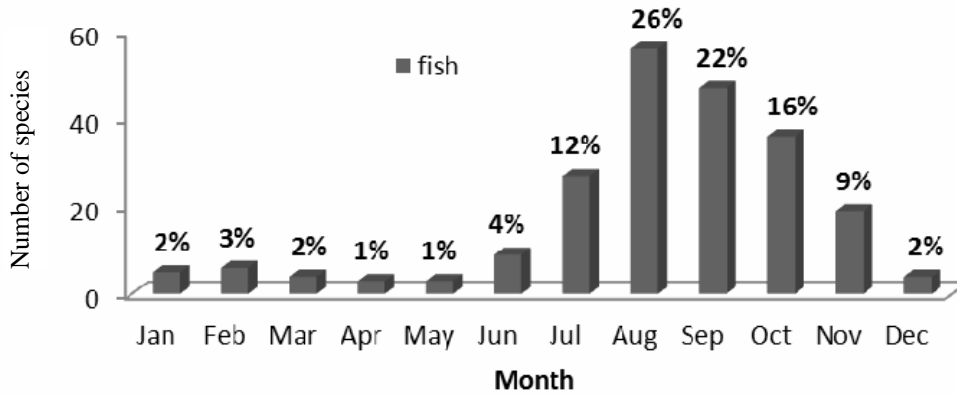


Fig. 3. Monthly percentage of fish species recorded from the Buriganga river.

Concern” “Endangered”, “Critically Endangered”, or “Vulnerable” fish species following IUCN status 2015 (Table 1). In August, number of species reached 56, afterward number of species declined in September. Clear seasonal patterns in the variation of total number of species was recorded (Fig. 3).

Table 1. List of fishes in the Buriganga river

Order	Family	Scientific name	English name	Local name	Recorded TL (cm)	Recorded W (gm)	IUCN status 2015
Synbranchiiformes	Synbranchidae	<i>Monopterusuchia</i>	Cuchia	Kuchia	32	40	VU
Belontiiformes	Belontiidae	<i>Xenentodon canctla</i>	Cancila	Kakila	15	20	LC
Osteoglossiiformes	Notopteridae	<i>Notopterus notopterus</i>	Grey Featherback	Foli/Foilla/Kangla	9	5	VU
Cyprinodontiiformes	Cyprinodontidae	<i>Aplocheilichthys panchax</i>	Blue Panchax	Techoukka	6.5	5	LC
Channiiformes	Channiidae	<i>Channa punctatus</i>	Spotted Snakehead	Taki/Lati	19	20	LC
Channiiformes	Channiidae	<i>Channa striatus</i>	Striped Snakehead	Shol/Shoul	22	35	LC
Channiiformes	Channiidae	<i>Channa striatilis</i>	Asiatic Snakehead	Raga/Ragua	15.5	30	LC
Cypriniformes	Cyprinidae	<i>Labeo rohita</i>	Rohu	Rui/Rohit	10.2	20	LC
Cypriniformes	Cyprinidae	<i>Labeo gonius</i>	Kurialabeo	Goni/Ghainna	16	70	NT
Cypriniformes	Cyprinidae	<i>Labeo calbasu</i>	Kalbasu	Kalibaus	7.8	8	LC
Cypriniformes	Cyprinidae	<i>Catla catla</i>	Catla	Catla	8.5	10	LC
Cypriniformes	Cyprinidae	<i>Cirrhinus cirrhosus</i>	Mrigal	Mirka	8.5	7	NT
Cypriniformes	Cyprinidae	<i>Cirrhinus reba</i>	Reba	Tatkini/Bata	13.5	20	NT
Cypriniformes	Cyprinidae	<i>Hypophthalmichthys molitrix</i>	Silver carp	Silver carp	14.5	40	NT
Cypriniformes	Cyprinidae	<i>Amblypharyngodon mola</i>	Mola carplet	Mola	7	4	LC
Cypriniformes	Cyprinidae	<i>Osteobrama cotio</i>	Cotio	Chela/keti	7	5	NT
Cypriniformes	Cyprinidae	<i>Puntius chola</i>	Swamp Barb	Punti/Chalapunti	14	20	LC
Cypriniformes	Cyprinidae	<i>Puntius sophore</i>	Spotfin Swamp Barb	Punti	9.5	4	LC
Cypriniformes	Cyprinidae	<i>Pethia conchonius</i>	Rosy Barb	Taka Punti	7	8	LC
Cypriniformes	Cyprinidae	<i>Pethia ticto</i>	Ticto Barb	Tit Punti	7.5	7	VU
Cypriniformes	Cyprinidae	<i>Rasbora daniconius</i>	Slender rasbora	Darkina	6	5	LC
Cypriniformes	Cobitidae	<i>Botia darjo</i>	Queen Loach	Rani	6.5	7	EN
Cypriniformes	Cobitidae	<i>Botia lohachata</i>	Y-Loach	Rani	8.5	5	EN
Cypriniformes	Cobitidae	<i>Lepidocephalichthys guntea</i>	Guntea loach	Gutum	8	5	LC
Cypriniformes	Clariidae	<i>Clarias batrachus</i>	Walking catfish	Magur	42	1500	LC
Siluriformes	Bagridae	<i>Rita rita</i>	Rita	Rita	6	5	EN
Siluriformes	Bagridae	<i>Sperata aor</i>	Long whiskered catfish	Ayre	15	25	VU

