

ICHTHYODIVERSITY OF A SMALL COASTAL RIVER IN BANGLADESH

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Abstract

Small rivers are often ignored in terms of conservation actions and biodiversity management in Bangladesh. Despite having significant ecological and economic importance of these rivers, there is limited study done so far. To partially fulfill this gap, this study aimed to assess the fish and shellfish biodiversity of a small coastal river named Tiakhali from southern Bangladesh. A total of 26 finfish and 7 shellfish species were identified where 50% of finfish and all of the shellfish species were from the order Perciformes and Decapoda, respectively. Results showed that 76.9% of finfish and all of the shellfish species were categorized into the least concern category based on IUCN Red List. Estimated Shannon's, Margalef's, Buzas & Gibson's and Simpson's indices were 1.189, 2.649, 0.435 and 0.435 for fish and 1.662, 0.758, 0.224 and 0.224 for shellfish, respectively. This study showed that Tiakhali river's fish biodiversity was comparatively smaller than big rivers. The findings of this study might serve as a baseline for future works and will help policymakers to pay attention to conserve such small rivers and their biodiversity in future.

Introduction

Bangladesh is a riverine country with numerous small and large rivers and tributaries flowing through the country. These rivers play a significant role in the national economy and food security by providing fisheries resources, transportation facilities and employment opportunities for millions of people who are directly and indirectly dependent on the rivers. A wide variety of freshwater and brackish water fish species inhabit in these rivers due to their variety of water supplies⁽¹⁾ and enriched ecosystem. Approximately 260 freshwater finfish species, 12 exotic fish species, and 24 prawn species have been recorded so far⁽²⁾. Moreover, 475 marine fish and 36 shrimp species are also available in marine waters of Bangladesh⁽³⁾. However, riverine aquatic biodiversity is decreasing alarmingly due to some anthropogenic and natural causes like pollution, extensive use of pesticide and xenobiotic compounds, routine discharges of city garbages, habitat destruction, introduction of invasive species, over-exploitation, flooding, increasing fluctuation of temperature, salinity alterations, phytoplankton blooms, siltation, etc.^(4,5,6,7).

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Tiakhali river, which originates from Andharmanik river and flows through coastal districts of Patuakhali and Barguna, is a small river with a total length of around 19 km. Despite being small in size, this river has a wide range of species diversity due to its productive and variable ecological conditions and brackish water confluence. Thus, it plays an important role in the fisheries and transportation sector of this region. Many fishing communities, especially some women's dependent fishery households, rely solely on this river for their survival. A growing number of development activities have been taking place beside this river, for example, Payra seaport and Payra 1,320 megawatt coal-fired power plant. Payra seaport is 2.5 km away from the entrance of this river which might have a massive influence on the aquatic ecosystem⁽⁸⁾. Port development activities can result in habitat destruction of aquatic and terrestrial fauna including Hilsa (*Tenuulosa ilisha*) and other freshwater and brackish water species. In the Great Barrier Reef region, ports and shipping exert a variety of pressures across multiple temporal and spatial scales with diverse impacts on biodiversity⁽⁹⁾. According to the study of Billings⁽¹⁰⁾, ecosystems have sometimes been seriously damaged by the dumping of waste and heat from coal plants.

Despite having significant importance of the Tiakhali river in the fisheries sector, there has no study on assessing fish and shellfish biodiversity in this river. In Bangladesh, most of the studies were conducted on systematic and ecological aspects of riverine fish biodiversity in big rivers or large city-centered rivers like the Padma, Meghna, Jamuna, Shitalakshya, and Talma rivers^(1,11-14). The fish biodiversity of some small rivers like the Buriganga, Dhaleshwari, Turag and Andharmanik with higher economic importance were also studied⁽¹⁵⁻¹⁷⁾. However, small rivers are often ignored despite having high ecological and economic importance because of their geographical remoteness, large distances from the major cities, and mostly because of sampling difficulties. These small rivers might be dead in course of time which could also affect fish biodiversity if appropriate measures have not been taken into account to protect them. Thus, it is crucial to assess the fish biodiversity of small rivers, such as the Tiakhali river, that are at risk of environmental disturbance, in order to identify the current status and to protect biodiversity from development activities. Considering all the above causes, the objectives of the present study was to assess the fish and shellfish biodiversity of the Tiakhali river. The findings of this study might be used as a baseline for future works, and might help to develop appropriate management strategies or policies for sustainable exploitation and conservation of fisheries resources.

