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An Assessment of Ichthyofaunal Diversity and Conservation Status of Fish from Charipunia Beel of Morigaon District, Assam, India

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Abstract

The ichthyofaunal diversity of Charipunia Beel was studied for 12 months, from May 2022 to April 2023. A total of 26 fish species, representing 18 genera, 11 families, and 4 orders, were identified in the beel. The order Perciformes was the most dominant, accounting for 5 families (45.45%), 5 genera (27.77%), and 7 species (26.92%) of the total fish population. The Siluriformes order contributed significantly as well, with 2 families (18.19%), 3 genera (16.67%), and 6 species (23.08%). Clupeiformes followed with 3 families (27.27%), 3 genera (16.67%), and 3 species (11.53%). The Cypriniformes order comprised 1 family (9.09%), 7 genera (38.89%), and 10 species (38.47%). Most species were categorized as Least Concern, with 20 species contributing 58.80% of the total. The Margalef's Richness Index (d), Pielou's Evenness Index (J), Shannon-Weiner Index (H'), and Simpson Index (1-λ) all indicated a high level of fish diversity in the beel, with a relatively even distribution of genera, suggesting the beel is favorable for fish production. Although the condition of the beel was found to be favourable for fish production, there is an urgent need for strict imposition and monitoring of fisheries regulations during the ban season. Also, the identification and protection of indigenous fishes' feeding and breeding grounds and awareness among the fishermen are very much needed for the sustainable use of the beel.

Keywords: Wetland, Ichtyofaunal Diversity, Biodiversity Indices, Conservation Status

Introduction

Wetlands are defined as areas that are either inundated or saturated with surface or groundwater for a duration and frequency sufficient to support, and typically do support, vegetation that is adapted to grow in saturated soil conditions [1]. Wetlands are a crucial part of the Ganga and Brahmaputra river basins, which are periodically flooded by overflow from the primary river channels [2]. These wetlands cover an area of 2.02 lakh hectares and are a significant source of fisheries in the states of Assam, West Bengal, Bihar, Manipur, Arunachal Pradesh, Tripura, and Meghalaya [3].

Floodplain wetlands refer to natural low-lying areas following large rivers, which are periodically flooded by overflow from the main river system. These regions often consist of small depressions or former riverbeds, typically connected to major rivers. They capture backflow from the rivers during flood events or after monsoon rains from the surrounding catchment areas. In Assam, there are a total of 3,474 wetlands, of which 1,392 are floodplain wetlands, covering an area of 101,229.4 hectares, which constitutes 1.29% of the state's total geographical area [4]. Proper wetland management necessitates an integrated approach that blends scientific expertise with knowledge of legal, institutional, and economic factors. This holistic approach ensures these essential ecosystems' protection and long-term sus-

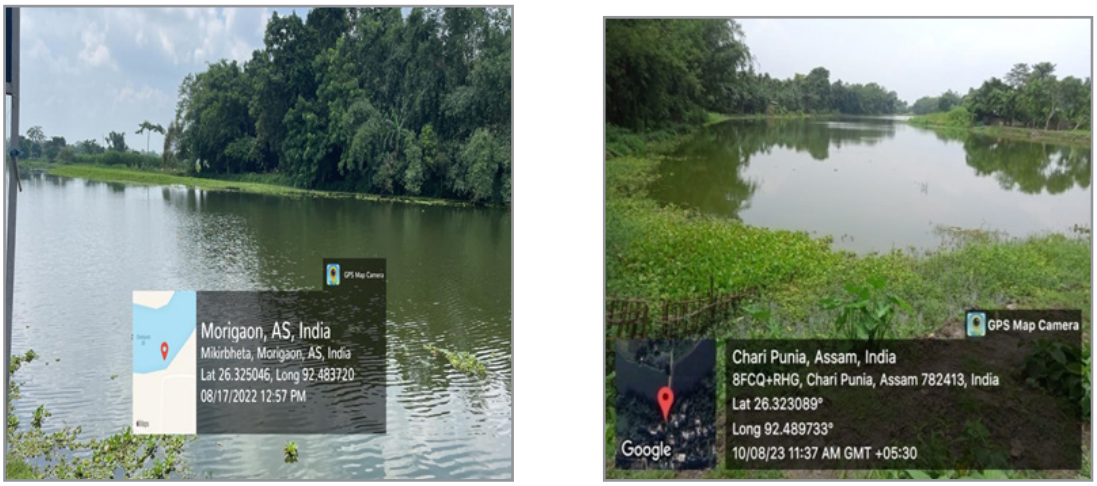
tainability (Good et al., 1978; Kusler and Montanari, 1978) [5].

