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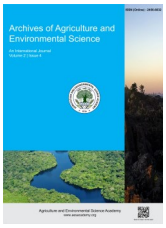

ORIGINAL RESEARCH ARTICLE

Ichthyofaunal diversity of Basurabad *Beel* in regards with threat factors and conservation measures, Bangladesh

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ABSTRACT

The present study was conducted to assess the temporal distribution of ichthyofaunal composition of Basurabad *beel* in Khulna, Bangladesh and investigated the fish biodiversity and core threats to biodiversity to provide recommendations for conservation in the *beel*. During the study period, total 33 fish species were recorded belonging to 6 orders. The order wise fish species availability was maximum in Perciformes (39.40%) and minimum in Beloniformis (3%). The value of Shannon-Weaver diversity index was found higher in Fultola (1.19±0.41) and lowest in Basurabad (0.68±0.17) while the maximum value of Margalef richness index found in Basurabad (1.12±0.35) and lowest in Debitola (0.68±0.34). The value of Pielou's evenness index was higher in Boroitola (0.61±0.20) and lowest in Basurabad (0.31±0.16) however the Pielou's index showed an uneven distribution of fish species in the Basurabad sampling point. The value of Simpson dominance index was higher in Fultola (0.58±0.10) and lowest in Kishmath-Fultola (0.39±0.16). Ten different kinds of fishing gears were identified under 5 major groups in the *beel*. Among all the gears operated, seine net (Jagat Ber Jal) had the highest catch 31.3±4.1 CC/haul/day/gear (kg) followed by current jal 10.5±2.5 CC/haul/day/gear (kg). This study suggests that comprehensive studies on fisheries biology including reproductive biology, growth, stock assessment and their association with existing laws are essential for the sustainable management and conservation of fish species in the Basurabad *beel*.

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INTRODUCTION

Aquatic biodiversity has enormous economic value and is mostly accountable for keeping and supporting overall environmental health (Hossain, 2012). The conservation of aquatic biodiversity has gained great environmental importance over recent years (Hossain *et al*., 2012) though fish biodiversity and management of associated habitats is a great challenge (Dudgeon *et al*., 2006). Biodiversity of freshwater has diminished quicker than either terrestrial or marine biodiversity over the years (Jenkins, 2003; UNESCO, 2003). However, fishes of freshwater are one of the most vulnerable groups (Darwall and Vie, 2005) because of their highly sensitivity to the qualitative and quantitative change of aquatic habits (Sarkar *et al*., 2008; Kang *et al*., 2009). The base of the management problems of freshwater fish is the fact that the freshwater fish inhabit reasonably restricted space with very condensed ability for movement (Hocutt and Wiley, 1986; Unmack, 2001). Moreover, fishes of freshwater are often

used as bio-indicators for assessment of water quality (Chovance, 2003). Decreasing in the richness of fish species from the inland waters of Bangladesh is a burning (Galib *et al*., 2013). However, Fisheries play an important role in the economy of Bangladesh in terms of nutrition, employment and income generation (Uddin *et al*, 2019). The population of numerous fish species has reduced promptly or on the verge of extinction due to over exploitation by destructive fishing gears, various ecological and environmental changes and degradation of their natural habitats (Chakraborty *et al*., 2006; Siddik *et al*., 2014, Saha *et al*, 2019). According to IUCN Bangladesh (2015), nearly one fourth of the species are under threat inclusive of 9 critically endangered, 30 endangered, 25 vulnerable and 27 species as near threatened. That is why, water body specific comprehensive biodiversity studies are prerequisite to assess the present status and for the sustainable management of any water body (Saha and Hossain, 2002; Galib *et al*., 2013; Imteazzaman and Galib, 2013).

Basurabad *beel* is one of the most important wetland (Batiaghata Upazila) in Khulna District, Bangladesh. The main river of Batiaghata is the Kajibacha River which feeds the Basurabad *beel*. The average depth of the *beel* become 5-6 ft during rainy season. The local respondents reported, diversity of fish species from Basurabad *beel* is gradually decreasing with increasing excess fishing pressure and other possible factors. Some studies have been conducted on several aspects of fish diversity, habitat, fishing gear and conservation status of available fishes in some *beels* of Bangladesh but the researchers could not find any research work related to the fish biodiversity, abundance and their status in the Basurabad *beel*. Fruitful research work is much required with updated list of fish species to take necessary management steps to conserve the fish biodiversity in this *beel* (MoL, 2017). As it is one of the important *beel* in the southwestern coastal Bangladesh therefore the authors' want to explore the fish assemblage of the *beel* focusing the present status and possible threats along with conservation measures.

MATERIALS AND METHODS

Study area

The Basurabad *beel* of Batiaghata Upazila under Khulna District, Bangladesh has purposively been selected as the study area (Figure 1). It is located in the southwestern coastal area of Bangladesh, between 22°42'45" to 22°43'46" north latitudes and between 89°29'54" to 89°31'15" east longitudes. The study area occupies an area of 2.43 sq. km. The *beel* is 2.21 km long from east to west and 1.86 long from north to south. The sampling points (Table 1 and Figure 1) were selected in such a way that they cover the entire major parts of the *beel*.