(Contd.)

Order	Family	Scientific name	English name	Local name	Recorded TL (cm)	Recorded W (gm)	IUCN status 2015
Siluriformes	Bagridae	<i>Mystus cavasius</i>	Gangetic mystus	Golsha tengra	16	20	NT
Siluriformes	Bagridae	<i>Mystus tengara</i>	Tengara mystus	Bujuri	9.8	10	LC
Siluriformes	Bagridae	<i>Mystus vittatus</i>	Striped Dwarf Catfish	Tengra	17	30	LC
Siluriformes	Siluridae	<i>Wallago attu</i>	Wallago	Boal	20	30	VU
Siluriformes	Siluridae	<i>Ompok pabda</i>	Pabdah cat fish	Madhupabda	8.5	5	EN
Siluriformes	Heteropneustidae	<i>Heteropneustes fossilis</i>	Stinging Catfish	Shing/Shingi	17	15	LC
Siluriformes	Schilbeidae	<i>Ailia coila</i>	Gangetic ailia	Kajuli	8	3	LC
Siluriformes	Schilbeidae	<i>Clupisoma garua</i>	Garu Bacha	Ghaura	18	13	EN
Siluriformes	Schilbeidae	<i>Eutropichthys vacha</i>	Bacha	Bacha	16.5	40	LC
Siluriformes	Schilbeidae	<i>Silonia silondia</i>	Silond catfish	Shilong	9	10	LC
Siluriformes	Schilbeidae	<i>Pangasius pangasius</i>	Yellowtail catfish	Pangas	6.2	5	EN
Siluriformes	Sisoridae	<i>Conta conta</i>	Conta catfish	Hara Macfish	8.5	5	NT
Siluriformes	Sisoridae	<i>Hara hara</i>	Moth catfish	Kutakanti	7.5	3	LC
Siluriformes	Sisoridae	<i>Bagarius bagarius</i>	Gangeticgoonch	Baghair	17	30	CR
Siluriformes	Sisoridae	<i>Gagata youssouffi</i>	Gang tangra	Pathorchata	5	2	NT
Clupeiformes	Clupeidae	<i>Gudusia chapra</i>	Indian river shad	Chapila	6	8	VU
Clupeiformes	Clupeidae	<i>Tenulosa ilisha</i>	Hilsa shad	Ilish/Ilisha	7	12	LC
Perciformes	Mastacembelidae	<i>Macrogonathus aculeatus</i>	Lesser spiny eel	Tara Baim	10.3	10	NT
Perciformes	Mastacembelidae	<i>Mastacembelus armatus</i>	Zig-zag eel	Sal Baim	13	8	EN
Perciformes	Mastacembelidae	<i>Macrogonathus pancalus</i>	Barred spiny eel	GuchiBaim	13.5	7	LC
Perciformes	Cichlidae	<i>Oreochromis mossambicus</i>	Tilapia	Tilapia	7	8	
Perciformes	Anabantidae	<i>Anabas testudineas</i>	Climbing Bass	Koi/Corvu	12	40	LC
Perciformes	Osphronemidae	<i>Ctenops nobilis</i>	Indian Gourami	Napit Khalisha	7	5	LC
Perciformes	Osphronemidae	<i>Colisa fasciata</i>	Banded gourami	Khalisha	9	10	
Perciformes	Osphronemidae	<i>Colisa lalia</i>	Red Gourami	LalKhalisha	5	5	
Perciformes	Gobiidae	<i>Glossogobius giuris</i>	Tank goby	Bele/Baila	9.2	10	LC
Perciformes	Ambassidae	<i>Pseudambassis lala</i>	High fin glassy perchlet	Lal Chanda	3	2	LC
Perciformes	Ambassidae	<i>Pseudambassis ranga</i>	Indian glassy fish	Chanda	6	4	LC
Perciformes	Ambassidae	<i>Pseudambassis baculis</i>	Indian glassy Fish	Chanda	3	3	NT

