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FISH DIVERSITY IN THE SOUTHERN COASTAL WATERS OF BANGLADESH: PRESENT STATUS, THREATS AND CONSERVATION PERSPECTIVES

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ABSTRACT

Despite the enormous anthropogenic and environmental hazards affecting wild fisheries resources, southern coastal waters are still considered one of the aquatic biodiversity hotspots in Bangladesh. Therefore, the present study was conducted to make a complete account of fishes and to assess their condition and conservation status in the rivers spread across four southern coastal districts of Bangladesh. During the study period from January to December 2014, a total of 98 species of fish were recorded belonging to 81 genera, 48 families and 13 orders. Perciforms were recorded as the most diverse fish group in terms of both number and individuals of species observed. Of the 98 species, 26.53% were listed as Locally Threatened in Bangladesh, including 11.22% species listed as Vulnerable, 10.20% as Endangered and 5.10% as Critically Endangered. Four population indices viz, Shannon–Wiener index (H), Simpson's dominance index (D), Simpson's index of diversity (1-D) and Margalef's index (d) were applied to demonstrate the species diversity, richness and evenness of fish in sampling areas and their overall values were 3.54-3.70, 0.04-0.05, 0.95-0.96 and 7.48-8.67, respectively. To sustain the prospect of fisheries biodiversity in the southern coastal areas of Bangladesh, management and conservation strategies like restocking economically important fish species, establishing and maintaining fish sanctuaries, banning indiscriminate fishing and destructive fishing gears, identification and protection of the breeding and nursery grounds should be taken into consideration with utmost priority.

How to Cite

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INTRODUCTION

The southern coastal rivers of Bangladesh are categorized by high levels of commercial fish catch which has direct contribution to the economy of the country (Islam, 2003; Sharker et al., 2015a). However, nowadays the riverine systems of southern Bangladesh have suffered from intense tourism and human intervention resulting in habitat loss and degradation, and as a consequence, wild fish populations have seriously declined in rivers and streams of this vast area (Sarkar et al., 2012; Siddik et al., 2013). The main causes behind the loss of fish diversity are over-exploitation augmented by various ecological changes and degradation of natural habitats, water abstraction, rampant installation of industries, introduction of exotic species, pollution and global climate change which led to the endangerment of

many species, including endemic fishes (Rao et al., 2014; Sharker et al., 2015b; Siddik et al., 2014). Moreover, sporadic measurement of water salinity along coastal fringe indicates intrusion of saline water in many areas (Khan et al., 2006). Anecdotal evidence also indicates that increased saltwater intrusion from the Bay of Bengal into the coastal region poses an imminent threat to coastal ecosystems and their biodiversity (Khan et al., 2006). As a result, a total of 54 fish species of Bangladesh have been declared as threatened by IUCN Bangladesh (2013) of which 12 species are recorded as critically endangered, 28 species are endangered and the remaining 14 species are vulnerable. This situation clearly indicates the need of detailed biodiversity study is imperative to assess the present status and sustainable management of water resources in southern Bangladesh (Galib et al., 2013; Siddik et al., 2013).

A scientific understanding of different management strategies to conserve biodiversity, fish abundance along with their natural distribution is essential to back up their optimum exploitation (Fu et al., 2003; Prpa et al., 2007; Eros and Scmera, 2010; Rao et al., 2014). Diversity index provides more information than simply the amount of species present in a particular waterbody which acts as an important tool that gives pivotal information on scarcity and commonness of species in a community. Over the decades, substantial research has been done on the systematics, biogeographical and ecological aspects of the inland fishes in the coastal areas of Bangladesh. However, actions to conserve fish biodiversity in the rivers are lacking. In this study, we attempt to collect information on fish biodiversity in the southern coastal areas of Bangladesh. The purposes of the present study were (1) to characterize the status of fish biodiversity; (2) to review the main threats to fish biodiversity; and (3) to provide recommendations for fish biodiversity conservation.

