A Study On Indigeneous Fish Diversity Of Kajalimukhia And Sorubhanga Beels Of Sivasagar District, Assam, India

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Abstract

Wetlands are recognized as distinct aquatic ecosystems that foster a diverse array of biodiversity, largely due to the presence of various habitats within them. Fish research has become an increasingly important study area, as the fish population is declining throughout the world. Wetlands are crucial ecosystems that support a wide range of flora and fauna, including numerous fish species that are adapted to specific environmental conditions. The study of fish diversity in two lentic wetlands has been carried out from January 2024 to May 2024 in Sivsagar, District, Assam. During the study period, we identified and documented the presence of 28 indigenous fish species, belonging to 14 families under 7 orders. The different families recorded are Ambassidae, Anabantidae, Arridae, Bagridae, Belonidae, Channidae, Clariidae, Cyprinidae, Gobiidae, Heteropneustidae, Mastacembelidae, Osphronemidae, Siluridae and Synbranchidae. Among the recorded fish species, twenty-one species are recorded under as least concern (LC), three as vulnerable (VU), three species as near threatened (NT) and one data deficient (DD). However, the present study shows less diverse forms of fishes. This is due to the confluences of population from various sources i.e. surface run-off from agricultural fields and many others anthropogenic activities are adversely affecting the ecology of both the systems as signifying the low species diversity. These two wetlands have played a crucial role in the socioeconomic development of the surrounding communities. Wetlands and their adjacent areas are vital ecosystems that significantly contribute to both ecological integrity and socioeconomic development. This study explores the multifaceted roles of wetlands in the surrounding regions, focusing on socioeconomic aspects such as resource utilization, income generation activities, community perceptions, and fishing practices. Through comprehensive analysis and field surveys, we highlight the pivotal role of wetlands in supporting local livelihoods and biodiversity. Understanding these dynamics is crucial for formulating effective conservation and management strategies aimed at ensuring the sustainable use of wetland resources while promoting environmental stewardship.

Keywords: Indigenous fish, lentic wetlands, fish diversity

INTRODUCTION

Fishes are craniate vertebrates adapted to an aquatic lifestyle, utilising pharyngeal gills for respiration and

fins for propulsion and balance. Fish exist at top of food chain and can serve as balance aquatic ecosystem (Talwar and Jhingram,1991). Fish flesh provides an excellent source of protein for human consumption. The decline in fish populations, a primary food source, has adverse impacts on both aquatic ecosystems and human populations. Pollution of water bodies, caused by modernization, environmental modification, cultural practices, harvesting, and other human activities, has significantly contributed to this decline by degrading fish habitats (Tiwari, 2011). Fish make up a substantial part of the biodiversity within aquatic ecosystems, contributing significantly to the maintenance of ecosystem services that benefit human communities Arthington *et al.* (2016). Floodplain wetlands and abandoned meandering river channels, locally referred to as beels, represent significant inland fishery resources in Assam. Beels offers considerable potential for capture fisheries, as they are naturally stocked with fish fry from the rivers. The nutrient rich waters of beels provide an ideal environment for fish growth. However, in recent years, inland fish production from floodplain wetlands has declined due to various natural and anthropogenic environmetal alterations in the ecosystem. Therefore, there is an urgent need to explore methods to optimize yields from these wetlands without causing significant disruptions to their ecosystem. Introducing fish culture in beels could serve as a viable alternative to boost fish production. Wetland species are inherently reliant on aquatic habitats and cannot thrive in terrestrial environments. Fish assemblages have been significantly impacted by environmental degradation (Arunachalan, 2000). Assessing fish diversity in rivers is considered a valuable tool to underscore the impact of environmental changes (Das and Chakrabarty, 2007). Wetlands, characterized by their natural waterlogged and marshy conditions, play crucial roles in regulating hydrological patterns, preserving environmental quality, and harboring a diverse array of biotic resources. Serving as habitats for fish and wildlife, wetlands are often disrupted for recreational purposes by human activities. (Lawson, 2011) studied that, the undesirable and toxic substances are regularly discharged into wetlands through surface run of that degrade water quality. Additionally, wetlands are important for essential resources such as food, fodder, and water for human and animal populations. Protecting and preserving wetlands is crucial for maintaining ecological balance and ensuring the wellbeing of both natural and human communities. Fish diversity encompasses both species richness, which refers to the number of species in a given area, and species abundance, which indicates the relative number of each species present (Flores, *et al.,* 2009).

