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The status of the fish diversity of the Turag River, Dhaka, Bangladesh

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Abstract
A research study was carried out to assess fish diversity of the Turag River, Dhaka, Bangladesh over a period of January to December 2017. Fish sample was collected from four sampling spots of the Turag River round the year. During this period, a total of 35 fish species under 28 genera, 20 families and 8 orders were recorded. Among the recorded fishes, finfish and shellfish were 97.14% and 2.85% respectively. The dominant order was cypriniformes and family was cyprinidae comprising 34.28% and 28.57% respectively. The abundant, common, moderate and rare species were 3(8.57%), 5(14.29%), 8(22.86%) and 19(54.29%) in number respectively. Regarding the national status of recorded fishes, threatened, near threatened, least concern and not evaluated species were 22.85%, 11.42%, 62.85% and 2.85% respectively. Again, among the threatened species, 2 species (25%) and 6 species (75%) were recorded as endangered and vulnerable respectively.

Keywords: Fish diversity, abundance, diversity parameter, Turag River

Introduction
River water becomes polluted in many ways and as a consequence diversity of fishes in most of the rivers of our country decreases day by day. High quantities of industrial wastes, petroleum products from ships, launches, cargoes, boats, untreated sewage etc. regularly get dumped into the Buriganga, Turag, Balu and Shitalakshya Rivers, which are already severely polluted (Khan *et al*., 2007) [1]. Fish diversity of a waterbody represents the fish faunal status and their abundance and river conserves comparatively varieties of fish species which supports commercial fishery. On the other hand, freshwater fishes are one of the most threatened taxonomic groups, because of their high sensitivity to the quantitative and qualitative alteration of aquatic habitats (Laffaille, *et al*., 2005; Sarkar *et al*. 2008) [2, 3]. As a consequence, they are often used as bio indicator for the examination of water quality, river network connectivity or flow regime (Chovance *et al*., 2003) [4]. Gupta *et al*., 2009 said that their size, community composition and structure often reflect nutrient status of a water body [5]. Fish health may therefore reflect and give a good indication of the status of specific aquatic ecosystem. So, it is inevitable to assess the fish diversity of the respective habitat to know their present status and how their habitat was destroyed as well. The study was done to carry out the assessment about the present status of fish diversity in the Turag River.

Materials and Methods
Study area and period
Four sampling sites were selected to get the available data of fish diversity of the Turag River from January to December 2017. The sampling sites were Gabtoli bridge (23°47′ 3.44° N, 90°20′8.34° E), Tamanna park (23°49′ 5.56° N, 90°20′8.34° E), Birulia bridge (23°51′ 4.64° N, 90°20′2.31° E) and Ashulia bridge (23°53′ 34.61° N. 90°21′36.43° E) on the said river (Fig.1).

Fig 1: Map of the Turag River showing the four sampling spots

Sampling procedure

For that research, four sampling sites were selected for getting almost complete record about the available fish species. From each of these sampling sites, fishes were harvested by local fishermen using different types of nets namely, gill nets, seine net, cast nets, lift net (dharma jal) and dragnets. Survey was usually done between 7.00 am to 5.00 pm. Data were collected from the direct observation of repeated visits to four sampling sites, personal interview of the fishermen, Focus Group Discussion (FGD). Collected data were cross-checked with the interview of the Upazila Fisheries Officer (UFO).

As soon as a new fish species was found, it was collected and immediately photographs were taken prior to preservation in 8-10% formalin containing plastic pots. Fishes were immediately brought to the laboratory for identification. Identifications were done based on keys used by Bhuiyan (1964), Talwar and Jhingaran (1991), Shafi and Quddus (2001) and Rahman (2005), Siddiqui *et al.* (2007) and IUCN (2015) [6, 7, 8, 9, 10, 11]. The relative abundance of the fish was classified into four categories namely abundant (76-100% of total catch), Common (51-75% of the total catch), moderate (26-50% of the total catch) and rare (1-25% of the total catch) according to Paunikar *et al.* (2012) [12]. On the other hand, national status of fish was determined according to IUCN Bangladesh (2015) [11].