MATERIALS AND METHODS

Study area

The survey extended for one year from January to December 2014 in order to collect fishery data in four southern central coastal districts of Bangladesh. They are Pirojpur, Bhola, Patuakhali and Barguna located between latitude 21°47' to 22°52' North and longitude 89°02' to 90°55' East (Fig. 1). Previous statistics (Hossain et al., 2012; Chowdhury et al., 2010) indicates that fish catch is relatively high in full moon and new moon, and therefore sampling schedule was made considering the time of full moon and new moon of southern Bangladesh. Data were collected from various sites especially from fish sellers in fish markets, fishing spots and questionnaire discussion with fishermen in fishing community. Fishes were also purchased from the fishermen at the fishing spots. However, species which seemed difficult to identify at a fishing spot were preserved in 7 to 10% buffered formalin solution and transported to the Laboratory of the Faculty of Fisheries, Patuakhali Science and Technology University, Bangladesh, for identification and further study.

Water characteristics in study areas

A wide range of salinity fluctuation (0.20-17.58 ppt) is recorded in four coastal districts of southern Bangladesh and it varied from location to location and season to season. Maximum water salinity was observed in pre-monsoon, whereas minimum was in monsoon for entire four costal districts. It was noticed that water salinity started increasing from post-monsoon and continued to increase in pre-monsoon, when it reached the highest level. The highest (19.8 ppt) water salinity was measured in pre-monsoon at the Andarmanik River, Kalapara in the Patuakhali district, while the lowest (0.2 ppt) was in monsoon at the Swarupkati River in the Pirojpur district.

Identification of the fishes

Fish fauna collected from the study areas were identified based on their morphometric and meristic characters following Rahman (2005) and Eschmeyer (2014). After identification, fish species were systematically classified according to Nelson (2006).

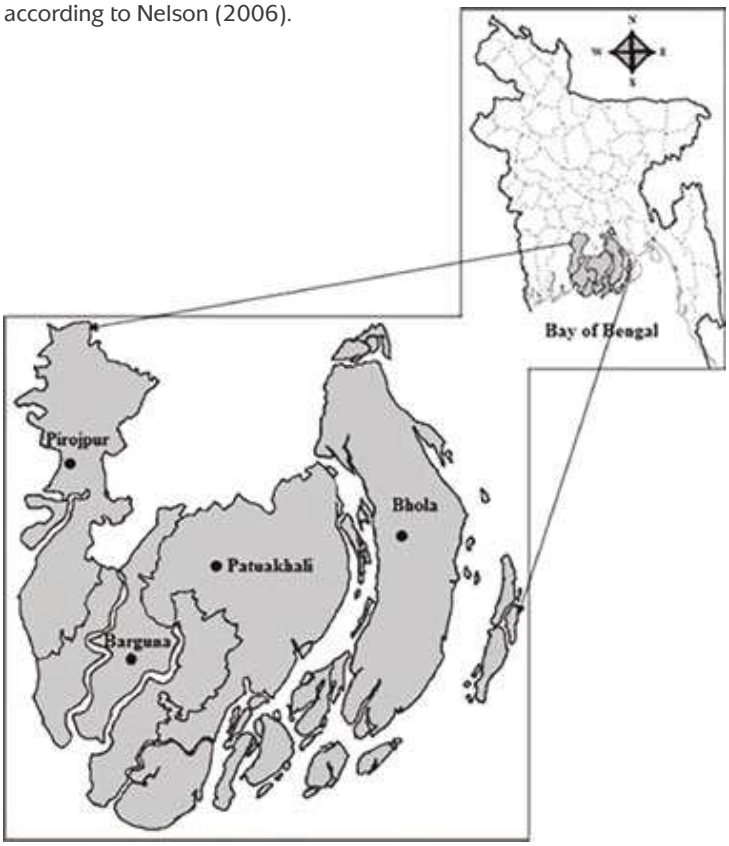

Fig 1. MAP showing the study area of four coastal districts in southern coastal region of Bangladesh

Table 1. Biodiversity and conservation status of fish fauna recorded at four southern coastal districts of Bangladesh for a period of one year from January to December 2014 (see Appendix 1)