METERIALS AND METHODS:

Fish species samples were collected from the two wetlands on monthly basis. Fish species were collected with the help of fisherman or from the fish landing centres of the beel, to ascertain the ichthyofaunal species composition. Fishing gears and devices used during fishing operation were moving nets (khewali jal and Drag nets of various mesh sizes), different traps namely Jakoi, Polo, Sepa and Bamboo bana. The secondary data was collected from various sources such as journals, books and other published works. Fishes were collected in live condition and photographs were taken by digital camera placing them in a clean paper with a scale along the length of the specimen. The collected fishes were

preserved in 10% formaldehyde solution for identification. The fishes were identified by using Dutta Munshi and Shrivastava (1988) and Jayaram (2010), Johal and Rawal (2015). The confirmation of the valid scientific name and classification of each species was done with the help of Fishbase (Froese and Pauly, 2021) and Catalog of Fishes (Eschmeyer, *et.al.,* 2021). The threatened status of all the identified fish species was determined by following the IUCN Red List2021 (IUCN, 2021).

The data were analysed using the diversity Shannon Wiener index (H'), the evenness index (E), the dominance index (C) .

index (Chao et al 2006). Statistical analysis of the data generated was made in Microsoft Excel. The basic statistical calculations like statistical mean, standard deviation (SD) and range were calculated. Statistical methods were applied to know the species diversity and species evenness.

The numerical relative abundance (RA) of fish species was determined following the method of Lakra *et.al.,* (2010) using the formula below.

$$RA = Number\ of\ Specimens\ of\ particular\ species \times 100$$
$$/(Total\ Number\ of\ specimens\ of\ all\ species)$$

The analysis of Diversity Indices was conducted using the Past3 (Paleontological Statistics Version 3) statistical software. The software produced diversity indices data based on Harper (1999), including the Dominance index, Simpson's index, Shannon Wiener index, Margalef species richness index, and Evenness index. The formulas used to calculate the values of the Diversity Indices are presented below.

Dominance index: The dominance index varies from '0' to '1' and indicates the level of dominance within a community of a specific habitat.

$$D = \Sigma\ [ni/N\ ]2$$

Where, ni = the number of individuals of taxon 'i' And N = the

total number of individuals in the sample

Shannon Wiener Index: Shannon and Wiener (1949) separately developed the function now known as the Shannon index of diversity. Shannon's index assesses both species richness and evenness, indicating how uniformly individuals are distributed across species. This index presumes that individuals are randomly sampled from a large, independent population. It also assumes that all species are represented in the sample.

$$H=-\sum (i = 1)\ ^s\ pi \times lnpi$$

Where, Pi = ni/N i.e. (the proportion of species 'i' in the assemblage)

Evenness Index

To calculate whether species are distributed evenly across seasons and across sampling sites, evenness index was determined by the following formula:

E= H'/ lnS Where,

H' = Shannon Weiner's diversity index S = Total

no. of species in the sample

Margalef index: Margalef's index (Margalef, 1958) is employed to quantify species richness. It is computed using the following formula:

