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Inventory of Ichthyofaunal Diversity, Fishing Gear and Craft in Turag River, Dhaka, Bangladesh

Naser Ahmed Bhouiyan, Mohammad Abdul Baki*, Anirban Sarker and Md. Muzammel Hossain

Department of Zoology, Jagannath University, Dhaka-1100, Bangladesh

Abstract

Biodiversity of many Bangladesh Rivers is seriously threatened by industrial and municipal pollution. The study was conducted in the Turag River starting from Amin Bazar bridge (23°47' N 90°20'E) to Kamarpara bridge (23°53' N 90°23'E). This inventory survey was sampled at a fortnightly interval usually between 7.00 am to 5.00 pm by a team using a boat from December 2012 to November 2013. Detailed information on catch by species, fish length and weight, different types of gear and craft were collected through direct observation. A total of 71 (65 indigenous and 6 exotic) fish species (under 25 families of 9 orders) have been identified. 17 different types of gears of two categories (active and passive gear) and 8 different types of crafts were observed to harvest fish in the study area. The survey revealed that rising floodwater stimulated an increase in fishing activities in the study area from July to October. Fish numbers were recorded lower from November to July (dry and pre-monsoon period) likely due to reduced water flow and adverse water quality of this river. A paired *t*-test indicate that fish species numbers were significantly difference between Dry and pre-monsoon (P=0.02), Dry and monsoon (P=0.02) and Dry and post-monsoon season (P=0.03) respectively. However, fisheries resources contribution is very limited for livelihood of the surrounding people.

Keywords: Fish species; Fishing activity; Flood water; Water quality; Extinct

Introduction

Population growth has resulted in increasing demand for the use of rivers to satisfy a diverse range of human needs, including solid waste disposal and the discharge of industrial, sewage and mining effluents. The modifications to rivers disrupt the aquatic ecosystem and diminish its integrity [1-3] affecting the capacity of fish and other organisms to survive. However, 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 [4]. Water quality has been affected by a combination of factors including sewage and industrial wastes and agricultural run-off [5]. 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 [6]. It has been established that pollution of the river impacts key physiochemical properties of water thereby causing reduced dissolved oxygen (DO) level [7]. Fishes are relatively sensitive to changes in their surrounding environment. The concept of using fish communities as biological indicator has been historically followed by several authors [8,9]. Their size, community composition and structure often reflect nutrient status of a water body. Fish health may therefore reflect and give a good indication of the status of specific aquatic ecosystem [10,11].

Turag River of Bangladesh is a tide-influenced River passing through west-north and north of Dhaka City [12]. In the recent past, the human population, different industries, agricultural land converted into industrial and housing development land, brick fields around the Turag river basin has increased tremendously caused serious environmental pollution through discharging their untreated effluents directly or indirectly into river water. Industrial area possesses about 29 heavy industries and this cluster of industries of the capital city generates 7,159 kg effluents daily discharge and pollutants enter freely into the river [13]. In September 2009, four rivers around the Dhaka city-the Buriganga, the Sitalakhaya, the Turag and the Balu, were declared as Ecologically Critical Areas (ECAs) by the Government of Bangladesh. Therefore, it is imperative to monitor the aquatic fauna of this river. However, the documented sources of pollution in this river are widely varied and range from Industrial Effluents; Solid Waste; Textile Dyeing Industries; Municipal and Sewerage Disposal; Heavy Metal in sediment and water; Oil discharge. These industries discharge untreated wastewaters into river containing various types of hazardous chemicals including enzymes, detergents, dyes, acids, alkalies, salts and toxic heavy metals [14-18].

Most of these wastes are non-biodegradable and continuously leaching pollutant into the water body. However, several studies indicated that the Turag river water and sediment are highly contaminated [5,19,20]. Therefore, the need for water body specific detailed biodiversity studies [21]. No quantitative data for assessing fish abundance is available for this river system. The objective of this study is to assess the ichyofaunal diversity of River Turag. We will classify fish species, how seasonal changes in water level impact the diversity of species.

