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Cover: Indian Grey Wolf *Canis lupus pallipes* and Smooth-coated Otter *Lutrogale perspicillata* sharing the territory in Chambal basin. Digital art on Procreate by Aakanksha Komanduri.

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ARTICLE

Post-impoundment changes in fish diversity and community structure of the Dikrong River, Arunachal Pradesh: a comparative assessment between 2000–2001 and 2025–2026

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Abstract: A study carried out on the dam impacted Dikrong River, which is one of the major tributaries of the Brahmaputra in Arunachal Pradesh, suggests that the river has undergone significant ecological alteration following the commissioning of the Sopo dam in 2018 and increasing anthropogenic pressures. The present study attempted to assess the fish diversity, community structure, trophic composition, and conservation status in the Dikrong River during 2025–2026 and the results were compared with pre-impoundment records made in the year 2000–2001. A total of 27 fish species belonging to 24 genera, eight families, and three orders were recorded, with Cyprinidae dominating the assemblage (51.9%). *Opsarius bendelisis* was the most abundant species (44.1%). The taxonomic comparison with previous data reveals an apparent reduction in the number of species, mainly bottom feeders, which highlights their sensitivity to flow regulation and habitat modification. There was a change in the food chain from the dominance of bottom feeders to column feeders. Water release from regulation, riverbed quarrying, and runoff reduced the quality of the habitat and fish behavior. The juveniles of *Semiplotus semiplotus*, *Opsarius bendelisis*, and *Devario aequipinnatus* were found to be accumulating in the clean-connected drainage system downstream (polluted zone). The findings suggest a need for environmental flow regulation and habitat restoration to conserve remaining fish diversity. Further, the study recommends promotion of culture-based fisheries selecting some of the indigenous ornamental and food fish as a future conservation and livelihood strategy.

Keywords: Conservation status, flow regulation, habitat degradation, habitat restoration, hillstream fishes, fish assemblage, river regulation, Sopo Dam, trophic composition.

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Author contributions: MS—conceptualization, data collection, analysis of data set and preparation of the initial draft of the manuscript; TM, RF—data collection, species identification, editing, data validation; DND—species identification, and editing of the final version of the manuscript.

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INTRODUCTION

The natural environment provides the foundation for life by supporting energy flow, nutrient cycling, and ecological stability for the well-being of all organisms. Therefore, biodiversity is central to regulating these processes, which sustain ecosystem functions such as water purification, food production, and livelihood security (Costanza et al. 1997). Within aquatic ecosystems, fishes play a key role in maintaining trophic structure, enhancing ecosystem stability, and acts as sensitive indicators of environmental change. Globally, about 37,553 fish species have been described and 19,232 (51.2%) of these occur in freshwater ecosystems (Fricke et al. 2025). Beyond their ecological significance, fishes constitute an important source of high-quality animal protein and essential micronutrients.

Many people in developing countries depend on small indigenous species that form the backbone of food security and rural livelihoods (Dugan et al. 2006; Bell et al. 2009; Jamu et al. 2011). Similarly, as in the case of Northeast India, fishing is closely linked to the socio-cultural fabric of tribal communities, where conservation of freshwater fish diversity is utmost importance for both ecological sustainability and human well-being for the long run (Vishwanath 2017).

However, the freshwater fish biodiversity is experiencing an unprecedented decline worldwide, attributed to increasing anthropogenic pressures resulting from rapid population growth. Other factors such as urbanization, agricultural and industrial expansion, excessive application of fertilizers and pesticides, overfishing, pollution, habitat degradation, and water diversion have collectively declined freshwater fish populations (Dudgeon et al. 2006; Lakra et al. 2010).

Among these drivers, river damming and hydropower development have led to serious threats to aquatic fauna, including river regulation, habitat fragmentation, and altered flow regimes, which result in high negative impacts on freshwater ecosystems and their biodiversity (Winemiller et al. 2016; Couto & Olden 2018; Kuriqi et al. 2021). Even though, hydropower is widely considered a renewable energy source essential for human development activities. However, in the modern era, despite growing awareness among human society and management efforts on various aspects, freshwater ecosystems continue to experience biodiversity loss and ecological imbalance.

Strategic conservation approaches are therefore critical to safeguarding freshwater ecosystems and ensuring the sustained delivery of ecosystem services vital for environmental sustainability and human well-being (Margules & Pressey 2000; Saunders et al. 2002).

The state of Arunachal Pradesh, which is located within the Eastern Himalayan biodiversity hotspot, is one of the well-known biologically diverse regions of India, covering an area of approximately 83,743 km². The state is characterized by having rugged mountainous terrain, with nearly 70% of its land area under dense forest cover. The extensive network of rivers, streams, tributaries, and rivulets that drain the state provides highly suitable habitats for diverse assemblages of ichthyofauna and other aquatic organisms, rendering Arunachal Pradesh ecologically unique among the northeastern states of India.

