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Ichthyofaunal diversity and certain Physico-chemical parameters in Nitai *beel* of Kamrup district of Assam, India

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Abstract
India is endowed with vast expanse of freshwater resources which can be broadly put under two categories depending on basic ecological consideration. They are ponds and lakes and streams and rivers. In Assam alone nearly one lakh hectare of water spread area is covered under beels. Assam is recognized as one of the hotspots of freshwater fish diversity. Biodiversity and its conservation are regarded as one of the major issues of enabling sustainable use of natural resources. The wetlands are providing ecological services to the fringe villages mostly in the form of fishery. Thus, documentation of biodiversity and habitat analysis is the need of the hour for framing out management strategies. A survey was conducted on the Nitai beel of Kamrup district since September 2017 till Oct-2020. Its geographical location falls under 91^0 31´06´´E longitude & $26^0$11´52´´N latitude. Situated on the North-west of Karmrup district lies the Nitai beel, which falls under Hajo revenue circle. The beel is almost 05 km far from Sualkuchi town. Primary data were collected by visiting the studied area twice a month. The local people and fishermans have been questioned and interviewed. In this study, ichthyofaunal diversity along with the physico- chemical parameters of water were studied. The total area of the wetland was recorded to be 50.68 ha. The present investigation reveals an ichthyofaunal diversity of 46 indigenous fish species belonging to 37 Genera, 8 Orders and 19 Families. Among these 5 species are nearly threatened (NT), 01 species vulnerable (VU), 39 species least concern (LC) and 2 Data deficient (DD). Conservation status is evaluated based on IUCN data (2017-2). 41 fish species belong to 9 orders and 20 families were recorded including many threatened fauna. Seasonal variations in species composition and physico-chemical parameters of abiotic components have been recorded. Catch composition study reveals the wetland is dominated by indigenous small group fishes such as Amblypharyngodon mola, Puntius sophore, Pethia ticto, Trichogaster fasciata and Badis badis having tremendous entrepreneurship potential in ornamental fish culture practice. So in this study an attempt has been made to know the actual status of icthyofaunal resources of the Nitai beel and its physic-chemical status.

Key-words: Wetland, Freshwater, fish-diversity, Physico-chemical, Plankton

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I. INTRODUCTION

Wetlands since time immemorial have been perceived as life sustaining units of the world. They are considered as future food and fodder resources for human population and its related allies. Ecologically, wetlands are of great significance as they support varied food chains and food webs, regulate hydrological cycle, recharge ground water and maintain its quality by acting as filters, provide refuge to a large number of endangered flora and fauna help in trapping of energy and carbon-di-oxide and in nutrient cycling treatment of waste water and provide natural check to floods. Wetlands also have great recreational and aesthetic values. As a part of the non–traditional agriculture the wetlands also support agricultural economy. Around 6.4% of the earth's surface is covered with wetlands. They are continuum of rivers and are locally known as *beels*, pats, mauns, jheels etc and are biologically sensitive ecosystems which play a vital role in the inland fish production of the eastern and northeastern part of the country. The *beels* are unique water bodies which need in depth scientific study before undertaking any management measure.

Fishes make up most of the abundant class of vertebrates, both in terms of number of species and of individuals. They exhibit enormous diversity of size, shape and biology, and in the habitats they occupy. Researchers have arrived at different estimates, most of which range between 17,000 and 30,000 for the numbers of currently recognized fish species. The eventual number of living fish species may be close to 28,000 in the world. Jayaram (1981)[1] listed 742 freshwater species of fishes under 233 genera, 64 families and 16 orders from the Indian region. Talwar and Jhingran (1991)[2] estimated 2,546 species of fish belonging to 969 genera, 254 families and 40 orders. The Indian fish population represents 11.72 per cent of species, 23.96 per cent of genera, 57 per cent of families and 80 per cent of the global fishes.

