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Fish biodiversity and conservation status of the Dhepa river sanctuary in protection and restoration of threatened fishes of the northwest Bangladesh

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Abstract

A fish sanctuary has established at the Dhepa river basin in Dinajpur district of Bangladesh to protect the threatened fishes. The present fish biodiversity status and the impacts of the sanctuary on the protection and restoration of fishes were mapped from January to December 2015 through an extensive survey and fish sample collection. A total of 55 freshwater fishes including 48 indigenous species and 7 exotic species were identified from the Dhepa river fish sanctuary. The fishes belong to 43 genera, 8 orders and 18 families. Cypriniformes was the most dominant order (51%), followed by siluriformes (19%), perciformes (19%), osteoglossiformes (3%), beloniformes, clupeiformes, cynbranchiformes, and tetraodontiformes (2%). Among 18 families, cyprinidae was the most dominant with 40% of the total fishes. According to the updated red list, 48 indigenous fishes were grouped into 6 endangered (EN), 5 vulnerable (VU), 9 near threatened (NT) and 24 least concerned (LC) categories. A cluster diagram using the un-weighted pair group method with arithmetic mean (UPGMA) algorithm was constructed that depicted the direct correlation of LC, VU, CR, EN and NT categories while the not threatened (NO) and data deficient (DD) were not related to the other categories. It may be assumed that fishes under LC go towards the endangered category. The questionnaire survey categorized the collected fishes into abundantly available (22), moderately available (23) and rarely available (03). The conservation of fishes found in the category of least concerned, moderately available and rarely available are extremely desired for the protection and restoration of the threatened fishes of the northwest Bangladesh.

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Introduction

Bangladesh is a riverine country consisting of about 230 rivers and tributaries that constituting a waterway of total length around 24,140km. The rivers of the country have vast aquatic resources including 260 indigenous fish species, 24 freshwater prawn and 18 species of exotic fish (FRSS, 2015). But habitat loss and environmental degradation caused rapid decline in biological diversity which is a critical challenge for the modern era (Vyas *et al.,* 2012). Dinajpur district, the northwestern part of Bangladesh is traversed by several small and medium sized rivers.

The Dhepa river is one of the major rivers of the district providing suitable habitat for a large number of freshwater fishes and support the livelihoods of many fishermen. The abundance and distribution of fishes of the river are decreasing day by day due to environmental degradation and anthropogenic activities. Degradation of stream and riverine ecosystem cause ultimate destruction to the structure and function of stream biota (Lakra, 2010). To save the freshwater fishes from the further losses, different conservation approaches are highly required as it help fish production to be more sustainable while at the same time maintains diversity. Conserving diversity also improves the likelihood of maintaining minimal viable populations of rare and late-succession species (Abell *et al.,* 2003). Aquatic conservation strategies support sustainable development by protecting biological resources in ways that will preserve habitats and ecosystem (Jenkins, 2003).

Fish Sanctuary, an important fisheries management tool is widely using world-wide for the conservation, protection and restoration of fish species. Establishment of a fish sanctuary is an easy way to save the existing fish diversity in a water body and in some cases restoration of habitat may be possible by establishing aquatic sanctuary. Many government organization and non-government organization have taken the attempt in fish stock development by establishing traditional sanctuaries in beels and rivers of Bangladesh (Ahmed and Ahmed, 2002).

The Department of Fisheries (DoF) under the government of Bangladesh in its fourth fisheries projects have been established many fish sanctuaries in open water bodies (rivers and *beels*), scattered all over the country. The Dhepa river fish sanctuary was established in the year 2014 by the local administration. The administration and the local fishing community residing near the fish sanctuary is involved in the management.The study was aimed to assess the fish biodiversity and conservation status of the Dhepa river sanctuary as well as the impact of the sanctuary in protection and restoration fish biodiversity.

Materials and methods

Study site and period

The Dhepa river fish sanctuary selected as the study site is located "between 25°48' and 26°04' north latitudes and 88°29´ and 88°44´ east longitudes (Fig. 1). Because of the presence of a sluice gate at this point of the river, the upper and lower basin of the river around the area contains sufficient water throughout the year. This sluice gate managed water is very suitable as fish sanctuary due to the availability of running water throughout the year and migration tendency of fishes towards upward basin. Since December 2014, the local administration has declared this area as fish sanctuary and has banded fishing from this zone. This study was conducted for a period of 24 months from January 2014 to December, 2015 including base line survey.