Systematic documentation of fish diversity in Arunachal Pradesh has increased over the past two decades. The first comprehensive account reported 131 fish species from the state (Nath & Dey 2000), followed by subsequent additions by several researchers (Tamang et al. 2007; Bagra et al. 2009; Gurumayum et al. 2016; Darshan et al. 2019). Gurumayum et al. (2016) have reported 32 endemic fishes in Arunachal Pradesh, and Abujam et al. (2021) documented 52 indigenous ornamental fishes from the state. A recent assessment by Tamang and Das (2024) updated the fish checklist to 233 species, including 72 new fish species originally described from the state. This signifies that Arunachal Pradesh is a globally important hotspot of freshwater fish biodiversity. However, this exceptional diversity is increasingly threatened by rapid urbanization, land-use changes, shifting lifestyles, and the indiscriminate use of modern fishing techniques, which have collectively resulted in a noticeable decline in fish populations across many aquatic systems in the region (Chaudhry & Tamang 2007; Tamang & Shivaji 2012). For instance, Taro et al. (2022) documented severe habitat fragmentation and degradation in the Senkhi River within the Itanagar Wildlife Sanctuary, along with the local extinction of 14 fish species.

The Dikrong River, one of the major tributaries in Papum Pare district, has received limited scientific attention in recent years. Nath & Dey (2000) recorded 85 fish species from the Dikrong River at Doimukh, which also constitutes the present study area. Since that initial assessment, no comprehensive investigation has been conducted on the changes that have occurred in fish diversity or population structure within this river system. In recent years, local communities have reported a perceptible decline in fish abundance and diversity following the operation of the Sopo Dam. Given that indigenous communities in Arunachal Pradesh predominantly depend on indigenous hillstream fishes that are closely linked with their cultural traditions and subsistence practices, such declines indicate serious hampering of ecological and socio-cultural aspects. Therefore, the present study aims to scientifically assess the perceived impacts of the Sopo Dam on fish diversity and population dynamics in the Dikrong River. In addition, among the freshwater ichthyofauna, ornamental fishes represent an important component, both ecologically and economically. Many species found in Arunachal Pradesh possess attractive coloration, distinctive body shapes, and interesting physical and behavioural traits that make them highly valuable in the aquarium trade (Abujam et al. 2021).

MATERIALS AND METHODS

Study Site

The study was conducted in the Dikrong River, a major north-bank tributary of the Brahmaputra River, which originates in the lesser Himalayan ranges beyond the Sagalee Hills (Image 1). The river is formed by the confluence of multiple tributaries and is locally known as the "Pare River" beyond Hoj Village. The Dikrong River is situated approximately about 35 km east of Itanagar near the eastern boundary of the Itanagar Wildlife Sanctuary (IWS). The Dikrong flows west to east before turning southward from Sopo Dam and then again turning to east at Doimukh and eventually merges with the Brahmaputra in Assam. The dynamic course of river and dependence on Himalayan catchments make it highly sensitive to seasonal rainfall, upstream interventions, and geomorphological changes, especially in the context of dam construction and watershed alterations. The study covered an approximately 11.5 km stretch (27.1290° N, 93.7692° E to 27.2532° N, 93.7669° E) of the Dikrong River downstream of Sopo Dam, with sampling conducted from downstream to upstream (image 1). River width was measured at 15 sites using a nylon thread and measuring tape during both low-flow and dam-release periods.

Sopo Dam

The Sopo Dam (27.2378° N, 93.8076° E to 27.2532° N, 93.8102° E), part of the Pare Hydropower Project, was commissioned in May 2018 and has been in operation for the last seven years. The project was developed by the North Eastern Electric Power Corporation Limited (NEEPCO). Water released from the Ranganadi Dam at Yazali in Lower Subansiri District is conveyed to the Dikrong Power House at Hoj village, contributing additional discharge to the Sopo Dam. Prior to dam construction, Nath & Dey (2000) documented 85 fish species from the Dikrong River.

Fish Sampling and Identification

Fish sampling was conducted using a cast net (2.3 m radius, 7 × 7 mm mesh size) over 10 days from 1–10 December 2025, primarily between 0500–0700 h, with three-night samplings from 1800–2000 h. Sampling covered various microhabitats, including shallow, deep, moderate, and torrential flow zones. The catch per unit effort (CPUE) was calculated from five replicates per hour, with the sampling intensity ranging 50–55 cast net throws/hour. Collected specimens were transported to the Laboratory of Department of Zoology, Rajiv Gandhi University, and then identified following Talwar & Jhingran (1991), Nath & Dey (2000), and Darshan et al. (2019), and subsequently deposited in the Rajiv Gandhi University Museum of Fishes (RGUMF). Valid scientific names were verified using Eschmeyer's Catalogue of Fishes (Fricke et al. 2025).

