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ORIGIN, HABITAT AND ECOLOGICAL CLASSIFICATION OF SOME BONY FISHES AVAILABLE IN KHULNA DIVISION, BANGLADESH

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Abstract: The study identified the origin, habitat and ecological classification of 78 bony fish species belonging to 30 families available in Khulna division. Of the total fish species, 9 were found exotic. Among the collected 78 species, a total of 69 fish species were inhabitants of freshwaters while 4 were found in both fresh and brackish waters and the rest 5 species were found in both brackish and marine waters. The collected fishes belonged to eight trophic guilds; carnivore (43) was the dominant group followed by omnivore (16), insectivore (5), planktivore (5), benthivore (4) and larvivore (1). The fishes also represented eight reproductive guilds; phytolithophil (35) was the most dominant guild followed by phytophil (20), pelagophil (6), psammophil (6), guarder (4), bubble nester (4) and mouth brooder (1). The present study indicates that Khulna Division is very rich in fish biodiversity having diverse forms of trophic and reproduction guilds.

Key words: Fish, origin, habitat, ecological classification, Khulna

Introduction

Fish is found in almost all conceivable aquatic habitats ranging from hot soda springs (e.g. *Sarotherodon grahami* in Lake Magadi, Kenya) where temperatures exceed 40°C (Lowe-McConnel, 1987) to the waters beneath the Antarctic ice-sheet (e.g. *Dallia pectoralis*) where the temperature is below 0°C (DeVries, 1980). Fish are found in high mountain lakes from approximately 5 km above sea level (e.g. *Schizothorax plagiostomus,* in the Tritican Lake) to more than 11 km below the sea level (e.g. deepsea ateleopid, *Ateleopus japonicus* in the Mariana Trench, Pacific Ocean) (Lagler *et al*., 1977), in stagnant waters (e.g. taki, C*hanna punctatus*), fast-flowing waters (e.g. masheer, *Tor tor*), and even in the deep caves (e.g. cavefish, *Anoptichthys jordani*) where there is total darkness (Jobling, 1995). Fish are numerically the largest group of vertebrates and account for roughly half of all vertebrate species (Jobling, 1995).

There are about 25 625 recognised species of teleost fishes in the world (Nelson, 1994; Anon., 2000; Anon., 2007). In South America there are over 2 400 freshwater species, while it is 2 500 in Africa (Wootton, 1990) and 2000 in South and South East Asia (Hora, 1937). Inland waters of Bangladesh harbour 260 fish species belonging to 145 genera representing 55 families (Day and Buchanan, 1877; Rahman, 2005; Rahman and Akhter, 2007) while 475 species belonging to 133 genera of marine and brackish water fishes are found in the Bay of Bengal and Sundarban (Day, 1878; Azadi, 1985). Khulna division, the Southwest region of Bangladesh is criss-crossed by

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rivers and canals occupying the world-largest mangrove forest, the Sundarbans. A total of 281 fish species belonging to 79 families inhabit in fresh, brackish and marine waters of Khulna division (Rahman and Akhter, 2008). Binomial classification of these fishes is available (Rahman, 2005) but information on the origin, habitat use and ecological classification are scanty. In view of the above, the present study was undertaken to prepare a checklist of fishes of Khulna division with information on origin, habitat use and ecological classification, which might help fishery scientists, students, hatchery operators, farmers and policy makers to formulate a comprehensive strategy for proper management and conservation of the resource.