Data collection

Data were collected on spot from local fishermen on monthly basis from July, 2017 to November, 2017. The study was set up based on both primary and secondary data. Primary data were collected from fishermen through well-structured questionnaire. Besides, secondary data were collected from the Upazila Fisheries Office, relevant research articles, reports etc. Finally, each single species found in the sampling station was preserved in 10% buffered formalin solution in an earlier leveled plastic jar. After transporting to the laboratory, all collected specimens were identified to species level with the help of standard taxonomic keys of Talwar and Jhingran (1991), Nelson (1994), Rahman (2005) and Hossain *et al*. (2007). Moreover, FishBase was also used as a guide (Froese and Pauly, 2015).

Data analysis

In the present conducted study, diversity of fishes were calculated by means of Shannon-Weaver diversity index (H′) (Shannon and Weaver, 1949), species richness by Margalef index (*d*) (Margalef, 1968), evenness by Pielou's index (*J′*) (Pielou, 1966), and dominance by Simpson index according to the following equations:

Shannon-Weaver diversity index (H') = Sum [pi x log (pi)]. Where, H' = Shannon-Weaver diversity index; Pi = ni/N; ni = no. of individuals of a species; and N = Total number of individuals. Margalef species richness (d) = (S-1)/log (N). Where, S = Total species; and N = Total individuals. Pielou's evenness index (J´) =H(s)/H (max). Where, H(s) = Shannon-Weaver information function; and H (max.) = Theoretical maximum value of H(s). Simpson dominance index (C) = $\sum_{i=1}^{s}(ni/N)^2$.

Where, ni = number of individuals in 'each' species; N = total number of individuals; and S = total number of species. The Statistical Package for the Social Sciences (SPSS) software version V25.0 was used for data entry, pre-processing and analyzing the collected data. PAST (Paleontological Statistics) version 2.16 was used to assess biodiversity indices. Mapping of the study area and representing study/sampling points was done by ArcGIS 10.0 software with the help of global positioning system (GPS). Both qualitative and quantitative analysis was done. Finally, data were presented as tabular or graphical format.

Table 1. Sample collection points in the Basurabad *beel*.

S.N.	Name of the point	Latitude	Longitude
1	Kishmath-Fultola	22° 42.898'N	89° 30.638'E
2	Basurabad	22° 43.227'N	89° 30.185'E
3	Fultola	22° 43.070'N	89° 31.032'E
4	Boroitola	22° 43.540'N	89° 31.172'E
5	Debitola	22° 43.002'N	89° 30.797'E

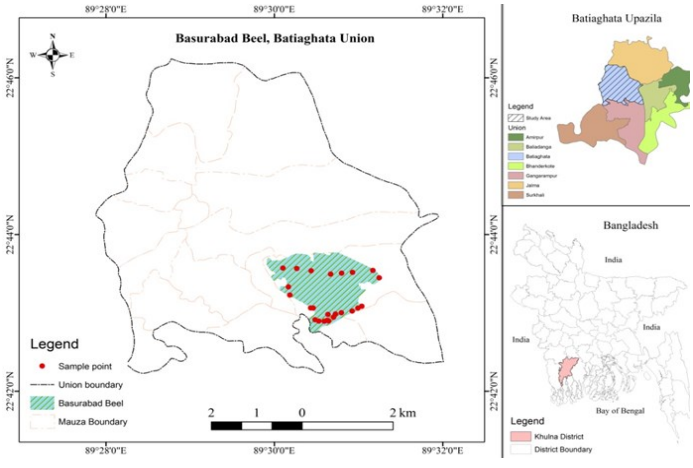

Figure 1. *Map showing reference of record of Basurabad beel, in Batiaghata Upazilla,*