Fish sample collection and identification

Fish samples were collected throughout the study period from the Dhepa river fish sanctuary using different types of nets including cast net and dip net. Total water body was divided into three sampling zones covering all representative habitats of the sanctuary. Immediately after collection the ice preserved fishes were transported to the Fisheries Biology and Genetics Laboratory of Hajee Mohammad Danesh Science and Technology University, Dinajpur. For the long term preservation 5% formalin solution was used. Systematic identification of the fishes was done with the help of standard keys provided by Talwar and Jhingran (1991) and Rahman (2005).

Survey data collection and cross-check

To supplement the sampling data, information of fishermen's catch residing adjacent to the fish sanctuary through a questionnaire survey were collected. During collection of data, both primary and secondary sources were considered to know the present biodiversity status of the river and the impact of sanctuary in protection and restoration of the threatened fish's biodiversity. Besides fishermen, Upazila Fisheries Officer (UFO), Upazila Parisad Chairman, leaders of the fisher's community, fish traders and community people were also included in the form of focus group discussion (FGD). Secondary information regarding the availability of fishes in the Dhepa river were collected from the office of the Department of Fisheries, Government of Bangladesh, Birganj Upazila, academicians, books, journals and theses. After collecting the data, it was cross-checked through key informant interviews with the government officials, academicians, local leaders and NGO workers in the study area.

Conservation status of the fishes

References to the conservation status of the fishes, the red list categorization (IUCN Bangladesh, 2000) and updated species red list of IUCN Bangladesh in 2016 (www.iucnredlistbd.org) were used. The availability of the different fishes was checked with the fishermen involved in harvesting of fishes from the adjacent area of the fish sanctuary. The fishes were grouped into 3 categories based on the fisher's information; the "abundantly available" fishes were categorized as "available", the "moderately available" fishes were categorized as "moderate" and the "rarely available" were categorized as "rare".

Data analysis

The collected data were sorted out and analyzed by using Microsoft office excels 2007. Tables, pie-charts, diagrams etc. were used to interpret the results. A cluster diagram using the un-weighted pair group method with arithmetic mean (UPGMA) algorithm using PAST software (3.14) was constructed based on the IUCN conservation status of the collected fishes for the year 2000 and 2016.

Result and discussion

The fish biodiversity of the Dhepa river sanctuary consisted of 55 taxa of freshwater fishes that included 48 indigenous species and 7 exotic species, belonging to 43 genera, distributed in 8 orders and 18 families (Table 1). Cypriniformes was ranked as the dominant order having 21 species of fishes with a contribution of 44% of the total fishes identified, followed by siluriformes with 11 species (23%), perciformes with 10 species (21%), osteoglossiformes with 2 species (4%), and with 1 species in each order beloniformes, clupeiformes, synbranchiformes, and tetraodontiformes (2%) (Fig. 2).

An analysis of the taxonomic composition of fish fauna suggests, that cyprinidae was the most abundant family with 22 representative species (40%) occurring in the study site. Bagridae is the second dominant family with 6 species (11%), followed by cobitidae with 4 species (7%), 3 species each to channidae (5%) and mastacembelidae (5%), with 2 species of each to anabantidae (4%) clariidae (4%), notopteridae (4%), and siluridae (4%) and 1 species to remaining family (Fig. 3). The of fish species number and total fish production were increased during the study period due the establishment of fish sanctuary. Haque, 2013 reported that fish sanctuary was very much effective for the protection and conservation of fish diversity during working with *Baikka beel* sanctuary and found some fishes which were rare in this area before establishing the sanctuary but were available at that time. Azher *et al*., 2007 reported that the impacts of sanctuary on fish production and fish biodiversity was from Dopi beel in Joanshahi haor. There was no previous studies of fish biodiversity of the Dhepa river, thus comparison of the present findings with previous one was not possible.

