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Ornamental fish and certain phytoplankton diversity in Digholi beel of Kamrup district of Assam, India

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Abstract
India is endowed with vast expanse of freshwater resources. 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. A survey was conducted on the Digholi beel of Kamrup district since March-2018 till February-2019. The present investigation reveals an ornamental fish diversity of 38 fish species belonging to 15 families has been recorded. Out of which 14 species belongs to cyprinidae family, 4 species from bagridae, 2 species from cobitidae, 2 species from ambassidae, 2 from nandidae, 2 species from osphronemidae, 2 species from Channidae, 3 species from mastacembelidae family. Other families such as anabantidae, synbranchidae, belonidae, heteropneustidae, claridae, notopteridae, and tetradontidae each contains 1 species. 33 species enlisted as least concern (LC), 1 specie as near threatened (NT), 3 species as not evaluated (NE) and 2 species as data deficient (DD). *Mystus vittatus*, *Nandus nandus*, *Anabas testidunieus*, *T. fasciatus*, *Botia derio*, *Notopterus notopterus*, *Monopterus cuchia* etc. for having high overseas demand have potential value as food and ornamental. 26 different spp. of phytoplankton belonging 4 classes were recorded. 10 species under chlorophyceae, 6 species from cyanophyceae. 8 species under bacillariophyceae and euglenophyceae contains 2 species.

Keywords: Wetland, ornamental fish, IUCN status, phytoplankton

1. Introduction
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. Goswami (2007) [3], Vishwanath et al., (2007) [4] studied Natural and Anthropogenic Hazards of fish fauna of Northeast India. Malakar *et al*., (2017) [5] studied diversity and present status of three flood plain wetland of central Assam. 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 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. Ornamental fishes are attractive and colourful species of fishes with peaceful nature of various characteristics, which are kept as pets in confined space of an aquarium or a garden pool for fun and fancy.

Ornamental fishes are also known as living jewels and are kept in house as pets. In the recent years the ornamental fishes has become one of the major income sources for the small scale farmers and unemployment people of the world. In India the North Eastern Region is one of the major hotspot for ornamental fish diversity in the world (Kottelat and Whitten, 1996) [6]. Including 82 ornamental fish species are available in the upper Assam districts like Tinsukia, Dibrugarh, Sibsagar and Jorhat (Pandey *et al.*, 1998) [7]. Total 87 potential ornamental fish species are available in the state of Assam (Bhattacharjya *et al.*, 2000) [8]. Out of 217 fish species recorded in Assam 150 fish species have good ornamental value (Bhattacharjya *et al.*, 2003) [9]. So far, in the North Eastern Region a total of 274 species has been recorded, of which 250 fish species have ornamental value, out of 250 species 187 recorded from the state of Assam (Mahapatra *et al.*, 2004) [10]. Phytoplankton is defined as free floating unicellular, filamentous and colonial organisms that grow photo-autrophically in aquatic environments. They are primary producers and hence are the basis of food chains and food webs which directly provide food for fishes and some aquatic animals (Millman *et al*., 2005) [11]. They form the base of ecological pyramid. They convert high energy to chemical energy through primary production which makes them very important in the food web. The species composition and abundance of phytoplankton population is altered by any change in the prevailing environmental conditions due to their quick response to toxins and other chemicals.

2. Study area

The present study was done in Dighali beel (91^0 38´34´´E longitude & 26^0 13´15´´ N latitude) with a waterspread area of 250 ha lies 35 Km northwest of Guwahati city within Hajo circle of Kamrup District at an elevation of 55 MSL (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 21.67°C, annual average rainfall is 161.9 cm, and annual average humidity is 79.01%. The Digholi beel is endowed with rich floral and faunal diversity.