Goswami, Kalita et al., 2012 reported 424 fish species from Northeast India, spanning 133 genera and 38 families, with the Cyprinidae family exhibiting the highest diversity. Wetlands, in general, contribute to about one-third of the inland fish catch in developing countries [6]. Gopal (1997) referred to wetlands as "distinct ecotones," acting as transitional zones between dry land and deeper water. These areas are not consistently wet or dry, fostering a unique ecological balance. In Assam, wetlands make up approximately 93% of the total lentic fish-prone areas in the state [7]. Protecting fish species in wetlands requires a comprehensive strategy that includes habitat preservation, sustainable resource management, pollution control, legal measures, and community engagement. By adopting these approaches, we can protect fish populations and the essential ecosystem services that wetlands provide, such as water purification, carbon storage, and flood mitigation. Proper wetland management ensures the health of aquatic life and sustains the rich biodiversity these ecosystems harbor. Due to continuous human-induced pressure, freshwater fish diversity is steadily declining. This biodiversity represents a valuable natural resource and is crucial in sustaining fisheries. Therefore, to develop an effective information system on freshwater fish species, comprehensive research and proper documentation of this diversity are urgently needed [8].

Materials and Methods

Study Area

The Charipunia with latitude 26°15'10.0" N and longitude 92°21'22.8" E. This beel is a part of the APART fishery initiative, and the communities are encouraged to collectively manage the beel and take forward the fish farming activities. The area of Charipunia beel is 7 hectares (17.297 acres). The minimum depth of this beel is 5 feet and the maximum depth is 12 feet. It is a perennially close beel. Around 250 families depend on this beel for their livelihood. Government registered number is 3625/88-89, Morigaon, Assam.



Map 1: GPS Map Locations of Study Sites of Charipunia Beel

Fish Sampling

The ichthyofaunal diversity of Charipunia beel was studied over one year, from May 2022 to April 2023. Two sampling stations were chosen for this study to represent the entire beel. Station 1 (S1) was situated at latitude 26°32'50.4" N and longitude 92°48'37.2" E. At the same time, Station 2 (S2) was located at latitude 26°32'30.8" N and longitude 92°48'97.3" E. Fish samples were identified directly in the field. Any unidentified samples were brought to the Department of FRM, Faculty of Fishery Sciences, AAU, Raha laboratory for further examination. Before preservation, photographs of the fish were taken using a digital camera. The collected specimens were preserved in a 5-8% aqueous formaldehyde solution. The identification keys provided by Talwar and were used as references for the identification of fish species. Statistical analysis was conducted using the PAST software [9, 10].

Results and Discussion

Fish Fauna

A total of 26 fish species, representing 18 genera, 11 families, and 4 orders, were recorded in Charipunia beel, indicating the rich ichthyofaunal diversity of the beel (Table 1 and Figs. 1, 2, 3, and 4). The Cyprinidaefamily was the most dominant, with 10 species (38.46%), followed by Bagridaewith 4 species (15.38%), and Channidae with 3 species (11.53%). Siluridae accounted for 2 species (7.69%). Clupeidae, Heteropneustidae, Claridae, Ambassidae, Gobiidae, Nandidae, and Anabantidae each contributed one species (3.85%). The Perciformes contributed 5 families (45.45%), 5 genera (27.77%), and 7 species (26.92%). The order Clupeiformes was contributed by 1 family, Clupeiformes (9.09%), 1 genera, Gudusia (5.55%) and 1 species, Gudusia chapra (3.84%). The order Siluriformes was comprised of 4 families (36.37%), 5 genera (27.78%), and 8 species (30.77%), followed by the order Cypriniformes with 1 family (9.09%), 7 genera (38.89%), and 10 species (38.47%).

The seasonal abundance of fish species in Charipunia beel is presented in Table 2. At Station 1, the highest species abundance was recorded during the pre-monsoon season, with 6,369 individuals, followed by 6,050 in the post-monsoon season and

1,207 in the monsoon season. At Station 2, the peak abundance occurred in the pre-monsoon season, with 5,834 individuals, followed by 5,487 in the post-monsoon and 1,161 in the monsoon season. The most dominant species were Amblypharyngodon mola, followed by Puntius sophore and Mystus tengara.

Recorded 29 fish species from 28 genera and 21 families in the Dighali, Dora, and Ghorjan beels of Assam [11]. Documented 22 fish species, belonging to 21 families and 4 orders, from several wetlands in Goa, including the Betul Assolna Velim wetland, Loutolim Raia Ambora wetland, and Curtorim Macazana wetland in the Salcete Taluka [12]. Recorded 30 species from Hasila Beel, 27 from Urpad Beel, 29 from Sidli Beel, and 31 from Sekselia Beel in Goalpara district, Assam (India) [13].