This problem seems not new in Bangladesh while working with fish biodiversity (Mohsin and Haque, 2009; Imteazzman and Galib, 2013), and indicates the need for water-body specific fish biodiversity study in Bangladesh. The study showed that the fish sanctuary across the Dhepa river basin is a reservoir of a very good number of threatened fishes of the country.

Several authors described the biodiversity of few rivers of the country that support the findings of the study. Galib *et al.,* 2013 identified 63 fish species belongs to 41 genera, 23 families and 9 orders during the biodiversity study from the river Choto Jamuna. Higher number of fish species was found by Hossain *et al.,* 2012 from the Meghna river estuary of Bangladesh. The recorded fish was lower than some other river of Bangladesh (Bhuiyan *et al.,*2008; Rahman *et al.,* 2012) but the presence of similar number of fish species was also reported from the Mahananda river (Mohsin and Haque, 2009).

On the other hand Parvez *et al.,* 2014 identified 84 species of fishes belonging to 21 families from three rivers of Dinajpur districts which were higher than this study. It may be due to the inclusion of different river of Dinajpur district. Similar to our study, cypriniformes was described as the most dominant fish order from the Padma distributary of the Ganges River, Northwestern Bangladesh (Rahman *et al.,* 2012), from three rivers of Dinajpur district of Bangladesh (Parvez *et al.,* 2014), from the Choto Jamuna river comprising 34.92% of all the number of species (Galib *et al.,* 2013; Chaki *et al.*, 2015). Hasan *et al*. in 2013 found cyprinidae as the dominant fish family in Baikka beel followed by the bagridae, siluridae and channidae. Galib *et al*., 2013 mentioned the similar observation where Cyrinidae comprising 28.57% of the total number of species observed as the dominant fish family from the Choto Jamuna.

Table 1. Systematic list and conservation status of fishes identified from the Dhepa river fish sanctuary

Sl No	Order name	Family name	Scientific name	Conservation Status		
				IUCN (2000)	IUCN (2016)	Availability (2016)
1	Beloniformes	Belonidae	*Xenentodon cancila* (Hamilton, 1822)	NO	LC	MO
2	Clupeiformes	Clupeidae	*Coricaso borna* (Hamilton, 1822)	NO	LC	AV
3			*Amblypharyngodon mola* (Hamilton, 1822)	NO	LC	AV
4			**Aristichthys nobilis* (Richardson, 1845)			
5			**Barbonymus gonionotus* (Bleeker, 1849)			
6			*Chagunius chagunio* (Hamilton, 1822)	DD	VU	MO
7			*Chela laubuca* (Hamilton, 1822)	EN	LC	MO
8			*Cirrhinus cirrhosus* (Bloch, 1795)	NO	NT	AV
9			*Cirrhinus reba* (Hamilton, 1822)	VU	NT	AV
10			**Ctenopharyngodon idella* (Valenciennes, 1844)			
11		Cyprinidae	**Cyprinuscarpio var. communis* (Linnaeus, 1758)			
12			**Cyprinuscarpio var. specularis* (Linnaeus, 1758)			
13			*Esomus danricus* (Hamilton, 1822)	DD	LC	AV
14	Cypriniformes		*Gibelion catla* (Hamilton, 1822)	NO	LC	AV
15			**Hypophthalmichthys molitrix* (Valenciennes, 1844)			
16			*Labeo bata* (Hamilton, 1822)	EN	LC	AV
17			*Labeo calbasu* (Hamilton, 1822)	NO	LC	MO
18			*Labeo gonia* (Hamilton, 1822)	EN	NT	MO
19			*Labeo rohita* (Hamilton, 1822)	NO	LC	AV
20			*Pethia ticto* (Hamilton, 1822)	VU	VU	AV
21			*Puntius chola* (Hamilton, 1822)	NO	LC	MO
22			*Puntius sophore* (Hamilton, 1822)	NO	LC	MO
23			*Raiamas bola* (Hamilton, 1822)	EN	LC	MO
24			*Systomus sarana* (Hamilton, 1822)	CR	NT	RA
25		Balitoridae	*Acanthocobitis botia* (Hamilton, 1822)	DD	LC	MO
26			*Botia dario* (Hamilton, 1822)	EN	EN	AV
27			*Botia lohachata (*Chaudhuri, 1912*)*	EN	EN	AV
28		Cobitidae	*Canthophrys gongota (Hamilton 1822)*	NO	NT	AV
29			*Lepidocephalus guntea* (Hamilton, 1822)	NO	LC	MO
30	Osteoglossiformes	Notopteridae	*Chitala chitala* (Hamilton, 1822)	EN	EN	MO
31			*Notopterus notopterus* (Pallas, 1769)	VU	VU	AV
32	Perciformes	Ambassidae	*Chanda nama* (Hamilton, 1822)	VU	LC	MO
33		Anabantidae	*Anabas testudineus* (Bloch, 1792)	NO	LC	AV

