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A Study on Balaikhuti Beel Fish Diversity in Kalgachia, Barpeta, Assam

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Balaikhuti beel, a substantial wetland of Barpeta district of Assam underwent a thorough examination of fish diversity in the current study. The present study was conducted to assess the fish diversity in Balaikhuti Beel' located in the Barpeta district of Assam, as well as to evaluate the current status of the fish population in the beel. Systematic collection of fish samples was made at six distinct sampling stations, with their diversity status evaluated. The investigation revealed a diverse ecosystem, housing 42 fish species spanning across 16 families. Significantly, the Cyprinidae emerged as the predominant group, exhibiting the highest occurrence percentage. Among the recorded species, *Puntius sophore* (Pool Barb) and *Labeo calbasu* (Orange-fin Labeo) stood out as the largest contributors, while minor-sized fish formed the bulk of the catch. Within the assessed categories of IUCN five fish were identified as Threatened, one Near Threatened, 34

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Least Concern and two not evaluated (NE). Notably, the beel also harboured five exotic fish species, with *Clarias gariepinus* (African Sharp-tooth Catfish) making the debut record in Assam' beel.

Keywords: Balaikhuti beel; fish diversity; catch composition; IUCN status; exotic fish.

1. INTRODUCTION

Beels are a unique ecosystem providing significant ecosystem services. From an ecological standpoint, it plays a key role in nutrient cycling and hydrological cycle and provides habitats for diverse flora and fauna [1]. Assam is endowed with an intricate web of inland open-water bodies, comprising rivers beels and marshes. These beels, mostly oxbow lakes, back swamps or tectonic depressions [2] serve as natural breeding, spawning, nursing and feeding grounds for fish. However, the indiscriminate exploitation of these beels without assessing their potential has led to a marked depletion of resources.

Fish & fisheries of different beel sites have been studied by several researchers [3-7]. Malakar and Boruah [8] conducted a study on fish diversity in the wetlands of central Assam recording 38 species. Saud et al. [9] reported 60 fish species from Urpad Beel, Goalpara, Assam expressing concerns about the impact of agricultural activities and warned about mundane anthropogenic disturbances that would eventually lead to the deterioration of beels. Barpeta in Assam possesses a large number of beels and only Kapla beel of the Barpeta district is evaluated [10-12].

The above discussion demonstrates a noticeable gap in the investigation of the fishery potentials and development benefits available from these beels with a focus on Barpeta District, Assam. Therefore, the present study was carried out to examine the piscine diversity of the Balaikhuti Beel in the Barpeta district of Assam, along with the status of fish in the beel.

2. MATERIALS AND METHODS

The study was carried out during the period January 2016 to June 2017 and data were collected monthly.

2.1 Study Area

The study area, Balaikhuti Beel (26°20'56" – 26°21'06" N and 90°51'54" – 90°52'33" E; 45m above msl) is a dormant tributary of the Beki River, covering an area of 1.25 km^2. The beel reaches depths of 4 – 5m in summer and 2 – 3m in winter. During the monsoon, the waterbody expands to cover up to 3 km^2. Presently, the beel is facing various stressors, including a reduction in area, shallowing of the waterbody, and pollution.

Fig. 1. An aerial view of Kalgachia Town showing Balaikhuti Beel and Beki River (Google Maps/Google Earth; Imagery from the dates:9/29/2023–3/29/2024)

Fish were collected from six different sampling sites of the beel and from the landing sites. After collection, fish were photographed and preserved in 10% formalin. Fish were identified using standard keys [13-15]. The local status was determined from the abundance of species in the collection and from the volume of landing of each species in the landing center.

A structured questionnaire was prepared to record local name of the fish, fishing gears used from randomly selected 34 fishermen and two fish dealers.

The fishes were classified into minor Indigenous fish (size < 15 cm in mature and adult stage), Intermediate indigenous fish (size 15 – 30 cm), Major indigenous fish (size> 30 cm) and exotic fish. Fish % cash was recorded, and the diversity, species richness and dominance were worked out using online "Biodiversity Calculator" (http://www.alyoung.com/labs/results.html as

Shanon Diversity index (H') = -∑ (p*i*ln p*i*).

p*i* is the proportion of individuals of species *i*, i.e., P*i* = S / N, where S = number of individuals of one species N = total number of all individuals in the sample; In = logarithm to base e and ln is the natural logarithm.