Recorded 46 indigenous fish species, representing 37 genera, 8 orders, and 19 families, in Puthimari beel of Barpeta, Assam [14]. Documented 72 fish species from 53 genera, across 25 families and 8 orders, in Dhir Beel of Dhubri district, Assam [15]. Reported 67 fish species, including 4 exotic species, from 49 genera across 25 families and 8 orders, in Diplai Beel of Kokrajhar district, Assam [16, 17]. Recorded 71 fish species from Dhir Beel, Assam [18]. Observed 75 fish species, spanning 45 genera and 23 families, in Dulkhojiya Beel in Lakhimpur district, Assam. A total of 45 species were identified, consisting of 42 native species, 3 non-native species, and one species each categorized as vulnerable and endangered [19]. Biological methods such as phytoremediation, phycoremediation, and ecological floating beds can significantly boost the populations of aquatic organisms while enhancing the overall health of aquatic ecosystems [20]. Kar, D. (2021), studies revealed a rich biodiversity of fishes in the North-East (NE) India biodiversity (BD) hotspot region. Kar, D. and Khynriam, D. (2023) conducted studies across various rivers in the Karbi Anglong district—part of the Northeast India biodiversity hotspot—identified 22 fish species. These surveys were carried out at several locations, including the Dhanasiri River at Rangapahar and Bokajan, the Kopili, the Jamuna River at Silvetta, and the Dikrupti and Siloni rivers. The recorded species span 19 genera, 10 families, and 6 taxonomic orders.

Biodiversity Index

The diversity indicators of Charipunia beel are presented for three seasons (Table 2). Biodiversity indices serve as valuable tools for assessing the rarity and frequency of species within a population. One of the simplest measures of biodiversity is Margalef's Richness Index (d), which counts the number of species in a specific area. During the study period, the highest value of Margalef's Richness Index (d) was recorded in the monsoon season (June-September) at 3.53, while the lowest value was observed in the post-monsoon season [21]. Reported the highest value of Margalef's Richness Index (d) in July (9.58) and the lowest in December (4.03) in Chalan Beel, Bangladesh. Pielou's Evenness Index (J') measures the uniformity with which individuals are distributed among various species. During the study period, the mean value of Pielou's Evenness Index was recorded as 0.63 in the pre-monsoon, 0.76 in the monsoon, and 0.61 in the post-monsoon season, respectively. These results indicate that fish species in the beel were almost evenly distributed across all seasons. Found the highest value of Pielou's Evenness Index in July (0.69), with the lowest recorded in November (0.25) in Chalan Beel, Bangladesh [22]. Reported Pielou's Evenness Index values ranging from 0.36 to 0.64, with a mean of 0.51, in a semi-closed oxbow lake, Chhariganga, in the Naida district of West Bengal. Sudhan (2017) observed the highest value of Pielou's Evenness Index (J') in the Pechipari Reservoir in Kanyakumari district, Tamil Nadu, ranging from 446 to 956, suggesting a significant fish diversity and a uniform distribution of the fish population.

The Shannon-Wiener Diversity Index is a measure of biodiversity that accounts for both species richness and the relative abundance of those species. In this study, the Shannon-Wiener Index was recorded as 2.79 during the pre-monsoon season (February-May), 2.99 during the monsoon season (June-September), and 2.77 during the post-monsoon season (October-January). According to, the Shannon-Wiener Index (H') typically ranges from 1.5 to 3.5, with values greater than 3.0 indicating greater diversity [23]. Suggested that various factors, such as climatological and environmental conditions, could influence seasonal differences in the Shannon-Wiener Index [24]. Observed the highest value of the Shannon-Wiener Index (H').

