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Ichthyofaunal resource of Chandubi wetland, Assam, India: Threats and Conservation

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ABSTRACT
The present investigation has been intended to study the fish diversity in Chandubi wetland while bringing out the threats and their possible conservation measures. The study reveals the occurrence of 73fish species which belong to47 genera under 21 families and 9 orders. The order Cypriniformes, which is found to be the most dominant order, comprises 28 species sharing 38.89% of the total fish population of the wetland. The study reveals that the fish species are of three sized cateogories, namely, the Major Group,the Intermediate Group and the Minor Group. The Paper deals with the Live Fish Group independently irrespective of the sizes with special concern. The abundance of the population indicates that the Major Group species occupy 22%, Intermediate Group 18% and Minor Group52% while the Live Fish Group holds 8.0% of the total population. Diversity indices are evaluatedfor different species under different families and the highest diversity is recorded in the family Cyprinidae (Shannon_H= 2.746) while the lowest (Shannon_H = 0) is found in those families which include solitary species viz. Clupeidae, Clariidae, Heteropneustidae, Chacidae, Belonidae, Synbranchidae, Gobiidae, Anabantidae, Aplocheilidae and Tetraodontidae. The IUCN conservation status of fish species in the wetland has been worked out as 1% endangered (En), 3 % Vulnerable (Vu), 10% Near threatened (NT), 82% Least concern (LC), 3% Data deficient (DD), and 1 % Not evaluated (NE).The paper has also identified and highlighted various threats confronted by the wetland and its ichthyo- denizens over years more than a century, and also its future conservation strategies.
Key words: *Chandubi wetland, ichthyofauna, threats, conservation measures*

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INTRODUCTION

Chandubi, a tectonic wetland (locally known as Chandubi *beel*) is located in the Assam - Meghalaya border of the southern Brahmaputra valley in Kamrup district of Assam, in an aerial distance of about 70 kms southwest of Guwahati city. It falls under Rajapara beat office of Assam Forest Department (Western Division - Loharghat Range). This dendritic wetland is of tectonic origin [1] and was remarkably formed during the great earthquake of June 12, 1897. The present basin area of the wetland estimated about 271 ha after the shrinkage from 712 ha from its origin [2]. It embraces a stretch of about 56 sq. km. catchment area and watersheds having rough hilly terrain, evergreen deciduous plants and silted shallow plains. The wetland in its western part is connected by a 2.5 km long inlet/outlet channel (named *Lokeyajan)* with the river Kulsi, a tributary of the River Brahmaputra. This channel acts as a passage of water from the wetland to the Kulsi tributary and vice-versa. The autostocking character of the wetland is maintained through this channel since a large number of fish species do migrate from Kulsi river to the wetland for feeding and breeding during the onset of flood. By itself the wetland had been conserving a wide range of aquatic biodiversity since inception including the ichthyofaunal resources by providing integrity of habitat suitability for feeding, breeding and spawning to a lot many fish species.

From fisheries standpoint, fishes not only play a significant role as members of different trophic levels in an aquatic ecosystem but also, they are considered an important economic, aesthetic and ecological resources [3]. Besides, fish is considered as biodiversity and ecological quality indicators in formulating environmental policies [4]. So, study of ichthyofauna diversity and the threats and probable conservation measures are important field of research in a wetland.

The lacustrine environment of Chandubi wetland attracts many researchers and their works have been documented either as Ph D. thesis[2] or research articles in scientific journals[5-7]. Indeed, a comprehensive and trustworthy study of the ichthyofaunal diversity of the wetland has been overlooked

for reporting its ichthyo-species in the light of emerging threats to its population and to suggest future conservation measures for proper management of the fish stock. The present status of the fish population in Chandubi, its threat and conservation measures as embodied in the present treatise is an outcome of a projectgranted by Assam Science Technology and Environment Council (ASTEC), Government of Assam during 2014-16.