Mergalef's Species Richness Index = $\frac{S-1}{\ln N}$

S = total number of species; N = total number of individuals in the sample; In = natural logarithm

Berger-Parker Dominance Index (D) = $\frac{\text{Nmax}}{N}$

Nmax is the number of individuals in the most abundant species and *N* is the total number of individuals in the sample

% Catch = $\frac{Number\ of\ a\ fish\ \ species\ in\ a\ sampling\ unit\ (n)}{Total\ number\ of\ all\ fish\ in\ the\ sampling\ unit\ (N)}$ x 100

Occurrence Frequency (F), Density (D) and Abundance (A) were determined following Dash [16]

F= $\frac{Number\ of\ sampling\ units\ in\ which\ the\ species\ occured}{Total\ number\ of\ sampling\ units}$

D = $\frac{Total\ number\ of\ individuals\ of\ the\ species\ in\ all\ sampling\ units}{Total\ number\ of\ sampling\ units}$

A = $\frac{\text{Total number of individuals of the species in all sampling units}}{\text{Number of sampling units in which the species occurred}}$

3. RESULTS

The findings of the current study unveiled the presence of 42 species distributed across 16 families (Table 1). Within these families, Cyprinidae accounted for the highest representation with 20 species (47.62%), followed by Bagridae with four species (9.52%). Cyprinidae also exhibited the highest percentage of occurrence at 69.82%, followed by Osphronemidae (7.16%) and Gobidae (6.76%) (Fig. 2). Small-sized fishes such as *Rasbora aniconic, Esomus danricus, and Cabdio morar* demonstrated a 100% occurrence frequency, while *Bangana dero* exhibited the lowest occurrence frequency in the study. *Puntius sophore* and *Labeo calbasu* recorded the maximum density (8.58) among the fishes in the beel, with *Puntius sophore* being the most abundant fish (11.44%), followed by *Labeo calbasu* (10.30%) and *Amblypharyngodon mola* (10.00%).