Diversity parameter

In the present study Shannon-winner diversity index (H), Marglef species richnes (d), Pielou's evenness index (J') and Simpson dominance index (c) were evaluated by the following formula:

Shannon-Winner diversity index (H')

H' = Sum [pi x log (pi)]

Where

H' = Shannon-Weaver index,

Pi = ni/N,

Ni = No. of individuals of a species,

N = Total number of individuals

Margalef species richness (d)

d = (S-1)/log (N)

Where,

S = Total species,

N = Total individuals

Pielou's evenness index (J')

$$(J') = \frac{H\,(s)}{H\,(max)}$$

Where,

H (s) = The Shannon-Weaver information function,

H(max.) = The theoretical maximum value for H(s) if all species in the sample were equally abundant,

Simpson dominance index (c)

$$D = \sum (n / N)^2$$

Where,

N = the total number of organisms of a particular species

N = the total number of organisms of all species

Result and Discussion

To fulfill the objectives of the present study, fish diversity of the Turag River was carried out at four sampling spots in three seasons (monsoon, post-monsoon and pre-monsoon) of the said river. During the study period, a total of 35 fish species under 28 genera, 20 families and 8 orders were recorded (Table 1). Among the recorded species, finfish and shellfish were 97.14% and 2.85% respectively.

The dominant order was cypriniformes comprising 34.28%. The other orders were Osteoglossiformes (2.85%), Clupiformes (5.71%), Channiformes (2.85%), Siluriformes

(22.85%), Perciformes (25.71%), Beloniformes (2.85%) and Decapoda (2.85%). (Table 1 and Fig. 2). On the other hand, there were 20 families recorded as Notopteridae (2.86%), Clupicidae (2.86%), Clupeidae (2.86%), Engraulidae (2.86%), Channidae (2.86%), Cyprinidqae (28.57%), Cobitidae (5.71%), Bagridae (11.43%), Siluridae (2.86%), Heteropneustidae (2.86%), Pangasiidae (2.86%), Schilbeidae (2.86%), Ambassidae (8.57%), Nandidae (2.86%), Cichlidae (2.86%), Gobiidae (2.86%), Anabantidae (2.86%), Osphronemidae (2.86%), Mastacembelidae (2.86%), Belonidae (2.86%) and Palaemonidae (2.86%). (Table 1 and Fig.3). The most dominant order and family were Cypriniformes (34.28%) and Cyprinidae (28.57%) respectively.

Table 1: List of the recorded fish species in the Turag River during the study period.

Order	Family	Scientific name	English name	Local name	Relative abundance	National status
Finfish						
Osteoglossiformes	Notopteridae	*Notopterus notopterus*	Grey Featherback	Foli, Fholui	+	VU
Cluperiformes	Clupeidae	*Tenualosa ilisha*	River Shad, Hilsa Shad	Ilish, Ilsha	+	LC
	Engraulidae	*Gudusia chapra*	Indian river shad	Chapila	+	VU
Channiformes	Channidae	*Channa punctata*	Spotted Snakehead	Taki, Lata, Lati	+++	LC
Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	Molacarplet	Mola, Moa	++	LC
		Catla catla	Catla	Catla, Katla	+	LC
		Labeo calbasu	Black Rohu, Kalbasu	Kalibaus, Baus	+	LC
		Labeo rohita	Rohu, Rohu Carp	Rui, Rohit	+	LC
		Labeo bata	Bata Labeo	Bata	+	LC
		Cirrhinus reba	Reba	Tatkini,	+	NT
		Puntius sarana	Olive Berb	SarPunti	++	NT
		Puntius sophore	Spotfin Swamp Barb	Punti, VadiPunti	++++	LC
		Puntius ticto	Ticto Barb	Tit Punti	+++	VU
		Esomus danricus	Common Rasbora	Darkina	++	LC
	Cobitidae	*Lepidocephalichthys guntea*	Guntea Loach	Gutum	++	LC
		Lepidocephalichthys irrorata	Loktak Loach	Puiya	+	VU
Siluriformes	Bagridae	*Mystus cavasius*	Gangetic Mystus	Golsha	++	NT
		Mystus tengara	Tengra Mystus	GhuittaTengra	++	LC
		Mystus vittatus	Stripped Dwarf catfish	Tengra	+++	LC
		Sperata aor	Long Whiskered	Ayre	+	VU
	Siluridae	*Wallago attu*	Boal	Boal, Boali	+	VU
	Heteropneustidae	*Heteropneustes fossilis*	Stinging Catfish	Shing, Jiol	++++	LC
	Pangasiidae	*Pangasius pangsius*	Pungas	Pungus	+	EN
	Schilbeidae	*Clupisoma garua*	GaruaBacha	Ghaura	+	EN
Perciformes	Ambassidae	*Pseudambassis lala*	Highfin Glassy Perchlet	LalChanda	+	LC
		Pseudambassis ranga	Round Perchlet	Golchanda	+	LC
		Chanda nama	Long Perchlet	Lombachanda	+	LC
	Nandidae	*Nandus nandus*	Mottled Nandus	Bheda, Meni	+	NT
	Cichlidae	*Oreochromis mossambicus**	Tilapia	Tilapia	+	NE
	Gobiidae	*Glossogobius giuris*	Tank Goby	Bele, Bailla	+++	LC
	Anabantidae	*Anabas testudineus*	The Climbing Perch	Koi, Kai	++	LC
	Osphronemidae	*Colisa fasciata*	Stripled Gourami	Khalisha, cheli	+++	LC
	Mastacembelidae	*Macrognathus pancalus*	Striped Spinyeel	GuchiBaim	++++	LC
Beloniformes	Belonidae	*Xenentodon cancila*	Freshwater Garfish	Kakila	+	LC
Shellfish						
Decapoda	Palaemonidae	*Macrobrachium rude*	Hairy river prawn	Kuchachingri	++	LC