Sl No	Order name	Family name	Scientific name	Conservation Status		
				IUCN (2000)	IUCN (2016)	Availability (2016)
34			*Trichogaster fasciata* (Bloch and Schneider, 1801)	NO	LC	AV
35			*Channa orientalis* (Bloch and Schneider,1801)	VU	LC	MO
36		Channidae	*Channa punctatus* (Bloch and Schneider, 1801)	NO	LC	AV
37			*Channa striata* (Bloch, 1793)	NO	LC	AV
38		Cichlidae	**Oreochromism ossambicus* (Peters, 1852)			
39		Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	NO	LC	MO
40			*Mastacembelus armatus* (Lacepède, 1800)	EN	EN	MO
41		Mastacembelidae	*Macrognathus aculeatus* (Bloch, 1786)	VU	NT	MO
42			*Macrognathus pancalus* (Hamilton, 1822)	NO	LC	MO
43			*Hemibagrus menoda* (Hamilton, 1822)	NO	NT	RA
44			*Mystus cavasius* (Hamilton, 1822)	VU	NT	RA
45		Bagridae	*Mystus tengra* (Hamilton, 1822)	NO	LC	AV
46			*Mystus vittatus* (Bloch, 1797)	NO	LC	MO
47			*Rita rita* (Hamilton, 1822)	CR	EN	MO
48	Siluriformes		*Sperata aor* (Hamilton, 1822)	VU	VU	AV
49		Claridae	*Clarias batrachus* (Linnaeus, 1758)	NO	LC	MO
50			*Heteropneustes fossilis* (Bloch, 1794)	NO	LC	AV
51		Schilbeidae	*Neotropius atherinoides* (Bloch, 1794)	NO	LC	AV
52		Siluridae	*Wallago attu* (Bloch and Schneider, 1801)	EN	NT	MO
53			*Ompok pabda* (Hamilton, 1822)	EN	EN	MO
54	Synbranchiformes	Synbranchidae	*Monopterus cuchia* (Hamilton, 1822)	VU	VU	MO
55	Tetraodontiformes	Tetraodontidae	*Tetraodon cutcutia (*Hamilton, 1822)	NO	LC	AV

*Exotic fishes, IUCN categories CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, NO: Not threatened. Availability Status: AV: Abundantly Available; MA: Moderately Available and RA: Rarely available

Fig. 2. Fish species composition under different orders found from the Dhepa river fish sanctuary during study period (2014-2015).

The conservation status of the fishes collected from the sanctuary was identified based on the IUCN Bangladesh (2000 and 2016) and the finding of this study is shown in the Table 1. Based on IUCN Bangladesh (2000) categorization, out of 48 freshwater indigenous fishes 24 were considered as threatened under the categories of critically endangered (2), endangered (10), vulnerable (9) and data deficient (3).

In the year 2016 updated red list category of IUCN Bangladesh the scenario has changed where all the identified fishes from the sanctuary are belongs to only four categories endangered (6), vulnerable (5), near threatened (9) and least concerned (28) (Table 1).

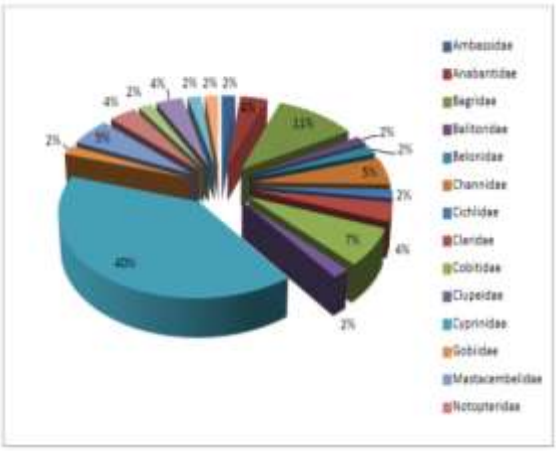

Fig. 3. Family-wise fish species distribution from the Dhepa river fish sanctuary during the study period (2014-2015).

