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Ram Krishna Das

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## FISH DIVERSITY AND THE CONSERVATION STATUS OF A WETLAND OF COOCH BEHAR DISTRICT, WEST BENGAL, INDIA

Ram Krishna Das

Department of Industrial Fish and Fisheries, Asutosh College, 92, Shyamaprasad Mukherjee Road, Kolkata, West Bengal 700 026, India  
ramkrishnazoology@gmail.com



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**Abstract:** A study was carried out from March 2016 to February 2017 to investigate the diversity of fishes and the conservation status of Bochamari Beel, a natural wetland of Cooch Behar District, West Bengal, India. The study revealed the occurrence of 40 species of fishes belonging to 31 genera under six orders and 15 families. Cyprinidae was the dominant family with 14 species followed by Channidae with four species, Ambassidae and Bagridae with three species each, Nandidae, Mastacembelidae, Belontiidae, Siluridae and Clariidae with two species each whereas Cobitidae, Belonidae, Gobiidae, Anabantidae, Tetraodontidae and Notopteridae were represented by a single species each. The status of species of this beel included one Endangered species, one Vulnerable species and four Near Threatened species. The maximum fish diversity was recorded in the monsoon season ( $H' = 2.876$ ) as compared with pre monsoon ( $H' = 2.124$ ) and post monsoon ( $H' = 1.735$ ). The evenness index varied from 0.640 (post monsoon) to 0.822 (monsoon), which indicates uneven distribution of fishes in this beel. Indiscriminate fishing throughout the year, along with extensive weed infestation could be responsible for depletion of fish diversity in this beel.

**Keywords:** Bochamari Beel, fish diversity, threatened fish, wetland.

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**Author Details:** Shri Ram Krishna Das is an Assistant Professor in Industrial Fish and Fisheries, Asutosh College. He obtained his master degree in Zoology (Specialization- Fish Biology) in 2005 from Visva-Bharati and qualified NET (CSIR) in Life Sciences in 2010. His interested field of research are fish diversity, taxonomy and fish toxicology.

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## INTRODUCTION

According to the Ramsar Convention, wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters (Ramsar Convention Secretariat 2013). Wetlands are classified into five categories such as (a) oxbow lake, (b) fresh water lakes, (c) fresh water ponds, (d) marshes, swamps and bogs, and (e) reservoirs (Kar et al. 2007). India has extensive flood plains in the form of oxbow lakes such as beels, jheels, mauns, and chauras especially in the states of West Bengal and adjoining places, like Assam and Bihar. Beels are shallow, nutrient rich water bodies formed due to a change in course of a river. Some of these retain connection with the main river, at least during monsoons, while others have lost it permanently. These are perennial wetlands that contain water throughout the year (Kar et al. 2007). Beels of Assam generally possess high potential for in situ fish production. A number of them also provide a collection sink for fish produced in the surrounding flooded catchments. The average yield of Assam on the basis of enquiries made in 23 beels in the state was 173kg/ha (Bhattacharjya & Sugunan 2000).

Northern Bengal comprises those districts of West Bengal that lie north of the river Ganga. The term does not denote any natural division and is purely an administrative connotation. Seven districts constitute northern Bengal. These are: Malda, South Dinajpur, North Dinajpur, Darjeeling, Jalpaiguri, Alipurduar and Cooch Behar. Faunistically, however, these areas are numerous in variety and taxonomically interesting. This may be because of the rich Himalayan foothills with the numerous streams and major rivers rushing to the plains through these districts (Jayaram & Singh 1977). A large number of wetlands in the form of beels are found in northern Bengal, especially in the district of Cooch Behar. Bochamari Beel is one of the very important natural wetlands located in the subdivision Tufanganj of the district of Cooch Behar. It is a part of Rasik Beel wetland complex (Das et al. 2013). The Rasik Beel wetland complex (RBWC) is the largest wetland complex in Cooch Behar District of West Bengal covering around 18.40km<sup>2</sup> of area of which the wetland occupies almost 1.78km<sup>2</sup> area. The Ministry of Environment, Forest & Climate Change (MoEFCC), Government of India, has identified 94 wetlands of national importance, many of which are protected areas including Rasik Beel (NWCP 2009). The vast wetland complex constitutes water