The work on limnological features of *beel*s have been reported by Pathak (1989)[3] and on macrovegetation dynamics by Mitra (1989)[4]. By virtue of their unique position, location and carrying capacity, these two lakes have emerged as major life sustaining entities. These water bodies are extremely rich in nutrients and have immense production potential as reflected by their rich nutrient status in the water phase.The shallow nature of these *beel*s with their rich nutrient status and penetration of light upto the bottom have led to the infestation of weeds to such an extent that both these *beel*s have remained choaked with macrophytes. Studies made in some *beel*s of Assam give valuable information regarding limnological features, productivity status and management measures for these resources. However, as *beel*s are peculiar ecosystems each having a separate identity, a general study on the various limnochemical parameters and assessment of the fisheries potential is very essential.In Northeast India several workers have studied fish diversity and reviewed many factors responsible for decline of fish biodiversity in aquatic ecosystem and conservation of various water bodies. Goswami *et al.* (2012)[5] reported 422 species under 133 genera and 38 families from Northeast India. Sen (2003)[6] recorded and reported 291 species from N .E. India. Goswami (2007)[7], Vishwanath at. al., (2007)[8] studied Natural and Anthropogenic Hazards of fish fauna of Northeast India. Malakar et al., (2017)[9] studied diversity and present status of three flood plain wetland of central Assam.

II. STUDY AREA

The study area Nitai *beel* is located on the flood plain of Kolajal River, at a distance of 05 km from Sualkuchi and 35 km. from Guwahati with a total area of 50.68 hectare. It lies between 91^0 31´06´´E longitude & $26^0$11´52´´N latitude (fig:1a & 1b). The climate of the studied area remains mild throughout the year. It falls under tropical monsoon climate. The annual average recorded temperature is 22.67°C, annual average rainfall is 159.7 cm, and annual average humidity is 81.01%. The Nitai *beel* is endowed with rich floral and faunal diversity.

Fig 1: a. Map showing the study area

Fig 1: b. Nitai *Beel*

III. MATERIALS AND METHODS

Data collection was carried out in consistent manner from September 2017 till Oct-2020. Fish species composition and variation was analysed at the commercial fishing grounds during two major fishing periods i.e. retreating monsoon and winter. Data analysis were done by visiting the *beel* itself on monthly basis and through questionnaire to the fishermen of the wetland having years of experience. Fishes were collected from the water body using locally available fishing gears from pre-selected sampling sites. Fishing gears and devices used during fishing operation were moving nets (*Dhekijal, Khewali jal etc* and *Drag nets* of various mesh sizes), Different traps namely *Jakoi, Polo, Sepa* and *Bamboo bana*. The moving nets were used throughout the year while, Gill net is extensively used during the monsoon period. Fishes were collected during pre-monsoon, monsoon, and post-monsoon seasons. The species which could not be identified on the spot were brought to the laboratory and these were identified by using different keys of various standard literatures and Morphometrics study. Fishes were sorted out species wise using taxonomic keys (Talwar *et al.,* 1999)[10], (Jayaram, 1999)[11], (Nath *et al.,* 2000)[12], (Vishwanath *et al.,* 2007)[13]. The latest scientific names of the fish species were used following Calacademy reports (2015)[14]. Percentage of species per catch was estimated. Fishes were photographed and preserved few individuals in 4% formalin for species representation. Further sorting of fish species were carried out into major group, intermediate group and minor group fishes. Fishes are categorized into threatened species based on IUCN Red List[15], CAMP (1998)[16]. Basic biological resources in terms of plankton, benthos and macrophyte from this place have been recorded. Fishermen and native people were interviewed for information on species diversity. Water samples were collected in four seasons viz., pre-monsoon, monsoon, post monsoon and winter. The pH of the water samples was measured using the electrical pH meter and major water quality parameters were analysed in replicates following standard methods given in APHA (1998)[17].Plankton samples were collected seasonally using a plankton net (nylo volt no.25) and analyzed after Edmondson (1956)[18] and Needham and Needham (1966)[19]. Fish catch statistics of

commercially important species have been collected covering all the months of the year. Landing sites were visited once a week and data collected have been supplemented by direct enquiries from fishermen and fish traders.

IV. RESULTS

a. Physico-Chemical Parameters of Water (Table 1 & fig 2)