$$D = ((S - 1))/ (in\ N)$$

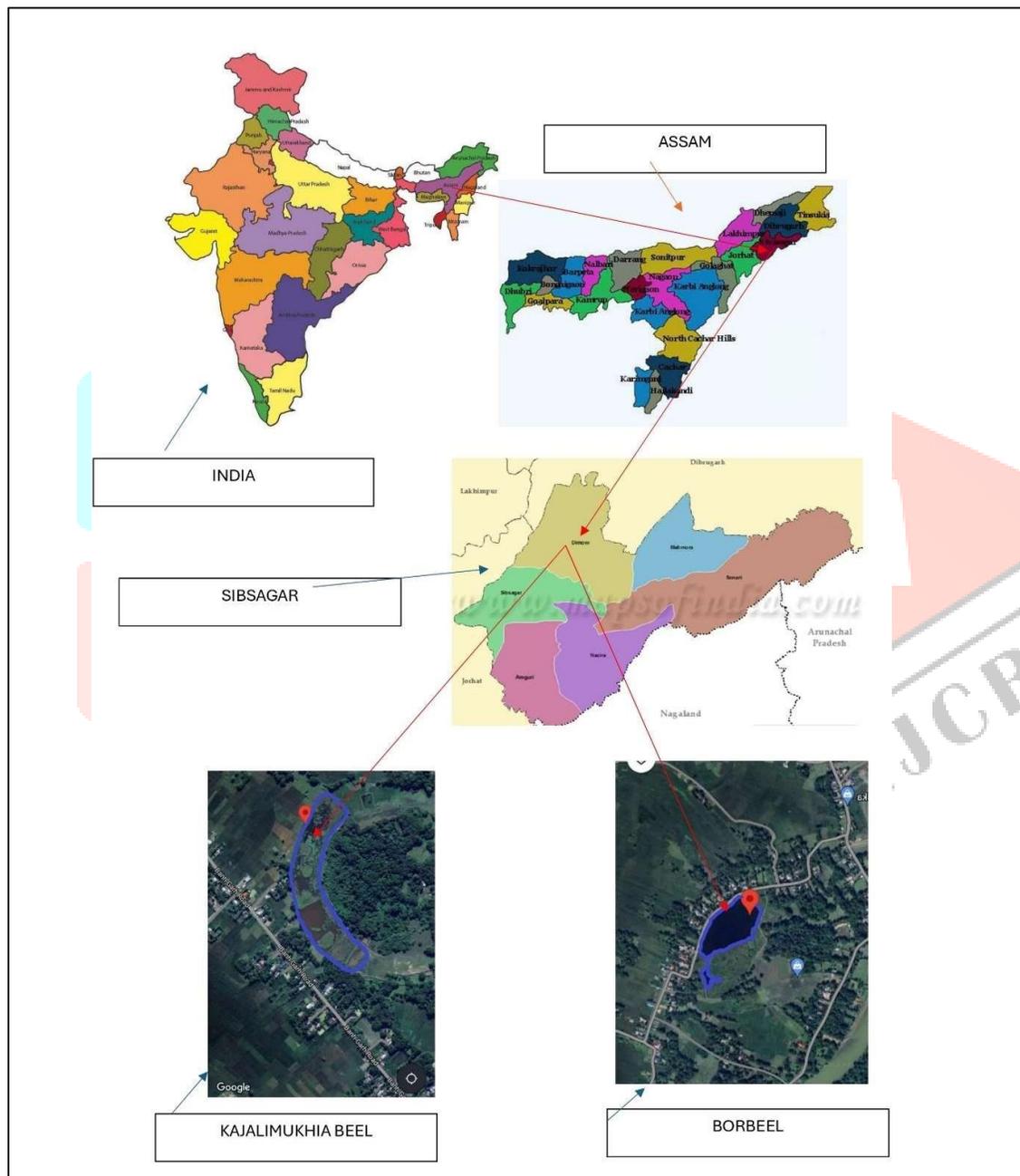Where, S= Species number and N= Number of individuals

Fig: Geographical   location   of   the   study   area

RESULTS:

Fish species assemblages

In the present indigenous ichthyofaunal study, different fish species were observed in the two wetlands of Sivasagar district, Assam where 28 fish species belongings to 14 families under 7 orders were recorded. The different families recorded are Ambassidae, Anabantidae, Arridae, Bagridae, Belonidae, Channidae, Clariidae, Cyprinidae. Gobiidae, Heteropneustidae, Mastacembelidae, Osphronemidae, Siluridae and Synbranchidae. Among these families the most dominating is the cyprinidae.

Table 1: Comprehensive list of fish species and their abundance encountered in kajalimukhia beel and borbeel