Fig 1a: Map showing the study area

Fig 1b: Digholi Beel

3. Materials and methods

Data collection was carried out in consistent manner from March-2018 till February -2019. 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 sorted out species wise using taxonomic keys (Talwar *et al.*, 1999) [12], (Jayaram, 1999) [13], (Nath *et al.*, 2000) [14], (Vishwanath *et al.*, 2007) [15]. The latest scientific names of the fish species were used following Calacademy reports (2015) [16]. 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 [17], CAMP (1998) [18]. Fishermen and native people were interviewed for information on species diversity. 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. For phytoplankton study samples were collected from four sampling sites *viz.* north, south, east and west corner of the beel. The samples were collected monthly. Plankton samples were collected between 8.0 AM to 9.30 AM, at every selected sampling site. Plankton net of bolting silk no. 25 was used for sampling purpose. Samples were taken at mid-stream 0.5 to 1m below the surface of water. Collected concentrated plankton samples (10 ml) were fixed and preserved in 5% formalin. Plankton samples were examined under high power microscope and identified. The qualitative and quantitative estimation were done by taking samples in Sedgwick Rafter plankton counting cell following the methodology of Edmonson (1959) [18] and Needam and Needham (1986) [19].The phytoplankton's were recorded as unit cell per litre following Welch (1948) [20].

4. Results and discussion

4.1 Ornamental fish fauna

In the present study a total of 38 fish species belonging to 15 families has been recorded. Out of which 14 species belongs to cyprinidae family, 4 species from bagridae, 2 species

from cobitidae, 2 species from ambassidae, 2 from nandidae, 2 species from osphronemidae, 2 species from Channidae, 3 species from mastacembelidae family. Other families such as anabantidae, synbranchidae, belonidae, heteropneustidae, claridae, notopteridae, and tetradontidae each contains 1 species. All the species has been recorded are listed in (Table-1 and Fig-2). It has been observed that cyprinidae family having 38% abundance, 11% from bagridae, 8% from mastacembelidae family, 5% abundance from cobitidae, ambassidae, nandidae, osphronemidae and Channidae family. Again 3% abundance from anabantidae, synbranchidae, belonidae, heteropneustidae, claridae, notopteridae, and 2% from tetradontidae families (Fig 3). Out of 38 species recorded during the study period, 33 species enlisted as least concern (LC), 1 specie as near threatened (NT), 3 species as not evaluated (NE) and 2 species as data deficient (DD).It has been observed that, 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. *Amblypharyngodon mola, Labeo calbasu, Puntius chola, Puntius conchonius, Puntius sophore, Lepidocephalichthys guntea, Chanda nama, Anabas testudineus, Channa stewarti* and *Channa punctatus* are found abundant in the beel. Whereas *Chela cachius, Danio aequipinnatus, Danio devario, Botia Dario, Mystus cavasius, Mystus vittatus, Clarias batrachus etc.* are found to be moderate. Apart from this *Notopterus notopterus, Barilius bendelisis, Danio rerio, Esomus danricus, Rasbora daniconius, Rita rita, Xenentodon cancilla, Monopterus cuchia, and Leiodon cutcutia* are found low occurrence in the beel. *Barilius barna* species are found to be near threatened species. Fishes like *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, Notopterus notopterus, Monopterus cuchia* etc. for having high overseas demand have potential value as food and ornamental.

Table 1: Ornamental fish diversity of Digholi beel.