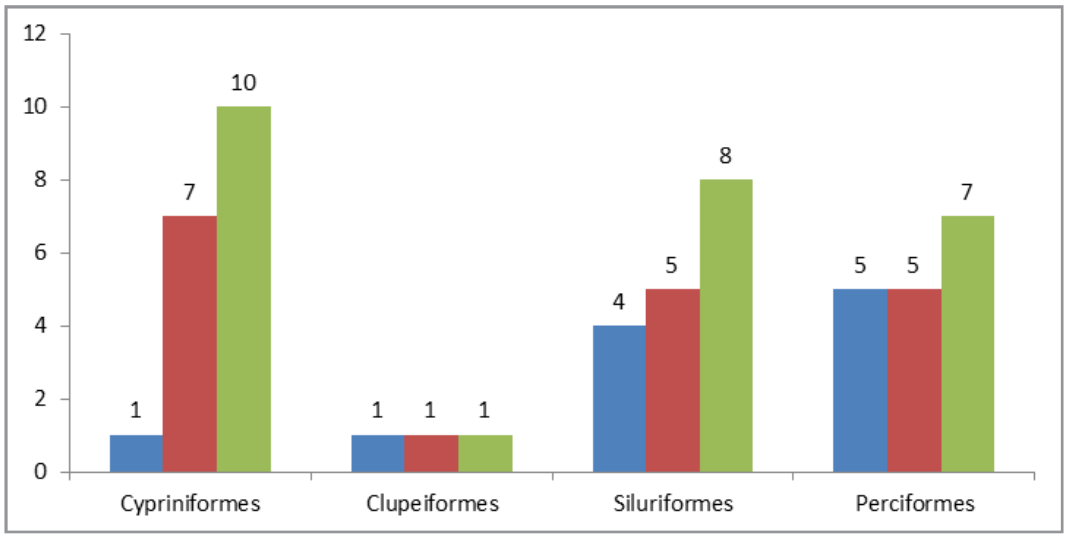


Figure 1: Fish Species Recorded Under Different Orders and Families in Charipunia Beel

Table 1: Fish Species Recorded in Charipunia Beel and Their Conservation Status Per the IUCN (2023)

S. No.	Order	Family	Species	Common Name	IUCN Conservation Status (2023)
1	Cypriniformes	Cyprinidae	Labeo catla (Hamilton,1822)	Catla	LC
2			Labeo calbasu (Hamilton,1822)	Orangefin labeo	LC
3			Cyprinus carpio (Linnaeus,1758)	Common carp	LC
4			Cirrhinus mrigala (Hamilton,1822)	Mrigal carp	LC
5			Labeo rohita (Hamilton,1822)	Rohu	LC
6			Labeo gonius (Hamilton,1822)	Kuria labeo	LC
7			Hypophthalmichthys molitrix (Cuvier and Valenciennes,1844)	Silver carp	NT
8			Puntius sophore (Hamilton,1822)	Pool barb	LC
9			Ctenopharyngodon idella (Valenciennes,1844)	Grass carp	DD
10			Amblypharyngodon mola (Hamilton,1882)	Mola carplet	LC
11	Clupeiformes	Clupeidae	Gudusia chapra (Hamilton,1822)	Indian river shad	LC
12	Siluriformes	Bagaridae	Mystus vittatus (Bloch,1794)	Striped dwarf catfish	LC
13			Mystus tengara (Hamilton,1822)	Tengara catfish	LC
14			Mystus bleekeri (Day,1877)	Day'smystus	LC
15			Mystus cavacius (Hamilton,1822)	Gangetic mystus	LC
16		Siluridae	Wallago attu (Bloch and Schneider,1801)	Fresh water shark	VU
17			Ompok pabda (Hamilton,1822)	Pabo catfish	NT
18		Heteropneustidae	Heteropneustes fossilis (Bloch,1794)	Stinging catfish	LC
19		Claridae	Clarius magur (Linnaeus,1758)	Walking catfish	EN

20	Perciformes	Ambassidae	Chandanama (Hamilton,1822)	Elongate glassy fish	LC
21		Nandidae	Nandus (Hamilton,1822)	Gangetic leaf fish	LC
22		Anabantidae	Anabus testudinius (Bloch,1793)	Climbing perch	DD
23		Channidae	Channa gachua (Hamilton,1822)	Dwarf snakehead	LC
24			Channa punctatus (Bloch,1793)	Spotted snakehead	LC
25			Channa striatus (Bloch,1793)	Snakehead murrel	LC
26		Gobiidae	Glossogobius giuris (Hamilton, 1822)	Tank goby	LC