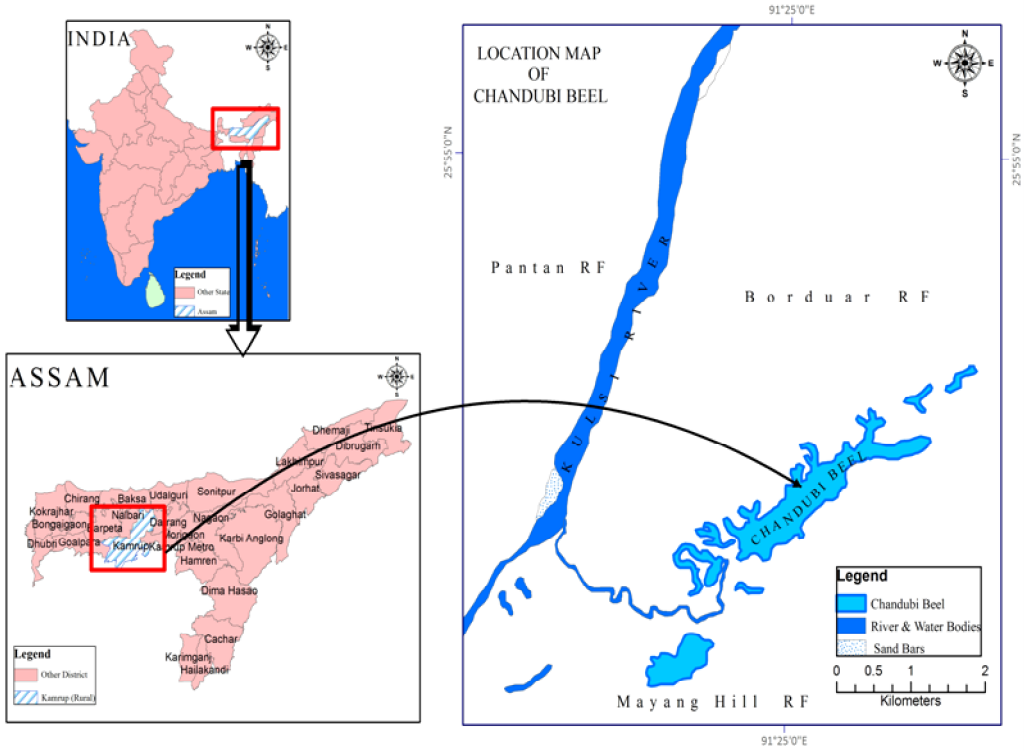

Figure-1: Location map of Chandubi wetland

Materials and Methods

The map of the study site is prepared from satellite imagery procured from IRS, Bengaluru in 2014 and is shown in the Figure-1.

Fish samples were collected from the Chandubi wetland in different seasons from January 2014 to December 2016 with the assistance of local fisherman by using cast net, dip net and gill net in the open water area while drag net and some indigenous fishing gears made of bamboo were used to collect fish from shallow pools and vegetation infested swamp area.The collected fish specimens were photographed and preserved in v/v 10% aqueous Formaldehyde solution.The fish species were identified after following the standard taxonomic keys available in the literatures [8-10]. The relative abundance in terms of percentage of catch of individual fish species was determined following [11].

Statistical analysis has been done by using PAST software and MS excel. The IUCN conservation status of the fishes was followed from the Fishbase website (www.Fishbase.in).The fish species were categorized according to their size ranges into three groups– Major Group, Intermediate Group, Minor Group while the Live Fish Group (irrespective of size ranges) was dealt with special concern. The Major Group comprises large growing big sized species (including their fingerlings and juveniles) above the size of juveniles of the Indian Major Carp (IMC) , the Intermediate Group includes the species having the sizes of post fingerling up to the size of juvenile stages of large growing IMC species and theMinor Group is composed of the fish species having the size up to the size of fingerlings of IMC species [12].

The study related to the threat parameters like reduction of open water area, dejection of autostocking capacity, shrinkage of fish breeding areas due to rapid siltation (both autochthonous and allochthonous), regulation and sustenance of inflowing water from river and the streamlets and outflowing from the wetlandwere based on the physical observations during 2014-2016, surface mapping, comparison of morphometry with earlier study [2] while the relative abundance and depletion of fish density were observed based on the catch trend. All other parameters including the anthropogenic stress were determined by the general observations during the field studies in 2014-2016.

The proposed conservation measures against the impact of the threat on the fish population of the wetland were formulated based on the general observations and practical understanding of the present situation.

RESULTS

In the present investigation 73 species of fishes are identified which belong to 46 genera under 21 families and 9 orders. The fish inventory of Chandubi wetland along with status of occurrence, economic importance and IUCN conservation status of the fish is shown in the Table-1. The species composition of different orders in terms of percentage is depicted in the Figure-2. The order Cypriniformes is having the highest species composition with 28 species (38.89%),out of which 26 species belong to the family Cyprinidae and 2 species belong to the family Cobitidae. Next to Cypriniformes is the order Perciformes, which is comprised of 19 species (26.03%) of 9 genera under 6 families. Most of the fishes of this order are having high ornamental values. The order Siluriformes is comprised of 16 species (21.92%) belongs to 13 genera under 6 families while the order Mastacembelliformes includes 3 species (4.11%) belong to 2 genera under the family Mastacembellidae. The order Osteoglossiformes comprises 2 species (2.74%) under the family Notopteridae. On the other hand,orders -Beloniformes, Synbranchiformes, Cyprinodontiformes and Tetraodontiformes are having single species each.

The diversity indices determined on account of the fishes are found to be -- Dominance_D = 0.03404, Shannon_H = 3.703, Simpson_1-D=0.966. Besides, the evenness of population of different fish species is calculated as Evenness_e^H/S = 0.5715, while, the values of Menhinick and Margalef indices are 0.5986 and 7.329 respectively (Table-3).

According to the size ranges and economic importance, the fish community of the wetland comprises 16 species of Major group, 13 species from the Intermediate group and 6 Live fish species while highest number of species (38 numbers) belongs to the Minor group (Table 1). Percentage composition of species in different groups results- Major group - 22%, Intermediate group - 18%, Minor group – 52% and Live fish - 8% (Figure-3).Concomitantly, the highest relative abundance is seen in Minor group (58%) followed by Intermediate group (23%) and Live fish group (13%) while that of the Major group is least (5%) (Figure-4).

IUCN conservation status of the fish species of Chandubi wetland in different categories can be represented as – 1% endangered, 3% Vulnerable (Vu), 10% belong to Near threatened (NT), 82% under Least concern (LC) category, 3% Data deficient (DD), and 1% Not evaluated (NE) (Figure-5).

