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Indigenous Freshwater Piscine Resources of Indian Sundarban Biosphere Reserve: Status and Prospects

[1]Sourabh Kumar Dubey, [1]Raman Kumar Trivedi and [2]Bimal Kinkar Chand

[1]Department of Aquatic Environment Management, Faculty of Fishery Sciences,
West Bengal University of Animal and Fishery Sciences, 5 Budherhat Road, Kolkata-700094, India
[2]Directorate of Research, Extension and Farms,
West Bengal University of Animal and Fishery Sciences, Kolkata-700037, India

Abstract: Study of indigenous piscine resources is utmost important because these fish species in its natural setting serves as ecological indicators. This contribution focuses on diversity and conservation aspects of freshwater indigenous fish resources of Indian Sundarban Biosphere Reserve. The study revealed the occurrence of 62 ichthyofauna belonging to 45 genera, 28 families and 9 orders. Of these fishes, 6% fish belonged to Endangered category and 2% were Vulnerable and Critically Endangered category. This article also addresses the culture potential of the small indigenous fishes as well as threat and conservation issues.

Key words: Indigenous Fish · Fish Diversity · Sundarban Biosphere Reserve · Conservation

INTRODUCTION

The inland water resources of India are renowned for their heterogeneity in fish diversity as for as their magnificent productive potential. India is the one of the mega-biodiversity countries in the world and occupies 9th position in terms of freshwater mega-biodiversity [1]. The Indian fish fauna is an assemblage of about 2500 species depicting diverse characteristics, of which 930 species belonging to 326 genera, inhabit the inland waters [2] and 1570 are found in marine water [3]. Out of these, 400 species are commercially important, which include cultured, cultivable and wild species. Globally, Indian fish represents 11% of total species, 24% of total genera and 57% of the total families [4].

The Indian Sundarban Biosphere Reserve (between 21°40'N and 22°40'N, lat. and 88°03'E and 89°07'E long.) is a UNESCO declared World heritage Site, lies on the southern fringes of the West Bengal state of India, where the Gangetic plain meets the Bay of Bengal. The Sundarban, world's largest mangrove ecosystem, is an archipelago of several hundred islands, spread across 9,630 km^2 in India and 16,370 km^2 in Bangladesh. The Indian Sundarban delta comprises of 102 low-lying islands, of which 48 islands are occupied by human habitation in 5,363 km^2 area. On the Indian side, it extends 19 community development blocks over two districts; 13 blocks in South 24 Parganas and 6 blocks in North 24 Parganas districts with total 190 Gram Panchayats and 1064 villages. The freshwater flows from the mainstream rivers and the tidal ingress from the sea result in a gradient of salinity that varies both spatially and temporally within the Biosphere Reserve. In general, the salinity is higher nearer the coast and the water in the inland side boundary of the Sundarban is nearly fresh [5]. Freshwater domains closed to blind rivers, creeks and canals in the Sundarban biosphere are about 891 km^2. The Sundarban biosphere Reserve is endowed with a vast expanse of often inland waters in the form of canals, estuaries, lakes, ponds, tanks, wetlands and paddy fields etc which always attracted attention for its cosmic aquatic recourses with rich indigenous fish diversity. Although the total estuarine habitat occupy a significant component available to fishes and play important roles as nursery and foraging grounds. The rural population, specially the rural poor, are dependent to varying degrees on these fishery resources for their livelihoods, income and food. It is well known that small indigenous fish species is significantly

Corresponding Author: Sourabh Kumar Dubey, Department of Aquatic Environment Management, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, 5 Budherhat Road, Kolkata-700094, India.
E-mail: sourabhkumardb@gmail.com.

contributed global food security through its high quality vitamin and mineral sources [6, 7], however very less interest has been rewarded on their role in production enhancement, processing, captive breeding and conservation approaches. Subsequently in Indian Sundarban coastal biome, many indigenous fishes has become a major concern due to its constant environmental changes, over exploitation of resources, habitat destruction, pollution, demographic pressure, introduction of exotic varieties, modern agriculture etc which might be responsible for species turn over. Thus, knowledge on species and communities can reveal crucial facts necessary to the management of the ecosystems as well as to the identification of important genetic resources.