Materials and Methods

Sampling sites: Finfish and shellfish samples were collected from two sampling sites of the Tiakhali river in Southern Bangladesh: East Tiakhali of Kalapara upazila (sub-district) in Patuakhali district (S1) and Ghughumari of Amtali upazila in Barguna district (S2) (Fig. 1).

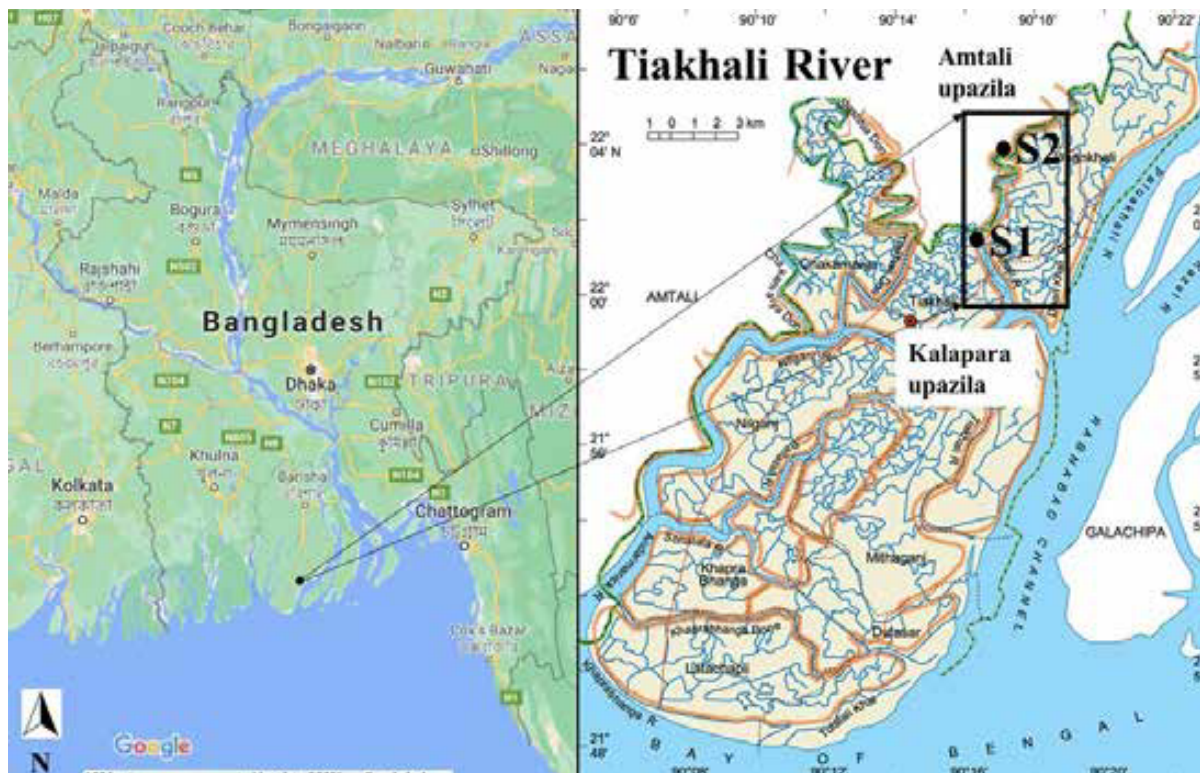


Fig. 1. Sample collection sites of East Tiakhali, Kalapara Southern part of Bangladesh.

Sample collection and identification: Samples were collected from fishers who use seine nets (locally called *ber jal*), a most commonly used net to catch fish in the river. The dimension of the net was 250 m x 3.5 m with a mesh size of 0.5 cm. The hauling period of the net was about 10 hours in the river as the net was set at the onset of high tides and hauled at low tides. The total catch by a single fishing effort was used in this study. In case of a small catch, finfish and shellfish samples collected from the study sites were separated species-wise on the spot (where possible) and the individual species abundances were recorded. Then the samples were examined based on both morphometric and meristic characteristics using the standard method followed by Shafi and Quddus⁽¹⁸⁾, and Rahman⁽²⁾ and their status were evaluated following the IUCN Bangladesh^(19,20). However, for the larger catches, 10% of the total catch was collected that were taken to the laboratory (when immediate on spot identification was not possible) covering with ice inside a box to identify those later in the lab⁽²¹⁾. Photographs were taken for each species to keep record. Water samples were also collected from four sites of the Tiakhali river (Table 1) to measure water parameters such as mean pH, electrical conductivity (EC), total dissolved solids (TDS) and temperature by Hanna Instrument HI9811-5.