Materials and Methods

Study area and period

The Turag is 75 km long of which only about 18.4 km are within the study area starting (Figure 1) from Amin Bazar bridge (23°47' N 90°20'E) to Kamar para bridge (23°53' N 90°23'E). Turag is the upper tributary of the Buriganga, a major river in Bangladesh. Turag River is supposed to derive massive pollutant loadings from industrial effluents directly as industries, textiles, dyeing and pharmaceuticals have

***Corresponding author:** Mohammad Abdul Baki, Assistant Professor, Department of Zoology, Jagannath University, Dhaka-1100, Bangladesh, Tel: +8801610184562; E-mail: mabaki@gmail.com

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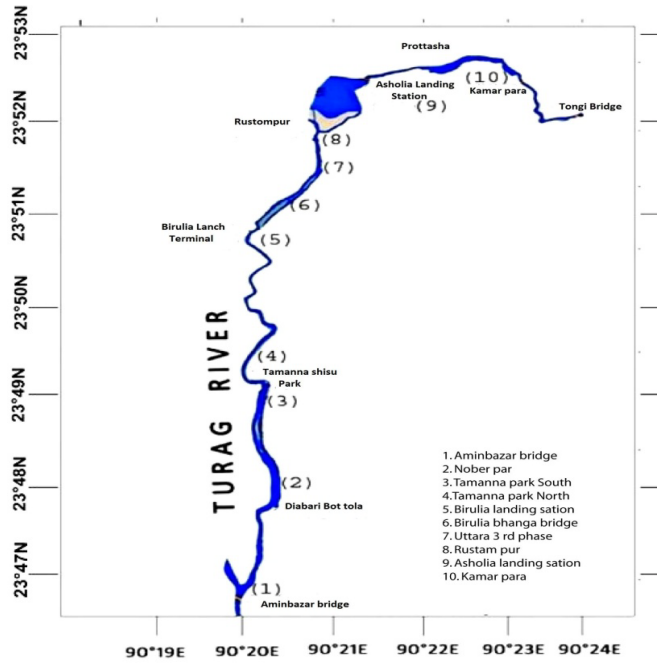

Figure 1: Map of Turag River.

clustered here. There are numerous canals, channels, and pipes directly discharging industrial, municipal and domestic sewage into the Turag, these observed by our study period (Figure 2). During the monsoon season, the water quality improves moderately, but on the advent of the dry season, pollution concentration increases abruptly because the water level of the rivers reduces a lot at this time, but the rate of pollutants released into the rivers remains identical. This inventory survey work of the Turag River was sampled inside at fortnightly interval for a total of 12 months from December 2012 to November 2013.

Sampling procedure

A team of two biologists carried out continuous survey using a boat. Detailed information on catch by species and different types of gear and craft were collected while fishermen were harvesting fish in the river. Survey procedure also included recording individual fish length and weight. Survey was usually made between 7.00 am to 5.00 pm. Materials were included digital camera, measuring tape, spring balance, polythene bags, data sheet, pencil, rubber band, map and other field logistics. The samples were photographed, immediately prior to preservation. The fish specimens caught by each fishing gears were also recorded separately.

Fish and gear identification

Fish identification, common and scientific names used throughout this study are in accordance with pictorial books and gear identified by Ahmed N [22-24].

Type of habitat preference categories

Fish species were divided into three categories according to [25] which are define below.

Riverine: Species usually found in rivers and estuaries throughout their life cycle with no dependence on the floodplain, although some of these species can be found more extensive floodplains.

Migratory: Species which move between river and floodplain during different stages in their life cycle. It remains unclear whether such movements are obligatory for their survival.

Floodplain resident (sedentary): Species which are generally sedentary and are capable of surviving in the perennial waters on the floodplain throughout the year. Many of these species also in habit a variety of other habitats including large rivers.

Hydrological year

Hydrological year can be divided into four seasons according to [25].

Rising flood (pre-monsoon): May-June.

Full flood (monsoon): July- September.

Flood drawdown (post monsoon): October-November.

Dry season (winter): December-April.

Bangladesh Water Development Board (BWDB) set up a water level monitoring station at Turag River for forecasting the flood situation of Dhaka city. This station was located at 23°78'33" and N 90°34'E for the daily monitoring of the water level of Turag 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. Bangladesh metrological department showed that pre-monsoon, monsoon, post-monsoon and dry period in 2013 received average rainfall in Dhaka city was 339.9, 330.0, 103.35 and 54.3 mm respectively.