LC- Least concern; CR- Critically endangered; EN - Endangered; VU - Vulnerable; NT- Near threatened.

According to Shannon-Weiner diversity index of the collected fishes (seasonal) indicated a diverse distribution and the species richness variation across the river sites ranged from 1.825 to 3.843 (Table 2). As per Shannon - Weiner index diversity were  $H' = 3.843$ ;  $D = 0.978$  for 56 species (220 individuals). The highest fish diversity was recorded during monsoon in the river, whereas lowest diversity was recorded during winter. The rarefaction curve indicates maximum species richness in monsoon and retreating monsoon period followed by post monsoon and winter season (Fig. 4). Descriptions of fish diversity in the upper Buriganga river are shown in Table 3. Maximum diversity variance ( $7.616 \pm 2.76$  Sd) was observed in the monsoon for 220 individual species. Lowest variance ( $0.953 \pm 0.976$  Sd) was recorded in the winter for 24 individual species (Table 3), Mean confidence interval was 1.493 in monsoon.

**Table 2. Seasonal diversity, Shannon-Weiner index for fish**

Seasons	Species diversity	Shannon-Weiner diversity index
Monsoon	56	3.843
Pre-monsoon	8	2.019
Post-monsoon	38	3.578
Winter	7	1.825

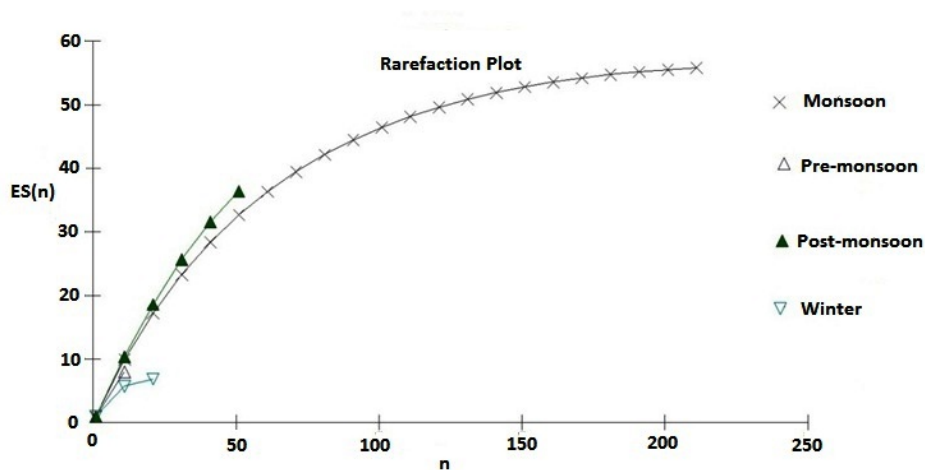


Fig. 4. Season-wise rarefaction curves, where X axis shows individuals actually sampled and Y axis shows estimation of the expected numbers of fish in the Buriganga river.