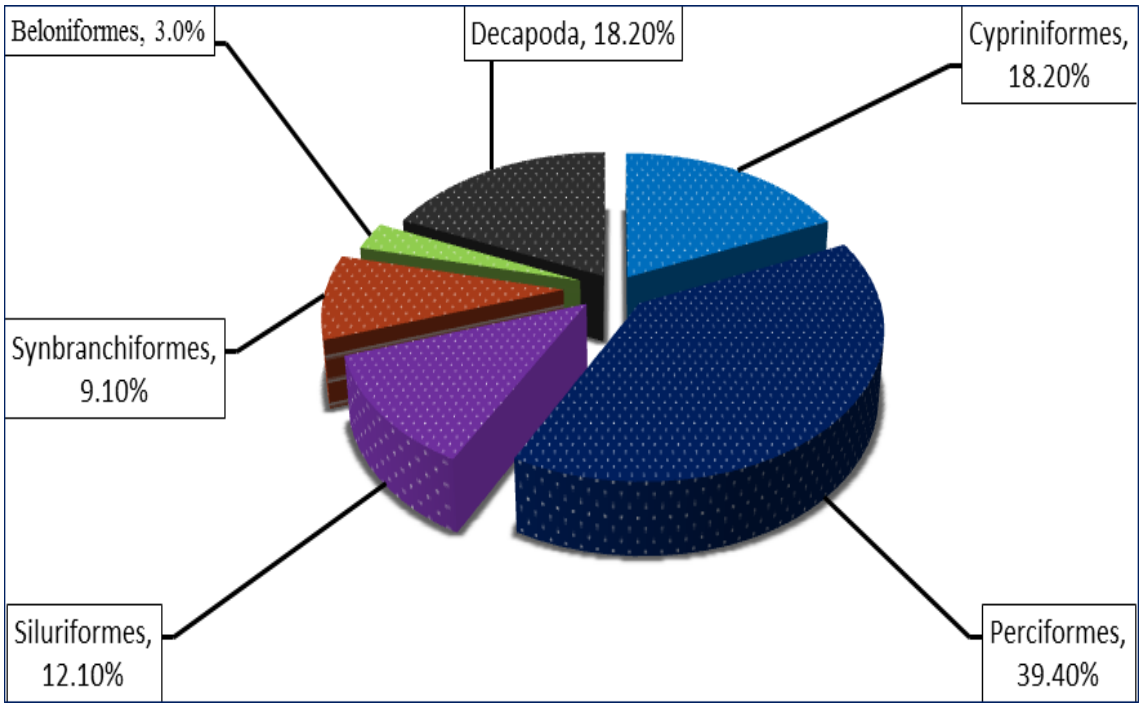

Figure 2. *The abundance of fish species (on the basis of order) in the study area.*

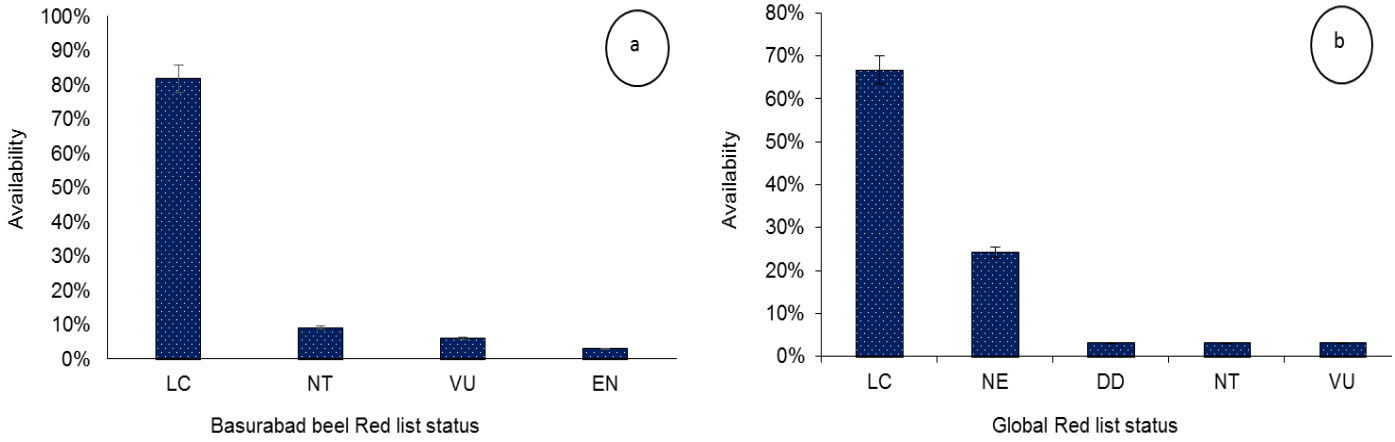

Figure 3. *IUCN local (a) and global (b) status along with percentage (%) of threatened fish found in the study area.*