- **pH:-** Water in Nitai was almost neutral to acidic. The average pH of water was found 7.2 ± 0.06 in pre-monsoon, 7.0 ± 0.12 in monsoon and 6.8 ± 0.09 in post-monsoon.
- **Temperature:-** The average temperature of water was found 19 ± 2.71 in pre-monsoon, 20 ± 1.11in monsoon and 22± 0.09 in post-monsoon.
- **Dissolved Oxygen:-** The water quality with respect to dissolved oxygen was quite rich in Nitai *beel*s. The range of variations was 7.17± 0.43 in pre-monsoon, 7.02 ± 0.12 in monsoon and 8.02 ± 1.05 in post-monsoon.
- **Free Carbon-di-Oxide:-** The free carbon-di-oxide in Nitai *beel* fluctuated as 10.50 ± 0.84 in pre-monsoon, 11.10 ± 1.09 in monsoon and 14.15 ± 1.14 in post-monsoon.
- **Total Alkalinity:-** Total alkalinity was recorded as 25.33 ± 3.71(mg/l) in pre-monsoon, 30.0 ± 0.77(mg/l) in monsoon and 22.0 ± 1.31(mg/l) in post-monsoon.
- **Total Hardness:-** Total hardness was medium in Nitai *beel* ranging 38.00 ± 0.58(mg/l) in pre-monsoon, 44.00 ± 0.77(mg/l) in monsoon and 53.00 ± 1.58(mg/l) in post-monsoon.
- **Chlorides:-** Total chlorides was found as 16 ± 1.22(mg/l) in pre-monsoon, 17 ± 1.02 (mg/l) in monsoon and 19 ± 0.76 (mg/l) in post-monsoon.

Table1: physico-chemical parameters of water of Nitai *beel*

Water Quality parameters	Pre-monsoon	Monsoon	Post- Monsoon
pH	7.2 ± 0.06	7.0 ± 0.12	6.8 ± 0.09
Temperature (^{o}C)	19 ± 2.71	20 ± 1.11	22± 0.09
Dissolve oxygen (mg/l)	7.17± 0.43	7.02 ± 0.12	8.02 ± 1.05
Free carbondioxide (mg/l)	7.61 ± 0.31	8.18 ± 1.44	9.18 ± 0.11
Alkalinity (mg/l)	25.33 ± 3.71	30.0 ± 0.77	22.0 ± 1.31
Hardness (mg/l)	38.00 ± 0.58	44.00 ± 0.77	53.00 ± 1.58
Chloride(mg/l)	16 ± 1.22	17 ± 1.02	19 ± 0.76

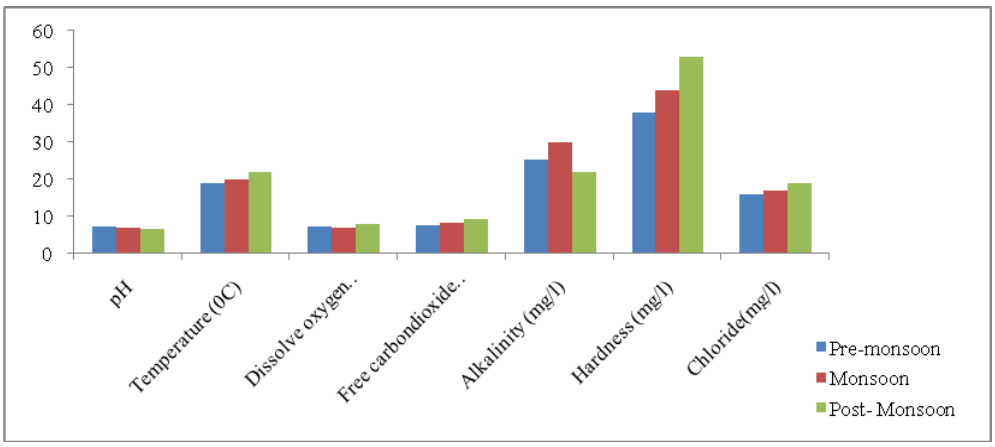

Fig 2: Graphical representation of Physico-chemical parameters of Nitai *Beel*

b. Plankton

Plankton play significant role in the food web of aquatic ecosystem. Phytoplankton including *Spirogyra* sp., *Chlorella* sp., *Anabaena* sp., *Microcystis* sp. *Closterium* sp. *Oscillatoria* sp. and Zooplankton including Copepoda, Rotifera and Cladocera are often observed in the Nitai *beel*.

c. Benthos

Pila globosa, Unio sp., *Tubifex* sp., *Chironomus* sp., Dragonfly and Stonefly larvae are the common benthic fauna of Nitai *beel*.

d. Macrophytes

Macrophyte diversity includes *Eichhornia crassipes, Azolla pinnata, Nelumbo sp., Hydrilla verticillata, Vallisneria spiralis, Ipomea fistulosa, Najas indica, Utricularia flexuosa, Ipomea* sp

e. Ichthyofauna

64 fish species belong to 9 orders and 19 families have been recorded from this part of the wetland (Table 2 & fig 3). As it is regular in the state, almost all the fish species bear food value. However, *Badis badis* is considered here as weed fish and does not bear any demand as fish food. But this species is an excellent ornamental fish because of its small size and beautiful colour patterns. Notwithstanding, *Badis badis* has not received any attention in this region for ornamental fish culture and most of the time discarded improperly during sorting of commercially important species. Exotic species such as *Cyprinus carpio* has also been recorded occasionally. Besides lentic water species, lotic water species including Indian Major Carps, Cat fishes are detected in the *beel* those enter into the water body when the seasonal connection sets up with the river Brahmaputra.