The result of our questionnaire survey categorized the collected fishes into abundantly available (22), moderately available (23) and rarely available (03). An important observation was that 6 species such as *Botia Dario*, *Botia lohachata*, *Chitala chitala, Mastacembelus armatus, Rita rita* and *Ompok bimaculatus*, those were placed under the category of endangered species by IUCN Bangladesh (2016) are found either as abundantly available or as moderately available population in the sanctuary (Table 1). The cluster diagram depicted that, the least concerned (LC), critically endangered (CR), endangered (EN), vulnerable (VU) and near threatened (NT) categories are directly correlated with each other while the not threatened (NO) and data deficient (DD) are not related to the other five categories (Fig. 4). It may be assumed that fishes under LC go towards the endangered category in the near future. In the year 2010, Amin and his co-authors described the availability of vulnerable and endangered small indigenous species of fish in the natural waters of this northwest part of Bangladesh. Galib *et al.,* 2013 found 41.27% species were in threatened condition from Choto Jamuna river in northern side of Bangladesh. Among them 15.87% vulnerable, 15.87% endangered and 9.52% critically endangered species. Sayeed, 2010 reported 6 critically endangered, 20 endangered, 10 vulnerable and 18 data deficient from Chalan beel. From the Sarada river of Andhra Pradesh in India, Rao *et al.,* 2014 reported 3 near threatened, 3 vulnerable, 4 lower risk near threatened, 1 lower risks least concern, 37 least concern, 15 not evaluated and for 3 data deficient as per IUCN (2013) red list category.

Apart from the indigenous fishes, 7 exotic fishes were also identified from the Dhepa river fish sanctuary during the study period (Table 1). The exotic fishes are *Aristichthys nobilis, Barbonymus gonionotus* (Bleeker, 1849) *Hypophthalmicthys molitrix*, *Oreochromis mossambicus, Cyprinus carpio var. specularis, Cyprinus carpio* var. *communis, Ctenopharyngodon idella*. Saha, 2007 also found six exotic species in Gawha *beel,* three exotic fish species by Alam *et al.,* 2013 in Halda river, two exotic species by Galib *et al.,* 2013 in Choto Jamuna river. Parvez *et al.,* 2014 also identified 12 exotic species in three river of Dinajpur districts.

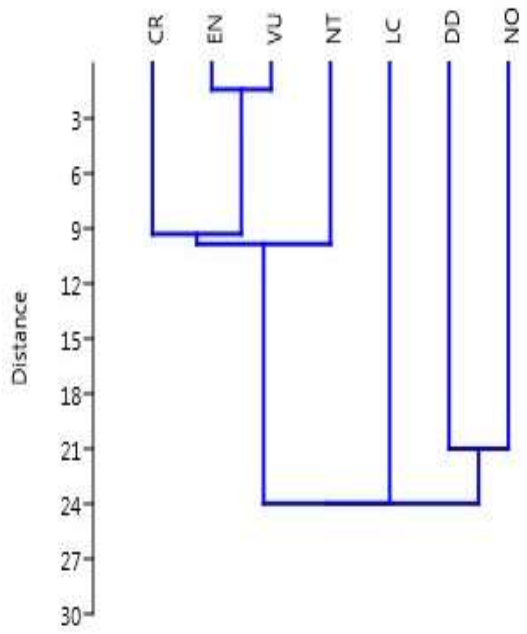

Fig. 4. UPGMA clustering (Euclidean) of various IUCN categories using distance matrix: CR-Critically Endangered, EN-Endangered, VU-Vulnerable, NT-Near Threatened, LC-Least Concerned, DD-Data Deficient and NO-Not Threatened

Two exotic species were found by Islam, 2014 in study on fish biodiversity of Ashura beel in Dinajpur district. These species was extremely popular in aquaculture of Bangladesh and also Dinajpur. Probably they escape from adjacent pond during heavy flood. The species can pose threat to native icthyofauna (Mukherjee *et al.,* 2002). So, consideration should be given to nonindigenous in order avoid the potential negative impact. Similar comment also made by researchers (Rixon *et al.,* 2013; Galib *et al.,* 2013).