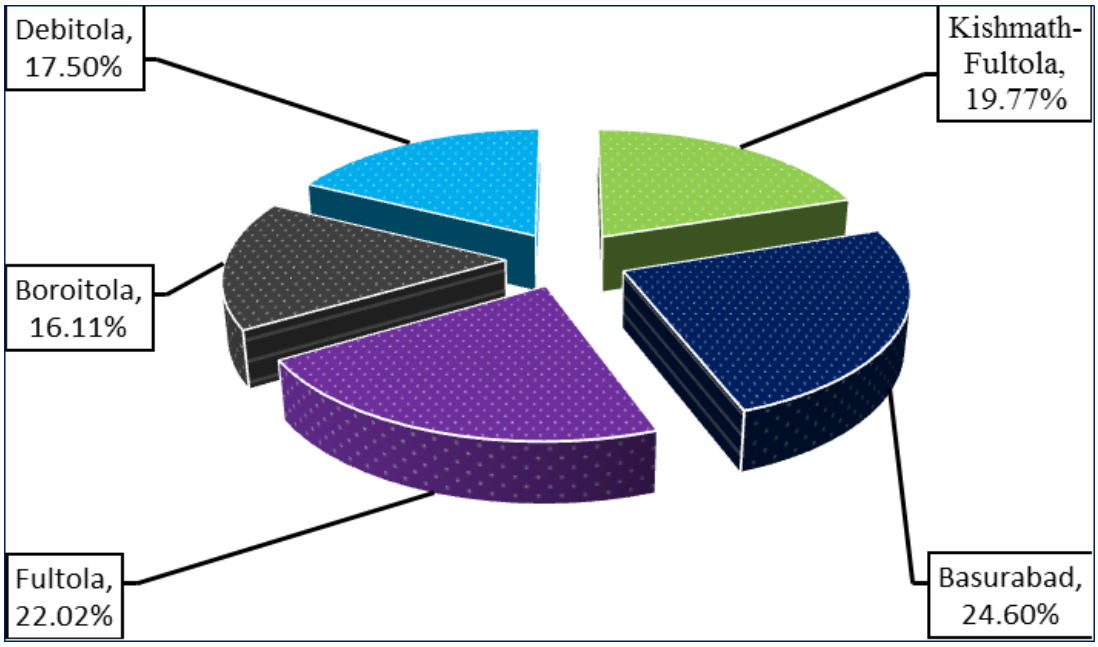

Figure 4. Status of fish species in Basurabad *beel.*

RESULTS AND DISCUSSION

Order based fish species availability

Basurabad *beel* supports a wide variety of fish species under different orders. Perciformes (39.40%) was the dominant order followed by Cypriniformes (18.20%), Decapoda (18.20%), Siluriformes (12.10%), Synbranchiformes (9.10%) and Beloniformes (3%). It is also explored that Beloniformes order is rarely found in the study area (Figure 2).

Fisheries diversity and status of fish species in the Basurabad *beel*

A total of 33 species were recorded under the identified 6 orders in the study area (Table 2). Amongst them, few of the species were facing some degrees of threat to cope up with the present circumstances. It is examined that out of the recorded species only 3% was found as endangered, 6% as vulnerable, 9 % as nearly threatened and 82% as least concerned (Figure 3a). After comparing IUCN local and IUCN global status (Figure 3) it is evident that the status of some fishes in the Basurabad *beel* is poor which may be resulted from over-exploitation.

Total average fish catch in different sampling points

Weight basis study of fish catch was explored during the research work at the sampling points. It is revealed that the highest occurrence was found in the Basurabad point (24.60%) followed by Fultola (22.02%), Kishmath-Fultola (19.77%), Debitola (17.50%) and Boroitola (16.11%) (Figure 4).

Ecological indices

Four ecological indices were calculated i.e. Shannon–Weaver index (H'), Simpson dominance index (c), Pielou's Evenness Index and Margalef index. The ecological status of the Basurabad *beel* was determined based on the Shannon-Weaver diversity index (H') value (Staub *at al*., 1970) (Table 3). Table 4 shows that, the average pollution level of Kishmath-Fultola, Basurabad and Debitola is less than 1 which indicates heavy level of pollution in the stated sampling points. These results may be influenced by some unrecognized driving forces which caused low level of species diversity in the study area. The pollution level of the Basurabad *beel* was also estimated based on the Margalef's Richness Index (Table 5). The Margalef Richness index (d) shows that Fultola (1.12 ±0.34) and Basurabad (1.12 ±0.34) point had the most rich and diverse fish community followed by Debitola point (0.68 ±0.34) (Table 6). From the findings, the health condition of the Basurabad *beel* was found seriously polluted to more serious pollution (d=1-2 to 0-1) according to the pollution level (Table 6). The value of Pielou's evenness index (J') shows that more even distribution of all the individuals among the different fish species in Boroitola (0.61 ±0.20) point than the Basurabad point (0.31 ±0.16) (Table 7). The value of Simpson Dominance index was found maximum in Fultola (0.58 ±0.10) point and minimum in Basurabad point (0.40 ±022) (Table 8). This result simply indicates that the Basurabad point (0.40 ±022) has the uppermost species dominance then Fultola (0.58 ±0.10) as maximum value results lowest dominancy.

Availability of threatened fish species

Basurabad beel supports some ecologically threatened species in its habitat. This beel harbors two vulnerable species i.e. *Puntius ticto*, *Monopterus cuchia* and an endangered species called *Mastacembelus armatus*. Although, *Puntius ticto* is vulnerable in Bangladesh but it is considered as least concern in global status. However, Basurabad beel supports this *Puntius ticto* vastly through its boundary.

Exotic fish species

During this study, two exotic fish species are found abundantly in the Basurabad beel namely Tilapia (*Oreochromis mossambicus*) and Thai Rajputi (*Barbonymus gonionotus*). These species can pose threats to indigenous species in terms of food consuming competition and as well as in niche occupying.

Fishing Gear Operated in the Basurabad Beel and Catch per Unit Effort (CPUE)

Total 10 types of gears under 5 groups were found to be used for catching fish. Amongst them, seine net (Jagat Ber Jal) had the highest catch 31.3 ±4.1 CC/haul/day/gear (kg) followed by current jal 10.5 ±2.5 CC/haul/day/gear (kg). The efficiency of Jagat Ber Jal in this beel found to be very high due to low depth of water (5-8 ft). Some other gears were also used in the study area such as fishing trap including Chari, Dhor, Ghuni, Pata/Tana. Jagat Ber Jal and Current Jal are found to be most destructive and the main fishing instrument in the study area (Table 9).

Relationship between Catch and Rainfall

The statistical analyses were performed to show correlation between the total fish catch and rainfall (Figure 5). It is evident from the value (r2 = -1.392) that in Basurabad beel there was negative correlation between monthly average rainfall and monthly fish catch. The rainfall data was collected from Bangladesh Meteorological Division (BMD), Khulna.