Documentations on indigenous fish resources from West Bengal were carried out by several workers [8-10]. Various workers explored estuarine, marine piscine resources from water of Indian Sundarban in a scattered way [11-15]. However, detail documentations on freshwater indigenous fish resources of Indian Sundarban biosphere are really scanty. In continuation to the fact, the present works deals with an aim to explore available freshwater indigenous fish fauna from Indian Sundarban Biosphere.

MATERIALS AND METHODS

Study Area: A rapid survey work has been conducted for collecting and or recording the available indigenous freshwater fish fauna in two selected deltaic blocks of Indian Sundarban Biosphere Reserve namely Basanti and Sagar block under district South 24 Parganas during the months of September to December, 2011. The largest deltaic block, Sagar Island is located in the extreme western sector of Sundarban lies between 21°53' N and 88°02' to 88°15' E. This island with an area of around 300 km² is surrounded by two rivers, Hoogly and Muriganga. Both the rivers meet Bay of Bengal on either side of the Sagar Island and are totally disconnected from mainland. Basanti is located in the eastern part of Indian Sundarban biosphere lies between 22°11'21?N and 88°40'14?E with an area of 286.03 km^2. It is bounded by the Matla and Vidyadhari rivers and numerous creeks. Both islands are surrounded by century old man made embankments which possible freshwater sphere within the land masses. 20 Gram Panchayats in the 2 blocks were covered during this survey (9 Gram Panchayats in Sagar block, 11 Gram Panchayats in Basanti block) and two reputed local NGOs were associated with this survey (Paribesh Unnayan Parishad for Sagar block and Joygopalpur Gram Vikash Kendra for Basanti block).

Sampling Methodology: During the survey period, fish specimens have been collected using different kinds of nets (hand net, gill net, scoop net and cast net) from almost all kinds of waterbodies like canals, beels, derelict waterbodies, ponds and road side ditches. Sampling has been conducted during early morning in between 6 to 8 AM involving the local fishermen. After collection, all the fishes captured have been immediately segregated according to their family. Those species was not identified in field, were preserved in 10% formaldehyde and brought to laboratory for further investigations. Identifications were made after following standard literatures [2, 16-18]. Conservation status of the fishes was determined according to CAMP report [19], National Bureau of Fish Genetic Resources [20] and IUCN Red list of Threatened Species [21]. Farmer's perceptions on loss of indigenous fish diversity were noted based on cross-sectional questionnaire-based survey and focused group discussion (FGD). Threat ranks of fishes were established in 1-10 ranked hypothetical scale.

RESULTS

From the present short span study, total 62 ichthyofauna belonging to 45 genera, 28 families and 9 orders have been recorded from the two blocks of Indian Sundarban Biosphere Reserve (Table 1). Order perciformes represented maximum number of species distribution followed by siluriformes, cypriniformes and synbranchiformes (Figure 1). Family wise species heterogeneity was conspicuous and cyprinidae family demonstrated maximum number of individuals (13 species) followed by bagridae (6 species), channidae and gobidae (5 species each). Family siluridae, mastacembelidae and osphronemidae represented 3 individuals respectively. Likewise family ambassidae, notopteridae and tetraodontidae represented 2 individuals respectively, whereas 18 families were found to share only 1 individual species (Figure 2). It is noted that out of 62 numbers of species, 17 fish species (family bagridae, gobidae, tetraodontidae, eleotridae, anguillidae, plotosidae, belonidae) have been encountered from both freshwater and brackish water region. The present set of data also revealed that out of 62 species, 6% indigenous fish belonged to Endangered category and 2% were

Table 1: Checklist of indigenous freshwater ichthyofauna of Sundarban Biosphere Reserve with their endemic status