Family	Species name	Occurrence	IUCN Status
Notopteridae	*Notopterus notopterus* (Pallas,1769)	Low	LC
Cyprinidae	*Amblypharyngodon mola* (Ham-Buch, 1822)	Abundant	LC
	Barilius barna (Ham-Buch, 1822)	Low	NT
	Barilius bendelisis (Ham-Buch, 1807)	Low	NE
	Danio aequipinnatus (McClelland,1839)	Moderate	LC
	Danio devario (Ham-Buch,1822)	Moderate	LC
	Danio rerio (Ham-Buch,1822)	Low	DD
	Labeo calbasu (Ham-Buch,1822)	Abundant	LC
	Osteobrama cotio (Ham-Buch,1822)	Moderate	LC
	Puntius conchonius (Ham-Buch,1822)	Abundant	LC
	Puntius chola (Ham-Buch,1822)	Abundant	LC
	Puntius sophore (Ham-Buch,1822)	Abundant	LC
	Pethia ticto (Ham-Buch,1822)	Moderate	LC
	Rasbora daniconius (Ham-Buch,1822)	Low	NE
	Salmostoma bacaila (Ham-Buch,1822)	Moderate	LC
Cobitidae	*Botia dario* (Ham-Buch, 1822)	Moderate	LC
	Lepidocephalichthys guntea (Ham-Buch,1822)	Abundant	NE
Bagridae	*Mystus cavasius* (Ham-Buch,1822)	Moderate	LC
	Mystus tengara (Ham. 1822)	Moderate	LC
	Mystus vittatus (Bl. 1794)	Moderate	LC
	Rita rita (Ham. 1822)	Low	LC
Claridae	*Clarias batrachus* (Linn. 1758)	Moderate	LC
Heteropneustidae	*Heteropneustes fossilis* (Bl. 1794)	Moderate	LC
Belonidae	*Xenentodon cancilla* (Ham. 1822)	Low	LC
Mastacembelidae	*Macrognathus aral* (Bl.&Schn. 1801)	Low	LC
	Macrognathus pancalus (Ham. 1822)	Moderate	LC
	Mastacembelus armatus (Lecepede,1800)	Moderate	LC
Synbranchidae	*Monopterus cuchia* (Ham-Buch,1822)	Low	LC
Ambassidae	*Chanda nama* (Ham-Buch,1822)	Abundant	LC
	Parambassis ranga (Ham-Buch,1822)	Moderate	LC
Nandidae	*Badis badis* (Ham-Buch,1822)	Moderate	LC
	Nandus nandus (Ham-Buch,1822)	Moderate	LC
Anabantidae	*Anabas testudineus* (Bloch,1792)	Abundant	DD
Osphronemidae	*Trichogaster fasciatus* (Bl.-Schn,1801)	Abundant	LC
	Trichogaster lalius (Ham. 1822)	Moderate	LC
Channidae	*Channa punctatus* (Bl. 1793)	Abundant	LC
	Channa stewarti (Playfair,1867)	Abundant	LC
Tetradontidae	*Leiodon cutcutia* (Ham-Buch,1822)	Low	LC

LC – Least Concern, DD – Data Deficient, NE – Not Evaluated, NT – Near Threatened

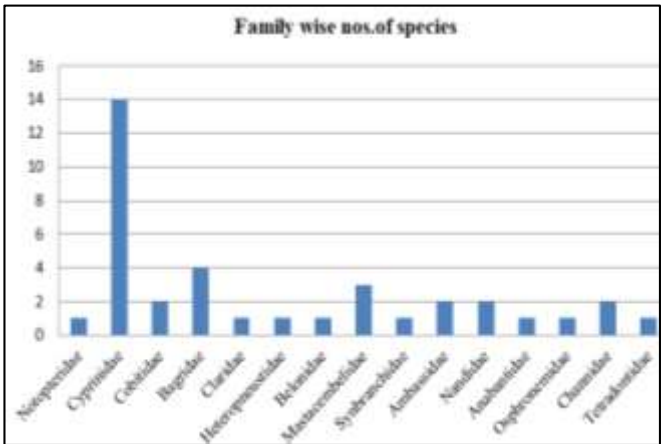

Fig 2: Graphical representation of number of fish species in families

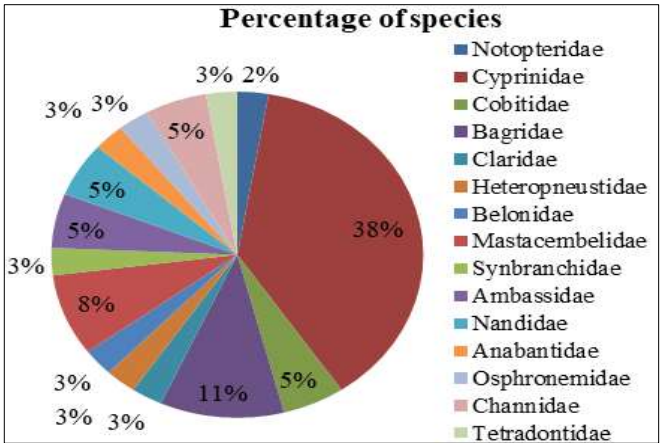

Fig 3: Graphical representation of fish population in percentage

4.2 Phytoplankton in digholi beel

During the study period, 26 different spp. of phytoplankton belonging 4 classes were recorded. Chlorophyceae (10 species), Cyanophyceae (6 species), Bacillariophyceae (8 species) and Euglenophyceae (2 species). The commonly encountered plankton population in Digholi beel along with their seasonal periodicity, unit/litre composition and percentage composition in different seasons are incorporated in the Table 2.

Table 2: Phytoplankton diversity of Digholi beel.