The ichthyofaunal resource of Chandubi has been facing significant threat due to the changing situation in the progression of time, which may be drawn as follows-

1. **Reduction of open water area**

In the present investigation the open water area of the wetland is estimated to be 147 ha which reveals a decrease of 137.48 ha (49.36%) from its previous record of 278.48 ha in 1985. On the other hand, dead area of the wetland increases from 298.41 ha to 310.87 ha, and eutrofied area choked with vegetation expands from 38.85 ha to 169.87 ha.

2. Dejection of autostocking capacity

The autostocking character of the wetland which takes place at the confluence of Kulsi river and lokeyajan channel has been altered due to natural allochthonous siltation in the mouth of the wetland and change of Kulsi river course. Due to poor and unattended condition of the inlet channels (Lokeyajan and other stremlets), the autostocking capacity of the wetland has been significantly reduced.

3.Shrinkage of fish breeding areas

Due to huge succession of reed swamp covering an area of169.78 ha and alteration of water regime to terrestrial meadows at least 60-70 % of the breeding habitat of the IMC species has been lost.

4. Increased local demand of fish vis-à-vis down trodden economy of the surrounding tribal population

The user population of the wetland is estimated to be about 50 % of 550 families (average 1250 population), who depend their livelihood on poaching despite all strict provision by the Forest department, Govt of Assam. Traditionally the fishes of Chandubi have special demand in the market. The poor economy of the user population against high demand of the fish in the region provokes them to go for unabated catching by flouting fishing restriction. This results in the killing of the coveted Major group species at any stage (including gravid state). Even poisoning is also reported from time to time. This condition is accelerated due to down trodden economy of the poor tribal population that surrounds the wetland as a whole.

Table 1: Fish species of Chandubi wetland with their economic importance, IUCN status and status of occurrence.

ORDER	FAMILY	SPECIES	Economic Importance	IUCN status	Fish group	Status of occurrence
Osteoglossiformes	Notopteridae	*Notopterusnotopterus*(Pallas 1769)	FF	LC	Int	++
		Chitalachitala(Hamilton, 1822)	FF	NT	M	_
Clupiformes	Clupeidae	*Gudusiachapra*(Hamilton 1822)	FF	LC	Mi	+
Cypriniformes	Cyprinidae	*Amblypharingodonmola*(Hamilton 1822)	FF	LC	Mi	+++
		Cabdiomorar(Hamilton 1822)	FF	LC	Mi	+
		Danio rerio (Hamilton 1822)	OF	LC	Mi	+++
		Esomusdanricus(Hamilton 1822)	OF	LC	Mi	+++
		Rasbora rasbora(Hamilton 1822)	OF	LC	Mi	+
		Rasbora deniconius(Hamilton 1822)	OF	LC	Mi	+++
		Gibelioncatla(Hamilton 1822)	FF	LC	M	+
		Cirrhinusmrigala(Hamilton 1822)	FF	LC	M	+
		Cirrhinusreba(Hamilton 1822)	FF	LC	Int	+
		Ctenopharyngodonidella(Valenciennes 1844)	FF	LC	M	++
		*Cyprinus carpio*Linnaeus 1758	FF	NE	M	+
		Labeobata(Hamilton 1822)	FF	Vu	Int	++
		Labeocalbasu(Hamilton 1822)	FF	LC	M	+
		Labeogonius(Hamilton 1822)	FF	LC	M	+
		Labeorohita(Hamilton 1822)	FF	LC	M	+
		Osteobramacotio(Hamilton 1822)	OF	LC	Mi	++
		Puntius chola (Hamilton 1822)	OF	LC	Mi	++
		P. sophor(Hamilton 1822)	OF	LC	Mi	+++
		P. terio(Hamilton 1822)	OF	LC	Mi	+
		Pethiaconchonius(Hamilton 1822)	OF	LC	Mi	+
		Pethiagelius(Hamilton 1822)	OF	LC	Mi	++
		Pethiaphutonio(Hamilton 1822)	OF	LC	Mi	+
		Pethiaticto(Hamilton, 1822)	OF	LC	Mi	+++
		Laubukalaubuca(Hamilton 1822)	OF	LC	Mi	++
		Hypophthalmichthys molitrix (Valenciennes 1844)	FF	NT	M	+
		Hypophthalmichthysnobilis(Richardson 1845)	FF	DD	M	_
	Cobitidae	*Lepidocephalichthysguntea* (Hamilton 1822)	OF	LC	Mi	++
		Botiadario (Hamilton,1822)	OF	LC	Mi	+
Siluriformes	Bagriidae	*Speretaseenghala*(Hamilton1822)	FF	LC	M	_
		Batasiobatasio(Hamilton1822)	OF	LC	Mi	+
		Mystusbleekeri(Day 1877)	FF	LC	Mi	+
		M. cavasius(Hamilton1822)	FF	LC	Int	+
		Hemibagrusmenoda(Hamilton1822)	FF	LC	M	_
		M. tengra(Hamilton1822)	FF	LC	Mi	+
		M. vittatus(Bloch 1794*)*	OF	LC	Mi	++
	Siluridae	*Ompokbimaculatus*(Bloch 1794)	FF	NT	Int	_
		O. pabo(Hamilton 1822)	FF	NT	Int	_
		*Wallago attu(*Bloch & Schneider 1801)	FF	NT	M	+
	Schilbeidae	*Clupisomagarua*(Hamilton 1822)	FF	LC	Int	_
		Eutropichthysvacha(Hamilton 1822)	FF	LC	Int	_
		Neotropiusatherinoides (Bloch 1794)	OF	LC	Mi	++
	Claridae	*Clariasmagur(Hamilton 1822)*	FF	En	L	+
	Heteropneusti	*Heteropneustisfossilis*(Bloch	FF	LC	L	++