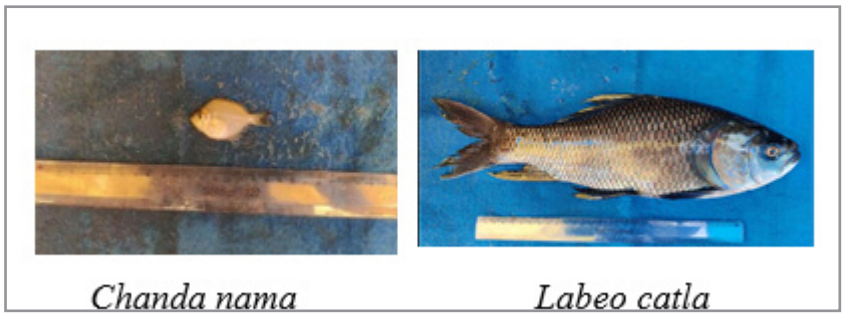
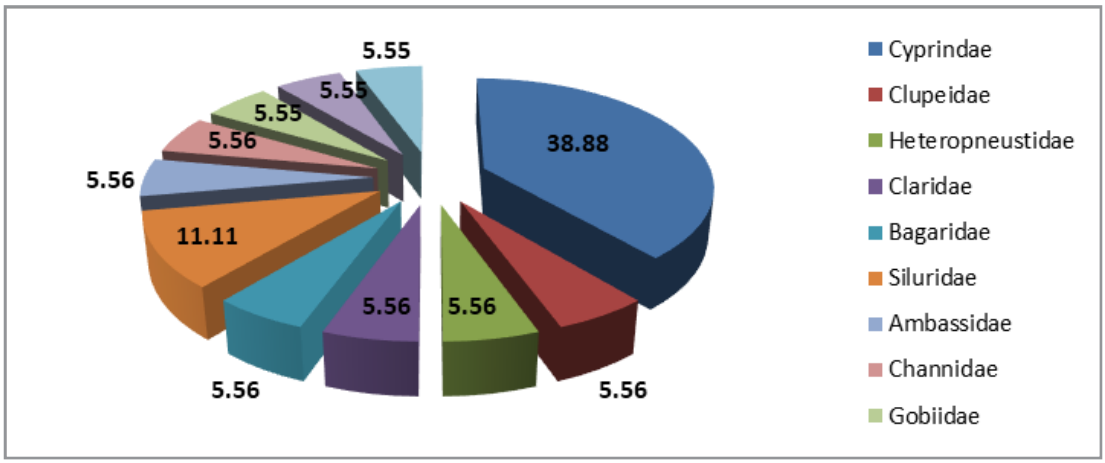


Figure 2: Recorded Fish Species of Charipunia Beel

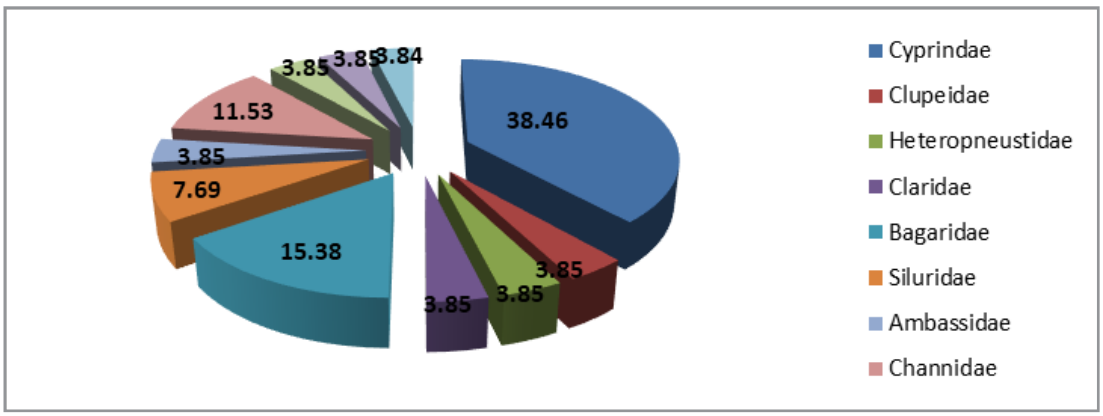
Table 2: Season-Wise Diversity Indices of Fish Species of the Charipunia Beel

	Margalef's Richness Index-(d)	Pielou Evenness Index-(J')	Shannon-Wiener Index(H')	Simpson Index(1-λ')	Margalef's Richness Index-(d)	Pielou Evenness Index-(J')	Shannon-Wiener Index(H')	Simpson Index(1-λ')	Margalef's Richness Index-(d)	Pielou Evenness Index X(J')	Shannon-Wiener Index(H')	Simpson Index(1-λ')
Station 1	2.85	0.63	2.8	0.9	3.51	0.78	3.01	0.93	0.33	0.62	2.79	0.9
Station 2	2.88	7.62	2.78	0.9	3.54	0.74	2.97	0.92	2.88	0.6	2.75	0.89
Mean	2.86± 0.01	0.63 ±0.01	2.79 ±0.01	0.90 ±0.01	3.53± 0.01	0.76 ±0.01	2.99 ±0.02	0.92 ±0.01	1.61± 1.27	0.61 ±0.01	2.77 ±0.01	0.90 ±0.01