Order	Family	Species	English name	Conservation Status	
				Bangladesh*	**Global****
Anguilliformes	Muraenesocidae	*Congresox talabon*	Yellow pike conger	NO	NA
Aulopiformes	Synodontidae	*Harpadon nehereus*	Bombay duck	NA	NA
Clupeiformes	Clupeidae	*Anodontostoma chacunda*	Chacunda gizzard shad	NA	NA
		Gudusia chapra	Indian river shad	NO	LC
		Tenualosa ilisha	Hilsha	NA	NA
		Tenualosa toli	Toli shad	NA	NA
	Dussumieriidae	*Dussumieria elopsoides*	Slender rainbow sardine	NA	NA
	Engraulidae	*Coilia neglecta*	Neglected grenadier anchovy	NA	NA
		Setipinna phasa	Gangetic hairfin anchovy	NO	LC
	Pristigasteridae	*Pellona ditchela*	Indian pellona		LC
Cyprinodontiformes	Beloniidae	*Xenentodon cancila*	Needle fish	NA	LC
		Dermogenys pussilus	Wrestling halfback	NA	LC
Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	Mola carplet	NO	LC
		Barbonymus gonionotus	Silver barb	EX	LC
		Catla catla	Catla	NO	LC
		Cirrhinus *mrigala*	Mrigal carp	NO	LC
		Ctenopharyngodon idella	Grass carp	EX	LC
		Cyprinus carpio var. communis	Common carp	EX	LC
		Cyprinus carpio var. specularis	Mirror carp	EX	LC
		Esomus danricus	Flying Barb	NO	LC
		Hypophthalmichthys molitrix	Silver carp	EX	NT
		Labeo gonius	Kuria labeo	EN	LC
		Labeo calbasu	Orangefin labeo	EN	LC
		Labeo rohita	Roho labeo	NO	LC
		Labeo pangusia	Pangusia labeo	CR	LC
		Labeo bata	Bata labeo	EN	LC
		Mylopharyngodon piceus	Black Chinese roach	EX	LC
		Osteobrama cotio	Cotio	EN	LC
		Systomus sarana	Olive barb	CR	LC
		Puntius sophore	Pool barb	NO	LC
		Pethia ticto	Ticto barb	VU	LC
	Cobitidae	*Lepidocephalichthys guntea*	Guntea loach	NO	LC
Mugiliformes	Mugilidae	Chelon *suviridis*	Greenback mullet	NA	LC
		Chelon parsia	Gold-spot mullet	NA	LC
		Rhinomugil corsula	Corsula mullet	NO	LC
Osteoglossiformes	Notopteridae	*Chitala chitala*	Humped featherback	EN	NT
		Notopterus notopterus	Grey featherback	VU	LC

Table 1. Continued

Order	Family	Species	English name	Conservation Status	
				Bangladesh*	**Global****
Perciformes	Ambassidae	*Chanda nama*	Elongate glass perch	VU	LC
		Parambassis ranga	Indian glassy fish	VU	LC
	Anabantidae	*Anabas testudineus*	Climbing perch	NO	DD
	Belontiidae	*Trichogaster fasciata*	Striprd gourami	NO	LC
	Carangidae	*Scomberoides tol*	Needlescaled queenfish	NA	NA
	Channidae	*Channa marulius*	Giant snakehead	EN	LC
		Channa gachua	Asiatic snakehead	VU	NA
		Channa punctata	Spotted snakehead	NO	LC
		Channa striata	Banded snakehead	NO	LC
	Cichlidae	*Oreochromis mossambicus*	Mozambique tilapia	EX	NT
		Oreochromis niloticus	Nile tilapia	EX	LC
	Drepaneidae	*Drepane punctata*	Spotted sicklefish	NA	NA
	Eleotridae	*Elotris fusca*	Dusky sleeper	NA	LC
	Gobiidae	*Apocryptes bato*	Mudskipper	NA	NA
		Glossogobius giuris	Tank goby	NO	LC
		Taenioides anguillaris	Eel worm goby	NA	LC
	Latidae	*Lates calcarifer*	Seabass	NA	NA
	Lobotidae	*Labotes surinamensis*	Tripletail	NA	NA
	Lutjanidae	*Lutjanus madras*	Indian snapper	NA	NA
	Nemipteridae	*Nemipterus japonicus*	Japanese threadfin bream	NA	NA
	Nandidae	*Nandus nandus*	Mud perch	VU	LC
	Polynemidae	*Eleutheronema tetradactylum*	Fourfinger threadfin	NA	NA
		Polynemus paradiseus	Paradise threadfin	NO	NA
	Scatophagidae	*Scatophagus argus*	Spotted butterfish	EN	LC
	Sciaenidae	*Johnius argentatus*	Silver jew	NA	NA
		Johnius carutta	Karut croaker	NA	NA
		Nibea soldado	Silver jew	NA	NA
	Scombridae	*Euthynnus affinis*	Mackerel tuna	NA	LC
		Katsuwonus pelamis	Skipjack tuna	NA	LC
		Pelamys chiliensis	Pacific bonito	NA	LC
	Stromateidae	*Pampus chinensis*	Chinese pomfret	NA	NA
	Sillaginidae	*Sillaginopsis panijus*	Lady fish	NA	NA
	Siganidae	*Siganus javus*	Streaked spinefoot	NA	NA
	Sparidae	*Acanthopagrus chinshira*	Yellowfin seabream	NA	NT
	Trichiuridae	*Trichiurus mutica*	Ribbon fish	NA	NA
Rajiformes	Dasyatidae	*Himantura bleekeri*	String ray	NA	VU
Scorpaeniformes	Platycephalidae	*Platycephalus caeruleopunctatus*	Bluespotted flathead	NA	NA