*=exotic fish; +++=very common, ++=common, +=rare; LC=least concern, NT=near threatened, VU=vulnerable, EN=endangered, NE=not evaluated

Obviously, it seems very poor condition compared to other rivers in Bangladesh and might be due to the worst water quality of river which did not support the diversified fish species. And Bhouiyan (2016) and Hossain *et al.* (2012) reported of 71 species of freshwater fishes (65 indigenous and 6 exotic species) and 53 species of finfishes respectively from the same river which were more than the present study and some other rivers of Bangladesh [13, 14]. (Bhuiyan *et al.*, 2008; Rahman *et al.*, 2012) [15, 16]. But presence of similar number of fish species was also reported in Mahananda River (Mohsin and Haque, 2009) [17]. Kamrujjaman and Nabi (2015) [18] found a total of 48 fish species in the Bangshi River which was more or less similar to the present findings. However, Ahmed and Akter (2008) found 35 species of fish in the Titas River which coincides with the present study [19]. Diversity of fish of the present study indicated the poor status of fish diversity both qualitatively and quantitatively. On the other hand, Bhouiyan (2016) recorded 9 orders and 25 families in the Turag River which were somewhat higher than the present study [13]. Kamrujjaman and Nabi (2015) observed 18 families and 8 orders in the Bangshi River which were more or less similar to the present findings [18]. Present status of fish diversity in the Turag River was obviously for the habitat destruction due to continuous discharge of untreated industrial effluents from surrounding industries as well as municipal discharge from Dhaka city.

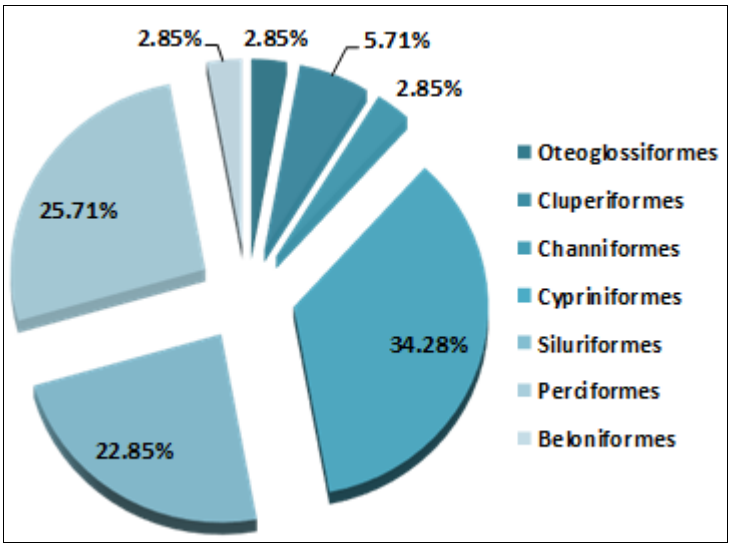

Fig 2: A graphical presentation of the percentage of recorded orders of fish species found in the studied area during the study periods.