Conclusion

The establishment of sanctuary showed positive impact with the availability of a good number indigenous fishes that are in IUCN red list categories. Fishes that are in IUCN red list categories are still abundantly available or moderately available. The proper management of this sanctuary could serve as gene pool of the threatened fishes of this part of the country.

References

Abell R, Thieme M, Lehner B. 2003. Eco-region conservation for freshwater systems, with a focus on large rivers. In: RL Welcomme and T Peter (Editors), Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries Volume - 2. Food and Agriculture Organization and Mekong river Commission. FAO Regional Office for Asia and the Pacific, Bangkok. RAP Publication **2004/17.** 1-14.

Ahmed KKU, Hambrey JB. 2005. Studies on the fish catch efficiency of different types of fishing gear in Kaptai Reservoir, Bangladesh. Lakes & Reservoirs: Research and Management **10,** 221-234.
DOI: 10.1111/j.1440-1770.2005.00280.x.

Ahmed K, Ahmed M. 2002. Fish Sanctuary; necessity, practice and prospects. Technical Assistance for Rural Development, Dhaka 165**.**

Alam MS, Mohammad S, Hossain, Mohammad M, Monwar, Mohammad E, Hoque, Faiz M, Taimur. 2013. Check-list of bony fish collected from the Upper Halda River, Chittagong, Bangladesh. Aquaculture, Aquarium, Conservation & Legislation International Journal of the Bioflux Society **6(4),** 333-338.

Amin R, Ahammad S, Amin HA, Mehbub F, Miah MU. 2010. Biodiversity study of SIS (Small Indigenous Species) of fish in Northwest part of Bangladesh and detection of threatened species. Biological Diversity and Conservation **3(1),** 56-65.

Azher SA, Dewan S, Wahab MA, Habib MAB and Mustafa GM. 2007. Impacts of fish sanctuaries on production and biodiversity of fish and prawn in Dopi beel, Joanshahi haor, Kishoregonj. Bangladesh Journal of Fisheries (Special Issue) **30,** 23-36.

Bhuiyan SS, Joadder MAR, Bhuiyan AS. 2008. Occurrence of Fishes and Non- fin fishes of the River Padma near Rajshahi, Bangladesh. University Journal of Zoology, Rajshahi University **27**, 99-100. www.dx.doi.org/10.3329/ujzru.v27i0.1965.

Chaki N, Jahan S, Fahad MFH, Galib SM, Mohsin ABM. 2014. Environment and fish fauna of the Atrai River: global and local conservation perspective. Journal of Fisheries **2(3),** 163-172.
DOI: 10.17017/ jfish.v2i3.2014.46.

FRSS. 2015. Fisheries Statistical Report of Bangladesh. Fisheries Resources Survey System (FRSS). Department of Fisheries, Bangladesh 31-57.

Galib SM, Naser SMA, Mohsin ABM, Chaki N, Fahad FH. 2013. Fish diversity of the River Choto Jamuna, Bangladesh: Present status and conservation needs. International Journal of Biodiversity and Conservation **5(6),** 389-395.
DOI: 10.5897/IJBC 2013.0552.

Hasan SJ, Flura, Alam A, Shafiqul AKMS, Haider I, Karim E. 2013. Ecological Aspects and Affectivity of Biodiversity Restoration of Baikka *Beel*, International Journal of Business, Social and Scientific Research **01**, 09-16.

Haque MMU. 2013. Impacts of Baikka *beel* sanctuary on protection and restoration of fish diversity and enhancement of local livelihoods. Connecting communities and conservation: Co-management initiatives by IPAC in wetlands and forests of Bangladesh. USAID/ Bangladesh 177-191.

Hossain SM, Das NG, Sarker S, Rahaman MZ. 2012. Fish diversity and habitat relationship with environmental variables at Meghna river estuary, Bangladesh. Egyptian Journal of Aquatic Research **38,** 213-226.
www.dx.doi.org/10.1016/j.ejar.2012.12.006.