SL N O	Order	Family	Scientific name	Common name	IUCN Status	Site 1	Site 2
1	Anabantiformes	Anabantidae	*Anabas testudineus*	Kawoi	DD	0.078	0.011
2	Anabantiformes	Channidae	*Channa punctata*	Goroi	LC	0.019	0.023
3	Anabantiformes	Channidae	*Channa stewartii*	Chengalee	LC	0.058	0.088
4	Anabantiformes	Osphronemidae	*Trichogaster fasciata*	Khalihona	LC	0	0.046
5	Anabantiformes	Osphronemidae	*Trichogaster lalia*	Bheseli	LC	0.018	0
6	Beloniformes	Belonidae	*Xenentodon cancila*	Kokila	LC	0.024	0.035
7	Cypriniformes	Cyprinidae	*Amblyphryngdon mola*	Moa	LC	0.158	0.158
8	Cypriniformes	Cyprinidae	*Barilius barila*	Boriyola	LC	0.012	0.076
9	Cypriniformes	Cyprinidae	*Cirrhinus mrigala*	Mirika	LC	0.012	0.038
10	Cypriniformes	Cyprinidae	*Cirrhinus reba*	Lachim	LC	0.034	0.026
11	Cypriniformes	Cyprinidae	*Cyprinus carpio*	Common carp	VU	0.003	0.011
12	Cypriniformes	Cyprinidae	*Labeo bata*	Bhagon	LC	0	0.028
13	Cypriniformes	Cyprinidae	*Labeo catla*	Bahu	LC	0.004	0.010
14	Cypriniformes	Cyprinidae	*Labeo gonius*	Kuri	LC	0.022	0.026
15	Cypriniformes	Cyprinidae	*Labeo rohita*	Rou	LC	0.037	0.010
16	Cypriniformes	Cyprinidae	*Puntius chola*	Puthi	LC	0.150	0.038
17	Cypriniformes	Cyprinidae	*Rasbora doniconius*	Balipotiya	NT	0	0.020
18	Cypriniformes	Cyprinidae	*Salmastoma bacaila*	Ilihili	LC	0.090	0.061
19	Gobiiformes	Gobiidae	*Glossogobius giuris*	Patimutura	LC	0.036	0.023
20	Perciformes	Ambassidae	*Chanda nama*	Chanda	LC	0.081	0.090
21	Siluriformes	Arridae	*Arius valenciennes*	Ari	NT	0	0.025
22	Siluriformes	Clariidae	*Clarias magur*	Magur	LC	0.012	0.011
23	Siluriformes	Heteropneustidae	*Heteropneustes fossilis*	Singi	LC	0.025	0.036
24	Siluriformes	Bagridae	*Mystus tengara*	Singora	LC	0.040	0.046
25	Siluriformes	Siluridae	*Ompok bimaculatus*	Pabho	NT	0.043	0.006
26	Siluriformes	Siluridae	*Wallago attu*	Borali	VU	0.027	0.021
27	Synbranchiformes	Mastacembelidae	*Mastacembelus armatus*	Bami	VU	0.006	0.023
28	Synbranchiformes	Synbranchidae	*Monopterus cuchia*	Kusia	LC	0.003	O

Diversity Indices

In the present study the diversity indices viz; Dominance (D), Shannon Weiner index (H), Evenness (J) and Margalef richness index were recorded on monthly basis.

4.1.1.1. Diversity index (Month wise)

Species diversity index was highest in the month of March (H' = 2.58) and lowest in February (H' = 2.381). The Evenness index was highest in May (E = 0.879) and lowest in March (E = 0.7334). The Dominance index (D) ranged between 0.083(in May) to 0.135 (in January) and the Margalef index was highest in the month of March (2.925) and the lowest was recorded in January (2.062). However, the individual number was maximum (350) in the month January and lowest (198) in April.

Table 2: Month wise representation of diversity index of the sampling sites

Diversity index	January	February	March	April	May
Individual number	337	220	334	200	171
Dominance D	0.135	0.114	0.09599	0.0911	0.083
Shannon H	2.277	2.381	2.58	2.562	2.579
Evenness J	0.75	0.7723	0.7334	0.81	0.879
Margalef richness	2.062	2.41	2.925	2.831	2.723

Order wise fish composition

Amongst the recorded families, the fish were dominated by Cypriniformes, with 12 species, followed by Anabantiformes with 5 species. Other orders included Siluriformes with 6 species, Synbranchiformes with 2 species, and Perciformes, Baloniformes each represented by 1 species.