Materials and Methods

The survey was conducted from May 2006 to December 2007 to collect different fish species available in the Khulna division. Survey sites included Bheramara, Jhenaidaha, Kaligang, Kotchandpur, Jessore, Magura, Narail, Debhata, Satkhira, Khulna and Paikgacha. Collected fish samples were taken to the laboratory of the Freshwater Sub-Station of the Bangladesh Fisheries Research Institute, Jessore. Information on origin, habitat use trophic and reproductive guilds of the collected fishes were obtained from different books (Jordan and Evermann, 1917; Hamilton, 1822; Day and Buchanan, 1877; Day, 1878; Bhuiyan, 1964; Gibson, 1978; Billard and Breton, 1979; Jayaram, 1981; Ameen, 1987; Jhingran, 1991; Khan, 1994; Jobling, 1995), from reports (Azadi, 1985; Anon., 1994; Felts *et al*., 1997; Hora, 1945) and from journals (Khan, 1924 and 1934; Ahmed, 1944 and 1955; Khanna, 1958; Alikunhi and Sukumaran, 1964; Doha, 1973; Balon *et al*., 1977; Jayaram, 1977; Johannes, 1978; Kramer, 1978; Dewan and Doha, 1979; Huda and Rahman, 1983; Austen *et al*., 1994; Lyons *et al*., 1996; Akhter and Rahman, 2008; Rahman and Akhter, 2008) while ecological classification was done according to Balon (1975 and 1981). For ecological classification the following definitions were used :

Trophic guilds:

Planktivores: Mainly depend on phytoplankton and zooplankton. Diet of the adult fish of this trophic guild consists of more than 75% zooplankton and/or phytoplankton (Lyons *et al*., 1995).

Herbivores: Primarily feed on higher aquatic plants/vegetation. Diet of the adult fish consists of more than 75% plant material (Lyons *et al*., 1995).

Omnivores: Take all possible food materials both of plant and animal origin. Choice of food depends on availability (Lyons *et al*., 1995).

Detritivores: Take detritus as food (Goldstein and Simon, 1999).

Insectivores/***Invertivores***: Take all kind of insects/invertebrates as the main food (Lyons *et al.,* 1995).

Larvivores: Specialist feeders that feed on larvae of insects, fish and other organisms (Goldstein and Simon, 1999).

Benthivores: Mainly feed on benthic organisms (Goldstein and Simon, 1999).

Molluscivores: Specialist feeders depending on mollusks and isopods (Goldstein and Simon, 1999).

Carnivores: Primarily feed on animal matters. Diet of the adult fish consists of more than 75% animal materials (Lyons *et al*., 1995).

Parasitic: Parasitism being a form of carnivorism in which the parasite is smaller in body size than the host (Goldstein and Simon, 1999).

Reproductive guilds:

Pelagophils/Broadcaster: Non-adhesive and non-photophobic eggs that are released and scattered in open waters, in areas where the direction of the water current is favourable for their distribution and survival (Balon *et al.,* 1977).

Lithopelagophils: Eggs deposited on rocks and gravel. Embryos and larvae are not photophobic (Balon *et al*., 1977).

Lithophils: Fish spawns exclusively on gravel, rocks, stones, rubble or pebbles where their embryos and larvae develop. Embryos are highly photophobic (Balon, 1975).

Phytophils: Fish scatters or deposits eggs with an adhesive membrane that sticks to submerged, live or dead aquatic plants, or to recently flooded terrestrial plants; sometimes they deposit eggs on logs and branches but never on the bottom. Embryos and larvae are not photophobic (Balon, 1975).

Phytolithophils: Fish deposits eggs in relatively clear water habitats on submerged plants, if available, or on other submerged items such as logs, gravel and rocks. Embryos and larvae are photophobic (Balon, 1975).

Psammophils: Fish scatter eggs directly on the clean sand/mud or near fine roots of plants that hang over sandy bottom. Eggs are small and adhesive, and the embryos are photophobic (Balon, 1975).

Nest builders: Build nests with plant materials or bubbles in rocks, gravels and sand or hard bottom. Eggs are adhesive and embryos are photophobic (Balon *et al*., 1977).

Guarders: Choose rocks, gravel and submerged plants for attachment of their eggs. Usually the male guard and fan the eggs but in many species both sexes are reported to guard the eggs (Balon *et al.,* 1977).

Mouth brooders: Incubate their eggs in the buccal cavity. Usually the male takes eggs in its mouth (Balon *et al*., 1977).