Data analysis: Species diversity of fish and shellfish community were assessed using four species diversity indices Shannon index⁽²²⁾, Simpson index⁽²³⁾, Margalef index⁽²⁴⁾ and Buzas and Gibson's index⁽²⁵⁾. The reason for using different indices was to cross-check

the reliability of the biodiversity measures in different approaches and to have robust confidence to conclude the result on fish biodiversity. The threatened status of each species (e.g., critically endangered, endangered, vulnerable, near threatened, least concern, not evaluated, data deficient) was assessed based on IUCN Bangladesh^(24,25).

Results and Discussion

Physio-chemical parameters: The physicochemical parameters i.e., mean pH, EC, TDS and temperature of the river water were recorded as 7.0, 227.5 μ S/cm, 102.5 mg/L and 31.1°C, respectively (Table 1) which are considered good for aquatic life (except temperature). The mean value of pH reported in this study was comparatively lower than the reported values in the Meghna⁽²⁶⁾ and Padma⁽²⁷⁾ rivers. The pH value of water within 6.9 and 9.0 is suitable for the survival of most aquatic life, whereas, pH = 7.5 to 8.4 is optimal for algae growth in an alkaline atmosphere, and pH = 6.0 to 7.2 is suitable for the survival of fish eggs⁽²⁸⁾. The recorded EC values for the studied sites were 227.5 μ S/cm that was lower than reported EC values of the Meghna⁽²⁶⁾ and Padma⁽²⁷⁾ rivers and international threshold limit. This might be occurred because of the size and water flow differences in the Tiakhali river with other big rivers in Bangladesh. The values of TDS (102.5 mg/L) in this study were lower than the findings of other rivers in Bangladesh^(26,27,29) and international standards⁽³⁰⁾. For diverse fish production, a maximum TDS value of 400 mg/L is permissible⁽³¹⁾. The recorded temperature at different sites of the Tiakhali River has slightly exceeded the reported values in different rivers of Bangladesh and international guidelines for the aquatic environment.

Table 1. Water parameters in different sites of the Tiakhali river, Southern part of Bangladesh.

Sampling site	pH	EC (μ S/cm)	TDS (mg/L)	Temperature (°C)
East Tiakhali	7.2	230	100	31.1
Chchonautha	7.1	190	90	31.1
Dhankhali	6.7	230	100	31.1
Ghughumari	7.0	260	120	31.1
Mean \pm SD	7.0 \pm 0.22	227.5 \pm 28.72	102.5 \pm 12.58	31.1 \pm 0.0
Meghna river ^a	7.8 \pm 0.18	128.7 \pm 42.63	-	27.6 \pm 0.68
Meghna river ^b	8.0 \pm 2.3	310.5 \pm 110.2	160.4 \pm 80.2	25.1 \pm 5.5
Padma river ^c	7.62	230.33	149.66	28.33
International standards	6.5-9	1000 ^d	\leq 425 ^e	25 ^d

SD = Standard deviation, ^aAhmed *et al.*⁽²⁹⁾, ^bFlura *et al.*⁽²⁶⁾, ^cIslam *et al.*⁽²⁷⁾, ^dEPA, Ireland⁽³²⁾, ^eMississippi Commission on Environmental Quality⁽³⁰⁾.

Finfish composition and abundance: This study collected a total of 12,553 individuals of 26 finfish species from two sampling sites of Tiakhali river (Table 2). The recorded species of this study were comparatively fewer than other big rivers which might be because of the size differences of the river. For instance, a total of 80, 63 and 49 fish species were reported in the Padma river at Chapai Nawabganj district⁽¹³⁾, Choto Jamuna at Naogaon district⁽¹¹⁾ and Old Brahmaputra river⁽³³⁾ respectively. Generally, biodiversity is higher in big rivers than the small rivers. But, Ali *et al.*⁽⁷⁾ reported 93 fish species in Andharmanik river- a 40 km long coastal river of Bangladesh. The main difference between Ali *et al.*⁽⁷⁾ and this study was in sampling methods; Ali *et al.*⁽⁷⁾ used different types of fishing gears to collect samples to assess fish biodiversity which might be the reasons of having more fish species in Andharmanik river than Tiakhali river. Another difference might be the location of the river. Andharmanik river is located at the mouth of the Bay of Bengal where Tiakhali river is a distributary of the Andharmanik river.