bodies of varying sizes, namely, Rasik Beel, Raichangmari Beel, Bochamari Beel, Sakobhanga Beel and Noldoba Beel. The nature of the beels is of the ox-bow lake and formed by the meandering of the Raidak, Sakobhanga and Ghoramara rivers (Roy et al. 2012). Most of the beels of the RBWC become well connected only during the monsoon months of a year. Bochamari Beel is a perennial beel which retains water throughout the year. On the basis of riverine connection, the Bochamari Beel may be termed as a closed beel as it is completely cut-off from the nearest rivers and receives water mostly from their catchment areas following the monsoon rains. Bochamari Beel has remained as a major resource for capture fisheries and serves as a means of livelihood for about five hundred fishermen families. The fishing activities are totally prohibited in the remaining beels of the Rasik Beel wetland complex.

Fish constitutes almost half of the total number of vertebrates in the world. Indian freshwater fish diversity is very rich with as many as 1,027 species, comprising primary, secondary and alien freshwater fishes. Among them primary freshwater fishes include 858 species belonging to 167 genera under 40 families and 12 orders. Further, 137 species of secondary freshwater fishes that frequently enter and thrive in freshwater reaches of rivers are also known from India. Thirty-two species of alien fishes belonging to 21 genera of nine families and seven orders are found in the fresh water systems of India. Out of this, 16 species are well known, potential invasive alien fishes in India (Gopi et al. 2017). On the other hand West Bengal contains about 207 freshwater fishes (Sanyal et al. 2012). The most comprehensive account of the fish fauna of northern Bengal was published by Shaw & Shebbeare (1938). They listed about 131 species in their treatise whereas, Jayaram & Singh (1977) recorded about 96 species of fishes in northern Bengal. Due to the presence of a number of threatened, endemic and unique/interesting species in northern Bengal, this region might be considered as a "Hot Spot" of fish resources of West Bengal (Barman 2007).

Das et al. (2013) studied the faunal diversity of RBWC, Cooch Behar. They reported the occurrence of 53 species of fishes belonging to nine orders, 22 families and 11 sub families in different beels of Rasik Beel wetland complex. They also reported the occurrence of 173 species of birds, four annelids, 49 arthropods, six molluscans, five amphibians, six reptilian and nine mammalian species. A detailed study of fish diversity and the conservation status in Bochamari Beel, however, is lacking. Therefore, the present investigation was carried out to document

the fish diversity and conservation status of Bochamari Beel of Cooch Behar District.

## MATERIALS AND METHODS

The study was carried out in Bochamari Beel (26.25°N & 89.44°E, 38m elevation), a natural wetland of Cooch Behar District, West Bengal, India from March 2016 to February 2017 (Fig. 1). The shortest distance from Cooch Behar Town to the Bochamari Beel is about 55–58 km whereas it is about 25–30 km from Alipurduar Town. Fish were harvested every fortnight from the beel using gill nets (mesh size 0.6–7.0 cm), cast nets (mesh size 0.6–6.0 cm), drag nets (mesh size 0.10–0.15 cm), push nets (mesh size 0.10–0.15 cm), box traps, 'Koncha' (spear fishing) or 'Teta', 'Barsha' (hook and line), and hook and line (Images 1 & 2). To investigate the seasonal variation of fish communities, this study period was categorized into three phases, viz., pre-monsoon (Feb–May) with little or no rainfall but with very high temperature, the monsoon (June–September) with heavy rainfall and relatively lower temperature, and post-monsoon (October–January) season with a drastic reduction of temperature and occasional rainfall. To find out the seasonal diversity index and evenness index, pooled data of these months together were taken. Colour, colour patterns, spots/blotches, stripes and