Live bearers: Eggs are fertilized internally before they are expelled from the body cavity (Balon *et al.,* 1977).

Results

A total of 78 fish species (69 native and 9 exotic) belong to 30 families were recorded from the 11 survey sites (Table 1). Three families namely Catostomidae, Characidae and Cichlidae were found exotic to Bangladesh. Of the 69 freshwater fish species, 4 were found in both fresh and brackish waters while 5 in both brackish and marine waters (Table 1). Collected fishes belong to 8 trophic guilds; carnivore (43) was the most dominant guild followed by omnivore (16), insectivore (5), planktivore (5) and benthivore (4) Only one larvivore species was recorded (Table 1). No molluscivore and parasitic fishes were recorded. Fishes of the study areas displayed a wide range of feeding habits and occupied many trophic guilds from detritivores to secondary carnivores. Similarly, collected fishes represented 8 reproductive guilds. Phytolithophil (35) was the most dominant guild, followed by phytophil (20), pelagophil (6), psammophil (6), guarder (4) and bubble nester (4). Only one mouth brooder species was recorded from the survey sites (Table 1). No lithopelagophils and livebearers were recorded.

Table 1 Origin, habitat use and ecological classification of some collected fish species (n=78) of Khulna division.

Sl	Family/ Fishbase/Scientific name	English common name	Bangla name	Origin	Habitat use	TG	RG
	Family$_1$= Cyprinidae						
1	*Amblypharyngodon mola* (Hamilton)	Mola carplet	Mola/Molongi	Bangladesh	F	P	Ph
2	*Aspidoparia jaya* (Hamilton)	Jaya	Jaya	Bangladesh	F	O	Ph
3	*Carassius auratus* (L.)	Goldfish	Goldfish	Europe	F	O	Ph
4	*Carassius carassius* L.	Cruician carp	Cruician carp	China	F	O	Ph
5	*Catla catla* (Hamilton)	Katla	Katla/ Katal	Bangladesh	F	P	Pe
6	*Chela cachius* (Hamilton)	Silver hachet	Chep chela	Bangladesh	F	O	Pl
7	*Cirrhinus mrigala* (Hamilton)	Mrigal	Mrigal/ Mirka	Bangladesh	F	B	Pe
8	*Cirrhinus reba* (Hamilton)	Tatkini/Bhagna/Raik/Laacho	Tatkini/ Raik	Bangladesh	F	O	Pe
9	*Cyprinus carpio* L.	Scale carp	Scale carp	China	F	O	Ph
10	*Cyprinus carpio* L.	Koi carp	Koi carp	China	F	O	Ph
11	*Esomus danricus* (Hamilton)	Flying barb	Darkina/ Darka	Bangladesh	F	O	Ph
12	*Labeo calbasu* (Hamilton)	Orange fin labeo	Kalibaus/Baus/Kalia	Bangladesh	F	B	Pe
13	*Labeo rohita* (Hamilton)	Labeo	Rui/ Rohu	Bangladesh	F	P	Pe
14	*Puntius conchonius* (Hamilton)	Rosy barb	Kanchan punti	Bangladesh	F	H	Ph
15	*Puntius gonionotus* (Bleeker)	Silver barb	Thai Sarpunti	Thailand	F	H	Ph
16	*Puntius sophore* (Hamilton)	Spotted barb	Jatpunti/ Vadipunti	Bangladesh	F	O	Ph
17	*Puntius ticto* (Hamilton)	Tic-tac-toe barb	Tit punti	Bangladesh	F	O	Ph
18	*Puntius guganio* (Hamilton)	Glass barb	Mola punti	Bangladesh	F	O	Ph
19	*Puntius cosuatis* (Hamilton)	Kosusti barb	Kosuati	Bangladesh	F	O	Ph
20	*Rohtee cotio* (Hamilton)	Barb	Dhela/ Dhipali	Bangladesh	F	O	Ph
21	*Securicula gora* (Hamilton)	Razorbelly minnow	Gora chela	Bangladesh	F	O	Ph
22	*Salmostoma bacaila* (Hamilton)	Large razorbelly minnow	Katari	Bangladesh	F	O	Ph
23	*Tor putitora* (Hamilton)	Mahaseer	Mohashol	Bangladesh	F	B	Li
	Family$_2$= Characidae						
24	*Serrasalmus nattereri* (Kner)	Common piranha	Piranha	South America	F	C	Ph
	Family$_3$= Channidae						
25	*Channa gachua* Hamilton	Walking snakehead	Cheng/ Raga	Bangladesh	F	C	Gr
26	*Channa marulius* (Hamilton)	Great snakehead	Gozar/ Gajal	Bangladesh	F	C	Gr
27	*Channa punctatus* (Bloch)	Spotted snakehead	Taki/ Lata/ Okol	Bangladesh	F	C	Gr
28	*Channa striatas* (Bloch)	Striped snakehead	Shol	Bangladesh	F	C	Gr
	Family$_4$= Cichlidae						
29	*Oreochromis niloticus* GIFT (Peters)	GIFT Tilapia	GIFT Tilapia	Africa	F & B	O	Mb
	Family$_5$= Nandidae						
30	*Nandus nandus* (Hamilton)	Mud perch	Meni/ Veda	Bangladesh	F	C	Pl
	Family$_6$= Siluridae						