Sl	Order	Family and Scientific name	Vernacular name	Conservation status
	Cypriniformes	Cyprinidae		
1		*Amblypharyngodon mola* (Hamilton)	Mourola	LRlc
2		*Brachydanio rerio* (Hamilton)	Anju	LRnt
3		*Chela laubuca* (Hamilton)	Dankena	LRlc
4		*Puntius conchonius* (Hamilton)	Kunchon Punti	VU
5		*Puntius phutunio* (Hamilton)		LRlc
6		*Systomus sarana* (Hamilton)	Sar Punti	VU
7		*Puntius sophore* (Hamilton)	Deshi Punti	LRnt
8		*Puntius terio* (Hamilton)	Teri punti	LRnt
9		*Esomus danricus (*Hamilton)	Darikhana	LRlc
10		*Rasbora daniconius (Hamilton)*	Darikhana	LRlc
11		*Pethia gelius* (Hamilton)	Gili punti	LC
12		*Pethia ticto*(Hamilton)	Tit Punti	LRnt
13		*Salmostoma bacalia* (Hamilton)		LRlc
		Cobitidae		
14		*Lepidocephalus guntea* (Hamilton)	Gunte	LC
	Cyprinodontiformes	Aplocheilidae		
15		*Aplocheilus panchax* (Hamilton)	Trichokha	LC
	Beloniformes	Belonidae		
16		*Xenentodon cancila* (Hamilton)	Bogo	LRnt
	Siluriformes	Bagridae		
17		*Mystus cavasius*(Hamilton)	Kabasi tangra	LRnt
18		*Mystus gulio*(Hamilton)	Nona Tangra	LC
19		*Mystus tengara* (Hamilton)	Tangra	LC
20		*Mystus vittatus* (Bloch)	Sona Tangra	VU
21		*Sperata aor* (Hamilton)	Aor	VU
22		*Sperata seenghala* (Sykes)	Aor	LC
		Siluridae		
23		*Ompok pabda* (Hamilton)	Pabda	EN
24		*Ompok bimaculatus* (Bloch)	Pabda	NT
25		*Wallago attu* (Schneider)	Boal	LRnt
		Plotosidae		
26		*Plotosus canius* (Hamilton)	Kan magur	NE
		Schilbeidae		
27		*Ailia coila* (Hamilton)	Kajri	VU
		Pangasidae		
28		*Pangasius pangasius* (Hamilton)	Pangus	CR
		Sisoridae		
29		*Bagarius bagarius* (Hamilton)	Bag mach	VU
		Clariidae		
30		*Clarias batrachus* (Linnaeus)	Magur	VU
		Heteropneustidae		
31		*Heteropneustes fossilis* (Bloch)	Singi	VU
	Anguilliformes	Ophichthidae		
32		*Pisodonophis boro* (Hamilton)	Baim	LC
		Anguillidae		
33		*Anguilla bengalensis* (Gray)	Sona Bam	EN
		Muraenesocidae		
34		Muraenesox cinereus (Forsskål)		VU
	Synbranchiformes	Mastacembelidae		
35		*Mastacembelus armatus* (Lecepede)	Bam/Pankal	LC
36		*Macrognathus aral* (Bloch)	Tara bam	LRnt
37		*Macrognathus panculus* (Hamilton)	Tora/Pankal	LRnt
		Synbranchidae		
38		*Amphipnous cuchia* (Hamilton)	Cuche	LRnt
	Perciformes	Channidae		

Table 1: Continue

39		*Channa gachua* (Hamilton)	Chang	VU
40		*Channa marulius* (Hamilton)	Sal/Gajal	LRnt
41		*Channa orientalis* (Bloch)	Ulko	VU
42		*Channa punctata* (Bloch)	Lata	LRnt
43		*Channa striata* (Bloch)	Sol	LRlc
		Badidae		
44		*Badis badis* (Hamilton)	Pod Koi	VU
		Nandidae		
45		*Nandus nandus* (Hamilton)	Nadosh /Veda	LRnt
		Gobidae		
46		*Boleophthalmus boddarti* (Pallas)		NE
47		*Glossogobius giuris* (Hamilton)	Gang Bele	LRnt
48		*Stigmatogobius sadanundio* (Hamilton)		NE
49		*Pseudapocryptes lanceolatus* (Cuvier)	Gule	LC
50		*Odontamblyopus rubicundus* (Hamilton)	Lal chewa	NE
		Eleotridae		
51		*Eleotris fusca* (Forster)	Kalo Bele	LC
		Ambassidae		
52		*Chanda nama*(Hamilton)	Kath Chanda	NE
53		*Parambassis ranga* (Hamilton)	Lal Chanda	LC
		Anabantidae		
54		*Anabas testudineus* (Bloch)	Koi	VU
		Polynemidae		
55		*Polynemus paradiseus* (Linnaeus)	Topse	
		Osphronemidae		
56		*Trichogaster fasciata* (Schneider)	Kholse	LRnt
57		*Trichogaster lalius*(Hamilton)	Lal Kholse	NE
58		*Trichogaster chuna* (Hamilton)	Chuno Kholse	NE
	Osteoglossiformes	Notopteridae		
59		*Chitala chitala* (Hamilton)	Chitol	EN
60		*Notopterus notopterus* (Pallas)	Pholui	LRnt
	Tetraodontiformes	Tetraodontidae		
61		*Tetraodon cutcutia* (Hamilton)	Tepa	LRnt
62		*Tetraodon fluviatilis* (Hamilton)	Potka	LRnt