Table 2: Ichthyofaunal Diversity of Nitai *Beel*.

Name of the Species	**Economic value**	**IUCN Status**
Family : Notopteridae		
Chitala chitala (Ham-Buch,1822)	CFF,OR	NT
Notopterus notopterus (Pallas,1769)	CFF,OR	LC
Family : Clupeidae		
Gudusia chapra (Ham. 1822)	NCFF,OR	LC
Family : Engraulidae		
Setipinna phasa (Ham. 1822)	NCFF	LC
Family : Cyprinidae		
Amblypharyngodon mola (Ham-Buch, 1822)	NCFF, OR	LC
Barilius barna (Ham-Buch, 1822)	NCFF, OR	NT
Barilius bendelisis (Ham-Buch, 1807)	NCFF, OR	LC
Barilius vagra (Ham-Buch, 1822)	NCFF, OR	LC
Cabdio morar (Ham-Buch,1822)	NCFF,OR	LC
Gibelion catla (Ham-Buch,1822)	CFF,	LC
Chagunius chagunio (Ham. 1822)	NCFF	LC
Chela cachius (Ham-Buch,1822)	NCFF,OR	LC
Cirrhinus mrigala (Ham-Buch,1822)	CFF,OR	LC
Cirrhinus reba (Ham-Buch,1822)	CFF	LC
Ctenopharyngodon idella (Val. 1844)	CFF, EX	NA
Cyprinus carpio (Linn. 1758)	CFF, EX	VU
Danio aequipinnatus (McClelland,1839)	NCFF,OR	LC
Danio devario (Ham-Buch,1822)	NCFF,OR	LC
Danio rerio (Ham-Buch,1822)	NCFF,OR	LC
Esomus danricus (Ham-Buch,1822)	NCFF,OR	LC
Hypophthalmichthys molitrix (Val. 1844)	CFF, EX	NT
Labeo bata (Ham-Buch,1822)	CFF	LC
Labeo calbasu (Ham-Buch,1822)	NCFF,OR	LC
Labeo gonius (Ham-Buch,1822)	CFF	LC
Labeo rohita (Ham-Buch,1822)	CFF	LC
Osteobrama cotio (Ham-Buch,1822)	NCFF,OR	LC
Puntius conchonius (Ham-Buch,1822)	NCFF,OR	LC
Puntius chola (Ham-Buch,1822)	NCFF,OR	LC
Puntius phutunio (Ham-Buch,1822)	NCFF,OR	LC
Puntius sophore (Ham-Buch,1822)	NCFF,OR	LC
Pethia ticto (Ham-Buch,1822)	NCFF,OR	LC
Raiamas bola (Ham-Buch,1822)	NCFF,	LC
Rasbora daniconius (Ham-Buch,1822)	NCFF,OR	NA