other characters of the fishes were noted immediately after harvesting and photographs were taken by a digital camera (Images 3–37). Harvested fishes were then killed and preserved in 10% formalin solution for further study. All the specimens are deposited in the aquatic animal biodiversity museum of the department of Industrial Fish and Fisheries, Asutosh College, Kolkata, West Bengal, India (Registration number: AC-IFF/AABM/Pisces/ specimen no. B/1–40). The fishes were identified in the laboratory using the taxonomic keys of Jayaram (2009, 2010) and Shaw & Shebbeare (1938). The diversity and evenness indices were calculated according to Shannon (1948) and Pielou (1966).

1. Shannon index of general diversity (Shannon 1948):  $H' = -\sum P_i \ln P_i$  where,  $P_i$  is the importance probability for each species =  $n_i/N$ ,  $n_i$  is the importance value for each species (number of individual, biomass, production and so forth),  $N$  is the total of importance values. In this study,  $n_i$  is the total number of individuals of each species and the  $N$  is the total number of individuals. This number of individuals from total catch using all the catching methods for a given sampling event.

2. Evenness index (Pielou 1966):  $e = H'/\ln S$  where,  $H'$  is the Shannon index of general diversity and  $S$  is the number of species.

The threat status of fishes were determined by following IUCN Red List of Threatened Species categories and criteria (2017). The frequency of occurrence of each

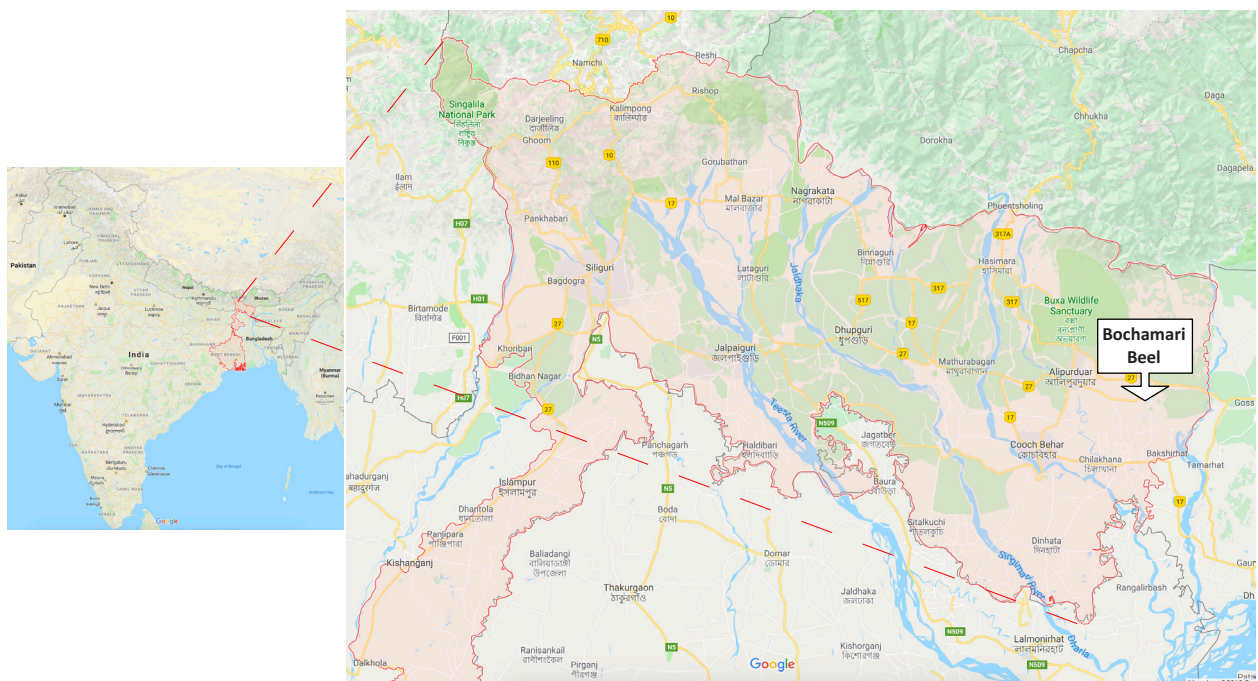


Figure 1. Location of Bochamari Beel (Courtesy: Google maps)