Trophic classification and conservation status

The trophic niche of each species was determined based on mouth position and categorized as: Inferior/Sub-inferior (bottom feeders), Terminal/Sub-terminal (column feeders), Oblique/Slightly oblique (surface feeders). Species richness categories were assigned as: Abundant (91–100 %), Common (81–90 %), Frequent (61–80 %), Occasional (31–60 %), Sporadic (15–30 %), Rare (5–14 %), and Extremely Rare (<5 %) (Table 1). The conservation status of each species was assessed according to the IUCN Red List of Threatened species (2025-2) (Table 1).To assess temporal changes, the present survey was compared with the fish checklist reported by Nath & Dey (2000) (Table 2). The specimens previously identified as *Aborichthys kempi* were re-examined and following Nanda et al. (2021), correctly identified as *Aborichthys uniobarensis*. So, *Aborichthys kempi* was previously misidentified.

Data Analysis

Species abundance was determined by counting individuals collected per sampling day. The Relative Abundance (RA) of each study site was calculated by dividing the number of individuals of a species by the total number of individuals of all the species multiplying by 100. The fish diversity indices were calculated as per standard method (Shannon & Wiener 1963) by the formula: $H = -\Sigma (ni/N) \log2 (ni/N)$, where, H = Shannon-

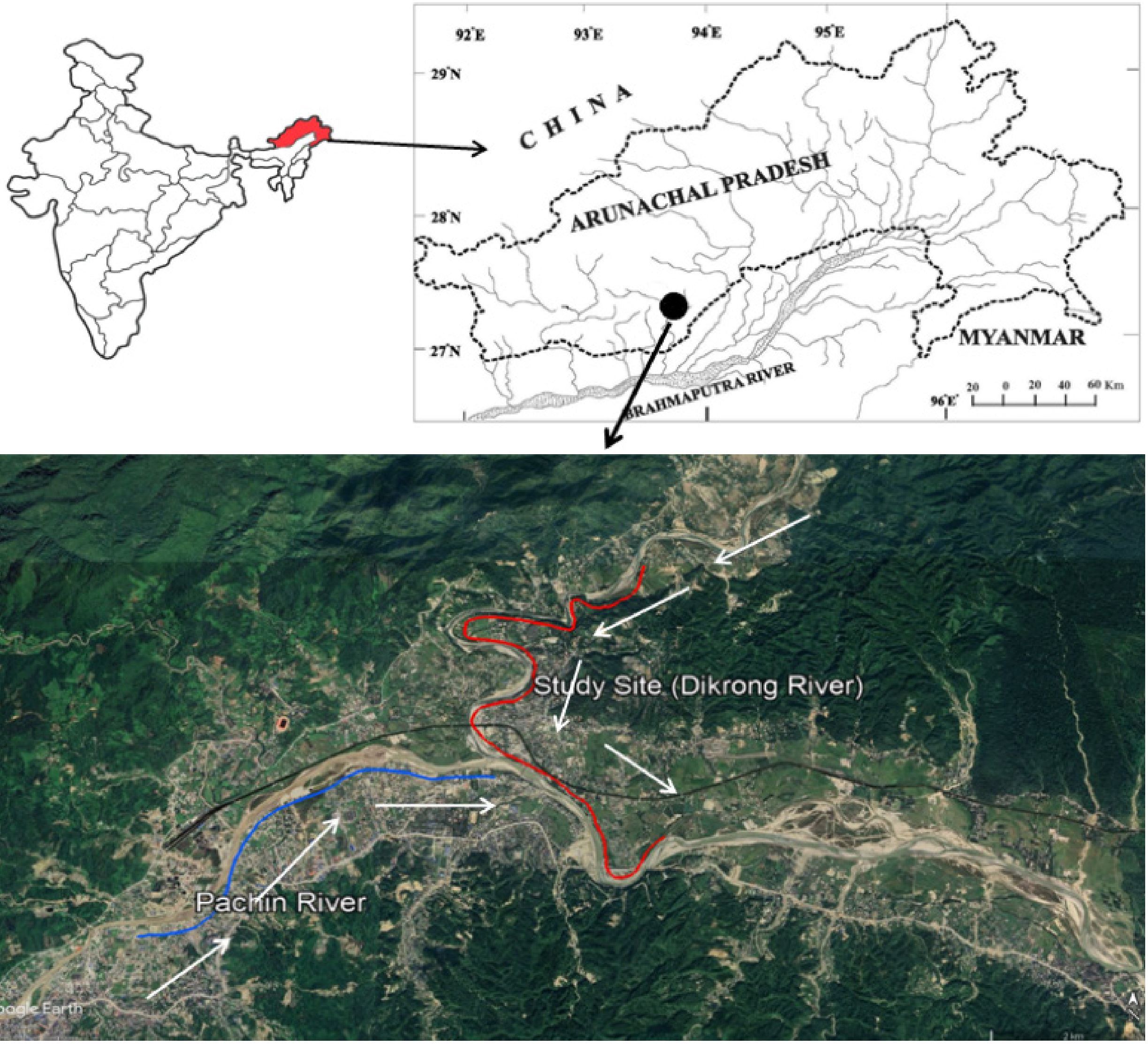

Image 1. Map of India showing Arunachal Pradesh and the study area. The red line indicates the Dikrong River (study site) and the blue line indicates the Pachin River. Both rivers converge just upstream of the Doimukh RCC bridge. Lines are drawn along the river courses, and arrows show direction of the water flow.

Image 2. Field conditions at the study site showing fish sampling activities, habitat degradation, and household debris pollution. © Minam Siram.

Wiener index of diversity, ni = total numbers of individuals of a species and N = total number of individuals of all the species. Evenness of the species was calculated following Pielou's evenness index (Pielou's 1966), i.e. J =H'max/logS, where: H'max = is the maximum value of Shannon-Wiener's index, and S = is the total number of species. The value of E falls between 0 and 1. The less variation in communities between the species, the higher would be the E value. Simpson's diversity index was calculated by the formula: $D = 1-(\Sigma n(n-1)/N(N-1))$, where D = Diversity, n = number of individuals of a single species, N = total number of all species. All the diversity indices were performed using PAST (Paleontological Statistics) software version 4.02 (Hammer et al. 2001).

RESULTS AND DISCUSSION

Fish Diversity, composition, and temporal change