During the entire study period, 33 species were recorded under 6 orders from the Basurabad *beel* and few species were found to be commercially important. Rahman (1996) identified a total of 47 species of fish in the catches of different gears by the fishermen in BSKB *beel*. Chakraborty and Mirza (2007) recorded 70 fish species so far from the Gharia *beel* and Ehshan *et al.* (2000) reported 40 species including three exotic species from Chanda *beel*. A total of 76 fish species belonging to 76 genera, 26 families and l species of prawn were identified so far from the kumarai *beel*. *Cypriniformes* and *Siluriformes* were recorded as the most dominant fish in the Hail haor (Mazumder *et al*., 2016). Identical findings were also reported from many other rivers of Bangladesh such as the river Choto Jamuna (Galib *et al*., 2013), the river Mahananda (Mohsin and Haque, 2009), the river Tista (Khan *et al*., 2013) and the river Padma (Rahman *et al*., 2012). A total of 68 fish species recorded in water bodies of Itna, Kishoregonj (Sakawat, 2002) and 38 fish species including 34 native and 4 exotic fish species were recorded from Basuakhali *beel* (Rahman *et al*., 2019). About 260 species of freshwater fish recorded belonging to 55 families in Bangladesh (Rahman, 2005).

Table 2. Systematic position of the recorded fish species in the study area (2017) with their common name, local name, scientific name and IUCN local and global red list status.

Order	Family	Local Name	Common Name	Scientific Name	IUCN Status BD, 2015	Global Status, 2015
Cypriniformes	Cyprinidae	Mola	Mola Carplet	*Amblypharyngodon mola*	LC	LC
		Darkina	Indian Flying Barb	*Esomus danricus*	LC	LC
		Jat Puti	Spot fin swamp barb	*Puntius sophore*	LC	LC
		Tit Puti	Fire-fin barb	*Puntius ticto*	VU	LC
		Catla	Indian Major Carp	*Gibelion catla*	LC	NE
		SharPuti / JapaniPuti	Silver Barb	*Barbonymus gonionotus*	-	LC
	Cobiidae	Bele	Scribbled Goby	*Glossogobius giuris*	LC	LC
	Eleotridae	Bhut Bele	Dusky Sleeper	*Eleotris fusca*	LC	LC
	Gobiidae	Chewa	Mud Skipper	*Pseudapocrypteselongatus*	LC	LC
	Centropomidae	Lomba Chanda	Elongated glass perchlet	*Chanda nama*	LC	LC
		Lal Chanda	Indian glass perchlet	*Chanda ranga*	LC	NE
	Channidae	Taki	Spotted snakehead	*Channa punctatus*	LC	LC
		Cheng	Walking snakehead	*Channa orientalis*	LC	LC
		Shol	Snakehead murrel	*Channa straita*	LC	LC
Perciformes	Cichlidae	Tilapia	Mozambique Tilapia	*Oreochromismossambicus*	-	NT
	Nandidae	Veda	Mud perch	*Nandus nandus*	NT	LC
	Anabantidae	Khalisha	Striped gourami	*Colisa fasciata*	LC	LC
		Choto Khalisa	Honey gourami	*Colisa chuno*	LC	LC
		Koi	Climbing perch	*Anabas testudineus*	LC	DD
Siluriformes	Bagridae	Choto Tengra	Day's Mystus	*Mystus bleekeri*	LC	LC
	Bagridae	Boro Tengra	Long Wiskers Catfish	*Mystus gulio*	NT	LC
	Heteropneustidae	Shing	Stinging catfish	*Heteropneustes fossilis*	LC	LC
	Clariidae	Magur	Walking Catfish	*Clarias batrachus*	LC	LC
Synbranchiformes	Mastacembelidae	Tara Baim	One-Striped spiny eel	*Mastacembelus armatus*	EN	NE
		Guchi Baim	Striped spiny eel	*Macrognathus pancalus*	LC	LC
	Synbranchidae	Kuchia	Gangentic Mud eel	*Monopterus cuchia*	VU	VU
Beloniformes	Belonidae	Kakila	Freshwater Garfish	*Xenentodon cancila*	LC	NE
Decapoda	Penaeidae	Harina Chingri	Speckled Shrimp	*Metapenaeus monoceros*	LC	NE
		Kotke / Gura Chingri	Monsoon river prawn	*Macrobrachium lumarrei*	LC	LC
		Bagda Chingri	Giant Tiger Shrimp	*Penaeus monodon*	LC	NE
		Beel / Chamni Chingri	River prawn	*Macrobrachium daganum*	LC	NE
	Palaemonidae	Golda Chingri	Giant Freshwater Prawn	*Macrobrachium rosenbergii*	LC	LC
	Varunidae	Choto Kakra	River Swimming Crab	*Varuna litterata*	LC	NE

Note: LC=Least Concern, NO=Not Threatened, NT=Near Threatened, VU=Vulnerable, EN=Endangered, NE=Not Evaluated.

Table 3. Shannon-Weaver diversity index and pollution level (Staub *at al*., 1970).

Value Range (H')	0-1	1-2	2-3	3-4
Interpretation	Heavy	Moderate	Light	Slight

Table 4. Month Wise and Average Shannon-Weaver Diversity Index (H') Value with Standard Deviation.