Class	Species	Class	Species
Chlorophyceae	*Chlamydomonas sp.*	Bacillariophyceae	*Cyclotella sp.*
	Chlorella sp.		*Cymbella sp.*
	Oedogonium sp.		*Fragillaria*
	Spirogyra sp.		*Navicula sp.*
	Ulothrix sp.		*Nitzchia sp.*
	Volvox sp.		*Pinnularia sp.*
			Synedra sp.
	Dinobryon sp.		*Tabellaria sp.*
	Eudorina sp.	Euglenophyceae	*Euglena sp.*
	Microspora sp.		*Phacus sp.*
	Zygnema sp.		
Cyanophyceae	*Anabaena sp.*		
	Microcystis sp.		
	Nostoc sp.		
	Oscillatoria sp.		
	Rivularia sp.		
	Spirulina sp.		

Table 3: Seasonal variations of Phytoplankton density (unit/l) in Digholi beel

Season	Bacillariop hyceae u/l (%)	Chlorophy ceae u/l (%)	Euglenophy ceae u/l (%)	Cyanophyc eae u/l (%)	Total Phytoplan kton (u-1/Avg
Pre- monsoon	132(21.11)	535(59.54)	6(1.13)	111(18.22)	784/243
Monsoon	87 (15.44)	355(57.58)	8(1.47)	130(21.32)	580/198
Post -Monsoon	109(19.58)	310(57.44)	10(1.51)	111(21.47)	540/178
Winter	97 (20.92)	234(54.78)	5(0.46)	108 (23.82)	444/147

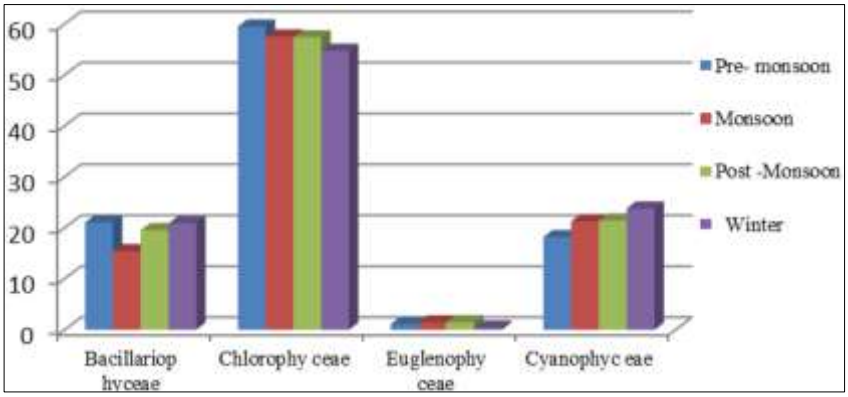

Fig 4: Variation of phytoplankton in different seasons in Digholi beel

The group wise abundance of phytoplankton population of Digholi beel during the study period reveals abundance of Chlorophyceae throughout the season (Table 3 and Fig 4). They were abundant during pre-monsoon (59.54%) followed by monsoon (57.58%), post-monsoon (57.44%) and lower during winter (54.78%) respectively. Bacillariophyceae were found in maximum number (21.11%) during pre-monsoon followed by winter (20.92%), 19.58% during post-monsoon and (15.14%) during monsoon. Cyanophyceae were abundant in winter (22.82%) followed by post-monsoon (21.47%), monsoon (21.32%) and pre-monsoon (18.22%).Though Euglenophyceae was always at a lowest count, they were found in maximum during post monsoon(1.51%) and minimum during winter seasons (0.46%). This shows the significance with Bhuyan (2011) [21] who reported similar trend in Deobali and Sondoba beel. Similar observations have also been reported by Sunkad (2002) [22] and Hujare (2005) [23].The phytoplankton abundance during pre-monsoon and monsoon suggests that primary production is high due to nutrient accumulation from freshwater runoff due to rainfall in pre-monsoon and monsoon. Low abundance of phytoplankton in winter was also reported by Ehshan *et al*., (2000) [24].

5. 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. 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. The Digholi beel supports other biological resources such as invertebrates and aquatic flora. The ornamental fish diversity of Digholi 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. Pre-monsoon and monsoon season shows higher abundance in the phytoplankton diversity of the beel.

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