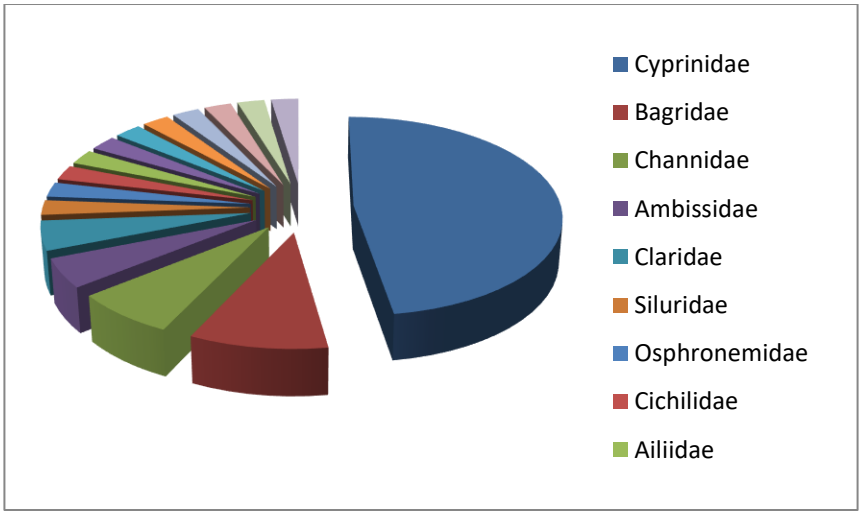

Fig. 2. Family wise distribution of fish of Balaikhuti beel

Table 1. Fish species found in Balaikhuti Beel and their status

Size group	Species	English Name	Local name	Family	% F	Density	Abundance	% Catch	Local status	IUCN
Major Fish	*Sperata seenghala*	Giant river catfish	Bheu	*Bagridae*	0.42	0.67	1.60	1.24	I	LC
	Aorichthys aor	Long-whispered catfish	Aari	*Bagridae*	0.67	2.08	3.13	0.98	I	LC
	Labeo catla	Catla	Bhokua/Bahu	*Cyprinidae*	0.75	5.67	7.56	3.49	C	LC
	Channa striatus	Striped snakehead	Sol	*Channidae*	0.5	2.17	4.33	1.33	I	LC
	Labeo rohita	Rohu	Rou	*Cyprinidae*	0.67	4.83	7.25	2.98	C	LC
	Wallago attu	Shark catfish	Borali	*Siluridae*	0.67	2.08	3.13	1.28	I	VU
	Bangana dero	Kalabans	Shilghoria/nepura	*Cyprinidae*	0.25	0.75	3.00	0.06	ER	LC
	Labeo gonius	Kuria Labeo	Kurhi	*Cyprinidae*	0.42	0.67	1.60	1.41	I	LC
	Labeo calbasu	Orange fin Labeo	Kolijaria/mali	*Cyprinidae*	0.83	8.58	10.30	5.29	C	LC
	Cirrhinus cirrhosa	Mrigel carp	Mirika	*Cyprinidae*	0.75	3.67	4.89	0.76	R	VU
Intermediate	*Cirrhinus reba*	Reba carp	Lachim	*Cyprinidae*	0.92	4.50	4.91	2.77	C	LC
	Channa gachua	Dwarf snakehead	Cheng	*Channidae*	0.5	2.58	5.17	1.59	I	LC
	Channa punctata	Spotted snakehead	Goroi	*Channidae*	0.83	4.33	5.20	2.67	C	LC
	Clarias magur	Walking catfish	magur	*Clariidae*	0.67	2.17	3.25	1.33	I	EN
	Clupisoma garua	Garua bachcha	Garuwa neria	*Ailiidae*	0.83	3.33	4.00	2.05	C	LC
	Heteropneustis fossilis	Stinging catfish	Singi	*Heteropneustestidae*	0.75	3.42	4.56	2.10	C	LC
	Labeo bata	Bata labeo	Bhangon/ naro	*Cyprinidae*	0.67	5.92	8.88	3.64	I	LC
	Mastacembalus armatus	Zig-zag eel	Bami	*Mastacembelidae*	0.33	0.42	1.25	0.26	R	NE
	Notopterus notopterus	Bronze featherback	kandhuli	*Notopteridae*	0.58	5.08	8.71	1.13	I	LC
	Nandus nandus	Gangetic leaf fish	gadgedi	*Nandidae*	0.42	2.50	6.00	1.54	I	LC
	Xenentodon cancila	Needle fish	Konkila	*Belonidae*	0.42	3.08	7.40	O.80	R	LC
Minor	*Amblypharyngodon mola*	Mola carplet	Mowa	*Cyprinidae*	0.75	7.50	10.00	5.72	C	LC
	Anabas testudineas	Climbing perch	Kawoi	*Anabantidae*	0.92	8.17	8.91	3.20	C	LC
	Barilius barila	Barred baril	Korang	*Cyprinidae*	0.75	2.17	2.89	3.33	C	LC
	Botia dario	Bengal loach	Rani botia	*Botiidae*	0.83	6.50	7.80	4.00	C	LC
	Cabdio morar	Morari	Boriola	*Cyprinidae*	1	6.17	6.17	3.80	C	LC
	Chanda nama	Elongated glass-perchlet	chanda	*Ambassidae*	0.92	6.33	6.91	3.90	C	LC
	Laubuca laubuca	Indian glass barb	Donrikana	*Cyprinidae*	0.67	3.17	4.75	0.95	I	LC
	Parambassis ranga	Indian glassfish	Chonda	*Ambassidae*	0.38	3.67	6.29	1.05	I	LC
	Trichogaster fasciata	Banded	Kholiana	*Osphronemidae*	0.75	1.08	1.63	1.67	C	LC

		gourami							
	Esomus danricus	Flying barb	Donrikana	*Cyprinidae*	1	9.33	9.33	5.75	C	LC
	Mystus tengara	Striped dwarf catfish	Singara	*Bagridae*	0.92	7.83	8.55	4.82	C	LC
	Mystus vittatus	Striped catfish	Lalowa singara	*Bagridae*	0.83	5.75	6.90	3.54	C	LC
	Pethia ticto	Two spots barb	Puthi	*Cyprinidae*	0.5	2.67	5.33	3.64	C	LC
	Pethia conchonius	Rosy barb	Puthi	*Cyprinidae*	0.33	0.75	2.25	0.46	R	LC
	Puntius sophore	Pool barb	Puthi	*Cyprinidae*	0.75	8.58	11.44	5.29	C	LC
	Rasbora daniconius	Black line Rasbora	Donrikana	*Cyprinidae*	1	6.92	6.92	4.26	C	LC
Exotic	*Ctenopharyngodon idella*	Grass carp	Grass carp	*Cyprinidae*	0.58	1.58	2.71	0.98	I	NE
	Cyprinus carpio	Common carp	Common carp	*Cyprinidae*	0.58	2.58	4.43	2.79	C	VU
	Hypophthalmichthys molitrix	Silver carp	Silver carp	*Cyprinidae*	0.5	1.00	2.00	1.62	I	NT
	Clarias gariepinus	African sharp-tooth catfish	thailand magur	*Clariidae*	0.42	0.67	1.60	0.41	R	LC
	Oreochromis mossambicus	Mozambique Tilapia	Japani kawoi	*Cichlidae*	0.42	1.50	3.60	0.92	R	VU