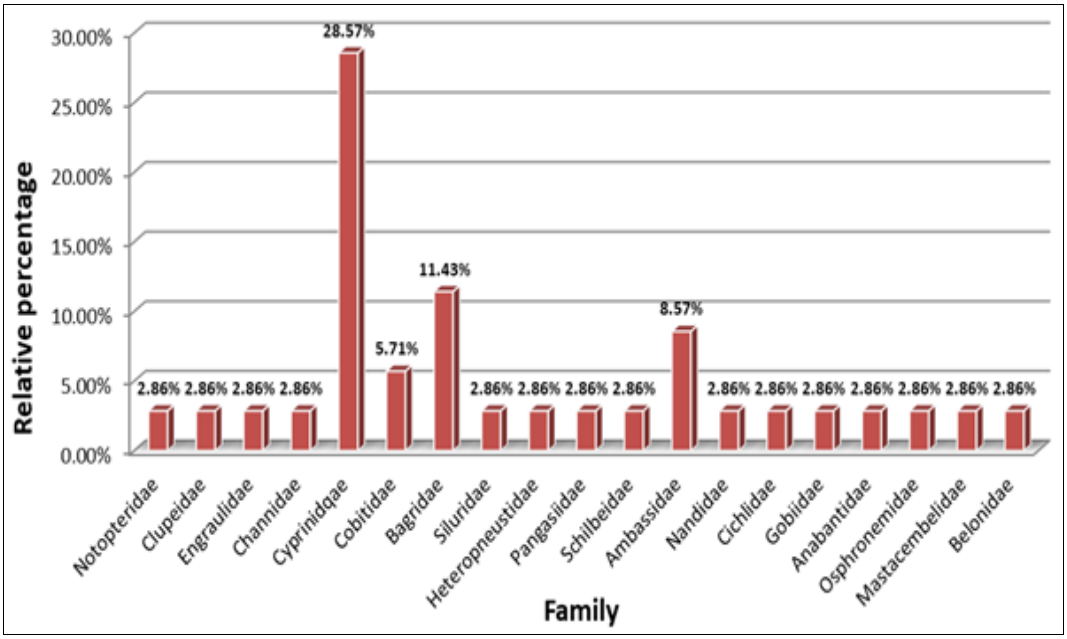

Fig 3: A graphical presentation of the percentage of families of fish species found in the studied area during the study periods.

Relative abundance of recorded fish

Among the recorded 35 species, 3 species (8.57%) were abundant. Those were *Puntius sophore*, *Heteropneustes fossilis and Macrognathus pancalus*. On the other hand, the common, moderate and rare number of species were 5 (14.29%), 8 (22.86%) and 19 (54.29%) respectively (Table 1). Kamrujjaman and Nabi (2015) reported that a maximum of 29 species were rare, whereas, only 3 were very common and 16 were common in the Bangshi River[18]. These findings were more or less similar to the present study. Ali *et al.* (2014) also stated availability of 10 species throughout the year, 12 species throughout the year in small quantities but, 7 species throughout the year in large quantities. However, rare and very rare species were recorded as 8 and 15 species respectively in the Chitra River [20].

National status of recorded fish

According to IUCN (2015), among the recorded 35 species of fish, threatened, near threatened, least concern and not evaluated species were 22.85%, 11.42%, 62.85% and 2.85% respectively (Fig. 4). Again, among the threatened species, 2 species (25%) and 6 species (75%) were endangered and vulnerable respectively [11]. But, no critically endangered species were recorded during the study periods (Fig. 5). This observation was not a good indication of the current status of this river which suggested immediate conservation strategy to protect the species diversity. Bhouiyan *et al.* (2016) reported of 5 critically endangered, 9 endangered and 12 vulnerable species among the 65 species of recorded fish in the Turag River according to IUCN (2000) [15]. Kamrujjaman and Nabi (2015) founded 25(52.08%) species were threatened out of the recorded 48 species in the Bongshi River [18]. Among the threatened fish species vulnerable, endangered, critically endangered species were 05(20%), 09(36%) and 11 (44%), respectively. Pramanik *et al.* (2017) reported of 20% threatened fish species in the Meghna River in which 11 species (10.28%) were found as Vulnerable (VU), 8 species (7.48%) as Endangered (EN) and 2 species (2%) as Critically Endangered (CR) according to IUCN (2015) [21]. The percentage of threatened fish more or less supported the present findings.