Fishing point	Month					Average ±SD
	July	August	September	October	November	
Kishmath-Fultola	0.77	0.76	0.86	0.56	0.45	0.68 ±0.17
Basurabad	1.52	0.98	0.58	0.98	0.46	0.90 ±0.38
Fultola	1.29	0.8	0.88	1.42	1.58	1.19 ±0.41
Boroitola	0.43	1.19	1.34	0.97	1.35	1.10 ±0.41
Debitola	0.87	0.66	0.86	0.39	1.2	0.8 ±0.39

Table 5. Margalef's Richness Index (d) and pollution level (Lad, 2015).

Value Range (d)	0-1	1-2	2-4	4-6	>6
Interpretation	More serious pollution	Serious pollution	Moderate pollution	Light pollution	Clear water

Table 6. Month Wise and Average Margalef Richness Index (d) Value with Standard Deviation.

Fishing point	Month					Average ±SD
	July	August	September	October	November	
Kishmath-Fultola	0.46	0.71	0.67	0.85	0.88	0.71 ±0.18
Basurabad	1.14	0.84	0.99	1.42	0.46	1.12 ±0.35
Fultola	1.20	1.15	0.93	1.31	1.03	1.12 ±0.34
Boroitola	0.49	0.78	1.02	0.79	1.13	0.84 ±0.33
Debitola	0.27	0.43	0.79	1.00	0.91	0.68 ±0.34

Table 7. Month Wise and Average Pielou's Evenness Index (J') Value with Standard Deviation.

Fishing point	Month					Average ±SD
	July	August	September	October	November	
Kishmath-Fultola	0.54	0.37	0.39	0.25	0.22	0.35 ±0.13
Basurabad	0.57	0.37	0.22	0.24	0.16	0.31 ±0.16
Fultola	0.40	0.25	0.30	0.6	0.4	0.39 ±0.13
Boroitola	0.38	0.82	0.63	0.44	0.77	0.61 ±0.20
Debitola	0.79	0.48	0.34	0.18	0.41	0.44 ±0.23

Table 8. Month Wise and Average Simpson dominance index (C) Value with Standard Deviation.

Fishing point	Month					Average ±SD
	July	August	September	October	November	
Kishmath-Fultola	0.51	0.44	0.53	0.24	0.17	0.39 ±0.16
Basurabad	0.71	0.53	0.23	0.38	0.17	0.40 ±022
Fultola	0.62	0.48	0.53	0.68	0.60	0.58 ±0.10
Boroitola	0.20	0.67	0.66	0.52	0.69	0.55 ±0.21
Debitola	0.55	0.41	0.46	0.13	0.65	0.44 ±0.20

Table 9. Fishing Gear used in the Study Area with CPUE.

Types of Gear	Name of the gear	Gear Specification	Species caught	*CC/haul/day/gear (kg)
Seine Net	Jagat Ber Jal	Rectangular shape with two border lines. Upper borderline contains float and sinker in the lower portions. Sometimes it is as long as 250m.	All species	31.3 ±4.1
	Current Jal	Poly amide, Polypropylene nylon	Punti, Bele, Gulsha, Veda, Koi, Chewa	10.5 ±2.5
Gill Net	Poa Jal	Poly amide, Polypropylene nylon	Koi, Veda, Punti, Gulsha	6.8 ±1.4
	Koi Jal	Poly amide, Polypropylene nylon	Koi, Veda, Punti	6.695 ±1.2
	Chari	Bamboo splits, nylon thread	Koi,Puti, Chanda,Tengra	2.3 ±.4
	Dhor	Bamboo splits, nylon thread	Taki, Mola, Chanda, Baim, Tengra	1.4 ±.2
Fishing Trap	Pata/Tana	Bamboo splits, nylon thread	Darkina, Bele, Baim, Puti	3.6 ±.6
	Ghuni	Bamboo splits, nylon thread	Chingri, Chanda, Tengra	2.7 ±.8
Hook & Line	Borshi	Nylon ropes, hooks	Kalibaus, Koi, Shing, Punti, Tengra and some carp species	0.57 ±.1
Wounding Gear	Koch	Bamboo, sharp iron	Kalibaus, Koi, Shing, Taki, Punti, Tengra and some carp species.	0.4 ±.1

*CC=Catch composition.