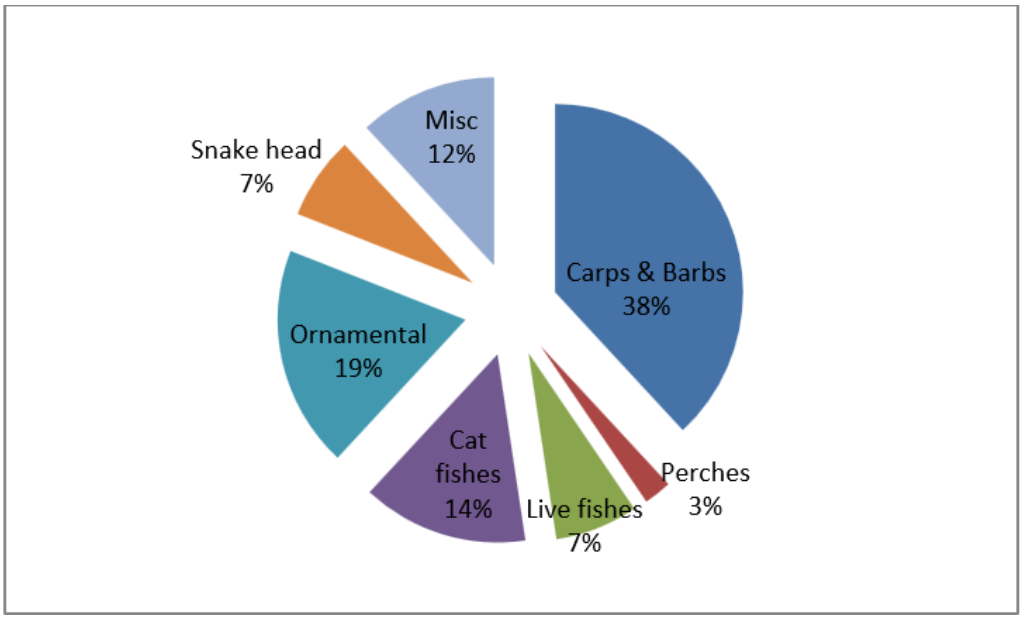

Fig. 3. Comparative account of different fish groups in Balaikhuti beel

Minor size fish were the most abundant among the Indigenous fish (43.24%), followed by imtermediate size fish (29.73%) and major-size fish (27.03%). It was observed that minor-size fish constituted the majority of the catch (52.11%) (Table 1). Seven groups of fish, from the beel, were identified, namely Carps & Barbs, Perches, Live fish, Catfish, Ornamental fish, snakehead and miscellaneous fish. Among these Carps and Barbs were found to be the most numerous (Fig. 3)

The fish status is detailed in Table 1, and according to the IUCN Red List of Threatened Species, five fishes fell under Threatened categories, comprising one Endangered (EN) and four Vulnerable (VU), along with one Near Threatened (NT), 34 categorized as Least Concern (LC) and two listed as Not Evaluated (NE). Furthermore, among the species identified in the beel, five are classified as exotic (*Ctenopharyngodon Idella, Cyprinus carpio, Hypopthalmichthys molitrix, Clarias gariepinus* and *Oreochromis mossambica*) and are regarded as potential pests.

Based on their occurrence and availability in the beel, we categorized 21 species as Common (C), 14 species as Infrequent (I), six as Rare (R), and one as Extremely Rare (ER). The beel demonstrated commendable fish diversity (H' = 3.51) and species richness (R = 5.41), accompanied by a dominance index (D) of 0.57.

The nets and gears employed in the beel were classified into four main types: encircling gears, entangling gears, scooping gears and traps. Gill nets (As. Langi jal), recognized as an entangling gear, and a variety of traps including Seppa, Dingora, Juluki and box traps, were the primary choices. Notably, when fishing activities involved a group of people, encircling the net was the more prevalent choice.