	dae	1794)				
	Chacidae	*Chacachaca*(Hamilton 1822).	OF	LC	Int	_
Beloniformes	Belonidae	*Xenontodoncancila*(Hamilton 1822).	FF	LC	Int	++
Synbranchiformes	Synbranchidae	*Monopteruscuchia*(Hamilton 1822).	FF	LC	L	+
Perciformes	Ambassidae	*Chanda nama*(Hamilton 1822).	OF	LC	Mi	+++
		Parambasisbaculis(Hamilton 1822).	OF	LC	Mi	++
		P. lala(Hamilton 1822)	OF	NT	Mi	+++
		P. ranga(Hamilton 1822)	OF	LC	Mi	+++
	Nandidae	*Nandus nandus*(Hamilton 1822)	OF	LC	Mi	++
		Badisbadis(Hamilton 1822)	OF	LC	Mi	++
		Badisassamensis, Ahl,1937	OF	DD	Mi	++
	Gobiidae	*Glossogobiusgiuris*(Hamilton 1822).	FF	LC		++
	Anabantidae	*Anabustestudinius* Bloch 1792	FF	DD	L	++
	Belontidae	*Ctenopsnobilis* McClelland 1845	OF	NT	Mi	+
		*Trichogasterfaciatus*Bloch &Schneider 1801	OF	LC	Mi	+++
		T. lalius(Hamilton 1822)	OF	LC	Mi	+
		T. chuna(Hamilton 1822)	OF	LC	Mi	+
		T. labiosa(Day, 1877)	OF	LC	Mi	++
	Channidae	*Channamarulius*(Hamilton 1822)	FF	LC	M	+
		C. punctatus (Bloch 1793)	FF	LC	L	+++
		C. striatus(Bloch 1793)	FF	LC	M	++
		C. gachua(Hamilton 1822)	LF	LC	L	++
		C. stewartii (Playfair, 1867)	FF	LC	Int	_
Mastacembelliformes	Mastacembelidae	*Macrognathusaral*(Bloch & Schneider 1801)	FF	LC	Int	+
		M. puncalus (Hamilton 1822).	FF	LC	Int	+
		Mastachembelusarmatus(Lacepède 1800)	FF	LC	M	_
Cyprinodontiformes	Aplocheilidae	*Aplocheilus panchax* (Hamilton, 1822)	OF	LC	Mi	+
Tetraodontiformes	Tetraodontidae	*Leiodoncutcutia* (Hamilton, 1822)	OF	LC	Mi	+

+++: Most abundant and frequently occurring,++: Abundant and frequently occurring; +: Less abundant and occurring sparingly,-: Least abundant and rarely occurring.

Abbreviations: FF-Food fish, OF- Ornamental fish, LF- Larvivorous fish, LC- Least concerned, NT- Near threatened, DD- Data deficient, Vu- Vulnerable, En- Endangered, NE- Not evaluated, M- Major Group, Int - Intermediate Group, Mi- Minor Group, L- Live fish Group

Table 2: Number and percent composition of families, genera and species of fishes under various orders

Orders	No. of Families	Percentage (%)	No. of Genus	Percentage (%)	No. of Species	Percentage (%)
Osteoglossiformes	1	4.76	2	4.35	2	2.74
Clupiformese	1	4.76	1	2.17	1	1.37
Cypriniformes	2	9.52	17	36.96	28	38.36
Siluriformes	6	28.57	11	23.91	16	21.92
Beloniformes	1	4.76	1	2.17	1	1.37
Synbranchiformes	1	4.76	1	2.17	1	1.37
Perciformes	6	28.57	9	19.57	19	26.03
Mastacembelliformes	1	4.76	2	4.35	3	4.11
Cyprinodontiformes	1	4.76	1	2.17	1	1.37
Tetraodontiformes	1	4.76	1	2.17	1	1.37

Table 3: Diversity indices of Fish in Chandubi wetland

Diversity indices	Value
Dominance_D	0.0340
Shannon_H	3.703
Simpson_1-D	0.966
Evenness_e^H/S	0.571
Menhinick	0.598
Margalef	7.329