Image 1. Juvenile fishes harvested

species was calculated based on the number of occasions the species was collected during the samplings. The status was determined with the help of a standard catch frequency chart presented by Tamang et al. (2007; Catch frequency: 91–100 % = Common, 81–90 % = Abundant, 61–80 % = Frequent, 31–59 % = Occasional, 15–30 % = Sporadic, 05–14 % = Rare, Less than 5% = extremely rare).

## RESULTS AND DISCUSSION

Details of fishes of Bochamari Beel are presented in Table 1 and in Images 3–37. A total of 40 species of fishes belonging to 31 genera under six orders and 15 families were identified from Bochamari Beel. Cyprinidae was the dominant family with 14 species followed by Channidae with four species, Ambassidae and Bagridae with three species each, Nandidae, Mastacembelidae, Belontiidae, Siluridae and Clariidae with two species each whereas Cobitidae, Belonidae, Gobiidae, Anabantidae, Tetraodontidae and Notopteridae were each represented by a single species. Previous study of this beel reported the occurrence of 44 species of fish (Das et al. 2013). Fifteen species of fishes were documented for the first time from this beel in comparison with the previous work. They are *Cirrhinus mrigala*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Puntius sophore*, *Barbonymus gonionotus*, *Badis badis*, *Parambassis lala*, *Trichogaster lalius*, *Mystus bleekeri*, *Mystus tengara*, *Wallago attu*, *Macragnathus aral*, *Xenentodon cancila* and *Notopterus notopterus*. Some of the species like *Cirrhinus cirrhosus*, *Rama chandramara*, *Labeo calbasu*, *Osteobrama cotio cotio*,



Image 2. Harvesting of fish with gill nets in Bochamari Beel

*Laubuca laubuca*, *Pethia gelius*, *Puntius terio*, *Ompok pabo*, *Paracanthocobitis botia*, *Botia dario*, *Aplocheilus panchax*, *Monopterusuchia*, *Macragnathus aculeatus*, *Macragnathus punctatus*, *Colisa labiosus*, *Colisa sota*, *Ctenoptis nobilis*, *Rasbora rasboa* and *Rasbora daniconius* were not documented in the present study, although they were recorded by Das et al. (2013).

In the present study about six threatened species including one Endangered, one Vulnerable and four Near Threatened were found. *Clarias magur* of the family Clariidae was identified as the endangered species. The vulnerable species of the beel was *Cyprinus carpio* of the family Cyprinidae. The Near Threatened species of the beel were *Hypophthalmichthys molitrix*, *Ompok pabda*, *Wallago attu* and *Parambassis lala*. On the basis of catch frequency, 16 species (39.02%) were found to be rare/extremely rare. The abundant species of fishes in the beel were *Puntius sophore* and *Esomus danrica* of the family Cyprinidae and *Mystus vittatus* and *Mystus tengara* of the family of Bagridae.

The species diversity index of different seasons ranged from 1.735 to 2.876. In this study a maximum fish diversity was recorded during the monsoon season ( $H' = 2.876$ ) as compared to the pre monsoon ( $H' = 2.124$ ) and post monsoon ( $H' = 1.735$ ) as this beel remained well connected to the other beels of the wetland complex during the monsoon months but well separated from each other during the rest of the season. Variety of different fishes enters into the Bochamari Beel from other beels during monsoon, which has resulted in a higher value of fish diversity index. The same result was also reported by Kar et al. (2006) in Sone beel of Assam, India. The evenness index at three seasons (monsoon = 0.822, post monsoon = 0.640, pre monsoon = 0.668) indicates uneven abundances of different fishes in this beel. The details about the number of species, number of individuals, Shannon index and Evenness index are presented in Table 2.