Table 3: Order of identified fish species with number of species

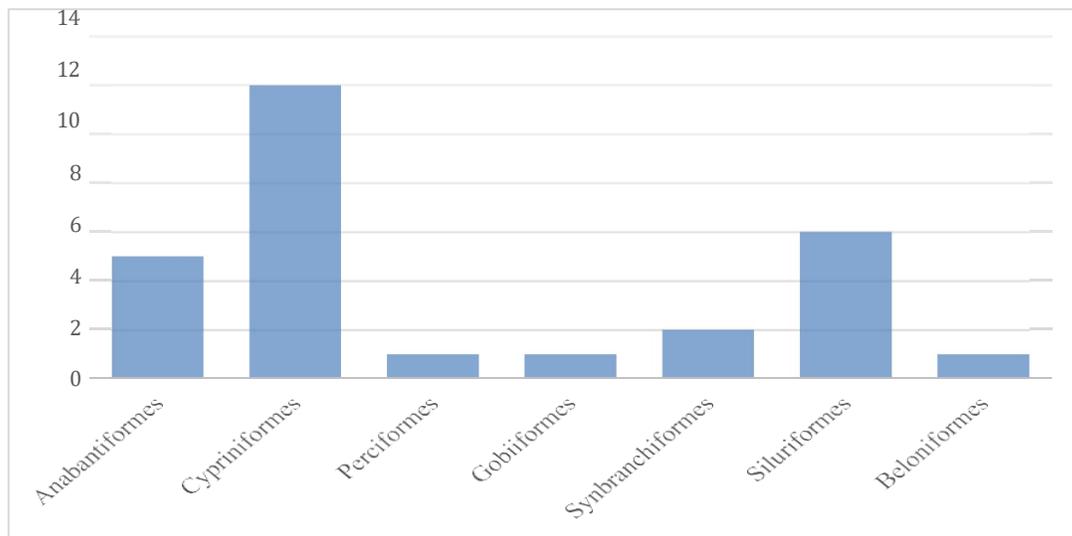| SL NO.	Order	No. of species
1	Anabantiformes	5
2	Beloniformes	1
3	Cypriniformes	12
4	Gobiiformes	1
5	Perciformes	1
6	Siluriformes	6
7	Synbranchiformes	2

Fig.2: Diagrammatic representation of number of fish species occurred in each family

4.1.2 Family wise Fish composition

In the present study, 28 fish species were identified, encompassing 7 orders and 14 families, from two sampling sites. The identified fish species belong to the following families: Ambassidae (1 species), Anabantidae (1 species), Arridae (1 species), Bagridae (1 species), Channidae (2 species), Clariidae (1 species), Cyprinidae (12 species), Gobiidae (1 species), Heteropneustidae (1 species), Mastacembelidae (1 species), Osphronemidae (2 species), Siluridae (2 species), and Synbranchidae (1 species).

Table 4: Family of identified fish species with number of species

Sl no	Family	No. of species
1	Ambassidae	1
2	Anabantidae	1
3	Arridae	1
4	Bagridae	1
5	Belonidae	1
6	Channidae	2
7	Clariidae	1
8	Cyprinidae	12
9	Gobiidae	1
10	Heteroneustidae	1
11	Mastacembelidae	1
12	Osphronemidae	2
13	Siluridae	2