Statistical analysis

We used a paired *t*-test to test whether the fish species number in different seasons were significantly different between dry season and pre-monsoon, dry season and monsoon, dry season and post monsoon or not. Correlation analysis was also done among water depth, fish species and fishing activity.

Results

Hydrology

The measurement of water depth, increased and depletion of Turag River water in different months are shown in Figure 3. Depth of Turag

Figure 2: Different types of threats for fish in the Turag River.

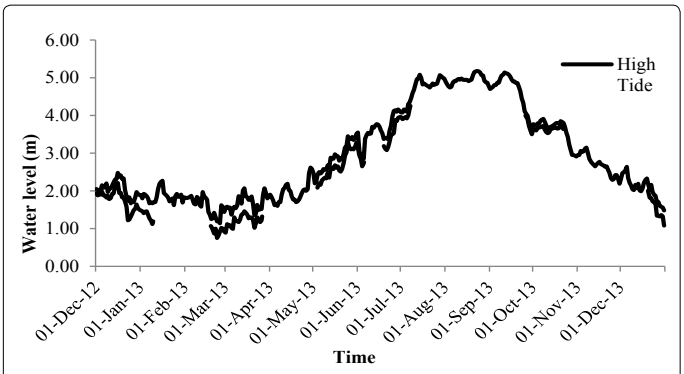

Figure 3: Daily water level of Turag River for study period.

River water starts to rise in May due to pre-monsoon water. This initial increase in discharge is followed by very sharp rise, usually occurring in July to reach flood peaks in August and September. This is result of monsoon. Depth of water normally decreases after peaks of September onwards, reaching a minimum level in March. Water depth data clearly show that water depth is lower in the winter and pre-monsoon (from December to June) periods compared to monsoon and post-monsoon period (July to November). There is no detectable change of water depth in Turag during winter period due to flow of water in this period.

Identification of fish species in Turag River

A total of 71 species of freshwater fishes (65 indigenous and 6 exotic species) belonging to 9 orders and included under 25 families were found in Turag River**.** Each of the individuals of all the species length and weight observations were recorded for the 71 fish species analyzed in this study also. Among fish species, 9 endangered, 5 critically endangered and 12 vulnerable species were classified respectively (Table 1).

Seasonal impact on fish distribution

Seasonal changes in the fisheries of rivers may be determined by fishing activities, cyclical changes in discharge, water velocity, water level and water pollution which in turns greatly influence the relative

Order	Family	Scientific name	English name	Local name	Length (cm)	Weight (gm)	Local Status
Osteoglossiformes	Notopteridae	*Chitala chitala*	Humped Featherback	Chital, Chetol	24	90	En
		Notopterus notopterus	Grey Featherback	Foli, Fholui	16	40	Vu
Cluperiformes	Clupeidae	*Tenualosa ilisha*	River Shad, Hilsa Shad	Ilish, Ilsha	10	10	
	Engraulidae	*Gudusia chapra*	Indian river shad	Chapila	10	10	
Channiformes	Channidae	*Channa punctata*	Spotted Snakehead	Taki, Lata, Lati	20	67	
		Channa striatus	Snakehead Murrel	Shol	13	48	
		Channa marulius	Great Snakehead	Gajar, Gajari	19	170	En
		Channa orientalis	Walking Snakehead	Gachua, Cheng	13	15	Vu
Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	Mola carplet	Mola, Moa	5	5	
		Barbonymus gonionotus	Java Barb	Thai Sarpunti	27	300	
		Hypophthalmichthys molitrix	Silver Carp	Silver Carp	29	210	
		Aristichthys nobilis	Bighead Carp	Bighead	46	1250	
		Labeo calbasu	Black Rohu, Kalbasu	Kalibaus, Baus	23	200	En
		Catla catla	Catla	Catla, Katla	440	31	
		Cyprinus carpio	Common carp	Carpu	42	2450	
		Cirrhinus cirrhosus	Mrigal carp	Mrigal, Mirka	13	45	
		Labeo rohita	Rohu, Rohu Carp	Rui, Rohit	220	27	
		Labeo gonius	Kuria Labeo	Ghannya, Goni	22	520	En
		Labeo bata	Bata Labeo	Bata, Bhangan Bata	13	45	En
		Cirrhinus reba	Reba	Tatkini, Bata	10.5	15	Vu
		Labeo boggut	Boggut Labeo	Ghania , Gohria	14	50	
		Osteobrama cotio	Cotio	Keti, Dhela, Dhipali	4.5	2	En
		Puntius sarana	Olive Berb	Sar Punti	7	7	Cr
		Puntius sophore	Spotfin Swamp Barb	Punti, Jat Punti	6	5	
		Puntius chola	Swamp Barb, Chola Barb	Chalapunti, Punti	6	5	
		Puntius terio	One spot Barb	Teri Punti	6	6	Vu
		Puntius guganio	Grass barb	Mola punti	6	5	
		Puntius conchonius	Rosy Barb, Red Barb	Kanchan Punti	6	5	
		Rasbora daniconius	Common Rasbora	Darkina	6	1	
		Salmostoma phulo	Finescale Razorbelly Minnow	Fulchela	7	3	
		Salmostoma bacaila	Large Razorbelly Minnow	Narkalichela	6	4	
		Aspidoparia jaya	Jaya	Jaya, Peali	7	3	
	Cobitidae	*Botia dario*	Queen Loach, Bengal Loach	Rani	8	7	En
		Lepidocephalichthys guntea	Guntea Loach	Gutum	8	5	