Table 1. Checklist of fishes of Bochamari Beel, Cooch Behar, West Bengal, India

Order	Family	Scientific name	Common / local name	Status (as per catch frequency)	Threat status (as per IUCN 2017)	
Cyriniformes	Cyprinidae	1. <i>Amblypharyngodon mola</i> (Hamilton, 1822)	Mola	Frequent	LC	
		2. <i>Gibelion catla</i> (Hamilton, 1822)	Catla	Rare	LC	
		3. <i>Cirrhinus mrigala</i> (Hamilton, 1822)	Mrigal	Rare	LC	
		4. <i>Esomus danrica</i> (Hamilton, 1822)	Darikina	Abundant	LC	
		5. <i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	Grass carp	Rare	NE	
		6. <i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	Silver carp	Rare	NT	
		7. <i>Cyprinus carpio</i> Linnaeus, 1758	Common carp	Rare	VU	
		8. <i>Labeo rohita</i> (Hamilton, 1822)	Rohu/rui	Sporadic	LC	
		9. <i>Labeo bata</i> (Hamilton, 1822)	Bata	Sporadic	LC	
		10. <i>Puntius sophore</i> (Hamilton, 1822)	Desi Punti	Abundant	LC	
		11. <i>Pethia ticto</i> (Hamilton, 1822)	Titla Punti	Frequent	LC	
		12. <i>Pethia conchonius</i> (Hamilton, 1822)	Lal Punti	Frequent	LC	
		13. <i>Barbonymus gonionotus</i> (Bleeker, 1849)	Java punti	Occasional	LC	
		14. <i>Systomus sarana</i> (Hamilton, 1822)	Sar Punti	Sporadic	LC	
	Cobitidae	15. <i>Lepidocephalichthys guntea</i> (Hamilton, 1822)	Gutum	Frequent	LC	
Perciformes	Channidae	16. <i>Channa gachua</i> (Hamilton, 1822)	Cheng	Occasional	LC	
		17. <i>Channa punctata</i> (Bloch, 1793)	Sati	Abundant	LC	
		18. <i>Channa striata</i> (Bloch, 1793)	Shol	Occasional	LC	
		19. <i>Channa marulius</i> (Hamilton, 1822)	Shal	Extremely Rare	LC	
		Nandidae	20. <i>Badis badis</i> (Hamilton, 1822)	Khorikata	Extremely Rare	LC
			21. <i>Nandus nandus</i> (Hamilton, 1822)	Veda	Occasional	LC
		Gobiidae	22. <i>Glossogobius giuris</i> (Hamilton, 1822)	Bele	Sporadic	LC
		Ambassidae	23. <i>Parambassis lala</i> (Hamilton, 1822)	Lal Chanda	Rare	NT
			24. <i>Parambassis ranga</i> (Hamilton, 1822)	Chanda	Rare	LC
	25. <i>Chanda nama</i> Hamilton, 1822		Chanda	Sporadic	LC	
	Belontiidae	26. <i>Trichogaster fasciata</i> Bloch & Schneider, 1801	Kholisa	Rare	LC	
		27. <i>Trichogaster lalius</i> (Hamilton, 1822)	Kholisa	Rare	LC	
	Mastacembelidae	28. <i>Mastacembelus armatus</i> (Lacepede, 1800)	Bam	Sporadic	LC	
		29. <i>Macrogonathus aral</i> (Bloch & Schneider, 1801)	Gochi	Sporadic	LC	
Anabantidae	30. <i>Anabas testudineus</i> (Bloch, 1792)	Koi	Sporadic	DD		
Beloniformes	Belonidae	31. <i>Xenentodon cancila</i> (Hamilton, 1822)	Bok machh	Sporadic	LC	
Siluriformes	Siluridae	32. <i>Wallago attu</i> (Bloch & Schneider, 1801)	Boyal	Rare	NT	
		33. <i>Ompok pabda</i> (Hamilton, 1822)	Pabda	Rare	NT	
	Clariidae	34. <i>Clarias magur</i> (Linnaeus, 1758)	Magur	Sporadic	EN	
		35. <i>Heteropneustes fossilis</i> (Bloch 1794)	Singi	Frequent	LC	
	Bagridae	36. <i>Mystus vittatus</i> (Bloch, 1794)	Tengra	Abundant	LC	
		37. <i>Mystus bleekeri</i> (Day, 1877)	Tengra	Rare	LC	
		38. <i>Mystus tengara</i> (Hamilton, 1822)	Tengra	Abundant	LC	
	Osteoglossiformes	Notopteridae	39. <i>Notopterus notopterus</i> (Pallas, 1769)	Pholui	Sporadic	LC
Tetraodontiformes	Tetraodontidae	40. <i>Leiodon cutcutia</i> (Hamilton, 1822)	Tapa	Rare	NE	