The present study recorded 27 fish species belonging to 24 genera, eight families, and three orders, which included Cypriniformes, Siluriformes, and Mugiliformes (Table 1, Image 3). The order Cypriniformes dominated the fish assemblage with 20 species, and Cyprinidae was the most abundant family (14 species; 51.9%), followed by Danionidae (14.8%), Nemacheilidae (11.1%), and Sisoridae (7.4%). Among these, four families, namely, Botiidae, Balitoridae, Psilorhynchidae, and Ambassidae were represented by a single species each (Table 1 and Image 4). Six additional species (*Balitora brucei*, *Glyptothorax trilineatus*, *Pseudolaguvia vespa*, *Garra birostris*, *Mustura dikrongensis*, and *Schistura scaturigina*) were new additions in the present study and were not reported by Nath & Dey (2000). Excluding these six new records, comparison with 85 species reported by Nath & Dey (2000) from the Dikrong River prior to dam construction revealed that 64 species were not encountered in the present survey, suggesting a substantial decline in fish diversity.

However, since the present sampling was limited to 10 days, it should be interpreted with caution, because the short sampling period may not capture rare, seasonal, or cryptic species. There may be differences in sampling season, sampling effort, and fishing gear between the present and previous studies, which may also have influenced species detectability. It would be more evident if an intensive survey throughout the year were conducted for better results. Despite this limitation, this sharp reduction in species richness suggests post-impoundment ecological alteration following the commissioning of the Sopo Dam in 2018 and may include other anthropogenic activities**.**

This pattern is partially supported by the findings of Bagra et al. (2009), who surveyed 35 rivers covering a wide range of Arunachal Pradesh, including the Dikrong River, between March 2004 and March 2008. The study showed records of 40 fish species in the Dikrong River, but the sampling duration was not given in the literature. Considering that the survey covered a large geographic area, the sampling effort was likely limited and may have been comparable to the present study (10 sampling days).

This is further supported by the findings of Gurumayum (2025), who recorded 20 fish species only after conducting two days of sampling for four hours each from a small drainage (Buka nallah), a tributary of the dam impacted Dikrong River that flows through Sopo village, during January and April 2023, which comprised mostly bottom feeders (65%). Interestingly, Gurumayum (2025) recorded 20 species within a short sampling duration, whereas we recorded 27 species from the main river despite more sampling effort. This comparison further supports a likelihood of a reduction in fish diversity in the Dikrong River.

Furthermore, in support of this interpretation, the study by Rao et al. (2021) highlighted that small hydropower projects have a substantial effect on river flow regimes, which consequently affect habitats, change the quality of water, and disrupt fish community compositions. Unpredictable alterations in downstream river water levels affect the stability of the habitats where natural flow regimes occur, which primarily affects sensitive and migratory species. Changes in breeding sites and recruitment processes are also affected by this instability. Thus, all the effects described above indicate that the influence of SHPs, including the Sopo Dam, may be degrading the riverine environment and associated aquatic ecosystems.