Siluriformes	Bagridae	*Mystus bleekeri*	Stripped Dwarf catfish	Bajari Tengra, Bujri	11	9	
		Mystus tengara	Day's Mystus	Gulsha Tengra	6	4	
		Mystus cavasius	Gangetic Mystus	Kabashi Tengra,	8	7	Vu
		Mystus vittatus	Stripped Dwarf catfish	Tengra	7	8	
		Sperata aor	Long Whiskered	Ayre	21	120	Vu
	Siluridae	*Wallago attu*	Boal	Boal, Boali	14	15	
	Schilbeidae	*Ailia coila*	Gangetic Ailia	Kajuli, Bashpata	10	5	
		Ailia punctata	Jamuna Ailia	Kajuli, Bashpata	10	5	Vu
		Clupisoma garua	Garua Bacha, Gagra	Garua Bacha	18	50	Cr
		Eutropiichthys murius	Murius vacha	Muri bacha	15	30	
		Eutropiichthys vacha	Batchwa vacha, Bacha	Bacha, Garua Bacha	15	30	Cr
	Pangasiidae	*Pangaius pangaius*	Pungas	Pangas	10	15	Cr
	Sisoridae	*Bagarius bagarius*	Gangetic Goonch	Baghair	14.5	245	Cr
		Gagata cenia	Indian Gagata	Cenia, Jungla	7	8	
	Heteropneustidae	*Heteropneustes fossilis*	Stinging Catfish	Shing, Jiol	15	25	
	Loricariidae	*Hypostomus plecostomus*	Suckermouth catfish	Choshok machh	18	75	
Synbranchiformes	Synbranchidae	*Monopterus cuchia*	Cuchia	Kuchia, Kuicha	51	180	Vu
Perciformes	Ambassidae	*Pseudambassis lala*	Highfin Glassy Perchlet	Lal Chanda	3.5	1	
		Pseudambassis baculis	Himalayan Glassy Perchlet	Kata Chanda	3.5	1	
		Chanda nama	Elongate Glass-perchlet	Nama Chanda	5	2	Vu
		Pseudambassis ranga	Indian Glassy fish	Ranga Chanda	6.5	2	Vu
	Sciaenidae	*Otolithoides pama*	Pama Croaker, Pama	Poa, Poma	13	50	C
	Nandidae	*Nandus nandus*	Mottled Nandus	Bheda, Meni	13	50	Vu
	Cichlidae	*Oreochromis mossambicus*	Tilapia	Tilapia	21	200	
		Oreochromis niloticus	Nile Tilapia	Nilotica, Tilapia	26	325	
	Gobiidae	*Glossogobius giuris*	Tank Goby	Bele, Bailla	7	3	
	Anabantidae	*Anabas testudineus*	The Climbing Perch	Koi, Kai	17	60	
	Osphronemidae	*Colisa lalia*	Red Gourami	Lal khalisha	4.5	4	
		Colisa fasciata	Stripled Gourami	Khalisha, cheli	5.5	12	
		Ctenops nobilis	Indian paradisefish, Frail Gourami	Naftani, Napit khailsha	5	2	En
	Mastacembelidae	*Macrognathus pancalus*	Striped Spinyeel	Guchi Baim	10	10	
		Macrognathus aculeatus	Lesser Spiny Eel	Tara Baim	25	20	Vu
		Mastacembelus armatus	Tire-track Spiny Eel	Sal Baim, Bro Baim	28	70	En
	Mugilidae	*Rhinomugil corsula*	Corsula Mullet	Khalla	4	8	
Beloniformes	Belonidae	*Xenentodon cancila*	Needle Fish	Kankila, Kakila	18	10	
Tetraodontiformes	Tetraodon	*Tetraodon cutcutia*	Ocellated pufferfish	Tepa, Potka	9	6	
		Tetraodon fluviatilis	Green puffer fish	Potka	3.5	4	