| 14 | Synbranchidae | 1 |
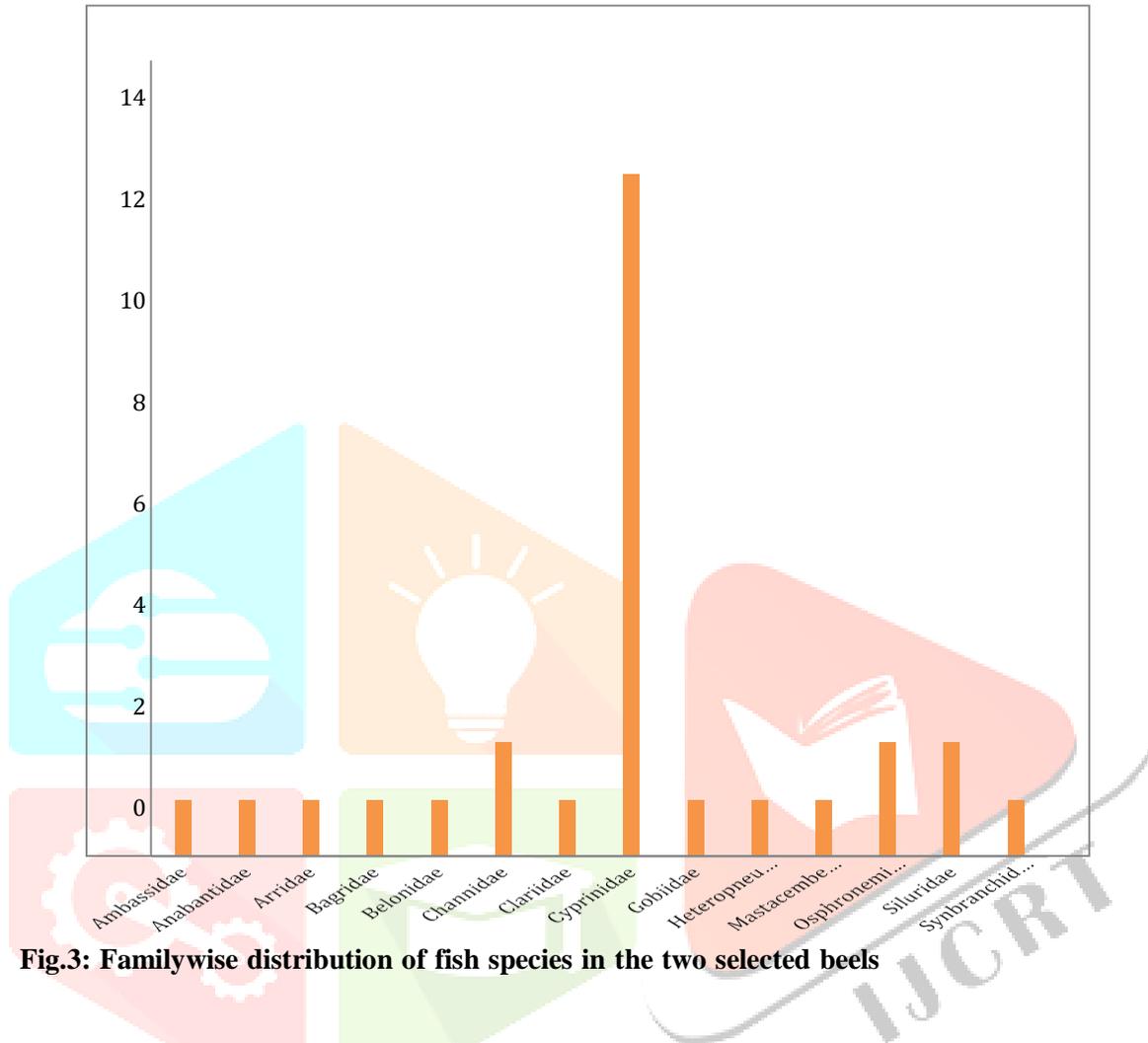
Fig.3: Familywise distribution of fish species in the two selected beels

IUCN status of the collected species of fishes

According to the IUCN status, the majority of collected fish species, accounting for 75%, are classified as "Least Concern" (LC), 11% are NT (Not evaluated), 3% are Data deficient (DD), 11%, are classified as "VU.