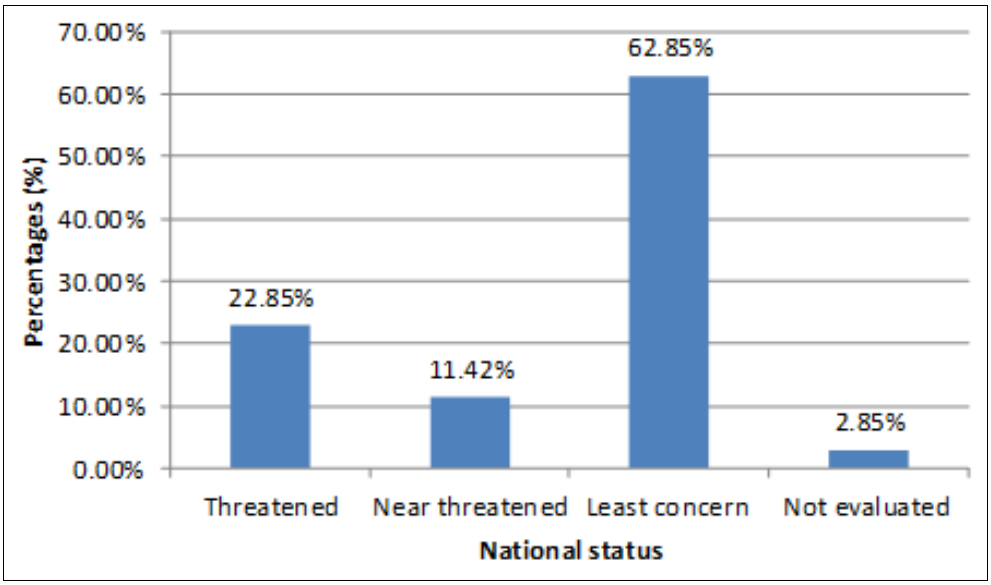

Fig 4: A graphical presentation of the percentage of the national status of the fishes found in the studied area during the study periods

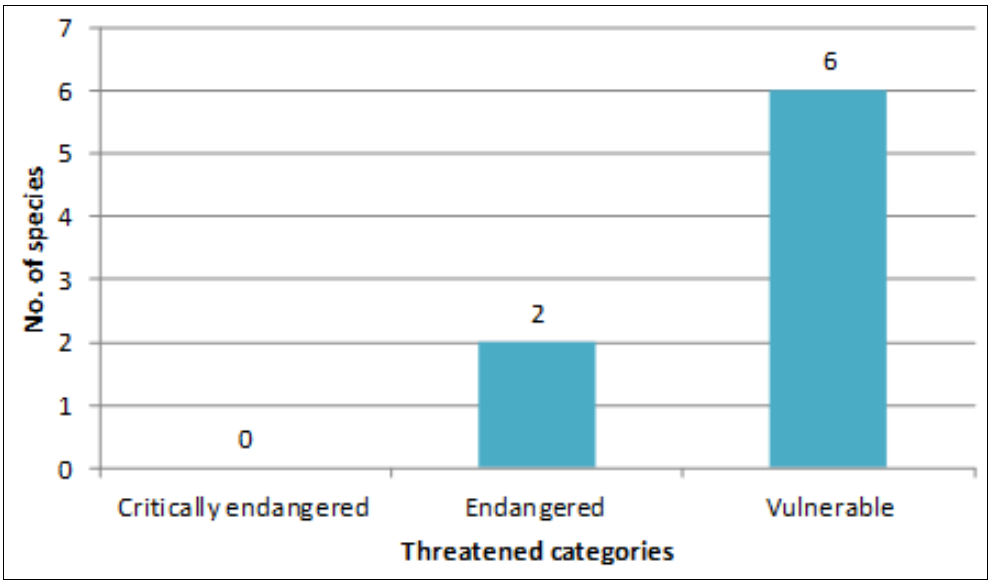

Fig. 5: A graphical presentation of the number of threatened categories of fishes found in the studied area during the study periods