Table 1. Continued

Order	Family	Species	English name	Conservation Status	
				Bangladesh*	**Global****
Siluriformes	Ariidae	*Arius gagora*	Gagora catfish	DD	NT
		Ketengus typus	Bigmouth sea-catfish	NA	NA
	Bagridae	*Sperata aor*	Long-whiskered catfish	VU	LC
		Mystus cavasius	Gangetic tengra	VU	LC
		Mystus tengara	Tengra mystus	NO	LC
		Mystus vittatus	Striped river catfish.	NO	LC
		Rita rita	Rita	CR	LC
	Clariidae	*Clarias magur*	Air breathing catfish	NO	LC
		Clarias gariepinus	African sharptooth catfish	NO	LC
	Plotosidae	*Plotosus canius*	Gray eel-catfish	VU	NA
	Heteropneustidae	*Heteropneustes fossilis*	Stinging cat fish	NO	LC
	Loricariidae	*Hypostomus plecostomus*	Sucker mouth catfish	EX	NA
	Pangasiidae	*Pangasianodon hypophthalmus*	Siamese shark	EX	EN
		Pangasius pangasius	River pungus	CR	LC
	Schilbeidae	*Ailia coila*	Gangetic ailia	VU	NT
		Clupisoma garua	Garua bachcha	CR	LC
		Silonia silondia	Silond catfish	EN	LC
	Siluridae	*Ompok pabda*	Pabdah catfish	EN	NT
		Wallago attu	Freshwater shark	NO	NT
Synbranchiformes	Mastacembelidae	*Macrognathus aral*	One striped spiny eel	VU	LC
		Macrognathus pancalus	Striped spiny eel	NO	LC
		Mastacembelus armatus	Tire track eel	EN	LC
Tetradontiformes	Balistidae	*Abalistes stellaris*	Trigger fish	NA	NA
	Tetraodontidae	*Leiodon cutcutia*	Gangaetic puffer fish	NO	LC

Note: CR-Critically Endangered, EN- Endangered, VU- Vulnerable, NT-Near Threatened, NO-Not Threatened, LC- Least Concern, DD- Data Deficient, NA- Not Assessed and EX-Exotic. According to * IUCN Bangladesh, 2013 and ** Eschmeyer, 2014.

Data Analyses

Shannon–Wiener index (H) is an insensitive measure of the character of the S:N (total number of individuals of one species and total number of individuals of all species) relationship and is dominated by the abundant species. The diversity index was calculated by using the Shannon–Wiener diversity index (1949).

Shannon-Weaver diversity index (H),

$$H = - \Sigma \text{ Pi ln Pi}$$

Where, Pi = S / N

S = number of individuals of one species

N = total number of all individuals in the sample

Evenness is a measure of the relative abundance of different species making up the richness of an area, which is measured by using the following formula:

$$E = e^{H}/S$$

Simpson's dominance index (D) is often used to quantify the biodiversity of habitat which takes into account the number of species, as well as the abundance of each species.

Formula used for calculating is:

$$D = \Sigma\, ni(ni-1)/N(N-1)$$

Where, *ni* is the total number of individuals of a particular species and *N* is the total number of individuals of all species.

Margalef's index (d) (Margalef, 1968) was used to measure species richness by the following formula:

$$d = (S-1/Ln\ N)$$

Where, *S* is the number of species and *N* is the number of individuals in the sample.