Shellfish community composition and abundance: In this study, a total of 2,732 individuals belonging to 7 shellfish species were collected from two sampling sites of the Tiakhali river (Table 3). In East Tiakhali, a total of 1,799 samples under 7 species were reported that was 65.8% of the total collected samples.

Finfish biodiversity indices: In Table 4 the richness and proportion of each species were represented by the Shannon index, whereas the relative number of individuals in the sample and the fraction of common species were showed by the evenness and dominance indices, respectively. The site-specific Shannon index (H) value of this study showed that the highest biodiversity of fish was found in East Tiakhali than Ghughumari. However, this study found comparatively much lower value of H (1.189) in the Tiakhali river than other big rivers such as the Old Brahmaputra (3.659)⁽³³⁾, Meghna river estuary (3.198)⁽³⁴⁾ and Halda (3.39)⁽³⁵⁾. But the H value of some small rivers was in line with the present study such as the Talma River (1.06 to 1.59)⁽¹⁾. In the case of Andharmanik river⁽⁷⁾, the mean H value was 3.11 which was higher than the H value (1.189) of the Tiakhali river.

The value of d shows that the species richness is comparatively higher in East Tiakhali than Ghughumari as the number of species was higher in East Tiakhali (Table 2). Unlike Shannon index, Margalef index was also comparatively higher in the Andharmanik river (7.84 - 8.19)⁽⁷⁾ than in the present study. Based on the value of D and D', this study showed that higher sample diversity was reported in the East Tiakhali than Ghughumari. However, pooled data showed moderate species diversity in the river. The values of different indices estimated in this study were varied from other studies that might be occurred because of seasonal variations, nutrients alterations, seasonal fish migrations or recruitment and difference in the aquatic ecosystem and bottom topography that support the coexistence of different species.

Table 2. List of finfish species and their conservation status in Tiakhali river, Southern part of Bangladesh.

Study area	Family name	Order name	Scientific name	Common name	Number	IUCN 2000 ^a	IUCN 2015 ^b	
East Tiakhali	Anguilliformes	Anguillidae	<i>Anguilla bengalensis</i>	Indian longfin eel	1	VU	VU	
	Belontiiformes	Hemirhamphidae	<i>Hyporhamphus limbatus</i>	Congaturi halfbeak	6	NT	LC	
	Channiformes	Channidae	<i>Channa punctata</i>	Spotted snakehead	14	NT	LC	
	Cypriniformes	Bagridae		<i>Mystus gulio</i>	Long whiskered catfish	32	DD	NT
		Cyprinidae		<i>Puntius sophore</i>	Pool barb	134	NT	LC
		Schilbeidae		<i>Ailia coila</i>	Gargetic ailia	3	NT	LC
		Siluridae		<i>Wallago attu</i>	Freshwater shark	2	NT	VU
		Ambassidae		<i>Chanda nama</i>	Asian glass fish	12	VU	LC
	Perciformes	Eleotridae		<i>Butis melanostigma</i>	Black Spot Sleeper	9	NT	LC
				<i>Eleotris fusca</i>	Dusky sleeper	17	NT	LC
				<i>Boleophthalmus boddarti</i>	Blue spotted mudskipper	7	NT	LC
		Gobiidae		<i>Glossogobius giurris</i>	Tank goby	227	NT	LC
				<i>Stigmatogobius sadanundio</i>	Knight goby	17	NT	LC
	Pleuronectiformes	Mugilidae		<i>Rhinomugil corsula</i>	Corsula mullet	43	NT	LC
		Sciaenidae		<i>Johnius coitor</i>	Coitor croaker	22	NT	LC
Taenioidae			<i>Trypauchen vagina</i>	Burrowing goby	35	NT	LC	
			<i>Cynoglossus cynoglossus</i>	Bengal tongue sole	10	NT	LC	
			<i>Amblytharyngodon microlepis</i>	Indian carplet	3,420	NT	LC	
Cypriniformes			<i>Puntius sophore</i>	Pool barb	7,366	NT	LC	
			<i>Labeo rohita</i>	Rohu	2	NT	LC	
			<i>Salmostoma bacaila</i>	Large razorbelly minnow	54	NT	LC	
			<i>Systemus sarana</i>	Olive barb	4	CR	NT	
			<i>Wallago attu</i>	Freshwater shark	4	NT	VU	
Ghughumari	Cyprinodontiformes	Cyprinodontidae	<i>Aplocheilichthys panchax</i>	Blue panchax	58	NT	LC	
			<i>Chanda nama</i>	Asian glass fish	464	VU	LC	
			<i>Parambassis ranga</i>	Indian glassy fish	174	VU	LC	
			<i>Colisa fasciata</i>	Branded gourami	116	NT	NT	
			<i>Lates calcarifer</i>	Seabass	2	NT	NE	
Perciformes	Gobiidae		<i>Glossogobius giurris</i>	Tank goby	294	NT	LC	
	Sparidae		<i>Acanthopagrus latus</i>	Yellowfin seabream	4	NT	DD	
			Total		12,553			