Imteazzaman AM, Galib SM. 2013. Fish Fauna of Halti *Beel*, Bangladesh. International Journal of Current Research **5(1),** 287-290.

Islam SM. 2014. Study on fish biodiversity of Ashura beel in Dinajpur district. MS thesis. Department of Fisheries Management, Hajee Mohammad Danesh Science and Technology University, Dinajpur.

IUCN Bangladesh, 2000. Red Book of Threatened Fishes of Bangladesh. IUCN the World Conservation Union, XII. 116.

IUCN. 2013. Red List of Threatened Species. Version 2013.2

IUCN. 2016. Red List of Threatened Species. Version 2016.1

Jenkins M, Williamson D. 2003. Biodiversity and the ecosystem approach in agriculture, forestry and fisheries Proceedings. Food and Agriculture Organization of the United Nations. Rome, Italy 100-116.

Lakra WS. 2010. Fish Biodiversity of Uttar Pradesh: Issues of Livelihood Security, Threats and Conservation. National conference on Biodiversity, Development Poverty Alleviation. Uttar Pradesh State Biodiversity Board, India 40-45.

Lima FP, Latini AO, Junior M. 2010. Environment perception by alien fish dispersal in Brazilian tropic lakes. Interciencia **35(2),** 84-91.

Mohsin ABM, Haque ME. 2009. Diversity of Fishes of Mahananda River at Chapainawabganj District. Research Journal of Biology and Science **4(7),** 828-831.

Mondol MMR, Hossain MY, Rahman MM. 2015. Check List of Fish Availability in the Karatoya River, Bangladesh. World Journal of Zoology **10(1),** 17-21.
DOI: 10.5829/idosi.wjz.2015.10.1.91149.

Mukherjee M, Praharaj A, Das S. 2002. Conservation of Endangered Fish Stocks Through Artificial Propagation and Larval Rearing Technique in West Bengal, India. Aquaculture Asia **7(2),** 8-11.

Parvez I, Mostakim GM, Ali MR, Sujan HS, Alam MA. 2014. Present Status and Potential Risks of Fishes of Northwest Bangladesh. The Festschrift on the 50th Anniversary of The IUCN Red List of Threatened Species 102.

Rahman AKM. 2005. Freshwater Fishes of Bangladesh, second edition. Zoological Society of Bangladesh, University of Dhaka, Dhaka, Bangladesh 263.

Rahman MM, Hossain MY, Ahamed F, Fatematuzzhura BR, Abdullah EM, Ohtomi J. 2012. Biodiversity in the Padma Distributary of the Ganges River, North-western *References* 61 Bangladesh: Recommendations for Conservation. World Journal Zoology **7(4),** 328-337.
DOI: 10.5829/idosi.wjz.2012.7.4.6634.

Rao JCS, Raju CHS, Simhachalam G. 2014. Biodiversity and Conservation Status of Fishes of River Sarada, Visakhapatnam District, Andhra Pradesh, India. Research Journal of Animal, Veterinary and Fishery Sciences **2(2),** 1-8.

Rixon CAM, Duggan IC, Bergeron NMN, Ricciardi A, Macisaac H. 2013. Invasion Risks Posed by the Aquarium Trade and Live Fish Markets on the Laurentian Great Lakes. Biodiversity Conservation **14,** 1365-1381.
DOI 10.1007/s10531-004-9663-9.

Saha BK, Hossain MA. 2007. Saldu Beel Fishery of Taingail. Bangladesh Journal of Zoology **30(2),** 187-194.

Sayeed MA. 2010. Fish biodiversity in the chalan *beel*, a natural depression in North West Bangladesh. Ph.D. Thesis, Department of Fisheries Biology and Genetics, BAU, Mymensingh.

Talwar PK, Jingran AG. 1991. Inland Fishes of India and Adjacent Countries. Oxford and IBH Publishing Company, Volume No.2, New Delhi. 936-1023.

Vyas V, Damde V, Parashar V. 2012. Fish Biodiversity of Betwa River in Madhya Pradesh, India with special reference to a sacred ghat. International Journal of Biodiversity Conservation **4(2),** 71-77.