Diversity, richness, evenness and dominance index

In the present study, Shannon-Winner diversity index (H') indicated the highest (2.49) and lowest (0.53) value was in the month of June and of December respectively. H' value of fish diversity is 5-4 indicating very good quality, 4-3 good quality, 3-2 moderate quality, 2-1 poor quality and very poor quality <1 (Mishra *et al*., 2010). So, present findings revealed that fish diversity remained moderate in quality only in the month of June (2.49) and July (2.04), in poor quality between January to May and August to October (Fig. 6). However, it became of a very poor quality in November (0.69) and December (0.53). Most of the fish species were available in the monsoon compared to other seasons as the river water volume increased during the monsoon and water quality of the river was suitable to fish. But, in other seasons especially in dry seasons, water volume became reduced and water turned peach black in colour in some area and destructed the fish habitat. These phenomena were not common to the other normal rivers of Bangladesh. Hossain (2012) found Shannon diversity index values high in December (3.14) and low in April (2.78) [22]. According to the study of *Galib et al.* (2013), Shanon Winner diversity index was ranged from 3.427 (June) to 3.818 (December) in the Choto Jamuna River. These results were completely reverse of the present findings [23]. However, Ruma *et al.* (2017) stated maximum (3.517) H' value in July and minimum (3.011) in March which was more or less similar with the present investigations [24].

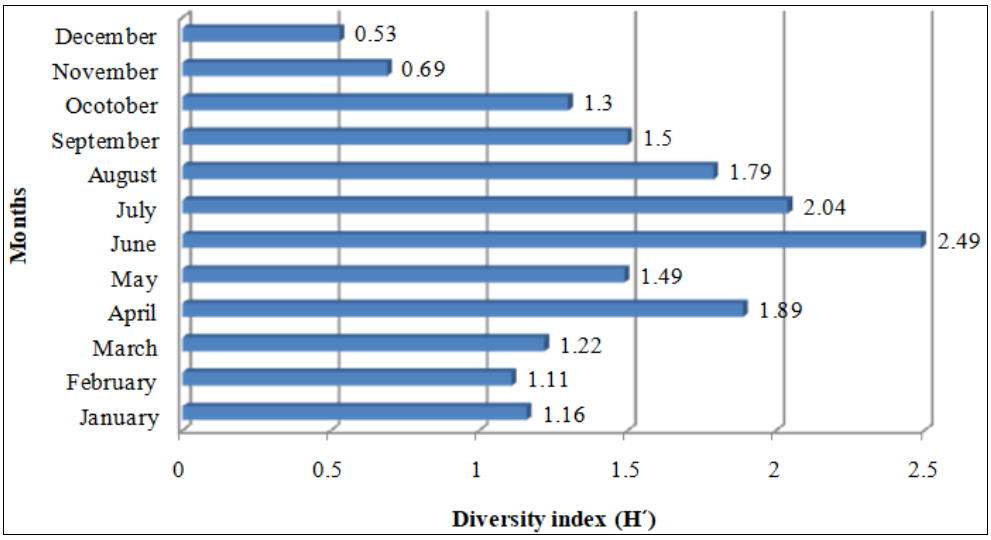

Fig 6: A graphical presentation of the diversity index of fish species found in the studied area during the study periods

In the present study, the Margalef richness index (d) ranged from 0.83 (in December) to 3.6 (in June) which indicated the river had healthy to poor-quality food chains (Fig.7). Healthy food chain retained from June to August. But, rest of the months this value decreased and was worst from November to December. Rahman (2017) described that Margalef's index (d) was 5.13 for species available in the Agunmukha River that was higher from the present study. Hossain (2012) found highest Margalef richness value 6.75 during March whereas, lowest value 6.10 during November [22]. According to Galib (2013), Margalef richness index ranged from 6.973 (June) to 8.932 (November) in Choto Jamuna River [23]. These results were not similar to the present study. However, Ruma *et al.* (2017) reported maximum richness from July to September and minimum in March which more or less supported the present observation [24].