Salmostoma bacaila (Ham-Buch,1822)	NCFF,OR	LC
Family : Cobitidae		
Botia dario (Ham-Buch, 1822)	OR	LC
Lepidocephalichthys guntea (Ham-Buch,1822)	NCFF, OR	LC
Family : Bagridae		
Mystus cavasius (Ham-Buch,1822)	NCFF,OR	LC
Mystus tengara (Ham. 1822)	NCFF,OR	LC
Mystus vittatus (Bl. 1794)	NCFF,OR	LC
Rita rita (Ham. 1822)	NCFF,OR	LC
Family : Siluridae		
Ompak pabo (Ham. 1822)	NCFF,OR	NT
Wallago attu (Bl.-Schn. 1801)	NCFF	NT
Family : Schilbeidae		
Eutropiichthys vacha (Ham. 1822)	NCFF, OR	LC
Neotropius atherinoides (Bl. 1794)	NCFF,OR	LC
Family : Claridae		
Clarias batrachus (Linn. 1758)	CFF,OR	LC
Family : Heteropneustidae		
Heteropneustes fossilis (Bl. 1794)	NCFF, OR	LC
Family : Belonidae		
Xenentodon cancilla (Ham. 1822)	NCFF, OR	LC
Family : Mastacembelidae		
Macrognathus aral (Bl.&Schn. 1801)	NCFF,OR	LC
Macrognathus pancalus (Ham. 1822)	NCFF,OR	LC
Mastacembelus armatus (Lecepede,1800)	NCFF,OR	LC
Family : Synbranchidae		
Monopterus cuchia (Ham-Buch,1822)	CFF,OR	LC
Family : Ambassidae		
Chanda nama (Ham-Buch,1822)	NCFF,OR	LC
Parambassis ranga (Ham-Buch,1822)	NCFF,OR	LC
Family : Nandidae		
Badis badis (Ham-Buch,1822)	OR	LC
Nandus nandus (Ham-Buch,1822)	NCFF,OR	LC
Family : Anabantidae		
Anabas testudineus (Bloch,1792)	NCFF,OR	DD
Family : Osphronemidae		
Trichogaster fasciatus (Bl.-Schn,1801)	NCFF,OR	LC
Trichogaster lalius (Ham. 1822)	NCFF,OR	LC
Trichogaster chuna (Ham-Buch,1822)	NCFF,OR	LC
Family : Channidae		
Channa marulius (Ham-Buch,1822)	NCFF,OR	LC
Channa punctatus (Bl. 1793)	NCFF,OR	LC
Channa stewarti (Playfair,1867)	NCFF,OR	LC
Channa striatus (Bl. 1793)	NCFF,OR	LC
Family : Tetradontidae		
Tetradon cutcutia (Ham-Buch,1822)	NCFF,OR	LC

NB: LC-Least Concern, EN-Endangered, VU-Vulnerable, DD-Data Deficient, NA-Not Assessed, NT-Near Threatened, EX-Exotic Species, OR- Ornamental, GF- Game fish, NCFF- Non cultivable food fish, CFF- Cultivable food fish.

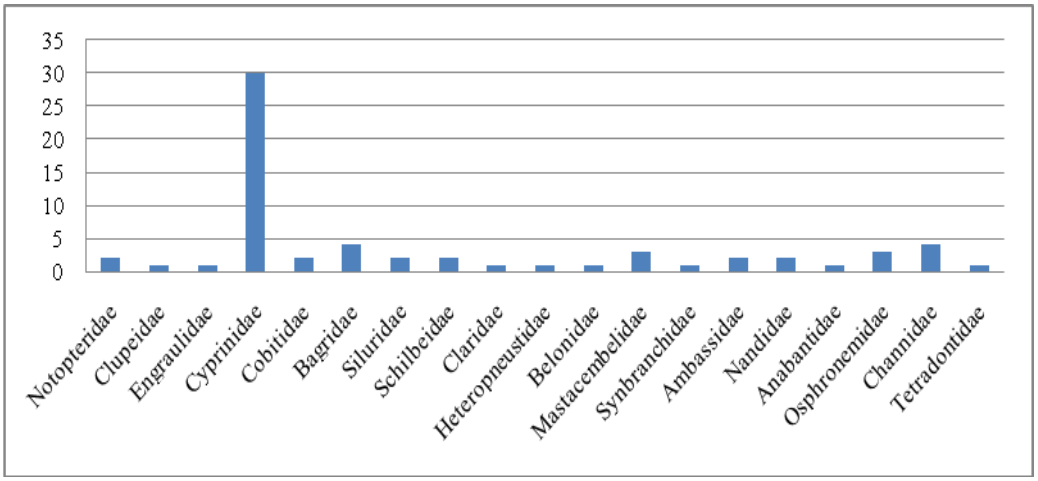

Fig 3: Graphical representation of number of fish species in families

V. DISCUSSION

Physico-chemical analysis revels that during the study period post-monsoon witness the highest catch. It can be said that during this period pH was found slight acidic, temperature, DO, FCO_2, Hardness and Chloride level increases while Alkalinity decreases. This physic-chemical analysis can also be justified with the findings of Durah & Das (2019)[20]. The study shows that plankton play significant role in fish production (Durah & Das, 2019)[20]. Further Benthos and Macrophytes as compared to earlier authors justify the findings of this survey. Species composition was analysed (fig 4) in two major fishing season viz., retreating monsoon and winter. Overall species diversity remains constant but occurrence varies in noticeable form in the two fishing season at the sampling stations of the wetland. The winter catch is dominated by *Amblypharyngodon mola* followed by *Puntius sophore*, *Trichogaster fasciata*. Cyprinidae family was found to be dominated (47%) followed by family Channidae and Bagridae with 6% & 5 % respectively.