CR: Critically endangered; EN: Endangered; LC: Least Concern; LRlc: Lower risk-least concern; LRnt: Lower risk-near threatened; NE: Not Evaluated; NT: Near Threatened; VU: Vulnerable

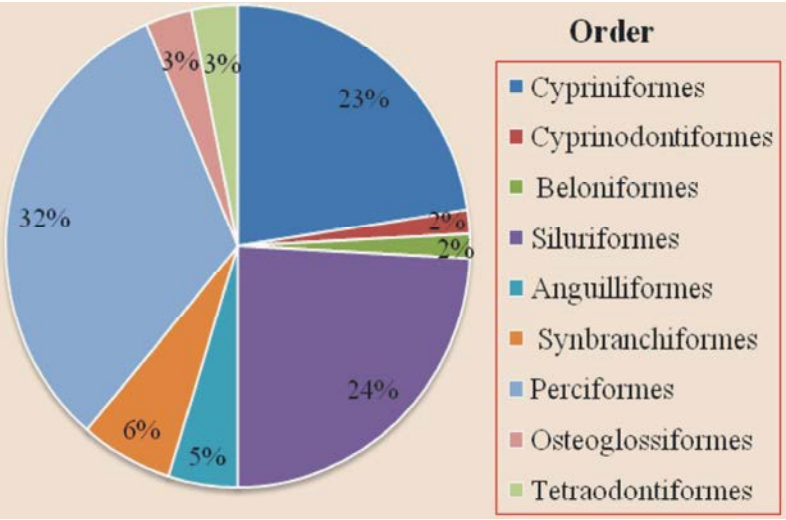

Fig 1: Order wise distribution of indigenous freshwater fishes of Sundarban Biosphere Reserve

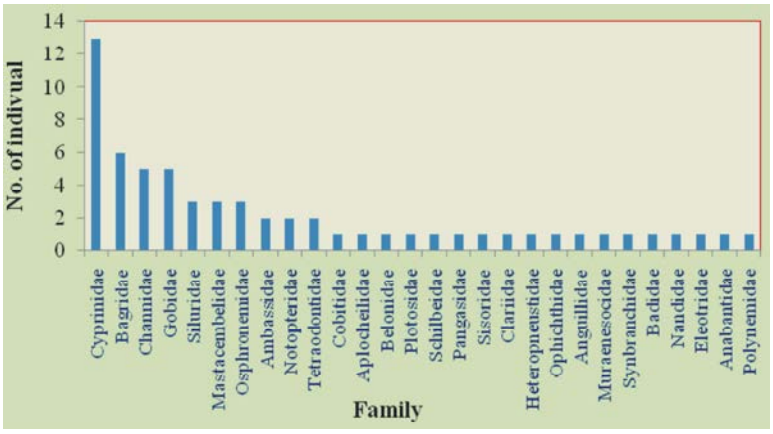

Fig 2: Family wise number of indigenous freshwater fishes of Sundarban Biosphere Reserve