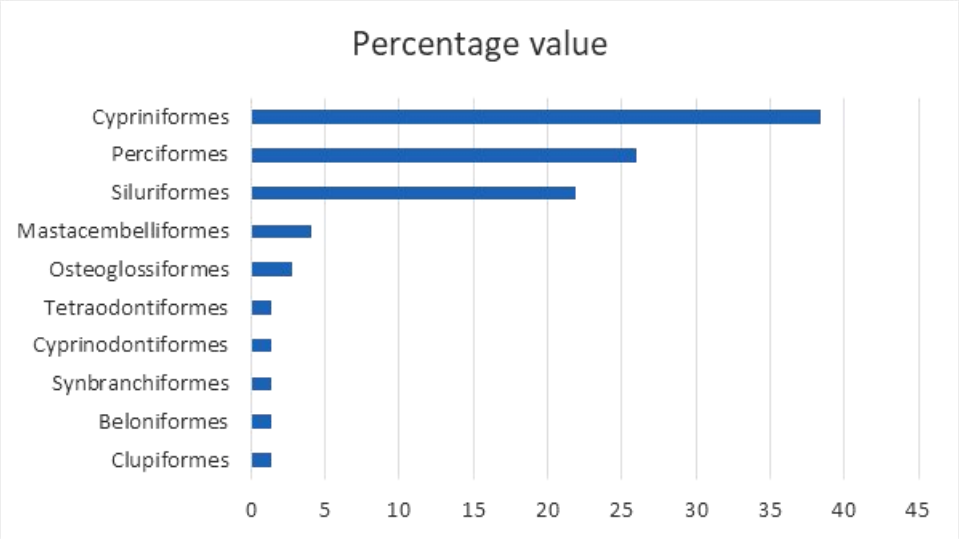

Figure 2: Species composition of fish orders in percentage

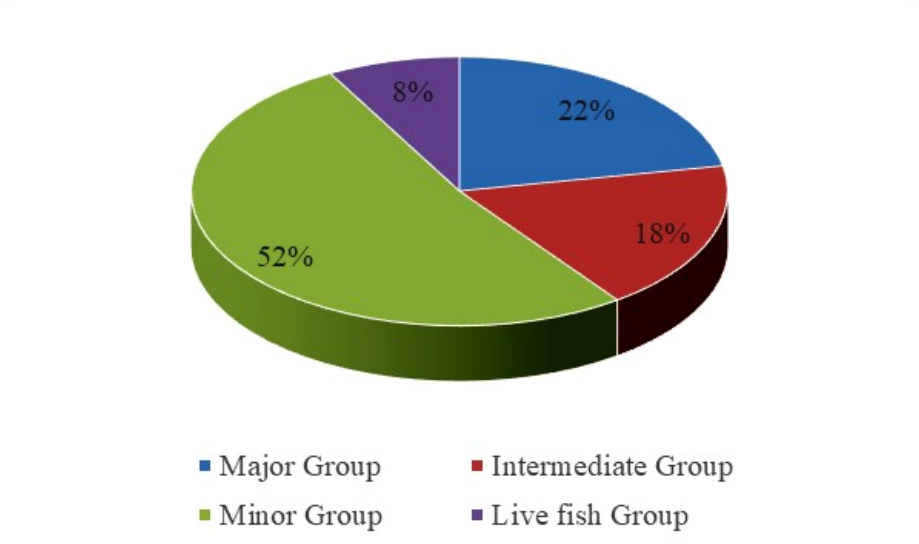

Figure 3: Species composition of fish groups

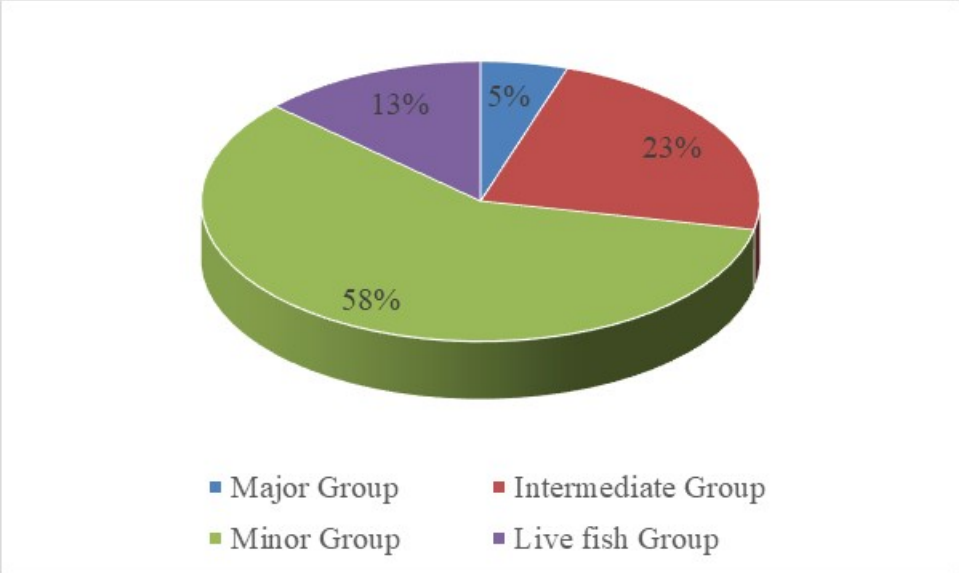

Figure 4: Relative abundance of Fish groups

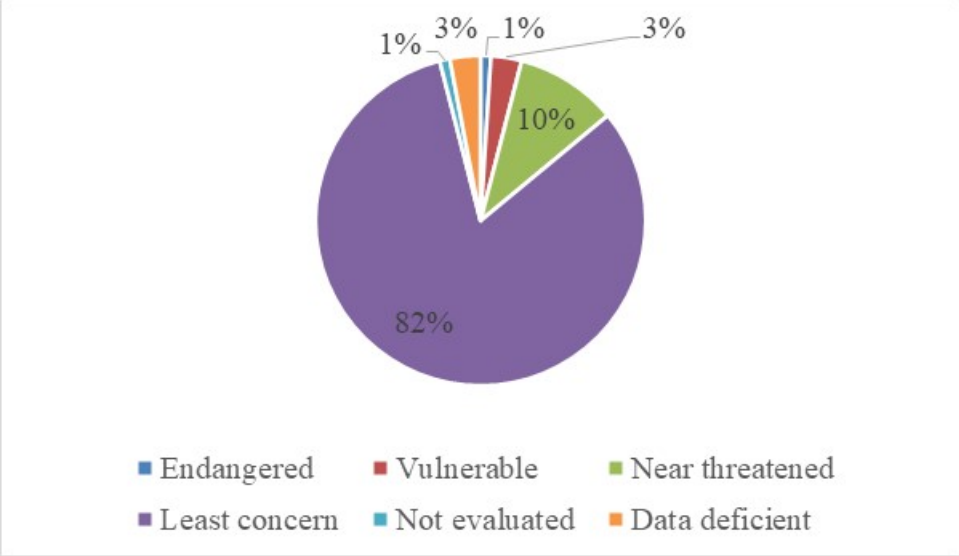

Figure 4: Percentage composition of fish species in IUCN category

DISCUSSION

Ichthyofaunal diversity of the wetland

On account of the fish resource of Chandubi wetland, the present study reveals a good diversity with 72 species of fishes, which is found to be higher in comparison to some important wetlands of Assam [13-17], and other states of India [18-21].This may be attributed to the fact that River associated wetlands have higher fish diversity [22]. The fish families encountered in the present investigation resembles those reported from the lower reaches of the River Brahamaputra [23].According to the species composition, the fish orders can be arranged as Cypriniformes> Perciformes >Siliuriformes>Mastacembelliformes= Osteoglossiformes>Beloniformes = Synbranchiformes = Cyprinodotiformes = Tetraodontiformes while the families can be arranged as Cyprinidae>Bagridae>Belontidae>Ambassidae=Channidae>Nandidae = Mastacembellidae>Notopteridae = Cobitidae >Clupeidae = Claridae = Heteropneustidae = Chacidae = Belonidae = Synbranchidae = Aplocheilidae = Tetraodontidae (Table-2).Such a sequence of fish orders in relation to species composition was also reported from the River Kaldia [24] while, the dominance of the family Cyprinidae followed by Bagridae corroborates the earlier findingsfrom the lower reaches of the River Brahamaputra[23].

The present investigation portrays the relative abundances of the large growing fish species - *Chitala chitala, Sperataseenghala, Hemibagrusmenoda* and *Wallago attu are* less than 0.5% each, while those of *Gebilioncatla, Labeo rohita, L. gonius and L.calbasu* are less than 1% and as a result the Major Group fish

records the lowest relative abundance (5%). In contrary, the history of fish abundance in Chandubi wetland as obtained from the local people and literatures[2] depicts the dominance Major Group in the fish assemblage of the wetland. But, during the past three decades the population of the large growing fish species has been drastically declining in this wetland.

Threats confronted by the ichthyofauna

Regarding the threats to the fishes in natural water bodies, many workers have been reporting several factors which are directly or indirectly anthropogenic in origin, or may be related with some autochthonous processes [25]. The threats to Global freshwater biodiversity have been described under five interacting categories- overexploitation, water pollution, flow modification, destruction or degradation of habitat and invasion by exotic fishes [26]. Chandubi wetland is located in a protected area far from the urban and industrial places and the practice of traditional agriculture by the native people keep the environment of the wetland free from pollution and other chemical hazards. However, injudicious exploitation of fish resource, killing of brood fish, degradation of habitat, obstruction in the inlet-outlet channels are of great concerns for the decline of abundance and diversity of ichthyofauna in the wetland.It has been observed that the people inhabiting the fringe villages are mainly dependent on the fish resource of Chandubi for obtaining the fish protein or /and for earning money. For fishing, they use cast net, dip net, traditional devices and gill nets of various mesh size to catch the fishes of all size groups. The very small mesh sized gill nets (<1inch)used by the people, which they place in short ranges, entrap the fingerlings and juveniles of the Major Group and thereby impedes their growth of adult population. Moreover, Community fishing (by placing *katals*) in the occasion of festivals (around the month of January) has been practiced which accounts for the demise of brood fishes resulting into the failing of the auto stocking of fish population in the wetland. Therefore, overfishing in inland water regime has been considered as a threat to the global fresh water fish diversity [27-29].

Habitat loss due to shrinkage of navigable area of Chandubi wetland and alterations occur in its physiography is another major threat to the fish fauna and the biodiversity of the wetland as a whole. The wetland encounters excessive flood every year during the monsoon period and enormous silt laden water from the Mayang hill range and agriculture landsis discharged in the wetland by the inlet channels. The silt deposited areas of the wetland become shallow where gradual and accelerated growth of macrophytes along with the secondary succession of reed swamp from the marginal dendrites not only alter the aquatic condition to a marginal terrestrial grazing land by drying out the underlying water but also reduce the open water area.Now a days terrestrilization occurring through eutrofication due to successional processes is considered as a major cause of disappearance of many wetland habitats worldwide [30].Over last three decades Chandubi wetland has experienced a dramatic increase in the coverage of floating mats, progression of invasive reed and grass vegetations from littoral towards the central open water area. Huge production of macrophytic load causes death of western water passage and eastern part of open water zone thereby obstruct fish migration. It results loss of about 90 % sighting occurrence of Major Group species and 70% of Intermediate Group species in fishing during last three decades although their diversity sustain.