A) Fish Genera



B) Fish Species



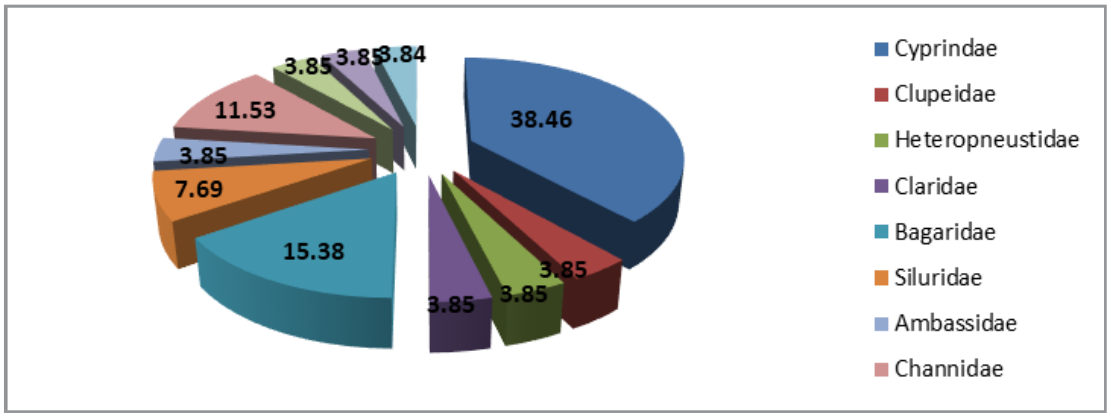


Figure 3: Percentage Composition of Fish Genera (A) and Species (B) Across Different Families

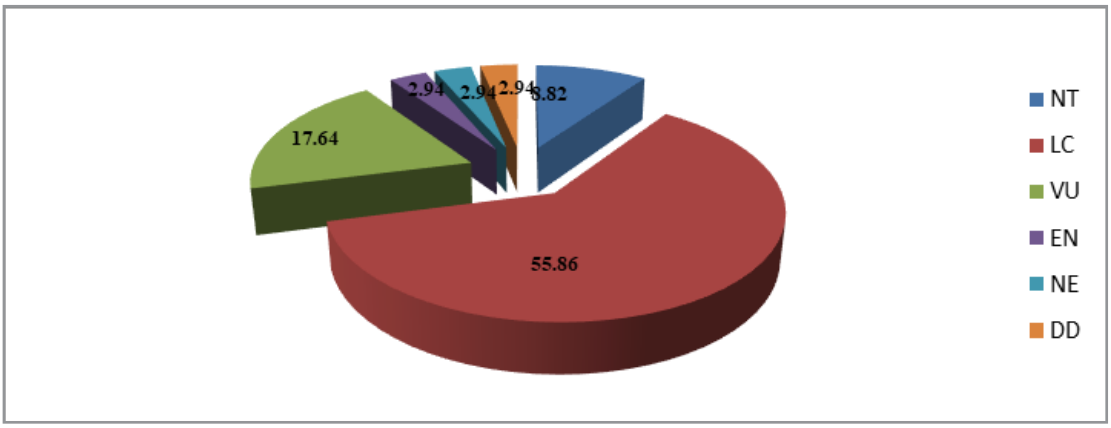


Figure 4: IUCN Conservation Status of Fish Fauna Represented as a Percentage

In December (3.15), with the lowest value recorded in July (2.54) in Chalan Beel, Bangladesh [25]. Indicated that lower H' values occur due to the depletion of the water spread area, while higher diversity in the post-monsoon season may result from adequate water volume and sufficient food resources. Sudhan (2017) found H' values ranging from 3.14 to 3.27 at the Pechiparai Reservoir in Tamil Nadu. The findings of the present study align with these previous observations.

Simpson's Diversity Index is a biodiversity measure that evaluates the number of species and their relative abundance. The Simpson Index ranges from 0 (indicating poor diversity) to 1 (indicating high diversity). The present study recorded the Simpson Diversity Index as 0.90 during the pre-monsoon season (February-May) and post-monsoon season, and 0.92 during the monsoon season [26]. Reported that the Simpson Diversity Index ranged from 0.965 to 0.974 in the Doyang Reservoir in Nagaland, India. Found the Simpson Index to vary from 0.49 to 0.79 in the semi-closed oxbow lake, Chhariganga, in the Naida district of West Bengal.

The results from the diversity indices—Margalef's Richness Index (d), Pielou's Evenness Index (J), Shannon-Weiner Index (H'), and Simpson Index (1-λ)—indicate high fish diversity in the beel, with a relatively even distribution of fish species and genera. This suggests that the beel is in favorable condition for fish production [27-30].