In the fishes, Cypriniformes were the most dominant order constituting (18) 32% of the total fish population followed by the Siluriformes (17) 30%, Perciformes (12) 21%, Channiformes (3) 5%, Clupeiformes (2) 4%, Synbranchiformes, Beloniformes, Osteoglossiformes, Cyprinodontiformes were the least



**Table 3. Seasonal fish diversity observed in the Buriganga river**

Seasons	Mean individual	Variance	Sd	SE	Total individuals	Total species	Mean CI
Monsoon	2.2	7.616	± 2.76	0.276	220	56	1.493
Pre-monsoon	0.11	0.159	± 0.399	0.04	11	8	0.031
Post-monsoon	0.55	0.593	± 0.77	0.077	55	38	0.116
Winter	0.24	0.953	± 0.976	0.098	24	7	0.187

Sd- Standard deviation, SE - Standard error, Mean CI - Mean confidence interval.

numerous orders constituting only 2% each of the total fish population (Fig. 5). Species distribution for the whole small indigenous fish community sampled revealed wide variation in distribution during all the seasons (Fig 6). Fish species numbers rose fairly from July. Most of the species was observed for 4 months from August to November (during monsoon and post monsoon). Extremely fewer species and lower number were recorded from December to June (3 fish species). Three species, namely *Channa punctatus*, *Heteropneustes fossilis* and *Colisa fasciata* were found abundantly throughout the year while *Osteobrama cotio*, *Oreochromis mossambicus*, *Pseudambassis lala* once in August only. Prominent migratory, commercially for both domestic and international species *Tenualosa ilisha* was recorded from the river. *Tenualosa ilisha* is an anadromus migratory fish of Bangladesh. Two exotic species *Oreochromis mossambicus* and *Hypophthalmichthys molitrix*, were observed in the monsoon season.

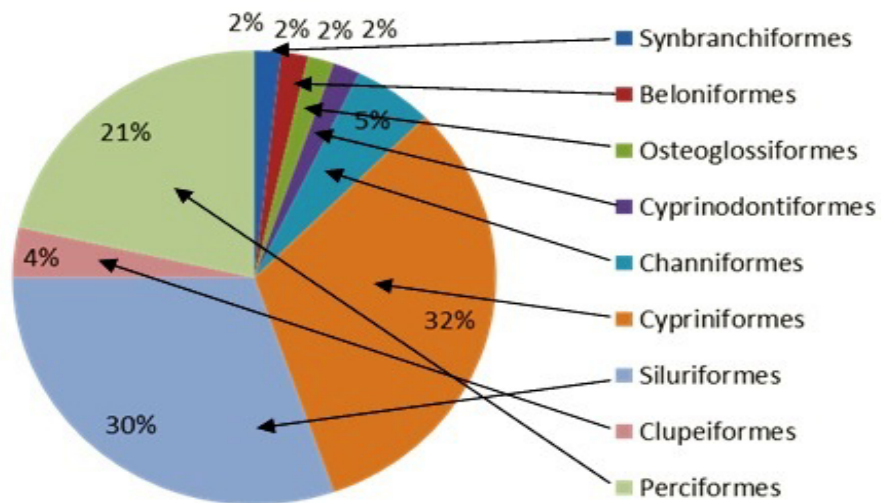


Fig. 5. Percentage of fish species composition under different orders found in the present study.