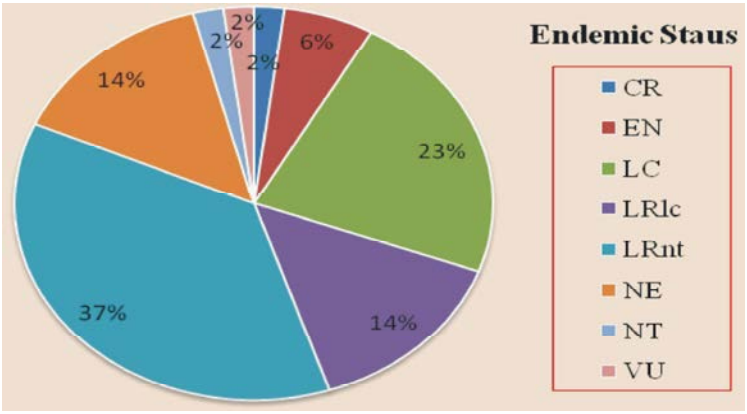

Fig 3: Conservation status of indigenous freshwater fishes of Sundarban Biosphere Reserve

Vulnarable and Critically Endangered category. However, 37 % species belonged to Lower Risk-Near Threatened category (Figure 3).

The freshwater food fishes and their fishery occupied an important portion in Sundarban Biosphere Reserve. The fishes are mostly belonged to order cypriniformes, perciformes and siluriformes. The cypriniformes includes both major and minor carps. At the time of field survey it has been observed that, the major indigenous carp species viz., *Labeo rohita* (Hamilton), *Catla catla* (Hamilton) and *Cirrhinus mrigala* (Hamilton) along with three exotic carps mainly *Cyprinus carpio* (Linnaeus), *Ctenopharyngodon idella,* (Valenciennes) and *Hypophthalmichthys molitrix* (Valenciennes) were widely cultured. Farmers also stocked minor carps like *Labeo bata* (Hamilton), *Labeo calbasu* (Hamilton) along with Indian major carps. Other exotic varieties like *Barbodes gonionetus* (Bleeker), *Hypophthalmichthys nobilis* (Richardson), *Oreochromis mossambicus* (Peters), *Oreochromis niloticus* (Linnaeus) were very popular. In recent years, invasive alien species like *Pygocentrus nattereri* (Kner), *Clarius gariepinus* (Burchell) were introduced in Sundarban region and cultured in freshwater pond along with other fish. During the study period, it has been observed that freshwater indigenous carps also cultured and grew nicely in slight brackish water (> 10 ppt salinity). Among small indigenous fishes, most of them are natural breeders and can easily breed during the period of monsoon and grow up with the carps. Indigenous brackish water fishes like *Lates calcarifer* (Bloch), *Chelon* (*Liza) parsia* (Hamilton), *Chelon planiceps* (*Liza tade)* (Valenciennes), *Chelon* (*Liza) macrolepis* (Smith), *Mugil cephalus* (Linnaeus), *Rhinomugil corsula* (Hamilton), *Etroplus suratensis* (Bloch), *Scatophagus argus* (Linnaeus), *Toxotes chatareus* (Hamilton), *Terapon jarbua* (Forsskal) etc were found abundantly in freshwater areas and few of them were widely cultured in freshwater ponds in Sundarban region.

Based on survey, some small indigenous fish species are noted out, which populations are drastically reducing since last thirty years. Farmers were rated threat rank of

Table 2: Threat rank of some indigenous fishes: Farmer's perception on loss of indigenous fish diversity since last 30 years at Sagar and Basanti block of Indian Sundarban

	Sagar		Basanti
Name of Fish	Threat Rank	Name of Fish	Threat Rank
C. gachua	I	*N. nandus*	I
W. attu	II	*W. attu*	II
C. batrachus, H. fossilis	III	*C. marulius, C.striata, C. punctata*	III
S. sarana	IV	*A. testudineus*	IV
O. pabda	V	*C. gachua*	V
C. marulius, C.striata, C. punctata	VI	*A. bengalensis*	VI
N. nandus	VII	*C. nama*	VII
A. bengalensis	VIII	*C. batrachus, H. fossilis*	VIII
A. testudineus	IX	*S. sarana*	IX
A. mola	X	*T. fasciata*	X

each species on 1-10 ranked hypothetical scale which are listed in Table 2. According to the farmers of Sagar Island, *Channa gachua* was ranked first and *Amblypharyngodon mola* was ranked last based upon their availability status. In Basanti block, *Nandus nandus* was ranked first and *Trichogaster fasciata* was ranked last based upon their availability status.