Relative abundance and community structure

Fish abundance was highly uneven, with *Opsarius bendelisis* dominating the assemblage (44.1%), followed by *Semiplotus semiplotus* (21.7%). A few species, such as *Bangana dero* (6.1%) and *Devario aequipinnatus* (5.4%), were relatively rare, while the majority of species (n = 23) were extremely rare, each contributing <4% of the total abundance (Image 5). This skewed distribution suggests a community under ecological stress, where only a few tolerant or opportunistic species dominate, whereas most species persist at very low frequencies.

Table 1. Taxonomic composition, IUCN Red List status, trophic niche, relative abundance (%) and abundance status of fish species recorded from the study area.

I. Order: Cypriniformes	IUCN Red List status	Trophic niche	Abundance (%)	Abundance status
i. Family: Botiidae				
1. *Botia rostrata* Gunther, 1868	Vulnerable	Sub-inferior	0.5	Extremely rare
ii. Family: Balitoridae				
2. *Balitora brucei* Gray, 1830	Near Threatened	Inferior	0.9	Extremely rare
iii. Family: Nemacheilidae				
3. *Aborichthys uniobarensis* Nanda et al., 2021	Not Evaluated	Inferior	0.5	Extremely rare
4. *Schistura scaturigina* (McClelland, 1839)	Least Concern	Inferior	1.1	Extremely rare
5. *Mustura dikrongensis* Lokeshwor & Vishwanath, 2012	Not Evaluated	Inferior	0.2	Extremely rare
iv. Family: Psilorhynchidae				
6. *Psilorhynchus balitora* (Hamilton, 1822)	Least Concern	Inferior	3.6	Extremely rare
v. Family: Cyprinidae				
7. *Chagunius chagunio* (Hamilton, 1822)	Least Concern	Sub-terminal	0.7	Extremely rare
8. *Barilius vagra* (Hamilton, 1822)	Least Concern	Terminal	0.9	Extremely rare
9. *Labio pangusia* (Hamilton, 1822)	Near Threatened	Sub-terminal	0.7	Extremely rare
10. *Tor putitora* (Hamilton, 1822)	Endangered	Terminal	2.5	Extremely rare
11. *Neolissochilus hexagonolepis* (McClelland, 1839)	Near Threaten	Terminal	0.5	Extremely rare
12. *Bangana dero* (Hamilton, 1822)	Least Concern	Sub-terminal	6.1	Rare
13. *Cabdio morar* (Hamilton, 1822)	Least Concern	Sub-terminal	0.5	Extremely rare
14. *Garra annandalei* Hora, 1921	Least Concern	Inferior	1.6	Extremely rare
15. *Garra birostris* Nebeshwar & Vishwanath, 2013	Not Evaluated	Inferior	0.9	Extremely rare
16. *Puntius conchonius* (Hamilton, 1822)	Least Concern	Terminal	0.2	Extremely rare
17. *Puntius sophore* (Hamilton, 1822)	Least Concern	Terminal	1.8	Extremely rare
18. *Pethia ticto* (Hamilton, 1822)	Least Concern	Terminal	0.7	Extremely rare
19. *Raiamas bola* (Hamilton, 1822)	Least Concern	Terminal	1.6	Extremely rare
20. *Semiplotus semiplotus* (McClelland, 1839)	Vulnerable	Terminal	21.7	Sporadic
vi. Family: Danionidae				
21. *Danio rerio* (Hamilton, 1822)	Least Concern	Oblique	1.1	Extremely rare
22. *Devario aequipinnatus* (McClelland, 1839)	Least Concern	Oblique	5.4	Rare
23. *Opsarius barna* (Hamilton, 1822)	Least Concern	Slightly oblique	1.4	Extremely rare
24. *Opsarius bendelisis* (Hamilton, 1807)	Least Concern	Terminal	44.1	Occassional
II. Siluriformes				
vii. Sisoridae				
25. *Glyptothorax trilineatus* Blyth 1860	Least Concern	Inferior	0.5	Extremely rare
26. *Pseudolaguvia vespa* Praveenraj et al., 2021	Not Evaluated	Inferior	0.2	Extremely rare
III. Mugiliformes				
viii. Ambassidae				
27. *Chanda nama* Hamilton, 1822	Least Concern	Oblique	0.2	Extremely rare

Diversity indices supported this pattern (Table 3). Moderate Shannon diversity (H' = 2.004) and evenness (E = 0.608), together with a relatively high Simpson's index of diversity (1 − D = 0.748), indicate that although species richness has declined, the remaining community still retains moderate diversity but is strongly dominated by a few species.