31	*Ompok pabda* (Hamilton)	Butter catfish	Madhu pabda	Bangladesh	F	C	Pl
32	*Ompok pabo* (Hamilton)	Pabo catfish	Pabda	Bangladesh	F	C	Pl
	Family$_7$= Anabantidae						
33	*Anabas oligolepis* (Bloch)	Spotted perch	Thai koi	Thailand	F	I	Bn
34	*Anabas testudineus* (Bloch)	Climbing perch	Koi	Bangladesh	F	I	Bn
35	*Colisa fasciatus* (Bloch & Schneider)	Giant gourami	Khailsha/ Khaila	Bangladesh	F	I	Bn
36	*Colisa lalia* (Hamilton)	Doarf gourami	Lal Khailsha/Boisa	Bangladesh	F	I	Bn
37	*Ctenops nobilis* McClelland	Frail gourami	Neftani	Bangladesh	F	I	Pl
	Family$_8$= Tetraodontidae						
38	*Tetraodon cutcutia* (Hamilton)	Freshwater puffer	Potka/ Tepa/ Kutkuitta	Bangladesh	F	C	Ph
	Family$_9$= Mastacembelidae						
39	*Macrognathus aculeatus* (Bloch)	Spotted spinyeel	Tara baim	Bangladesh	F	C	Pl
40	*Mastacembelus armatus* (Lacèpéde)	Stripped spinyeel	Sal baim/ Baim	Bangladesh	F	C	Pl
41	*Mastacembelus pancalus* (Hamilton)	Spinyeel	Guchi/ Pankal/ Chikra	Bangladesh	F	C	Pl
	Family$_{10}$= Bagridae						
42	*Batasio tengara* (Hamilton)	Bagrid catfish	Tengra	Bangladesh	F	C	Pl
43	*Mystus bleekeri* (Day)	Day's mustus	Golsha tengra	Bangladesh	F	C	Pl
44	*Mystus gulio* (Hamilton)	Long whiskers catfish	Nona tengra	Bangladesh	F & B	C	Pl
45	*Mystus tengara* (Hamilton)	Bagrid catfish	Guitta tengra	Bangladesh	F	C	Pl
46	*Sperata aor* (Hamilton)	Long whiskered catfish	Ayre	Bangladesh	F	C	Pl
	Family$_{11}$= Clupeidae						
47	*Gudusia chapra* (Hamilton)	Indian river shad	Chapila	Bangladesh	F	P	Pl
	Family$_{12}$= Belonidae						
48	*Xenentodon cancila* (Hamilton)	Freshwater gar fish	Kakila	Bangladesh	F	C	Pl
	Family$_{13}$= Ambassidae						
49	*Chanda nama* Hamilton	Glassy fish	Nama chanda	Bangladesh	F	C	Pl
50	*Pseudaambassis lala* (Hamilton)	High fin glassy perchlet	Lal chanda	Bangladesh	F	C	Pl
51	*Pseudaambassis ranga* Hamilton	Indian glassy fish	Ranga chanda	Bangladesh	F	C	Pl
52	*Pseudaambassis beculis* Hamilton	Glassy fish	Chanda	Bangladesh	F	C	Pl
	Family$_{14}$= Schilbeidae						
53	*Ailia coila* (Hamilton)	Gangetic ailia	Kajuli/ Baspata	Bangladesh	F	C	Pl
54	*Clupisoma garua* (Hamilton)	Garu bacha	Gharua	Bangladesh	F	C	Pl
55	*Eutropiichthys vacha* (Hamilton)	Bacha	Bacha	Bangladesh	F	C	Pl
56	*Pseudeutropius atherinoides* (Bloch)	Indian potasi	Batasi	Bangladesh	F	C	Pl
57	*Silonia silondia* (Hamilton)	Silond catfish	Shilong	Bangladesh	F	C	Pl
	Family$_{15}$= Notopteridae						
58	*Notopterus chitala* (Hamilton)	Clown knife fish	Chitol	Bangladesh	F	C	Pl
59	*Notopterus notopterus* (Pallas)	Bronge feather back	Foli	Bangladesh	F	C	Pl
	Family$_{16}$= Gobiidae						
60	*Apocryptes bato* (Hamilton)	Mud skipper	Chiring/ Rutta	Bangladesh	F	C	Ps