DISCUSSION

Marine and freshwater catches are dominated by a great diversity of small species [22]. On the contrary, aquaculture is characterized by production of a limited number of large freshwater fish species. Owing food security, lowering of indigenous freshwater fish diversity is now global concern in many developing countries. In neighboring country Bangladesh, 15% of species reported to have disappeared, 20% critically endangered and the rate of disappearance increasing in recent years due to various reasons [23].

A total number of 62 indigenous fishes occurring in freshwater zones of Sundarban Biosphere Reserve were recorded from the present short span study. In earlier study, Sen [11] reported 61 finfish species, Mandal and Nandi [12] documented 141 species under 100 genera, Nandi *et al*. [13] reported 76 species belonging to 28 family and Bose *et al.* [15] reported 74 species. Recently, Basu *et al*. [9] reported 52 indigenous freshwater fishes from South 24 Parganas district alone. This indicates a good health of freshwater indigenous fish co-occurring in Indian Sundarban region. Noteworthy, among documented fishes from the present investigations, maximum species have ornamental value which has been already noted by various authors [9-10]. Based on the assessment of NBFGR, among 450 small indigenous fishes in India, about 23% (104 species) are highly important as food and aquarium trade and provides local livelihood security [24].

However, over exploitation of bio resources, ever expanding population pressure, pollution etc is threatened Sundarban day by day. In addition to this, temperature variability, climate induced sea level rise and subsequent erosion coupled with frequent extreme weather events, increasing salinity level etc has a serious and emergent problem in Indian Sundarban over the past two decades [25]. Due to salinity intrusion in freshwater areas, many freshwater fish species are subjected to severe stress and threat due to their inability to cope up with such extreme conditions. These may have serious impacts on the distribution, feeding regimes, breeding periodicity of indigenous freshwater fish gene pool of Sundarban. Lethal effect of salinity on two small indigenous species, *A. Mola* and *P. ticto* from Indian Sundarban was already noted by Dubey *et al*. [26]. Invasive alien fish species has been emerging as a growing threat to biodiversity of small indigenous fishes, as some are highly carnivorous and predatory [27-28]. In this back drop, achieving sustainable utilisation of indigenous fishes, appropriate planning for conservation and management strategies are of utmost importance.

Among the indigenous fishes, many species have wider potentialities as a candidate species in freshwater aquaculture domain. These are mainly *A. mola, N. notopterus*, *C. chitala*, *O. pabo* and *Puntius* group. Murrels (*Channa* spp.) and air breathing fishes like *A. testudineus, C. batrachus* and *H. fossilis* are becoming a candidate species for aquaculture in India and also fetching high price in domestic markets. Non-air breathing cat fishes like *M. cavasius, M. vittatus, M. tengara, S. aor* etc also attracted attention for culture due to their growth

and market value [24]. Based on wild seed collection, some of the fishes are being cultured in small scale. For large scale propagation, proper seed production technology and scientific farming is needed to be popularized and diversified in Sundarban area. It is also noted that, successful artificial breeding of several species like *A. Mola, N. notopterus, C. chitala*, *O. pabo*, *M. Vittatus, M. gulio, S. sarana, C. batrachas, A. testudineus*, *N. nandus* were achieved [29-31].

Maintaining piscine diversity is important because fish species in its natural setting serves as ecological indicators. To conserve and augment the sustainability of indigenous fishes in Sundarban Biosphere Reserve, research and policy framework is essential for diversification of potential cultivable indigenous fishes. *In situ* and *ex situ* conservation practice is need to be developed in various pockets of Sundarban to protect the native fish gene pool. In addition to this, through creating freshwater aquatic sanctuaries (FAS) within the protected area, public awareness can be expanded.

CONCLUSION

It can be concluded that Indian Sundarban Biosphere Reserve sustains a unique and wealthy resources of freshwater indigenous ichthyofauna. Owing various exploitation parameters, sustainable management and artificial propagation might be a suitable process for future protection and conservation of small indigenous fishes as well as food security of local people inhabiting in Sundarban.

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