RESULTS AND DISCUSSION

The present study on fish diversity in the southern coastal waters of Bangladesh recorded a total of 98 fish species including 10 exotic species and 5 native carps. The conservation status of these species along with their order, family and English name are presented in Table 1.

The percent composition of families, genera and species under various orders are placed in Table 2. The dominant order was Perciformes comprising 35.71% of all the number of species recorded. Nearest dominant orders were Cypriniformes, Siluriformes and Clupeiformes comprising 20.41%, 19.39% and 8.16%, respectively. Anguilliformes, Aulopiformes, Rajiformes and Scorpaeniformes were the least dominant species, comprising 1.02% individually. The maximum number of fish species in the study was recorded during the winter season. This is because of water depth reduced to the minimum level due to insufficient rainfall during this time, allowing fishermen to utilize their fishing gears more effectively. Similar outcome was also reported by Rao et al. (2014) who has recorded the highest fish diversity in winter. The lowest numbers of species were recorded during the month of June and July due to heavy rain during this time which makes fishing very difficult as water level reached its maximum level. Moreover, the order Perciformes was found to be the most diversified fish group in terms of both number of species and individuals recorded, followed by Cypriniformes and Siluriformes. These three groups are also the most dominant groups in freshwater bodies of Bangladesh (Rahman, 2005).

In the present study, the dominant family was Cyprinidae comprising 19 species (Table 1), which was about 19.39% of the total number of species caught. Other diversified families were Bagridae (5.15% species), Clupeidae, Channidae and Schilbeidae (4.12% species each), and Mugilidae, Sciaenidae, Scombridae and Mastacembelidae (3.09%), respectively. Cyprinidae represented major contribution with large number of species in respect to numerical composition in different open water bodies reported by Ahsan et al. (2014) and Rao et al. (2014), which supports the findings of the present study. 12 exotic species were recorded under the order of Cypriniformes, Perciformes and Siluriformes during the study period. The exotic species were grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), Thai sharpunti (*Barbonymus gonionotus)*, Common carp (*Cyprinus carpio var communis*), mirror carp (*Cyprinus carpio var specularies*), black carp (*Mylopharyngodon piceus*), tilapia (*Oreochromis mossambicus*), nilotica (*Oreochromis niloticus*), sucker mouth catfish (*Hypostomus plecostomus*) and Thai pangas (*Pangasianodon hypophthalmus*). Furthermore, the order Perciformes was found to be the most dominant fish group in terms of total number of individuals observed. Maximum of 97 species were recorded from the Patuakhali district, 95 from the Pirojpur district, and from Barguna and Bhola 85 and 82, respectively (Table 3). Within the collected fish samples, critically endangered data were the highest in the Patuakhali and Pirojpur districts each containing 5 in numbers, and the lowest in Bhola and Barguna (both were 2). The endangered species are highest in Patuakhali and

Table 2. Number and percent composition of families, genera and species under various orders of fishes recorded in the southern coastal waters of Bangladesh

Order	No. of family	No. of genera	No. of species	% Family	% Genera	% Species
Anguilliformes	1	1	1	2.13	1.23	1.02
Aulopiformes	1	1	1	2.13	1.23	1.02
Clupeiformes	4	7	8	8.33	8.64	8.16
Cyprinodontiformes	1	2	2	2.08	2.47	2.04
Cypriniformes	2	14	20	4.17	17.28	20.41
Mugiliformes	1	2	3	2.08	2.47	3.06
Osteoglossiformes	1	2	2	2.08	2.47	2.04
Perciformes	23	30	35	47.92	37.04	35.71
Rajiformes	1	1	1	2.13	1.23	1.02
Scorpaeniformes	1	1	1	2.13	1.23	1.02
Siluriformes	9	16	19	18.75	19.75	19.39
Synbranchiformes	1	2	3	2.13	2.47	3.06
Tetradontiformes	2	2	2	4.17	2.47	2.04

Pirojpur comprising 10 each, whereas in Bhola and Barguna the species numbers were 9 and 8, respectively. The vulnerable species were highest in Patuakhali and Pirojpur (both were 11), while Bhola and Barguna consisted of 10 and 9 in number, respectively (Fig. 2).