Trophic structure and ecological shifts

The functional ecological guilds provide greater

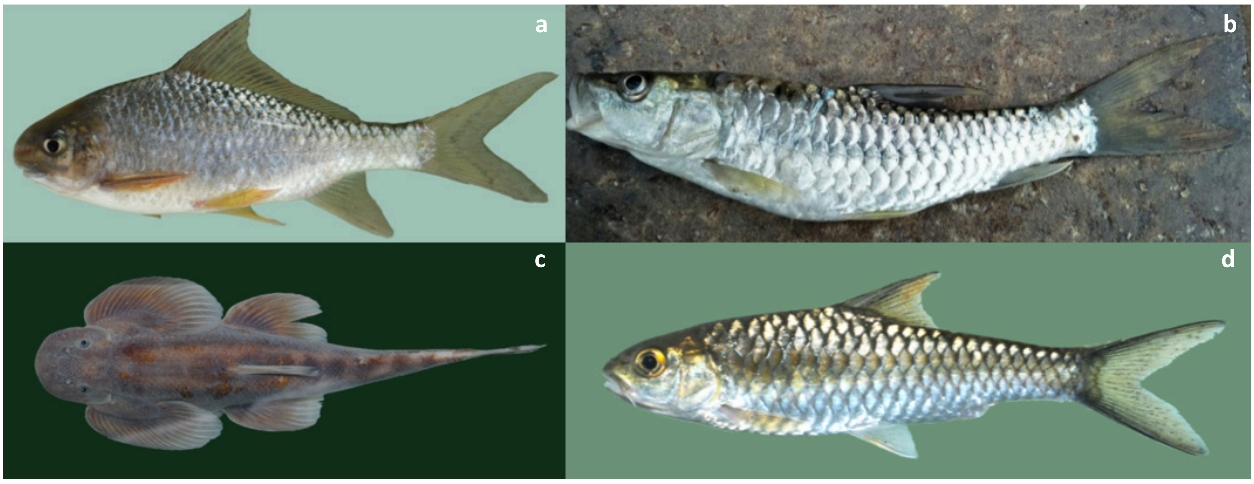

Image 3. Fish species of conservation concern recorded from the study site (Dikrong River): a—*Semiplotus semiplotus* (Vulnerable) | b—*Tor putitora* (Endangered) | c—*Balitora brucei* (Near Threatened) | and d—*Neolissochilus hexagonolepis* (Near Threatened). Photographed by- Lakpa Tamang (Museum Attendant, RGUMF).

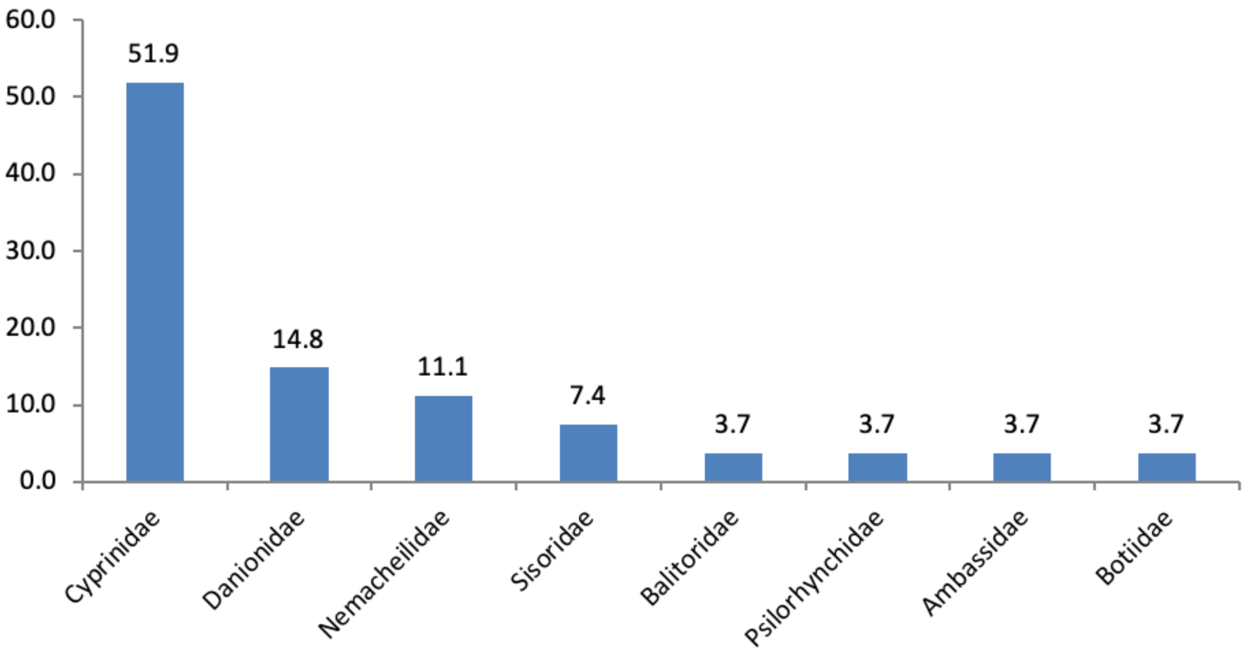

Image 4. Percentage composition of fish species among families in the Dikrong River, showing the dominance of Cyprinidae.