*Fishing Gear and Craft* : During the study period a total of 12 different types of fishing gears of two categories (active and passive gear) were observed to harvest fish in the study area (Table 5). Major categories of gears include nets, traps and hooks. The monthly gear diversity was also observed in study area. The maximum number of gears were observed to operate in October (78 gears) and the minimum in March and April (1 gear) were used for fish capture in the river. The highest number of gears were recorded as: 17 Borsi and 3 Dahun Borsi in October, 15 Dharma Jal in August, 12 Veshal Jal in September, 7 Current Jal and 3 Ber Jal in October, 2 Veshal Dhangi and Bhndi Jal in July to October, 3 Thala Jal in October to November and Cast net (Jaki Jal) was found throughout the year which have been used as permanent, temporary and subsistence fishing in the river. Maximum number of cast net (11) have been operated in the river in October 2013 (Fig. 7). Different mesh size were recorded of the fixed beg net (Bandi Jal), lift net (Veshal Jal), boat lift net (Veshal Dingi Jal) in the river (Table 5). Fixed beg net has been operated at Kamrangichar within current water in the month of July to October 2013. A total of 5 different types of boat of 2 categories (engine boat and non-engine boat) were used for fish capture in the Buriganga River (Table 4). Kosa boat, Jaila boat, Veshal dingi boats were used with engine and Bandi Jal, Veshal Dingi Jal operated from those boats in the study area. Kosa boat and Dingi boat have been used as non-engine boat which most of the Current Jal and Khepla Jal were operated in the river. Usually jackfruit wood, jamrul wood, bamboo materials were used to make craft.

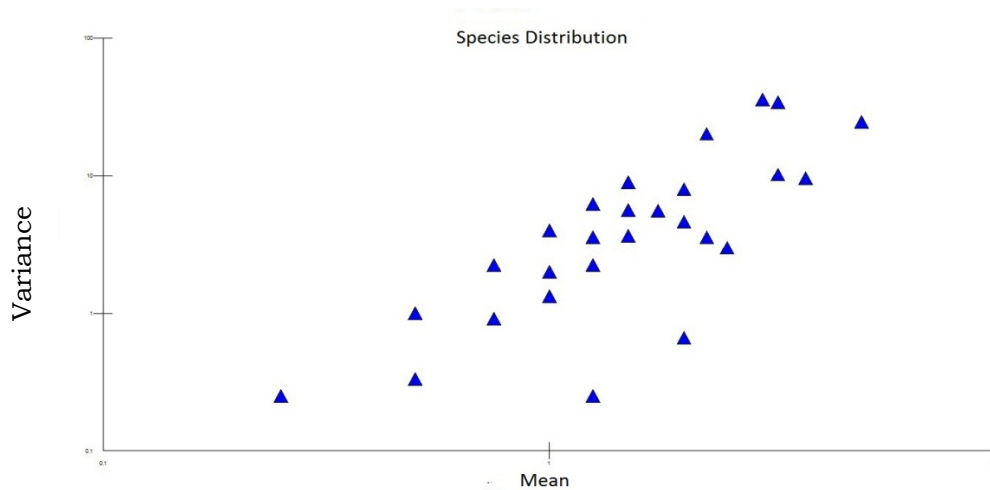


Fig. 6. Species distribution plot for fish community sampled from the Buriganga river.

**Table 4. Different types of crafts used for fish capture in the Buriganga river**

Types of craft	Craft name	Measurement of the craft		Materials used for made	Gear used in craft	Operator person
		Length (ft)	Wide (ft)			
Engine boat	Kosa boat	32	8	Jamrul wood, bamboo	Bandi Jal	2 - 4
	Jaila boat	37	8	Jamrul wood, bamboo	Bandi Jal	2 - 4
	Veshal Dingi boat	40	10	Jackfruit wood, Jamrul wood, Bamboo	Veshal Dingi Jal	3 - 5
Non-engine boat	Kosa boat	14 - 15	2.5 - 3.5	Jackfruit wood, Jamrul wood, bamboo	Khepla Jal, Berjal, current Jal, Borsi, chai, etc	1 - 2
	Dingi boat	15	5	Jackfruit wood, Jamrul wood, bamboo	Veshal Jal, Ber Jal, etc	1 - 2