Table 3. Total number of species and specimens recorded including exotic species and native carp from southern coastal waters of Bangladesh

Study Area	Total number of species (S)	Total number of individuals (N)	Exotic species	Native carp
Pirojpur	95	65323	10	5
Bhola	82	50261	9	5
Patuakhali	97	64163	9	5
Barguna	85	44885	9	5

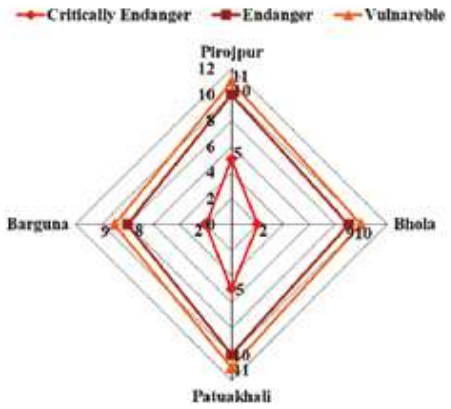

Fig 2. Number of species under different categories of threat as per IUCN 2013 in the coastal waters of Bangladesh

Diversity index, richness and evenness

The district-wise values of Shannon–Wiener index (H), Simpson's dominance index (D), Simpson's index of diversity (1-D) and Margalef's index (d) are shown in Fig. 3. However, considering all the specimens studied during the period of study, the values of Shannon–Wiener index (H) were higher in Patuakhali (about 3.70) than Pirojpur (3.64), and lower in Bhola and Barguna (both were 3.54). Evenness (E) was higher in Bhola and Patuakhali (each 0.42), and Barguna (about 0.41) and lower in Pirojpur (about 0.40) (Fig. 4). Average richness within 13 orders, perciformes were shown higher and range from 0.15 to 0.12. Nearest orders, including cypriniformes (0.08 to 0.09), siluriformes (0.07 to 0.08) and clupeiformes (0.03 to 0.04) and Tetradontiformes, showed the lowest value which was almost nil in the Bhola and Barguna districts (Fig. 5).

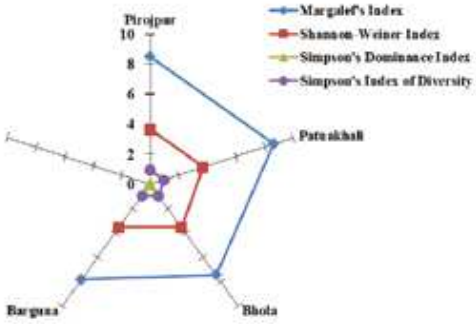

Fig 3. Different fisheries diversity index at sampling site of four coastal districts in Bangladesh

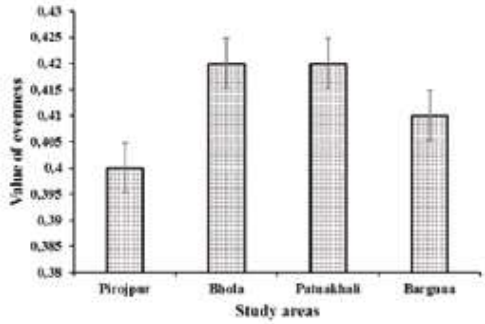

Fig 4. Evenness of fish diversity in four coastal districts of Bangladesh

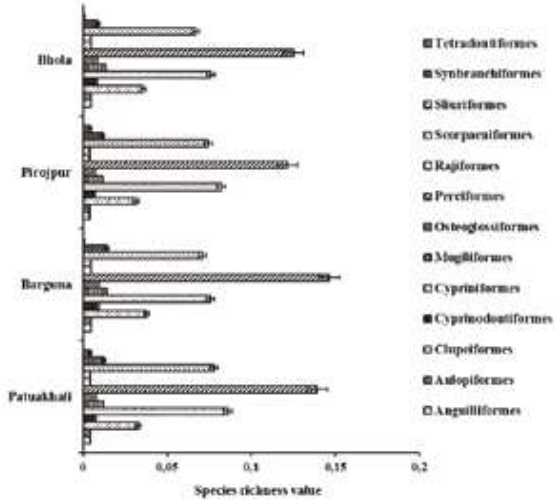

Fig 5. Average species richness under various orders in four coastal districts of Bangladesh