61	*Awaous guamensis* (Valenciennes)	Mud skipper	Budhbaillya/Bele	Bangladesh	F	C	Ps
62	*Glossogobius giuris* (Hamilton)	Tank goby	Bele/ Bailla	Bangladesh	F	C	Ps
	Family$_{17}$= Cobitidae						
63	*Lepidocephalus guntea* (Hamilton)	Guntea loach	Gutum/ Puiya	Bangladesh	F	C	Ps
	Family$_{18}$= Clariidae						
64	*Clarias batrachus* (L.)	Walking catfish	Magur	Bangladesh	F	D	Pl
	Family$_{19}$= Heteropneustidae						
65	*Heteropneustes fossilis* (Bloch)	Stinging catfish	Shingi/ Shing	Bangladesh	F	D	Pl
	Family$_{20}$= Taenioididae						
66	*Gobioides rubicundus* (Hamilton)	Red chewa	Lal chewa	Bangladesh	F & B	C	Ps
	Family$_{21}$= Mugilidae						
67	*Rhinomugil corsula* (Hamilton)	Freshwater mullet	Khalla/Arwari/Ural	Bangladesh	F	P	Ph
	Family$_{22}$= Cyprodontidae						
68	*Aplocheilus panchax* (Hamilton)	Blue panchax	Kanpona/Choukani	Bangladesh	F	L	Ph
	Family$_{23}$= Polynemidae						
69	*Eleutheronema tetradactylum* (Shaw)	Four finger threadfin	Tailla	Bangladesh	B & M	C	Pe
70	*Polynemous paradiseus* L.	Paradise fish	Tapasi/ Muni	Bangladesh	F & B	C	Ps
	Family$_{24}$= Engraulidae						
71	*Setipinna taty* (Valenciennes)	Scaly hairfin anchovy	Teli phasa	Bangladesh	B & M	C	Pl
72	*Thryssa purava* (Hamilton)	Oblique jaw thryssa	Ram phasa	Bangladesh	B & M	C	Pl
	Family$_{25}$= Toxotodae						
73	*Toxotes chatareus* (Hamilton)	Archer fish	Archer fish	Bangladesh	B & M	C	Pl
	Family$_{26}$= Sciaenidea						
74	*Johnius coitor* (Hamilton)	Croaker	Koitor/Koitor poa	Bangladesh	B & M	C	Pl
	Family$_{27}$= Chacidae						
75	*Chaca chaca* (Hamilton)	Squarehead catfish	Cheka/Gangainna	Bangladesh	F	C	Li
	Family$_{28}$= Catostomidae						
76	*Hypostomus plecostomus*	Black sucker fish	Black sucker fish	North America	F	B	Pl
	Family$_{29}$= Hemirhamphidae						
77	*Hyporhamphus gaimardi* (Valenciennes)	Half beak	Ek thuita	Bangladesh	F	C	Pl
	Family$_{30}$= Anguillidae						
78	*Anguilla bengalensis* Gray & Hardwicke	Gray eel	Bamosh	Bangladesh	F	C	Pl