insight into fish community structure, and it is easier to examine the trophic state and environmental stresses affecting the rivers (Deegan et al. 1997; Mathieson et al. 2000; Elliott et al. 2007; Henriques et al. 2008; Keila et al. 2014). Trophic guild analysis revealed clear shifts in feeding structure. Among the 21 comparable species recorded in the present study (excluding six newly recorded species), column feeders dominated (62%), while bottom feeders and surface feeders each accounted for 19% (Image 6). In contrast, Nath & Dey (2000) reported a higher proportion of bottom feeders, reflecting a benthic-resource-rich system prior to dam construction. Remarkably, among the 64 species not encountered from the present study, bottom feeders constituted the largest proportion (52%), followed by column feeders (36%) and surface feeders (12%) (Image 7). The above loss of some benthic fish species shows that the bottom-feeding fishes are quite sensitive to alterations in flow regimes, sediment dynamics, and substrate composition, all of which are characteristic

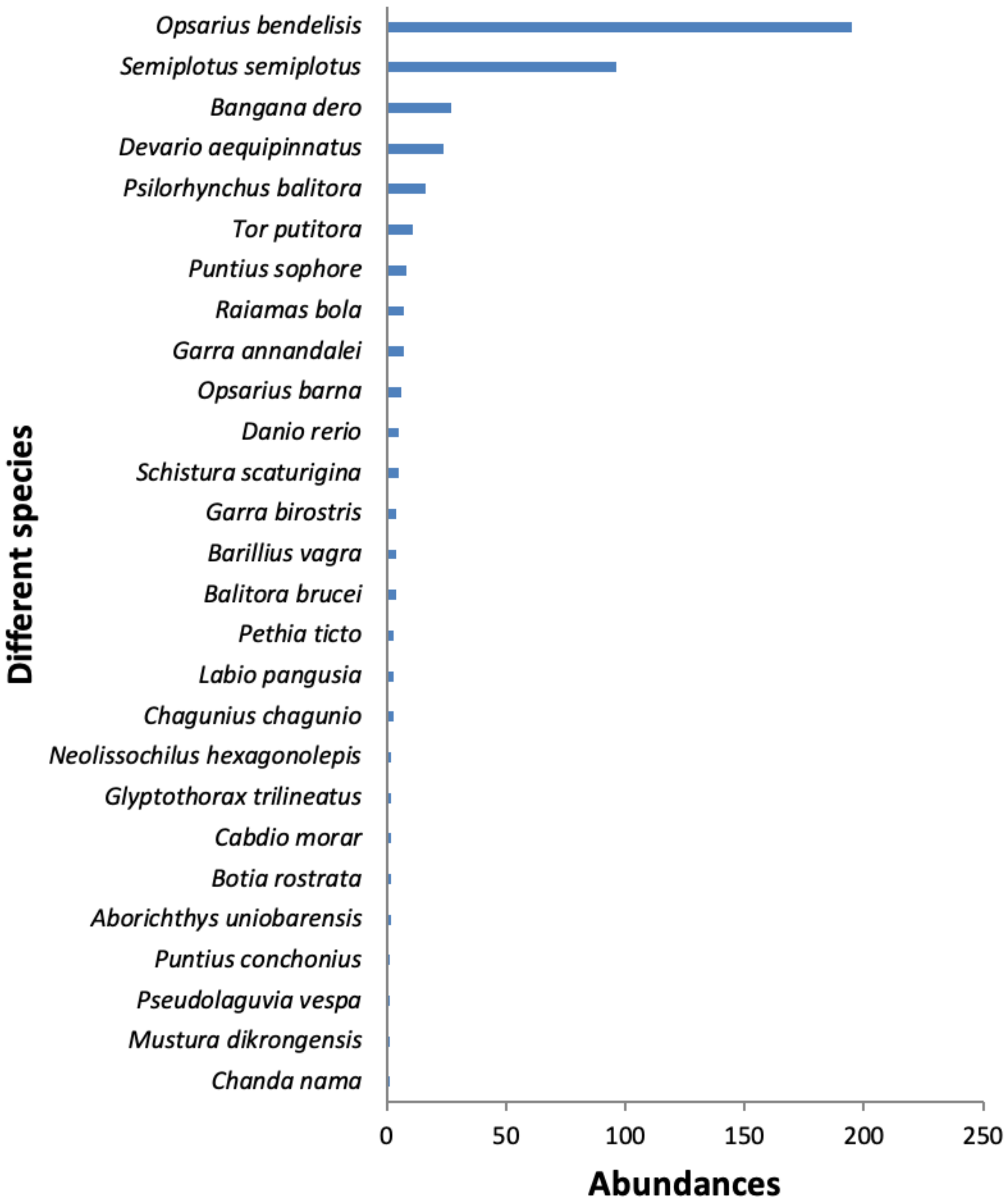

Image 5. Species-wise abundance of fishes recorded from the site (Dikrong River) during the present study.