The value of a diversity index increases when both the number of species and evenness increases in a population. The value of the Shannon–Wiener index (H) usually ranges from 1.5 to 3.5 for ecological data and hardly exceeds 4.0, which is mostly related with our calculated data. May (1975) stated that if species follow a normal abundance distribution, the sample must have to hold 100,000 species for Shannon–Wiener index (H) to be greater than 5.0. Simpson's dominance index (D) value ranges from 0.05-0.04 and Simpson's index of diversity (I-D) depends on Simpson's dominance index (D). This partial difference may be due to the temporal variation of dominance status among all sampling areas. The Margalef's index (d) of richness value ranges from 7.48-8.67, which is not much different from Hossain et al. (2012) who recorded maximum Margalef's index (d) of 6.75 and lowest of 6.10. Diversity index and richness showed that diversity of fish species was higher in the district of Patuakhali and lower in Bhola. Figure 4 shows that the fish species of Patuakhali and Bhola are more similar than the Pirojpur and Barguna districts. Simpson's dominance index (D) is heavily weighted towards the most abundant species in the sample, while being less sensitive to species richness. Simpson's index of diversity (I-D) was higher in the Patuakhali and Pirojpur districts than in other districts. Though a number of studies on the biodiversity of fishes have been conducted around the world (Goswami et al., 2012; Rixon et al., 2005; Shinde et al., 2009; William et al., 2010), in Bangladesh such studies are much more limited (Hossain et al., 2012; Rahman et al., 2012). But all these research efforts in Bangladesh, except Hossain et al. (2012), are lacking analyses of diversity indices in which many studies have been completed in different parts of the world (Penczak et al., 1994; Nyanti et al., 2012).

Threats

Over the decade, ever increasing anthropogenic and natural hazards squeeze the species distribution across the country and subsequently many species are categorized as endangered in Bangladesh (IUCN Bangladesh, 2013). A large number of catadromous, anadromous and diadromous fishes use the southern coastal waters of Bangladesh seasonally as a major breeding, feeding and migratory routes conjoining with the Bay of Bengal (Sharker et al., 2015b). But in the last few years the riverine ecosystems within this area have changed considerably due to human intervention, intense tourism, pollution and even global climate change consequences which have resulted in destruction of migratory routes, altered wild ecosystems and deteriorated water quality in these areas (Hossain et al., 2013; IUCN Bangladesh, 2013; Hossain et al., 2014). These factors also rendered physiological characteristics such as body morphology and growth rate of many fishes (Froese, 2006; Tomljanović et al., 2011). Furthermore, indiscriminate harvesting of fry and fingerlings, habitat modification, reduced water flow, growing human intervention on wetlands are also considered as significant threats for dwindling species diversity (Chaklader et al., 2014; Hossain et al., 2015). Habitat loss through divergence of coastal rivers and streams for irrigation is probably the most important factor that threatens a species in its wide geographical range.

Conservation recommendations

There is a growing awareness that a large number of fish fauna in the southern coastal region of Bangladesh are out of assessment due to insufficient scientific study. Therefore, a thorough study on species structure, along with their life history and reproductive biology, is imminent to conserve the biodiversity of fish species in this area (Hossain et al., 2015). Declaration of some parts of coastal region as "fish sanctuary" could be the effective step for conservation of threatened species. Moreover, systematic dredging especially in some main points of the coastal areas, introduction of fish bypasses to ease fish movement is also imperative as a sustainable management strategy (Meyer and Hinrichs, 2000; Carpio et al., 2011). Fishing practice during spawning season and use of illegal and destructive fishing gears must be banned. The most important conservational aspect of biodiversity conservation of coastal resources is to create awareness in stake holders through proper communication, cooperation and education. Furthermore, financial assistance from government and donor agencies is crucial with the intention of commencing further studies, research, monitoring and raising awareness among the fishermen for the conservation of fish diversity in the coastal area of Bangladesh.

To sum up, since the fish and fisheries in this region supports the sustenance and livelihood of thousands of millions of marginal poor people, especially fishermen, government should step up with long-term conservation strategies to retain sustainable production from the southern coastal waters of Bangladesh.