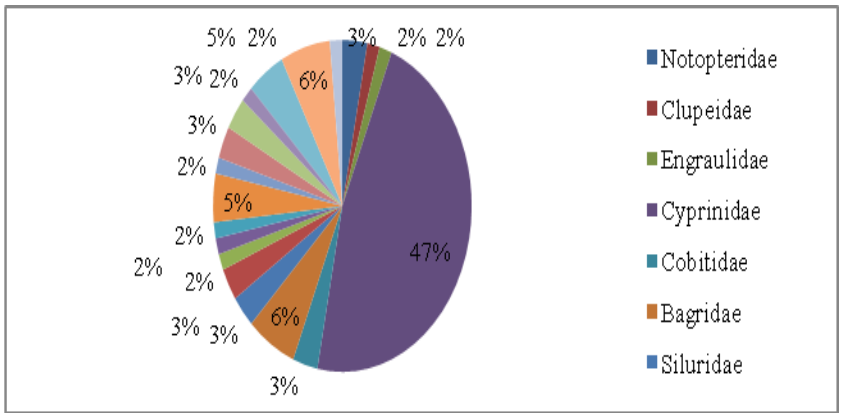

Fig 4: Graphical representation of fish population in percentage

Occurrence of *Badis badis* observed mostly in winter. Indigenous small fishes dominate the catch all round the year. *Labeo gonius* the Indian carps constitute major occurrence of the *beel.* Large cat fishes are observed occasionally in comparison to small sized catfishes. It has been noticed that *Chitala chilala, ompok pabdo, Hypopthalmichthys molitrix, Barilius barna* and *Wallago attu* were fish among nearly threatened (NT) category, 2 species *viz Ctenopharyngodon idella* and *Anabas testudinius* were data deficient (DD) category and *Cyprinus carpio* was the lonely species assessed under vulnerable (VU) category. Out of 8 recorded orders, Perciformes contributed 07 families, followed by Siluriformes 05, Synbranchiformes 02 and Beloniformes, Cypriniformes, Osteoglossiformes, Clupieformes and Tetraodontiformes each with 01 families respectively. Among families Cyprinidae is highly dominant representing 16 individual species. Jhingran (1991)[8] reported 16 exotic fish species from India and in the present study site 3 exotic Carps i.e. *Cyprinus carpio, Ctenopharyngodon idella, and Hypothalmichthys molitrix* were recorded. of the Murrels, the large sized Murrels like *Channa marulias* and *C. striatus* is very rarely found while *C. punctatus* dominates the *beel* among the murrels. Out of the two feather backs, the most important *Chitala chitala* which once dominated the *beel* is now depleting in a very high rate while *N.notopterus* was observed moderately. The most dominant species of

the perch is Anabas testudineus. Among cat fishes *Wallago attu is hardly observed and many other fishes like* Xenentodon *cancila and Ompok pabo* etc are already endangered. *Trichogaster lalius, T.fasciatus, Badis badis, etc* were the larvicidal fish found. Air breathing fishes such as *Clarias magur, Heteropneustes fossilis, Channa spp.* and *Mastcembelus armatus* fetch having high market value as live fish. Moreover the rate of fish catch is increasing over years due to presence of many commercially important species like *Mystus vittatus, Nandus nandus, Anabas testidunieus, T. fasciatus, Botia derio, Sperata aor, Notopterus notopterus, Monopterus cuchia, chitala chitala* etc.for having high overseas demand have potential value as food and ornamental.

VI. CONCLUSION

Wetlands are socio-culturally associated with the native people.Wetlands are the sources of water for agriculture, food in the form of fish, edible aquatic flora and molluscans (Das *et al.*, 2014). It harbours a wide variety of indigenous ornamental fishes. But, now a day, the production of the fish species is declined according to the fishermen communities living in and around *beel* due to over exploitation and human interference or economic benefit. In order to take advantage of the availability of a large number of varieties Appropriate steps are necessary for the protection of breeding ground like, free migration of the breeders, control of overfishing by optimizing the gears and nets and stock assessment of the populations in the capture fishing improvement.The *beel* supports other biological resources such as invertebrates and aquatic flora. The ichthyofaunal diversity of Nitai *beel* is dominated by indigenous small sized fishes. *Amblypharyngodon mola* and *Puntius sophore* are the most abundant fish species during winter and post monsoon fishing respectively. Fish diversity comprises of both lentic and lotic water species due to seasonal river connection.

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