Conservation Status of Fish Species

Based on the IUCN Red List of Threatened Species (2023), the conservation status of fish species in the current study showed that 20 species (50.8%) were classified as Least Concern, 3 species (8.82%) as Near Threatened, and 6 species (17.64%) as Vulnerable. One species (2.94%) fell under the Endangered, Not Evaluated, and Deficient categories. For instance, Clarius magur was listed as Endangered and was found to be quite scarce in the beel. Hypophthalmichthys molitrix, Wallago attu, and Ompok pabda were categorized as Near Threatened. These species require special attention for their conservation and propagation. According to the Conservation Assessment and Management Plan (CAMP, 1998), the majority of species (13 species, 38.22%) were categorized as Lower Risk Near Threatened (LRnt), 3 species (8.82%) as Lower Risk Least Concern (LRlc), 7 species (20.58%) as Vulnerable (VU), 3 species (8.82%) as Near Threatened (NT), 1 species (2.94%) was Not Evaluated, and 2 species (5.88%) were Data Deficient (DD). Since the CAMP report's release in the late 1990s, threats to these fish species have likely increased due to habitat loss, degradation, climate change, and other environmental pressures. Our findings for Charipunia Beel reflect a similar pattern, with 2.94% of the species classified as threatened, underscoring the importance of long-term management and conservation efforts to maintain sustainability [31, 32]].

Conclusion

From the study, the beel supports a high level of fish diversity, with a relatively balanced distribution of fish genera, which suggests a healthy ecosystem conducive to fish production. How-

ever, the study also identified challenges local fishermen face, such as water pollution, inadequate aquaculture management, environmental degradation, and a lack of knowledge regarding the characteristics of cultured species. The fisheries of Charipunia beel are mainly dominated by Cirrhinus mrigala, Puntius sophore, Mystus tengara, Amblypharyngodon mola, Labeo rohita, Catla and other miscellaneous species. Some indigenous fish species in the Charipunia beel are listed under the endangered (EN) category, e.g., Clarius magur. Fishes like Hypophthalmichthys molitrix, Ompok pabda, and Wallago attu are under the Near Threatened (NT) category. The ornamental fish industry, representing 35.28% of the species (12 species) recorded, offers an opportunity for local youth. Nevertheless, human activities such as jute retting, the disposal of domestic waste, and frequent fishing could negatively impact fish growth and overall production, unless effective management measures are implemented. Mass awareness programmes should be conducted for the sustainable use and conservation of fishery resources [33].