4. DISCUSSION

In the district of Barpeta, Assam, there are 12 beel fisheries (http://afdc.assam.gov.in/frontimpotentdata/district-wise-list-of-beels-of-fisheries), and Balaikhuti stands out as an unregistered beel with significant fishery potential. The current study unveiled the presence of 42 fish species across 16 families, with Cyprinidae emerging as the most dominant, closely followed by Bagridae. Researchers [10-12]) and documented 67, 39 and 65 identified species in Kapla Beel, a registered beel in Barpeta district, with Cyprinidae being the most dominant family. Similarly, in Diplai beel of Kokrajhar district, Assam, 67 species belonging to 25 families, with fish of the cyprinidae family dominating, followed by Bagridae have been recorded [17]. The Ramsar site of Assam, Deepor beel was found to harbor 54 species, where again Cyprinidae emerged as the most dominant family, contributing about 40%, followed by Bagriade and Channidae, each holding a share of 7.4 % [18]. The findings of the present study align with the above-mentioned study and also studies

made by other researchers [19- 25, 9, 6, 26- 28] across various beels in Assam.

Three fish groups could be recognized in the beels of Assam, which are Minor, Intermediate and Major [26]. According to Kalita [29], the minor group constituted the majority of fish species (48.89%), followed by the intermediate group (28.89%) and the major group (22.22%). The current study echoes this pattern in fish composition, aligning with previous research.

The diversity of fish (H') and species richness (R) across various beel systems in Assam, exhibited a range of 2.30 to 3.60 and 2.76 to 9.07 respectively [30, 31]. These findings align closely with the outcome of the present study.

Several studies [22, 32, 24, 17, 25, 33, 8, 26-28] have examined the IUCN status of the fish in diverse beels of Assam. Consistently, these earlier investigations found that approximately 75% or more of the fish species were classified as Least Concern (LC), with only small percentage (2 – 13%) of species in the beels being identified as threatened. In line with this trend, the present study unveiled that around 12% of the species were threatened, while the majority, constituting 81%, fall under Least Concern Category. However, Sarma et al. [19] and Saud et al. [9] revealed an elevated percentage of threatened species in Goronga beel (Moraigaon) and Urpod beel (Goalpara) respectively.

Presence of exotic species in natural ecosystem is a significant concern, as reported in various bells across Assam (Patiasola beel [34], Sone beel [22], Kamandanga beel [33], Kumri beel [6], Diplai beel [17], Dhir beel [26], Deepor beel [18, 35], Chandubi beel [30, 36], Era Kopili beel [37], Kapla beel [11], Urpod beel [9], Doria beel [23], Charan and Manaha beel [24], Motapung-Maguri beel [32], Mailata-Diplinga beel [27] and Gageli beel [31]. The current study also identified five exotic species, including *Clarias grasiepinus,* a first-time record in Assam's beels.

Earlier studies [38, 39, 19, 29] exclusively documented Indigenous fish species within the beels of Assam. Additionally, Sugunan and Bhattacharjya [2] focused on studying beel fisheries in various districts of Assam, singling out *Cyprinus carpio* as the sole exotic species found in beels of Barpeta. However, Acharjee et al. [40] recorded the presence of *Cyprinus carpio, Ctenopharyngodon Idella* and *Hypopthalmichthys molitrix* in Deepor beel. Recent investigations have indicated a widespread infiltration of exotic species, introduced for production enhancement in the culture system and subsequently released during floods [35, 41], across almost all the beels of Assam. Numerous studies have suggested the devastating impacts of these exotic culturable species, affecting beel ecosystems and the fishing communities dependent on them [42-46].

5. CONCLUSION

The Balaikhuti beel, hosting a variety of fish species, provides a favourable habitat. Despite the confirmed presence of exotic species, achieving complete eradication poses a significant challenge [46]. To address this issue, it is advisable to reduce the populations of exotic species by targeting macrophytic vegetation, which serves as a food source of *Ctenopharyngodon Idella* and an egg-laying habitat for *Cyprinus carpio*, through manual removal. Implementing eradication measures, such as continuous netting and removal, is advised for all exotic species. Additionally, proposed strategies involve the regulation of overfishing and the optimization of nets (mesh size) and gears to ensure the sustainable maintenance of the fish stock in the Balaikhuti beel.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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