B= Brackishwater, Be= Benthivore, Bn= Babble nester, C= Carnivore, D= Detritivore, F= Freshwater, Gr= Guarder, I= Insectivore, L= Larvivore, Li= Lithophil, M= Molluscivore, Mb= Mouth-brooder, O= Omnivore, P= Planktivore, Pa= Parasitic, Pe= Pealagophil, Ph= Phytophil, Pl= Phyto-lithophil, Ps= Psammophil, RG= Reproductive guild, TG= Trophic guild.

Discussion

Result of the present study indicate that aquatic habitats of Khulna division have high fish species diversity, which demand attention for their management. The present findings are on line with the works of Rahman and Akhter (2007) and Akhter and Rahman (2008). Information on trophic and reproductive guilds of the collected samples were determined to provide guildlines to develop strategies for conservation of the fishery resources. The concept of the ecological classification was developed to simplify analysis and to assist in the prediction of community change (Austen *et al*. 1994). Guild concept may be used to classify fish species according to their habitat preference, feeding habit, reproductive strategy, and tolerance of water quality degradation (Root, 1967). The studied fish samples displayed a wide range of feeding habits. They exhibit diverse trophic guilds from detritivores to secondary carnivores. However, it is rare for fish to specialise in one particular food category throughout the entire life cycle. There is often a correlation between morphological traits and trophic role because morphology determines how a fish can feed. Generally body shape, mouth morphology, teeth, gill rakers and the structure of the alimentary canal are used to determine pattern of diet selection. Presence of high percentage of carnivores and omnivores indicates a healthy trophic structure in the aquatic habitats of Khulna division.

Presence of high percentage of phytolithophils and phytophils indicating availability of the quality spawning habitats for the fishes in Khulna division, which is supported by Rahman and Akhter (2007) who reported that ichthyodiversity in the Khulna division is high. Reproductive processes are diverse in fish populations. Each group of fishes has their own reproductive strategies and tactics, which require different habitats and climatic conditions. Majority of fish in the world are seasonal breeders and each species has its own periods of breeding. Each species shows a series of regular temporal changes in its reproductive activity, which are repeated annually, and therefore, make up the annual reproductive cycle (Gibson 1978, Johannes 1978, Billard & Breton 1979). Spawning requirements are different in different groups of fishes and generally fish reproduce *enmasse*. Therefore, it is recommended to undertake detailed studies on habitat use and ecological classification of fish species available in the Khulna division by exploring all possible fish habitats.

Conclusion

Present study indicates that the aquatic habitats of Khulna Division have high fish diversity. A healthy trophic structure in the aquatic habitats is also proved through the presence of high percentage of carnivores and omnivores. Also, the presence of phytolithophils and phytophils in high percentage indicate the availability of quality spawning habitats. However, more detailed study on the resource and its habitats is recommended. Attention should also be taken for maintaining proper management and conservation to keep hold the status of the fish resources in the Division.

Disclaimer: The views expressed in this paper represent those of the authors and not necessarily those of the Bangladesh Fisheries Research Institute (BFRI) or Khulna University.

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