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Sažetak

RAZNOLIKOST IHTIOFAUNE JUŽNIH OBALNIH VODA BANGLADEŠA: POSTOJEĆE STANJE, PRIJETNJE I MOGUĆNOSTI OČUVANJA

Unatoč visokoj ugroženosti brojnim antropogenim i

ekološkim faktorima koji utječu na ribolovne resurse, južne priobalne vode se još uvijek smatraju jednom od vodenih vrućih točki biološke raznolikosti u Bangladešu. Ova je studija provedena da bi se utvrdila brojnost riba, ocijenilo njihovo stanje i status zaštite u rijekama koje se prostiru preko četiri južne priobalne oblasti Bangladeša. Tijekom istraživanja, u razdoblju od siječnja do prosinca 2014. godine, zabilježeno je ukupno 98 vrsta riba koje pripadaju 81 rodu, 48 porodica i 13 rodova. Najveću raznolikost u broju jedinki i broju vrsta utvrđena je kod skupine Perciformes. Od 98 vrsta, 26,53% su navedene kao lokalno ugrožene u Bangladešu, uključujući 11,22% vrsta koje su navedene kao ranjive, 10,20% kao ugrožena i 5,10% kao kritično ugrožene. Pri istraživanju četiri populacije utvrđeni su Shannon–Wiener indeks (H), Simpsonov indeks dominacije (D), Simpson indeks raznolikosti (1-D) i Margalefov indeks (d) kako bi se utvrdila raznolikost i bogatstvo vrsta u području istraživanja, čija je ukupna vrijednost iznosila 3,54-3,70, 0,04-0,05, 0,95-0,96 7,48-8,67. Za održanje perspektive ribarske bioraznolikosti u južnim priobalnim područjima Bangladeša, treba uzeti u obzir s najvećim prioritetom strategiju upravljanja i očuvanja kao i poribljavanja gospodarski važnih vrsta riba, uz uspostavljanje i održavanje ribljih skloništa, te zabranu nekritičnog ribolova i destruktivnih ribolovnih alata, identifikaciju i zaštitu područja mrijesta i rastilišta.

Ključne riječi: Biodiverzitet, obalno područje, indeks diverziteta, IUCN, konzervacija

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APPENDIX 1. Typical specimens of several fish species from Bangladesh (captured by Md Abu Hanif and Md Reaz Chaklader)

Congresox talabon (Cuvier, 1829)

Anodontostoma chacunda (Hamilton, 1822)

Tenualosa ilisha (Hamilton, 1822)

Dussumieria elopsoides (Bleeker, 1849)

Coilia neglecta (Whitehead, 1967)

Xenentodon cancila (Hamilton, 1822)

Liza parsia (Hamilton, 1822)

Harpadon nehereus (Hamilton, 1822)

Gudusia chapra (Hamilton, 1822)

Tenualosa toli (Valenciennes, 1847)

Setipinna phasa (Hamilton, 1822)

Pellona ditchela (Valenciennes, 1847)

Eleutheronema tetradactylum

Amblypharyngodon mola (F. Hamilton, 1822)

Systomus sarana (Hamilton, 1822)

Puntius sophore (Hamilton, 1822)

Chelon subviridis (Valenciennes, 1836)

Clarias gariepinus

Nandus nandus

Polynemus paradiseus

Barbonymus gionionotus (Bleeker, 1850)

Cirrhinus cirrhosus (Hamilton, 1822)

Osteobrama cotio (Hamilton, 1822)

Pethia ticto (Hamilton, 1822)

Lepidocephalichthys guntea (Hamilton, 1822)

Leiodon cutcutia

Channa gachua

Platycephalus caeruleopunctatus

Acanthopagrus chinshira

Rita rita

Ompok pabda

Mystus vittatus

Labeo calbasu

Chitala chitala

Chanda nama

Parambassis ranga

Mastacembelus armatus

Macrognathus aral

Sperata aor

Clupisoma garua

Labeo gonius

Silonia silondia

Notopterus notopterus

Ailia coila

Trichogaster fasciata

Scatophagus argus

Johnius carutta

Channa striata

Wallago attu

Nibea soldado

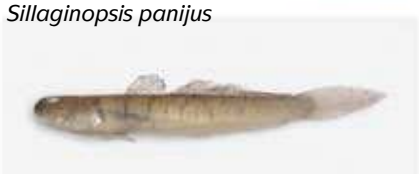
Abalistes stellaris

Plotosus canius

Eleotris fusca (Forster, 1801)

Sillaginopsis panijus

Chelon parsia (Hamilton, 1822)



Apocryptes bato (Hamilton, 1822)

Clarias magur

Euthynnus affinis

Hypostomus plecostomus

Scomberoides tol