**Table 5. Different types of nets, traps, hook and line used for fishing in the Buriganga River**

Types of gear/net	Local name of gear	Measurement			No. of operating person	Location
		Length (ft)	Width (ft)	Mesh size (cm)		
Seine net	Ber Jal	250 - 500	20-30	0.5 - 3.5	5- 6	B, C
Cast net	Khepla Jal/Jaki Jal	12 - 15	40-90	1.5 - 2.0	1	A, B, C
Lift net	Dharma Jal	12 - 15	12-15	1.5	1	A, B, C
Lift net	Veshal Jal	40 - 50	40 - 45	1.5 - 2.0	1	A, B, C
Gill net	Current Jal	750 - 1000	9-10	1.5 - 2.0	1 - 2	B, C
Fixed beg net	Bhndi Jal	450	40	1 - 7.0	3 - 5	B
Boat lift net with engine	Bashal Dinghi Jal	40 - 50	20-30	1 - 3.5	5	A, B, C
Push net	Thala Jal	5	2.5	0.5 - 1.5	1	A, B, C
Box trap	Paran/Chai Chai	3	1.5	Bamboo stick	1	B, C
		1.5	1.5	Bamboo stick	1	B, C
Hook and line	Local name of gear	No. of hook	Use of bait	Boat needed	No. of operating person	Location
Hand line	Chip Barshi	1 - 2	Red Earthworms, prawn	No boat needed	1	A, B, C
	Boal Barshi	1 - 2	Earthworms	No boat needed	1	B, C
Long line	Hajar Barshi	1000	Red Earthworms, prawn	Boat needed	1 - 2	B, C

The present study is the first of its kind for the River Buriganga on fish diversity and conservation priority in view of interlinking. The number and monthly variation of species recorded result with total length clearly indicating a loss of fish biodiversity in the Buriganga river. The number of species and its maximum size of fishes are very important for sustainable management in the water body. Most of the people depend on river fisheries for their livelihood but fishermen get less fishing opportunity in the river system. A total of 52 fishes belonging to 15 families and 33 genera were recorded during January, 2013 to December, 2014 from the River Brahmaputra in Assam, north-eastern India (Baishya *et al.* 2016). Fish diversity in the upper Brahmaputra river, India was maximum diversity variance ( $140.39 \pm 11.85$  Sd) was observed in the monsoon season for 49 species (680 individuals). Lowest variance ( $66.35 \pm 8.15$  Sd) was recorded in the winter season with 423 individuals (45 species) (Baishya *et al.* 2016) and currently 56 fish were recorded from the upper Buriganga river. Among the fishes *Tenulosa ilisha* also migrates in the river to breed in the rainy season but they cannot visit properly due to water pollution and different ages of people collected fish from the fishermen. A total of 80 species of fish under 9 orders and 24 families were recorded in the Padma river, NW Bangladesh (Rahman *et al.* 2012). Fish species size (length, weight and number) has very limited presence in the samples collected as well as the fishermen's catches. Large fishes (Table 1), which are more valuable, modifies the size structure and functioning of fish assemblages, with consequences for productivity and resilience of some stocks are highly limited in these water bodies even when fish are available. The size of fish depends on the availability of food and habitat. The length or other physical dimension including weight of fish can be influenced by environmental factor (Shukor *et al.* 2008, Jobling *et al.* 2002). One of the notable factors in the study is that deliberately or accidentally introduction of exotic fish species has occurred in this river as is evidenced by their presence. As this exotic fish is a prolific breeder, it can compete and replace the native fishes, over the entire stretch of the river within a limited period of time which may lead to reduce biodiversity and the ecosystem's ability to adapt to natural or human-induced changes. Therefore, it is better to prevent them from invading and becoming established to reduce the ecological impacts of exotic species in this water body.

Seasonal changes in the fisheries of rivers are principally determined by cyclical changes in discharge, water velocity and water level which in turns greatly influence the relative abundance of different species of fish. The results indicated clear seasonal patterns in the variation of total monthly fish species number recorded in this river fluctuated extreme widely among different