Table no. 5: Number of species and percentage of fish species as per IUCN red list category		
status	No of species	percentage
LC	21	75
NT	3	11
DD	1	3
VU	2	11
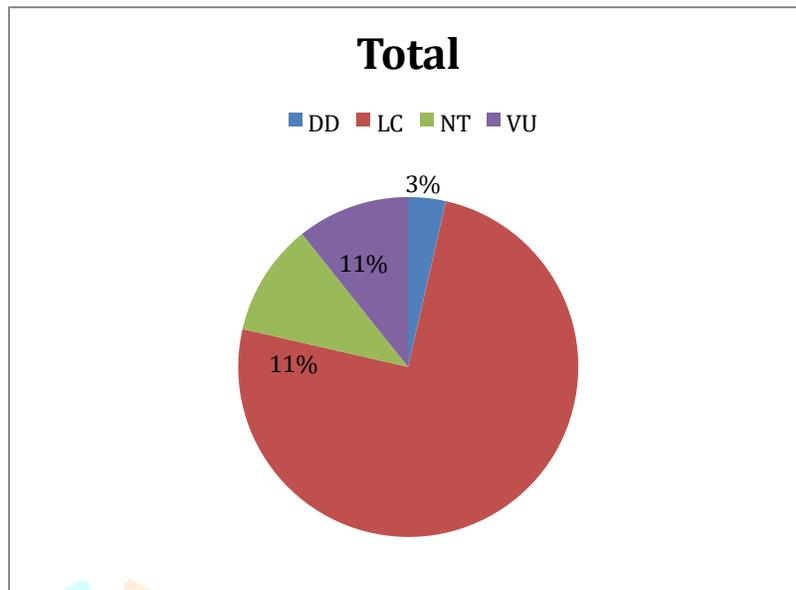
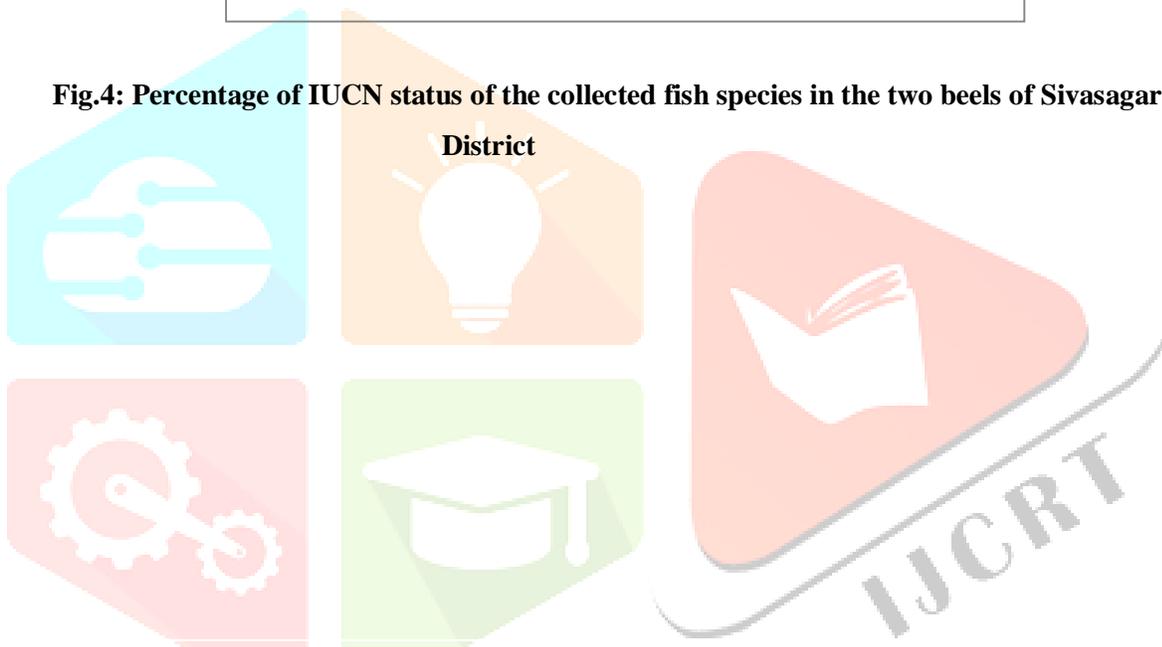**Fig.4: Percentage of IUCN status of the collected fish species in the two beels of Sivasagar District**

Photo plate No.3: Photographs showing the different types of fish species during the study period in sampling sites (from Jan-May 2024).

ORDER: CYPRINIFORMES
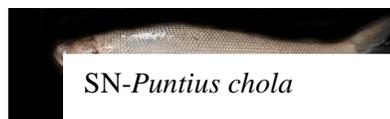

SN- *Amblyphryngdon mola*
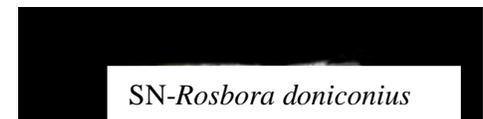Family- Cyprinidae