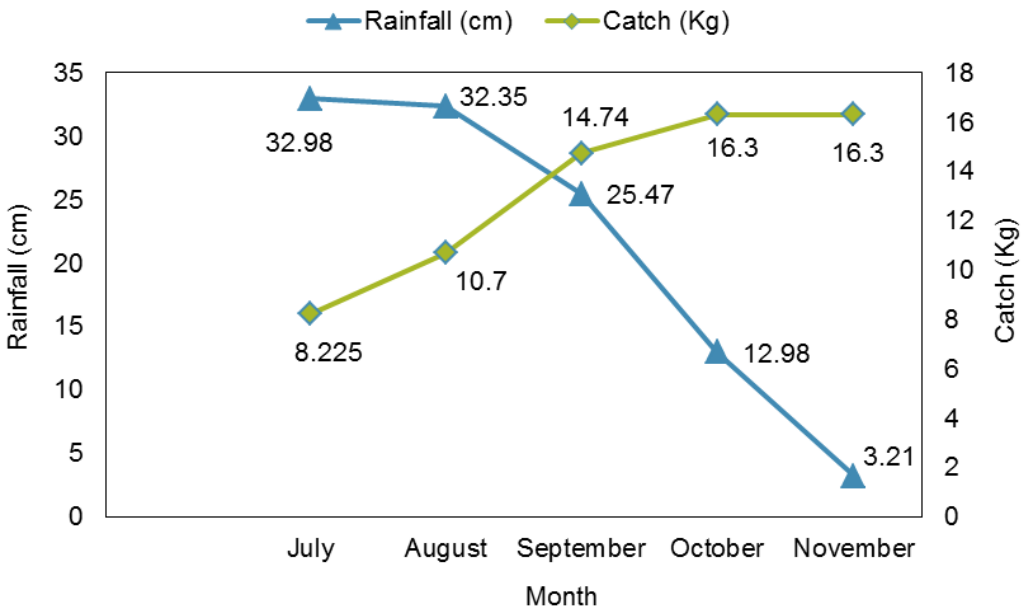

Figure 5. *Rainfall versus fish catches in the study area.*

During the study period, average Shannon-Weaver diversity index (H') value was highest in Fultola *beel* (1.19 ±0.41) and lowest in Basurabad (0.68 ±0.17). Margalef richness index (d) value was highest in Basurabad (1.12 ±0.35) and lowest in Debitola (0.68 ±0.34). Pielou's evenness index (J') value was highest in Boroitola (0.61 ±0.20) and lowest in Basurabad (0.31 ±0.16). Simpson dominance index (C) value was highest in Fultola (0.58 ±0.10) and lowest in Kishmath-Fultola (0.39 ±0.16). Shannon-Weaver index value typically ranges from 1.5-3.5 for ecological data that can hardly exceed 4.0 and it can be above 5.0 when the samples hold 100,000 species (Hanif *et al*., 2015). Nabi *et al*. (2011) found the Shannon-Weaver diversity index values as 0.95 to 2.62 in the Bakkhali River estuary. In every case, high Shannon-Weaver diversity index denotes high individuals and low diversity involved with low number of individuals. Simpson's dominance index and diversity index value were highest 0.95 and 3.49 respectively and lowest were observed 0.94 and 3.29 correspondingly in the upper Halda River which indicates that the dominance was shared by more species for the highest value. The highest and lowest evenness values were recorded as 0.61 and 0.50 respectively (Alam *et al*., 2013). The Margalef richness value is used as an indicator to compare the sites, generally show deviation depending on the species number (Vyas *et al*., 2012). Margalef richness value was observed maximum 7.91 and minimum 6.60 in the upper Halda River (Alam *et al*., 2013). Margalef index was encountered ranging from 3.71 to 6.70 in the Betwa River in Madhya Pradesh of India (Vyas *et al*., 2012). The value of Shannon-Weaver diversity index, H' increases when both the number of species and evenness, J' increases. For a given number of species, the value of H' is maximized when all species are equally abundant. However, quantifying biodiversity is a complicated task. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species (Bibi and Ali, 2013).

In this conducted study, 1 endangered, 2 vulnerable, 3 near threatened, and 27 least concern species were recorded from the sampling area. Ahsan (2008) recorded a total of 105 fish species where 45 were threatened including 25 endangered, 14 vulnerable and 6 critically endangered in the Chalan *beel*. Sayeed (2010) reported 106 species of fishes including critically endangered (6), endangered (20), vulnerable (10) and threatened (18) from Chalan *beel*. At a time, small fishes were abundant in the rivers, *beels*, *jheels*, canals, streams, ponds etc. in Bangladesh (Shafi and Quddus, 1982; Ahsan, 2008). In this research work, maximum catch was found in the Basurabad point (24.60%) followed by Fultola (22.02%), Kishmath-fultola (19.77%), Boroitola (16.11%) and Debitola (17.50%). In Basurabad *beel*, average fish catch was observed as 2.76 ±0.38 kg per hour including all the gears operated in the *beel*. In the chalan *beel*, fish catch was 2.08 ± 0.49 kg and 1.29 ± 0.32 kg per hour per person, by suti jal (set bag net– the most common gear used in the *beel*) in 2005 and 2006 respectively. In 2005-2006, the annual fish production in Chalan *beel* was 12217 tons, being less than half of the production observed in 1982 (Hossain *et al*., 2009). In Chandagari *beel*, average fish production was 20.90 MT approximately (Halim *et al*., 2017). But, in Basurabad *beel*, yearly average fish production was 9.48 MT. This study revealed that the health condition of Basurabad *beel* was not satisfactory according to the pollution level (Staub *et al*., 1970; Lad, 2015) based on ecological indices like Shannon-weaver diversity index and Margalef Species Richness index respectively.