*(C=Common, Cr=Critical endangered, En=Endangered and Vu=Vulnerable).

Table 1: Identification of Fish species in the Turag River.

abundance of different species of fish. Clear seasonal patterns in the variation of total number of species recorded in this study area were evident (Figure 4). Most of the species was observed from August to November (during monsoon and post monsoon period) for 4 months only. It can be seen that the higher species numbers were captured from July to November with two peaks in August and October (Figure 4) respectively. Correlation analysis between water depth and fish species number (r=0.74) and fishing activities (r=0.96) showed strong correlation. A paired *t*-test indicate that fish species numbers were significantly difference between dry and pre-monsoon (P=0.02), dry and monsoon (P=0.02) and dry and post-monsoon season (P=0.03) respectively. Fish species numbers rose fairly sharply from July when floodwaters also rose during monsoon (July-September) (Figure 4). 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. Whilst second and highest peak in October was associated with flood drawdown (October-November) coincided with the entry of floodplain fishes into the river. The importance of the flood drawdown period to the catch of other species can clearly be seen as number of species increased (Figure 4) which had migrated from the rapidly drying floodplains. However, highest fish diversity was observed in October compared to August peak. These results support that the fish species composition was greatly influences by the flood water situation. Also is showed that the study proportion of the length of the rivers is fish less during this period. Despite this, water level and flow also sharply reduced in this period (Figure 3).

Gear and its distribution, number of species in gear

List of gears, trap and hooks are presented for this river in Figure 5. A total of 17 different types of fishing gears of two categories (active and passive gear) were observed to harvest fish in the study area. Dominant gear was cast net observed for 10 months followed by lift net (khora jal) observed for 7 months. Higher numbers (7-14) of the gears were used from July to November while extremely lower numbers (1-3) from December to June (Figure 6). The highest numbers of fish species were found in lift net (khora jal) and the lowest number of fish species was found in Box trap (Chai).

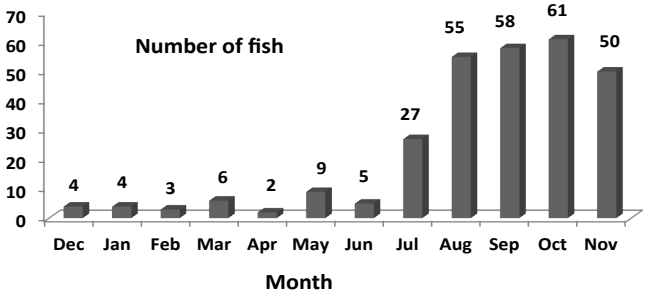

Figure 4: Monthly distribution of Fish species.