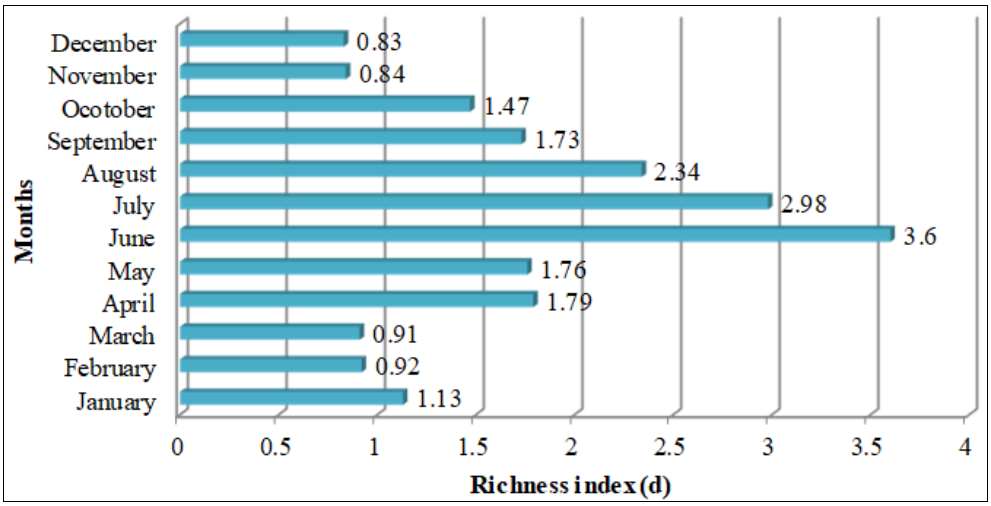

Fig 7: A graphical presentation of the richness index of fish species found in the studied area during the study periods

On the other hand, the values of Evenness (E) usually ranged from 0 to 1 (Rahman *et al*., 2015 and Krebs, 1999) where the closer to 1, the more even the populations of fish that form the community [25, 26]. In present study, the evenness value found almost closer to 1 (0.71 to 0.91) during January to October which indicated very few or no dominating species in the Turag River (Fig. 8). However, in the month of November to December indicated the dominating species in the said river. Hossain (2012) described highest evenness value as 0.686 in November and lowest as 0.350 in April [22]. Galib (2013) found evenness index ranged from 0.891 (July) to 0.936 (December) in the choto Jamuna River which were not supported by the present findings [23]. However, Ruma *et al.* (2017) stated maximum (0.752) in March and minimum (0.616) in September which was more or less similar to the present findings [24].