Conservation measures

Substantial management policy encompassing restrictive fishing, eco restoration of the diminishing fish species, participatory approaches for conservation of threatened species, monitoring of limnological attributes, periodic assessment of the wetland basin, sustainable use of the resources, is necessary to build up a healthy fish stock and to maintain the biodiversity of the wetland. People's awareness in this regard is of great importance for which Government and Non-Government organizations have to play significant role to execute mass awareness programs among the natives to impart the knowledge concerning the threats to the ichthyofauna of the wetland. Restrictive fishing should be employed with people's participation, and to prevent the killing of brood fishes, strict vigilance of administration should be deployed during the breeding season.

Besides, generation of alternative source of livelihood such as ornamental fish trade through culture and breeding of the Minor Group fish is also commendable. It is observed that the Minor Group constitutes more than 50% of the total fish species present in the wetland and also holds the highest relative abundance (58%) (Figure 3). As a result, the catches are chiefly composed of the Minor Group species and the fishermen are hardly benefited by selling the fishes. Though, this group of fish do not have good market value as 'food fish', they are highly priced as Ornamental fish in domestic and international markets [31]. Commercial production through culture and breeding of Minor Group fish species in aquaculture systems will not only help the local people to get good earnings but will also lessen their dependence on the fish fauna of the wetland for their livelihood. Furthermore, the paddy fields present in the hilly terrain retain good amount of water during the monsoon season where along with agriculture,

live fish and carps can be reared through which the native people will able to get the dual benefit of Paddy cum Fish culture.

To mitigate the shrinkage of open water area and habitat loss due to high sedimentation, water flow along the wetland basin has to be assessed meticulously and appropriate geomorphic applications are to be exercised to minimize the sedimentation process [32,33]. The inlet and outlet channels of Chandubi wetland namely Lokeyajan, Choraikhurung, Nokhreng, Borgurungnijara, Jaramukhorianijara and Gutiparadung should be engineered with proper dykesto prevent the soil erosion which may help in reducing the siltation process in the wetland.

CONCLUSION

The location inside the woodland of dominant tree, *Shorearobusta*, with beautiful landscape of hilly terrain catchments and watersheds, Chandubi wetland is not only important from fisheries standpoint but also a notable place for ecotourism.The wetland is endowed with diversified avifauna and herpetofauna along with a large number of ethnomedicinal plant species that entice tourists and scientific communities. The fish denizen of this wetland is well diversified, yet the population abundance has been drastically reduced due to the diminutive replenishment of fish population caused by habitat shrinkage, over fishing and killing of brood fishes and juveniles. Besides, conversion of certain open water areas into reed swamp choked with macrophytes is affecting the niches of many fish species. Conservation strategies incorporating the participation of local inhabitants must be initiated by framing inclusive management plan to uphold the fish fauna and biodiversity of this wetland along with sustainable development of ecotourism.

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REFERENCES

1. Oldham R.D.(1899). Report on the great earthquake of 12th June 1897. Memories of the Geological Survey of India, 29, p. 1-379.
2. Goswami, M.M. (1985). Limnological Investigations of a tectonic lake of Assam, India and their bearing on fish production. Ph.D. Thesis, Gauhati University, Assam, pp.395
3. N’Zi K.G., Yao S.S., Bi G.G. and Ndouba V. (2015). Update of ichthyofauna diversity and ecological status of coastal River Nero (Côted’Ivoir- West Africa), Saudi J.Bio.Sc. 22, p. 265-273
4. Kestemont P., Didier J., Depiereux E., and Micha J.C. (2000). Selecting ichthyological metrics to assess river basin ecology quality. Arch. Hydrobiol. Suppl. 121(3), p. 321-348
5. Duarah, B.P. and Phukan, S. (2011). Understanding the tectonic behavior of the Shillong Plateau, india using remote sensing data. J.Geo.Soc,Ind. 77 (2), p.105-112.
6. Nath, B. and Deka, C. (2012). A study on fish diversity, conservation status and anthropogenic stress of Chandubi tectonic lake, Assam, India, J.Biol.Innov. 1 (6), p. 148-155.
7. [Kalita M., Raju P.L.N. and Devi N. (2018). Vegetation coverage change and risk assessment-A case study of Chandubi Lake, Assam. Journal of Emerging Technologies and Innovative Research. 5(9), p.409-418
8. Talwar P.K. and Jhingran A.G. (1991). Inland Fishes of India and Adjacent Countries Vol I & II. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi. India,pp.1158
9. Jayaram, K.C. (2010). The Freshwater Fishes of the Indian Region, 2nd Edition. Zoological Survey of India, Calcutta, India, pp. 616
10. Viswanath,W., Lakra,W.S. andSarkar,U.K. (2007). Fishes of North East India. National Bureau of Fish Genetic Resources. Lucknow, India, pp.290
11. Lakra,W.S., Sarkar U.K., Kumar R.S., Pandey A., Dubey V.K. and Gusain O.P. (2010). Fish diversity, habitat ecology and their conservation and management issues of a tropical River in Ganga basin. The Environmentalist, DOI.10.1007/s10669-010-9277-6
12. Deka T.K., Kakati M. and Goswami M.M. (2001). Diversity of wetland fish and its impact on the income of fisherman community of Assam. J. Inland Fishery association, 28, p.11-22
13. Saikia, P.K. (2005). Qualitative and quantitative study of lower and higher organisms and their functional role in the DeeporBeel ecosystem. Final Technical Report, North Eastern Space Applications Centre, Dept. of Space, Govt. of India,Meghalaya.