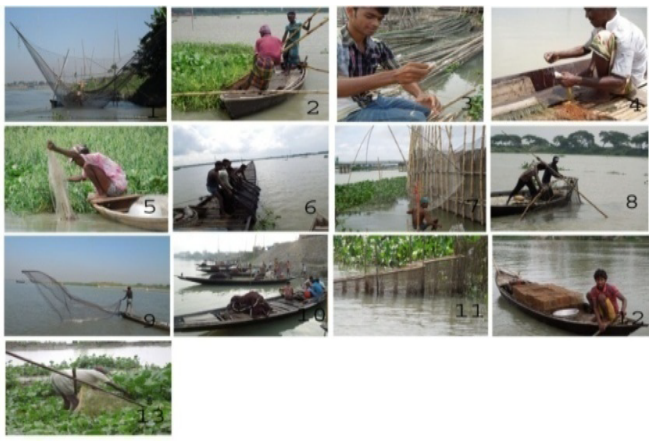

Figure 5: Different types of gears used for fishing in the Turag river: 1. Bel jal/Khora jal (Lift net, active gear) 2. Bash jal (Drag net, active gear) 3. Borshi (Hand line) 4. Borshi (Long line) 5. Carrent jal (Gill net, passive gear) 6. Uthar jal (Cast net, active gear) 7. Dharma jal/ toni jal (Lift net, active gear) 8. Moi jal (Drag net, active gear) 9. Jhaki jal Cast net) 10. Ber jal (Seine net, active gear) 11. Chai (Box trap) 12. Anta (Box trap). 13. Felun jal (Triangle trap, active gear).

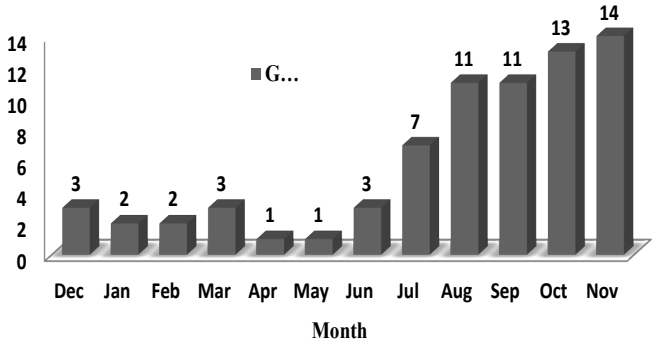

Figure 6: Monthly Gear distribution in Turag River.

Discussion

No previous statistics of fish fauna in this river was found and thus comparison of the present findings with previous one was not possible. This problem seemed not new in Bangladesh while working with fish diversity [21,26] and indicates the need for water-body specific fish diversity study in Bangladesh. The fish species of study area has been classified in terms of "endangered", "critically endangered", or "vulnerable" fish species by IUCN Bangladesh 2000 [27]. This same characteristic was noted in rivers Jamuna and Padma [25]. However, fish species numbers gradually decrease from October to November when gear number gradually increased in these months. This results indicated that reduce number of fish in these months may be associated with increased fishing activities. But fish species and gear numbers were sharply decreased starting from November. This continues till June with more or less constant number of fish and gear respectively. Our data indicated that there was almost zero catches during these periods.

Very low dissolved oxygen (DO) 1.9 mg/l to 0.7 mg/l) were recorded in this river from November to June (Dry and Pre-monsoon period) by Sharmin [28]. Furthermore, Rahman measured the DO concentration of Turag was lower from December to April and lowest value was 0.11 mg/l [5]. When DO goes below 4 to 5 mg/l, the survival of water organisms begin to go down, when anaerobic condition exists, higher life form like fish may be driven out. Furthermore, our data indicated that only *Channa puctata, Heteropneustes fossilis* and *Anabas testudinus* were observed during Dry and Pre-monsoon periods in the study area. *Heteropneustes fossilis* can respire aerially by gulping in air at various intervals when the oxygen content of water is low, [29]. The air-breathing apparatus of these species enables it to exist in almost any kind of water. Ahmed mentioned that Black fish have a broad environmental tolerance and can sustain the harsh conditions during the dry season [30]. Black fish include members of the Clariidae, Siluridae and Ophiocephalidae. However, only presence of these species during Dry and Pre-monsoon periods indicated that the health of river is highly polluted. Coates indicated that environmental degradation and habitat loss, not excessive fishing effort, is reported as the major cause of declining fisheries in most rivers under stress situation [31]. Furthermore, Naidu mentioned that the amount of catch depends upon its productivity of the fishing grounds [32]. Therefore, the extreme significantly 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. The lowest quality in fish assemblages occurred near cities that receive large amount of organic and industrial pollutants [33,34]. Considering the mentioned fact, 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 if something is not done for their conservation.

In conclusion, this study provides the first basic and baseline information on ichyofaunal diversity, fishing Gear and Craft in the Turag river that would be beneficial for fishery biologists and conservationists to impose adequate regulations for sustainable fishery management and conservation of biodiversity for the river as well as for other rivers in Bangladesh.

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