References

1. Mitsch, W. J., & Gosselink, J. G. (1986). Wetlands. Van Nostrand Reinhold. New York. 539
2. Srivastava, N. P., & Bhattacharjya, B. K. (2003). Status of fisheries of floodplain wetland of Assam. In G. K. Vinci, B. C. Jha, U. Bhaumik, & K. Mitra (Eds.), Fisheries management of floodplain wetlands in India. Bulletin No. 125. CIFRI. 22-29.
3. Sugunan, V. V., & Bhattacharjya B. K. (2000). Ecology and fisheries of beels in Assam. Bulletin No. 104. CIFRI, Barrackpore. 65.
4. Bhagabati, A. K., Kar, B. K. & Bora, A. K. (2002). Geography of Assam (2nd ed.), Rajesh Publications, New Delhi.
5. Greeson, P. B., Clark, J. R., & Clark, J. E. (1979). Wetland Functions and Values: The State of Our Understanding. Proc. Of the National Symposium on Wetlands, 1978. Amer, Water Resources Assoc., Minneapolis, Minnesota. 674.
6. Jhingran, A. (1991). Inland Fishes of India and Adjacent Countries. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 1158.
7. Goswami, U. C., Viswanath W., Jayaram K. C., & Datta M. J. S. (2007). Fish fauna of north east India. In: Goswami U.C. (ed) Natural and anthropogenic hazards on fish and fisheries, Narendra Publication House, Delhi. 21–46.
8. Farkade, S. V., Bhandarkar, K. B., & Sangve, K. B. (2023). Diversity and abundance of ichthyofauna in Shekhdari Dam, District Amravati, Maharashtra. Species, 24, e39s1531.
9. Jayaram, K. C. (2010). The Freshwater Fishes of the Indian Region. 2nd Edition, Narendra Publishing House, New Delhi, India.
10. Vishwanath, W. (2000). Fishes of North East India: A field guide to species Identification. National Bureau of Fish Genetic Resources.Lucknow.
11. Acharjee, B., Chaudhury, M., Dutta, A., & Goswami, U. C. (1998). Productivity and fish yield in the beels of the lower Brahmaputra basin. Indian Journal of Fisheries, 45(4), 419-427
12. Fernandes, B., & Achuthankutty, C. T. (2010). Seasonal variation in fishery diversity of some wetlands of the Salcete Taluka, Goa, India. Indian Journal of Marine Science, 39(2), 238-247
13. Barhai, A., Das, S., Das, & Kar. D. (2015). A preliminary survey on the ichthyospecies diversity of Hasila Beel, Urpad Beel, Kumari Beel, Sidli Beel, and Seksekia Beel in the Goalpara district of Assam, India. International Research of Advanced Research, 3(6), 678-684.
14. Talukdar, K.J. and Rajbongshi, M. K (2018). Ichthyofaunal Diversity and Conservation Status of Puthimari beel of Barpeta, Assam, Indian. International Journal of Applied and Advanced Scientific Research,3(1), 233-237.
15. Nag. R., Singha, N., and Deka, P. (2017). A study on the fish diversity of Dhir Beel of Dhubri District of Assam, India. International Journal of Applied Research,3(5), 19-26
16. Singha, N. and Deka, R.N.P (2017). A preliminary study on ichthyofaunal diversity of Diplai Beel of Kokrajhar district of Assam, India. International Journal of Fisheries and Aquatic Studies, 5(3), 269-275.
17. Hussain, B. A., Chandra, B. Rand Amalesh, D. (2015). A study of the Limnology and Ichthyology of Dhir Beel at Dhubri, Assam, India. Int. Res. J. Biological Sci., 4(8), 40-48
18. Gogoi, B., Das, R., Abujam, S.K., and Das, D. N. (2016). Enumeration of Fish from Dulakhojiya beel (wetland) of Lakhimpur District, Assam, India. Journal of Fisheries Sciences, 10(4), 037-042.
19. Kalita, B., Chakraborty, A., & Dey, A. (2025). A Study on the Present Status of Fish Population, Abundance, and Anthropogenic Stressors Affecting the Ichthyofaunal Diversity in Deepor Beel, Assam, India, 17(2), 2249–3239.
20. Chawla, H., Singh, S., & Haritash, A. K. (2024). Reversing the damage: ecological restoration of polluted water bodies affected by pollutants due to anthropogenic activities. Environmental Science and Pollution Research, 31(1), 127-143.
21. Siddique, M. A. B., Hussian, M. A., Flowra, F. A., & Alam, M. M. (2016). Assessment of fish fauna in relation to biodiversity indices of Chalan Beel, Bangladesh. International Journal of Aquatic Biology. 4(5), 345–352.
22. Ghosh, D., & Biswas, J.K. (2017). Fish Fauna Faces Anthropogenic Double Trouble: Erosion of Fish Diversity in Tropical Oxbow Lake of the Ganga River Basin in Eastern India. Journal of Biodiversity and Endangered Species,5(2), 1-9.
23. Mugurran, A. E. (2004). Measuring Biological Diversity, Blackwell Publishing Service Ltd., Oxford, 256.
24. Hossain, M. S., Das, N. G., Sarker, S., & Rahaman, M. Z. (2012). Fish diversity and habitat relationship with environmental variables at Meghna River estuary, Bangladesh. The Egyptian Journal of Aquatic Research, 38(3), 213-226.
25. Murugan, A. S., & Prabaharan, C. (2012). Fish diversity about physico-chemical characteristics of Kamala Basin of Darbhanga District, Bihar, India. International Journal of Pharmaceutical and Biological Archives, 3(1), 211-217.
26. Kumzuk, R. (2019). Studies on finfish diversity with physico-chemical parameters of Doyang reservoir, Nagaland, India. Ph.D. Thesis. Vidyasagar University, Midnapore, West Bengal, India.
27. Baruah, D., Kunal, K., Sarma, D., Ahmad, P., Sharma, P., Singh, A. K., & Singh, N. D. (2018). Aquatic biodiversity in upland streams of Kameng drainage in Arunachal Pradesh. Journal of Krishi Vigyan, 7(1), 10-15.
28. Devashish, K. (2021). Fish and their habitats in the North-East India biodiversity hotspot. Oceanography & Fisheries Open Access Journal, 13(2), 555856. https://doi.

org/10.19080/OFOAJ.2021.13.555856
29. Devashish, K. (2023). Fish and food security: Pioneering updated taxonomic study of the fishes of Karbi Anglong in the Northeastern biodiversity hotspot. Nutrition & Food Science International Journal, 12(4), 555844. https://doi.org/10.19080/NFSIJ.2023.12.555844
30. Gopal, B. (1997). Biodiversity in Inland Aquatic Ecosystems in India. An overview. Inter. J. of Eco. and Env. Sci., 23, 305-313.
31. Goswami, C., & Kalita, M. P. (2012). Ichthyofaunal diversity and anthropogenic stress on Deepor Beel: the only Ramsar site in Assam. IOSR Journal of Environmental Science, Toxicology and Food Technology, 2(1), 54-59.
32. IUCN Red List of threatened species. (version 2021.1). www.iucnredlist.org downloaded in June 2021.
33. Talwar, P. K., & Jhingran, A. G. (1991). Inland fishes of India and adjacent countries. Volume 1. Oxford and IBH Publishing house, India. 1158.