SN- *Cirrhinus mrigala*
Family- Cyprinidae

SN- *Cirrhinus reba*
Family- Cyprinidae

Family- Cyprinidae

SN-*Puntius chola*
Family- Cyprinidae

SN-*Rosbora doniconius*
Family- Cyprinidae

ORDER: SILURIRIFORMES

SN- *Arius valenciennes*
Family- Arridae

SN-*Heteropneustes fossilis*
Family- Heteropneustidae

SN- *Ompok bimaculatus*
Family- Siluridae

SN- *Clarias magur*
Family- Clariidae

SN- *Mystus tengara*
Family- Bagridae

SN- *Wallago attu*
Family- Siluridae

ORDER : SYNBRANCHIFORMES

SN- *Monopterus cuchia*
Family- Synbranchidae

SN- *Mastacembelus armatus*
Family- Mastacembelidae

ORDER- BELONIFORMES

ORDER- PERCIFORMES

SN- *Xenentodon cancila*
Family- Belonidae

SN- *Chanda nama*
Family- Nandidae

ORDER: GOBIIFORMES

SN- *Glossogobius giuris*
Family- Gobiidae

ORDER: ANABANTIFORMES

SN- *Anabas testudineus*
Family- Anabantidae
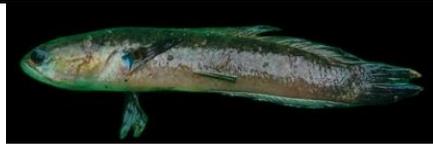
SN- *Channa stewartii*
Family- Channidae

SN- *Channa punctata*
Family- Channidae

SN- *Trichogaster fasciata*
Family- Osphronemidae

SN- *Trichogaster lalia*
Family- Osphronemidae

DISCUSSION:

In Assam, beels serve as vital fishery resources, thriving due to abundant natural nutrients. The fishing landscape in Assam comprises three key groups: individuals fishing for personal sustenance, fisherfolk whose livelihood depends on it, and rural entrepreneurs who lease fishing rights. However, the present study reveals a total of 28 fish species. The fishes belonging to order Cypriniformes were dominant with 12 species followed by order Siluriformes with 6 species and order Anabantiformes with 5 species, while orders like Beloniformes, Perciformes, Gobiiformes were represented with 1 species and rest of the order Synbranchiformes by 2 species. As anticipated, Cyprinidae emerges as the predominant family in the current study, consistent with earlier findings by Dutta (2013), Bordoloi and Hazarika (2015), Kalita and Deka (2015), and Rahman *et.al.,* (2016). Information gathered from local fish sellers indicates a significant decline in fish populations in recent years. Previously, species like Channa, Heteropneustes, Clarias, Rita, Puntius, Mystus, Mastacembelus, Nandus, and Anabas were commonly caught by fishermen but are now rarely encountered during fishing operations. There is a pressing need to reassess the threatened status of these fishes, despite their high market demand, as their availability has dwindled, possibly due to unchecked fishing practices aimed at meeting market demands. Additionally, the introduction of modern fishing gear and techniques has intensified fishing activities, exacerbating the situation (Johal, *et.al.,*2002). According to IUCN Red list of threatened species (2014), among the recorded fish species, twenty-one species are recorded under as least concern (LC), three species as vulnerable (VU), three species as near threatened (NT) and one as data deficient (DD). A rich diversity of indigenous fish species has been reported by a number of previous workers (Chakarvarty, P. *et al,* 2012; Nath, B. and Deka, C., 2012; Das, M. K. and Bordoloi, S., 2012; Bhattacharjya, B. K., 2003; Goswami, U. C.*et al.,* 1988) from various wetlands of Assam. But the current study indicates that the fish species richness in kajalimukhia beel and borbeel aligns closely with findings from other beels in Assam, the actual number and density of species are comparatively lower. This decline can be attributed to significant anthropogenic pressures, leading to the precarious status of species such as Ompak, which are nearing extinction. Furthermore, habitat destruction has resulted in decreased populations of *Chitala chitala, Cirrhinus reba*, and *Puntius serana*.

SUMMARY:

The current study seeks to examine the diversity of fish species in two wetlands. During study period 28 fish species across two selected sampling sites were documented, representing 7 orders and 14 families. The family Cyprinidae was notably predominant, comprising 12 species. According to IUCN Red list of threatened species (2014), among the recorded fish species, twenty-one species are recorded under as least concern (LC), three species as vulnerable(V), three species as near threatened (NT) and one data deficient (DD). These two wetlands have played a crucial role in the socioeconomic development of the surrounding communities. Socioeconomic studies have provided insights into the utilization of wetland resources, income generating activities, community perceptions of the wetland environment, and various fishing methods. It was observed that local residents have been utilizing wetland resources for personal gain, including income from fishing, sale of livestock, and aquatic plants.

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