In the current study, 4 types of net, 4 types of traps, 1 type of hook, and 1 type of wounding gear were recorded. The fishing technique that are currently used by the fishermen of Bangladesh are netting, trapping, de-watering, spearing, angling and hand picking (Dewan and Mazid, 1994). Saha *et al*., (2005) encountered 7 different types of gears under 3 categories (nets, traps and wounding gears) in the Gawha *beel*. According to BCAS (1991), approximately 30 different types of fishing gear have been identified to use in halti *beel*. Rahman *et al*. (1993), reported that fishing gear operating in the floodplains (chanda, BSKV and halti *beel*) comprised four groups: fish net (7 types),

fish trap (5 types), hooks and line (5 types) and spears/harpoon (4 types). Rahman (2001) identified total 38 fish in the catches of different gears in the haor which is congruent to the present findings.

The study unveiled that month wise maximum fish catch was in October and November (16.3 kg) when rainfall was 12.98 cm and 3.21 cm respectively and lowest in August (10.2 kg) when rainfall was 32.35 cm which indicates that rainfall influences the amount of fish catch and shows negative relationship between the rainfall and the total catch of fish. This factor also influences the transparency and carries out sediment from surrounding land area. Results of the present study were found similar with the findings of Siddiq *et al.* (2013). They recorded the maximum fish catch in October (402 kg/month) and minimum in June (213 kg/month) in Dogger *beel*.

Threats to Biodiversity of Basurabad *Beel*

In the world, wetlands are perhaps losing faster than any other types of habitats. In truth, siltation of water bodies contributes specially to the aquatic habitat loss and degradation (Craig *et al.*, 2004). Rivers carry annually 2.4 billion mt silts, which is deposited on the river beds, floodplains and *beel* bottoms (Spillmann and Bachler, 1993). The peripheral areas of the *beels* have been converted to agricultural fields and this process is still continuing in this area. For this reason, most of the species of the Basurabad *beel* is at a stake now. In addition, overfishing not only affects the fishes but also affects the other aquatic resources as by-catches. Overfishing is considered as a key reason for the decline of fisheries (Zalinge *et al.*, 2001). Fishing by dewatering of water bodies and poisoning particularly in winter (dry season) are apparently destructive fishing methods that are usual in the Basurabad *beel*. Boosting up the crop production involves the use of pesticides and fertilizers in the crop fields. Pesticides are mainly poisonous and thus are hazardous to aquatic organisms and affect ecosystem integrity and disrupt its functioning (Parveen and Faisal, 2002). Many pesticides are used in the fields adjacent to the Basurabad *beel* that are carried out by the rain water and degrade the quality of *beel* water that is incredibly great threat to the aquatic organisms. The impacts and consequences of climate change are too much dangerous. A recent work shows that the potential consequences of climate change across the world habitats reduced abundance and altered species composition (Ashely *et al.*, 2007). The combined effects of these threats (siltation, habitat loss, conversion of wetland to agricultural fields, overfishing, dewatering during lean season, poisoning, pesticides and fertilizers, climate change etc.) may be damaging the entire fisheries resources of this *beel*.

Conservation implications

Freshwater fishes is the world's most threatened group of vertebrates after amphibians (Bruton, 1995; Hiddink *et al.*, 2008; Liu *et al.*, 2017) and without protection, 20% of the world's freshwater fishes may become extinct in the next 50 years (Moyle and Leidy, 1992; Fu *et al.*, 2003). In this study, the first component to protect fish biodiversity assumed to be the establishment of protected areas in the Basurabad *beel*. Most of the aquatic ecosystems are degraded due to the habitat loss (land filling and conversion) that should be minimized as soon as possible. Secondly, the fish acts and rules should be implemented rigorously and illegal fishing tackles like small mesh size nets and monofilament gill nets should be prohibited in the *beel* area. Overfishing and dewatering of the *beel* area need to be stopped. Thirdly, the use of inorganic fertilizers and pesticides should be banned and a guideline for the use of fertilizers and pesticides must be developed and implemented for the environment and fisheries protection. However, awareness rising on the impacts of loss of biodiversity, destructive fishing, overfishing, use of destructive gears, fertilizers, and pesticides etc. should be conducted and strong monitoring against these should be imposed. Therefore, the reported threats could be managed through proper awareness campaigns, billboards, bottom-up communication approach, ban on fishing in the particular season, keen monitoring by concern authority etc.

Conclusion

The fish diversity of the world is indisputably undergoing critical stage than the past. To achieve the conservation goal, in depth research on different arenas such as minimizing the pollution threats from the industries and agrochemical inputs should be carried out. Currently, the fish biodiversity of the Basurabad *beel* is under great threat due to fishing pressure, pollution, siltation, urbanization and other anthropogenic causes. These have been creating a great impact on the *beel* ecology. As a result, the water quality is deteriorating day by day and the availability of fish species is decreasing gradually. In the present study, total 33 species under 6 orders were recorded in Basurabad *beel*. There has been no Governmental and non-governmental survey introduced to estimate the fish biodiversity and fishing gears of Basurabad *beel*. During the study period, it was found that the fish abundance of Basurabad *beel* is declining at an alarming rate. The causes of these biodiversity declining are complete drying up in many parts of the *beel* during lean season, which is detrimental to fish populations and ecosystem. Some *beel* management policies should be adopted to protect the species which are at the degree of extinction and to recover sustainable production of the *beel*.

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