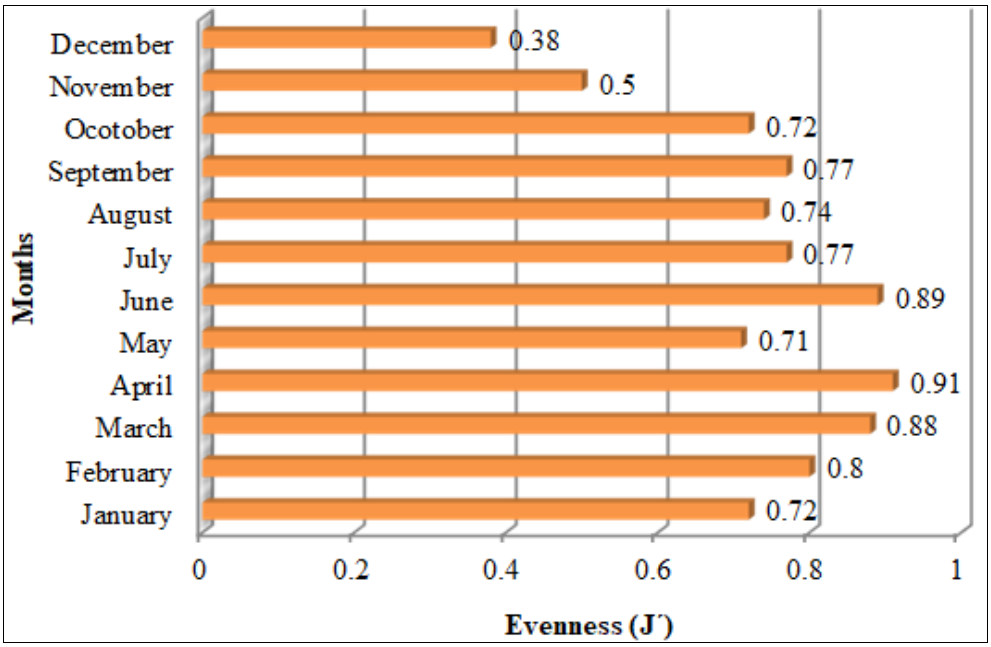

Fig 8: A graphical presentation of the evenness index of fish species found in the studied area during the study periods

Again, dominance index (D) value ranged from 0 to 1. 0, represents no dominance/complete diversity and 1, represents complete dominance/no diversity (Rahman *et al*., 2015). In the Turag River it was shown that the river had very few dominated fish species thus with higher diversified fish community structure in April to August (Fig. 9) [16]. However, it remained moderate from January to March and September to October. But there was no diversity in November to December. Hossain (2012) found highest monthly dominance diversity index value was 0.102 during March and lowest value was 0.062 during December [22]. Ruma *et al.* (2017) reported ranged between 0.043 and 0.048 [24]. These finding were not supported by the present study.

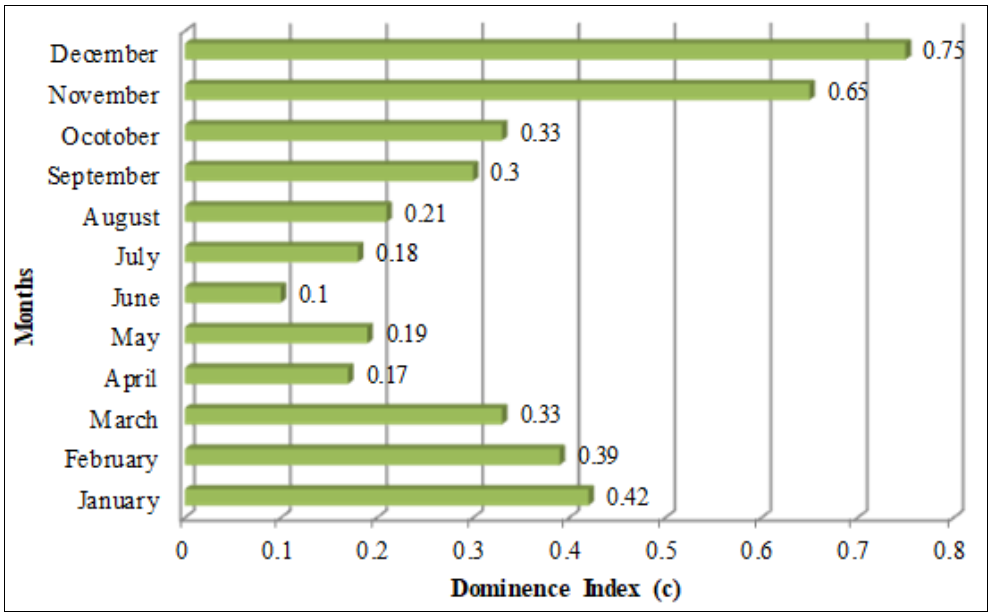

Fig 9: A graphical presentation of the dominance index of fish species found in the studied area during the study periods

Conclusion

Bangladesh being an economically rising country, life and river are closely interrelated for their fishery, agriculture, navigation and even sanitation development. Present study revealed that the fish diversity of the Turag River was not the up to the mark. This river is currently experiencing severe water pollution due to discharge of untreated industrial effluents from the surrounding industries, municipal discharge and various anthropogenic activities which destroying the fish habitat. It was evident from the present study that the fish is the worst victim in this said river. Study and conservation of fish diversity is essential to maintain ecological or nutritional and socio-economic equilibrium. Therefore, proper management and maintenance of river is important not just because of their crucial role in maintaining ecological balance but to increase fisheries production as well as to provide livelihood for the fishermen who are dependent on the Turag River.

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