months. It can be seen that the higher number of species were captured from July to November with peaks in August (Fig. 3). Correlation analysis between water depth and fish species number ( $r = 0.74$ ) and fishing activities ( $r = 0.96$ ) showed strong correlation. Numbers rose fairly from July when floodwaters also rose during monsoon (July-September) (Fig. 2). So peak observed in August may be associated with monsoon because there is different kind of fishes which breeding cycle and migrations up and down river related with monsoon. These results support that the fish species composition was a great extent influenced by the flood water situation. This same characteristic was noted in rivers Jamuna and Padma (FAP - 17, Vol. No. 10, 1994). However, fish species gradually decreased from August to November when gear number gradually increased in these months. The number of results indicated that reduced number of fish in August to November may be associated with increased fishing activities. But fish species and gears numbers sharply decreased starting from November. This statuesque continues till June with more or less constant numbers of fish and gear, respectively. Data indicated that there was almost zero number of catches during these periods. Water level and flow also sharply reduced during this period (Fig. 2).

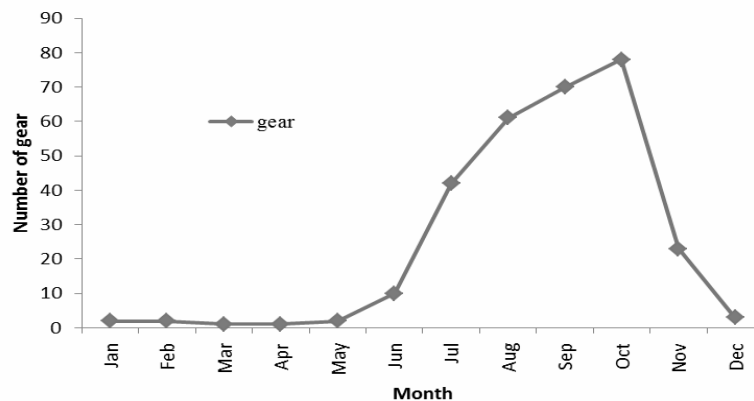


Fig. 7. Monthly total number of gear (active and passive) operated in the Buriganga river.

Furthermore, data indicated that only *Channa punctatus*, *Heteropneustes fossilis* and *Anabas testudinus* were observed during dry and pre-monsoon. *H. fossilis* can respire aerially by gulping in air at various intervals when the oxygen content of water is low (Munshi 1993). The air-breathing apparatus of these species enables it to exist in almost any kind of water. Catfish have a broad environmental tolerance and can sustain the harsh conditions during the dry season (Ahmed 2008). Catfish include members of the Clariidae, Siluridae

and Ophiocephalidae. However, presence of these species during dry and pre-monsoon periods indicated that they cannot survive due to water pollution. Environmental degradation and habitat loss is reported as the major causes of declining fisheries in most rivers under stress situation (Coates *et al.* 2004). Furthermore, the amount of catch depends upon its productivity of the fishing grounds (Naidu 1939). Therefore, the extreme lower number and diversity of fishes (almost zero) were recorded in dry and pre-monsoon period mainly due to adverse water quality of this river not for increased fishing activities. However, considering the above mentioned facts, it is noted that observed almost zero catch from December to June caused by reduced water flow and adverse water quality which may lead towards extinct of fishes from this river at least in this period. The survey revealed that a wide variety of fishing gears and crafts were operated with clear seasonal patterns of fishing methods. Entering/rising of floodwaters in the study area stimulated an increase in fishing activities using different fishing methods and species targeted by these methods. Some of the gears were selective for a particular species, whereas others account for a number of species caught during operation giving multispecies nature of the fishing. Long line operated from drifting or anchored boats.

The result suggests that best water level, flow and freshwater ecology can increase fish diversity with production. Also suggests that both indirect and non-use values should be given due consideration by the policy makers before taking any development project or program at the river. For the conservation of these fishes of the upper Buriganga river, strategies such as control of water pollution, illegal fishing and development, control of ship, water bus etc. In the breeding season fishing activities must be stopped in the river. More studies, on biology and population dynamics of commercially exploited species are also needed to formulate a sustainable management strategy for this river. The study shows the need of improved public policies aiming at the conservation of its ichthyofauna diversity, as well as programs of environmental education to raise the awareness of local settlers regarding their land and its fishes, dumping of municipal and industrial wastes, continuous water flow almost throughout the year etc.

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