CR = critically endangered, VU = vulnerable, LC = least concern, NT = not threatened, NE = not evaluated, DD = data deficient
^aIUCN Bangladesh 2000⁽¹⁹⁾, ^bIUCN Bangladesh 2015⁽²⁰⁾

Table 3. List of shellfish species (Order: Decapoda, Family: Palaemonidae) and their conservation status in the Tiakhali river, Southern part of Bangladesh.

Site name	Scientific name	Common name	Number	IUCN status ⁽²⁰⁾
East Tiakhali	<i>Macrobrachium birmanicum</i>	Birma river prawn	77	LC
	<i>Macrobrachium dolichodactylus</i>	Ghoda river prawn	124	LC
	<i>Macrobrachium mirabilis</i>	Short leg river prawn	215	LC
	<i>Macrobrachium malcolmsonii</i>	Monsoon river prawn	143	LC
	<i>Macrobrachium rosenbergii</i>	Giant river prawn	368	LC
	<i>Macrobrachium rudis</i>	Hairy river prawn	392	LC
	<i>Macrobrachium villosimanus</i>	Dimua river prawn	480	LC
		Sub-total	1,799	
Ghughumari	<i>Macrobrachium rosenbergii</i>	Giant river prawn	555	LC
	<i>Macrobrachium malcolmsonii</i>	Monsoon river prawn	54	LC
	<i>Macrobrachium rude</i>	Hairy river prawn	191	LC
	<i>Macrobrachium villosimanus</i>	Dimua river prawn	133	LC
			Sub-total	933
		Total	2,732	

Table 4. Finfish and Shellfish biodiversity index in different sites of the Tiakhali river, Southern part of Bangladesh.

Fish Type	Sampling area	Shannon index H= $-\sum P_i \ln(P_i)$	Margalef richness index d= $(s-1)/\ln(N)$	Buzas & Gibson's evenness index E=eH/S	Simpson index D= $\sum n(n-1)/\sum N(N-1)$	Simpson's Index of Diversity D'=1-D
Finfish	East Tiakhali	2.003	2.507	0.436	0.214	0.786
	Ghughumari	1.041	1.278	0.218	0.463	0.537
	Combined		1.189	2.649	0.126	0.435
Shellfish	East Tiakhali		1.784	0.801	0.850	0.187
	Ghughumari	1.076	0.439	0.733	0.419	0.581
	Combined	1.662	0.758	0.753	0.224	0.776

Shellfish biodiversity indices: The site-specific Shannon index (H) value showed that shellfish biodiversity was higher in East Tiakhali (H=1.784) than Ghughumari (H=1.076) (Table 4). The Margalef richness index (d) and Buzas & Gibson's evenness (E) showed that shellfish species richness was comparatively higher and more evenly distributed in East Tiakhali than Ghughumari. The Simpson index (D) and Simpson's diversity index (D') also represented that shellfish species dominance was higher in East Tiakhali than Ghughumari as the number of species was higher in East Tiakhali. However, comparing finfish species diversity in different rivers of Bangladesh, there is a paucity of published documents on shellfish diversity in different small and big rivers of the country.

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