14. Devi, N. (2008). A preliminary study of fish diversity of Dora Beel. Proceeding of the UGC-sponsored National seminar on Wetland and Livelihood, Boko College, Kamrup, Assam, p. 219-223
15. Saha, S. and Bordoloi, S. (2009). Ichthyofaunal diversity of two beels of Goalpara District, Assam, India. Journal of Threatened Taxa, 1(4), p. 240-242
16. Kalita, J.C., Deka,U., Haque, A., Kalita, T.C. and Deka, S. (2011). Assessment of fish- biodiversity of KoyaKujiyabeel, Abhayapuri, Assam in relation to certain physicochemical and anthropogenic factors. Bioscan, 6 (3), p. 425- 431
17. Malakar M. and Boruah S. (2017). Diversity and present status of fish species in three floodplain wetlands of Central Assam. IOSR Journal of Environmental Science, Toxicology and Food Technology,11(1), p. 54-59
18. Das. R.K. (2018). Fish diversity and conservation status of a wetland of Cooch Bihar District, West Bengal, India. Journal of Threatened Taxa, 10 (3), p.11423-11431
19. Fernandes B. and Achuthankutty C.T. 2010. Seasonal variation in fishery diversity of some wetlands of Salcete Taluka, Goa, India. Indian Journal of Marine Sciences, 39(2), p. 238-247
20. Devi Prasad A.G., Venkataramana G.V. & Thomas M. (2009). Fish diversity and its conservation in major wetlands of Mysore. Journal of Env. Biol, 30(5). p. 713-718
21. Jain S.(2017) Current status of ichthyofaunal diversity of various water sources of western Uttar Pradesh, India. Int. J. Fish and Aquatic Study, 5(2), p.473-478
22. Bruton M.N. & Jackson P.B.N. (1983). Fish and Fisheries of wetlands. Journal of the Limnological Society of Southern Africa. 9(2). p.123-133
23. Sarma D., Das J., Bhattacharyya R.C. and Dutta A. (2012). Ichthyofaunal diversity of Lower reach of the Brahmaputra River. Int. J. App. Bio.Pharama. Tech. 3(2), p.126-130
24. Sarma, P.K. (2014). Fish germplasm diversity and their conservation status of River Kaldia in lower Brahmaputra valley of Assam, India. Int. J. Pure. App. Biosci, 2 (6), p.46-54
25. Arthington A.H., Dulvy N.K., Gladstone W and Winfield I.J. (2016). Fish conservation in freshwater and marine realms: status, threats and management. Aquatic Conserv. Mar.Freshw.Ecosyst. 26, p. 838-857
26. Dudgeon D., Arthington A., Gessener M.O., Kawabata Z.I., Knowler D.J., Leveque C., Naiman R.J., Prieur-Richard A-H, Soto D. Stiassny M.L.J. and Sullivan C.A. (2006). Freshwater biodiversity: importance, threats, status and conservation challenges. Biological Reviews. 81, p. 163-182
27. Ramsundar H. (2005).The distribution and abundance of ichthyofauna, and exploitation of the fisheries in Godineau Swamp, Trinidad-case study. Rev. Biol. Trop. 53(1), p. 11-23
28. [28] Torres-Castro I.L., Vega-Cendejas M.E., Schmitter-Soto J.J., Palacio-Aponte G. and Rodiles-Hernandez R. (2009). Ichthyofauna of Karstic wetlands under anthropic impact: the "petenes" of Campeche, Mexico. Rev.Biol.Trop. 57 (1-2), p. 141-157
29. Aloo, P. (2003) Biological diversity of the Yala Swamp lakes, with special emphasis on fish species composition, in relation to changes in the Lake Victoria Basin (Kenya): threats and conservation measures. Biodiversity and Conservation **12,** p. 905–920.
30. Yan LAN,Baoshan CUI, Xia LI, Zhen HAN and Wei DONG (2010). The determinants and control measures of the expansion of aquatic macrophytes in wetlands. Procedia Environmental Sciences 2, p 1643–1651
31. Mandal S.C. and Barman D. (2014). Identification of the most potential indigenous ornamental fishes of South Tripura District in India for commercial production. Int. J. Aquacult. 4(7), p. 43-47
32. Fondriest Environmental, Inc. "Sediment Transport and Deposition." Fundamentals of Environmental Measurements. 5 Dec. 2014. Web. < https://www.fondriest.com/environmental-measurements/parameters /hydrology/sediment-transport-deposition/ >.
33. Wetzel, R.G. (2001). Limnology: Lake and River Ecosystem, Gulf Professional Publishing, Science, p.1006

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