IUCN Categories: LC - Least Concern, NT - Near Threatened, VU - Vulnerable, EN - Endangered, DD - Data Deficient, NE - Not Evaluated.

**Table 2. Details of fish diversity index and evenness index in three seasons.**

Seasons	Total number of species	Total number of individuals	Shannon index of general diversity	Evenness index
Pre-Monsoon	24	1045	2.124	0.668
Monsoon	33	1700	2.876	0.822
Post-Monsoon	15	518	1.735	0.640

**Table 3. List of fishing gear operated in the beel**

	Name	Local name	Shape	Type	Mesh Size (cm)	Length (M)	Height (M)	No. of Fishermen required	Fishing period
1	Gill net	Phansi jal	Rectangular	Net fishing gear	0.6–7.5	20–60	0.65–3.5	1–2	Throughout the year
2	Cast net	Chhabi jal	Bell shaped	Net fishing gear	0.6–6	-	4.30–5.20	1	Throughout the year
3	Drag net	Masari jal	Rectangular	Net fishing gear	0.10–0.15	50	6	3–4	Throughout the year except monsoon
4	Push net	Thela jal	Triangular	Net fishing gear	0.10–0.15	-	-	1	Throughout the year
5	Hook and line	Barshi	Rod shaped	Tackle	-	2-3	-	1	Throughout the year
6	Barsha	Barsha	-	Tackle	-	-	-	1	Monsoon
7	Koncha/Teta	Koncha/Teta	Rod shaped	Miscellaneous	-	2-3	-	1	Throughout the year
8	Box trap	Tapai	Rectangular	Miscellaneous	-	0.5–1.5	0.1–0.2	1	Monsoon

The fishing gears used in this beel were fishing net (gill net, drag net, push net, cast net), tackle (hook and line, 'Barsha') and miscellaneous gears ('Koncha' or 'Teta', box trap) as also reported in the lentic and lotic water bodies of Cooch Behar District (Das & Barat 2014). The details about the fishing gears operated in this beel are presented in Table 3. Most of the fishing nets have a very small mesh size (1cm and below), as a result a large number of juvenile fishes are being captured. It was also observed that a significant number of brood fishes were invariably killed in this beel during the monsoon month. Moreover, indiscriminate fishing throughout the year is likely to result in the depletion of fish diversity.

The Bochamari Beel is extensively infested by a number of aquatic weeds such as *Eichornia* sp., *Eutricularis* sp., *Trapa* sp., *Erienthus* sp. and *Phragmites* sp. (Das et al. 2013). These species have high growth rate and clog waterways, making fishing, boating, and almost all other water related activities impossible. The mats of these plants block the penetration of sunlight. It was also revealed that the beel has been affected by the siltation, water pollution due to leakage of pesticide used in nearby agricultural lands and over flooding during heavy rainfall in monsoon months.

## CONCLUSION

The present investigation reveals that the Bochamari Beel exhibits a rich fish diversity. To conserve the fish diversity in Bochamari Beel the following recommendations are suggested to be implemented immediately.

1. Prevention of indiscriminate fishing: Overexploitation is tremendously detrimental to the overall fish diversity of the Bochamari Beel. Indiscriminate fishing should be prevented at any cost to save the fish diversity in the beel. Strict measures should be taken for those who will catch juvenile fishes.

2. Mesh size restriction: To maintain a sustainable stock, the fishing net with lower mesh size should be prevented. Fishing net with mesh size of more than one centimeter may be used. Regular inspection by the authorities of fisheries department should be undertaken to prevent such malpractices. In this respect, net makers should also be given the proper instructions.

3. Declaration of closed season: To carryout undisturbed spawning, closed season should be implemented during the monsoon months (June to August) to maintain the optimum fish stock. All types of fishing activities should strictly be prohibited at that



time.

4. Control of aquatic weeds: As the beel is thickly infested by a number of aquatic weeds, the eradication of these aquatic weeds should be undertaken at regular intervals. To eradicate these aquatic weeds, different weed eating fishes might be introduced in addition to mechanical methods.

5. Culture and capture fisheries: Simultaneous operation of both culture and capture fisheries are beneficial for common fishermen. In this regard some areas of the beel mostly on the periphery may be converted for culture fisheries, for a period of five months from January to May of every year. The central part of the beel, which contains water throughout the year, may be utilized for capture fisheries.

6. Development of existing Fishermen cooperative societies: The development of infrastructure of existing fishermen co-operative society is strongly felt for the betterment of the socio-economic status of poor fishermen families.

7. Awareness programme: Awareness programme regarding the conservation of threatened and endemic fishes should be undertaken. In this aspect, the state and district fisheries department, educational institutions, other government and non government organizations can play a vital role.

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Image 3. *Channa gachua*



Image 4. *Channa punctata*



Image 5. *Mystus vittatus*



Image 6. *Mystus tengara*

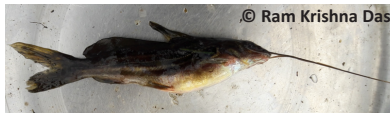


Image 7. *Mystus bleekeri*



Image 8. *Wallago attu*



Image 9. *Clarias magur*



Image 10. *Ompok pabda*



Image 11. *Heteropneustes fossilis*



Image 12. *Parambassis lala*



Image 13. *Parambassis ranga*



Image 14. *Chanda nama*



Image 15. *Trichogaster lalius*



Image 16. *Trichogaster fasciata*



Image 18. *Nandus nandus*



Image 17. *Anabas testudineus*



Image 19. *Badis badis*



Image 20. *Glossogobius giuris*

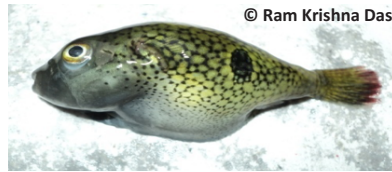


Image 21. *Leiodon cutcutia*



Image 22. *Pethia ticto*



Image 23. *Puntius sophore*



Image 24. *Pethia conchonius*



Image 25. *Barbonyms gonionotus*



Image 26. *Systemus sarana*



Image 27. *Amblypharyngodon mola*



Image 28. *Labeo rohita*



Image 29. *Ctenopharyngodon idella*



Image 30. *Cirrhinus mrigala*



Image 31. *Esomus danrica*



Image 32. *Lepidocephalichthys guntea*



Image 33. *Macrognathus aral*



Image 34. *Xenentodon cancila*



Image 35. *Notopterus notopterus*



Image 36. *Channa striata*



Image 37. *Channa marulius*





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##### National Biodiversity Authority