effects of dam construction. As indicated in Table 1, extremely rare hillstream bottom feeders included multiple taxa such as *Botia rostrata*, *Balitora brucei*, *Aborichthys uniobarensis*, *Schistura scaturigina*, *Mustura dikrongensis*, *Psilorhynchus balitora*, *Garra annandalei*, *Garra birostris*, *Glyptothorax trilineatus*, and *Pseudolaguvia vespa*. The disproportionate loss of bottom-feeding species highlights their vulnerability to flow regulation, sediment modification, and habitat homogenization associated with dam operations.

Influence of Sopo Dam and flow regulation

Rheophilic and bottom-dwelling fish species are among the most vulnerable to hydropeaking due to their constant exposure to fluctuating river regimes (García et al. 2011; Moreira et al. 2019). These populations have been reported to declined over the past 50 years (Deinet et al. 2020) as river fragmentation obstructs the natural migration process required to complete their life cycles (Ovidio & Philippart 2008; Branco et al. 2017; Pfauserová et al. 2020). Low flow causes fish stranding and egg dewatering (Nagrodski et al. 2012), while high flow cause fish to find shelter and egg dislodging (Costa et al. 2019; Baladrón et al. 2021). Moreover, variability in flow and temperature impacts prey abundance by eliminating benthic invertebrates (Bruno et al. 2013).

Table 2. Comparative checklist of fish species of the Dikrong River current status based on Nath & Dey (2000) and the present study (2025).

	Family/Species	Revised nomenclature	Dikrong River (Nath & Dey 2000)	Dikrong River (present study)
	i. Family: Anguillidae			
1	*Anguilla bengalensis* (Gray, 1839)	-	+	0
	ii. Family: Clupeidae			
2	*Gudusia chapra* (Hamilton, 1822)	-	+	0
	iii. Family: Botiidae			
3	*Botia dario* (Hamilton, 1822)	-	+	0
4	*Botia rostrata* (Günther)	-	+	+
	iv. Family: Cobitidae			
5	*Lepidocephalus guntea* (Hamilton, 1822)	*Lepidocephalichthys guntea*	+	0
6	*Lepidocephalus annandalei* (Hora, 1921)		+	0
	v. Family: Balitoridae			
7	*Balitora brucei*(Gray, 1830)	-	0	+
	vi. Family: Nemacheilidae			
8	*Aborichthys elongatus* (Hora)	-	+	0
9	*Aborichthys kempi* (Chaudhuri, 1912)	*Aborichthys uniobarensis* Nanda et al., 2021	+	+
10	*Acanthocobitis botia* (Hamilton, 1822)	*Paracanthocobitis botia*	+	0
11	*Mustura dikrongensis* Lokeshwor & Vishwanath, 2012	-	0	+
12	*Noemacheilus* arunachalensis (Dutta & Barman)	*Schistura tirapensis,* Kottelat, 1990	+	0
13	*Schistura scaturigina* (McClelland, 1839)	-	0	+
14	*Shistura sikmaiensis* (Hora, 1921)	-	+	0
	vii. Family: Psilorhynchidae			
15	*Psilorhynchus balitora* (Hamilton, 1822)	-	+	+
	viii. Family: Cyprinidae			
16	*Acrossocheilus hexagonolepis* (McClelland, 1839)	*Neolissochilus hexagonolepis*	+	+
17	*Amblypharyngodon mola* (Hamilton, 1822)	-	+	0
18	*Aspidoparia jaya* (Hamilton, 1822)	*Cabdio jaya*	+	0
19	*Aspidoparia morar* (Hamilton, 1822)	*Cabdio morar*	+	+
20	*Barilius bola* (Hamilton, 1822)	*Raiamas bola*	+	+
21	*Barilius tileo* (Hamilton, 1822)	*Opsarius tileo*	+	0
22	*Barilius vagra* (Hamilton, 1822)	-	+	+
23	*Chagunius chagunio* (Hamilton, 1822)	-	+	+
24	*Chela laubuca* (Hamilton, 1822)	*Laubuka laubuca*	+	0
25	*Cirrhinus reba* (Hamilton, 1822)	-	+	0
26	*Crossocheilus latius latius* (Hamilton, 1822)	*Tariqilabeo latius*	+	+
27	*Garra annandalei* Hora, 1921	-	+	+
28	*Garra birostris* Nebeshwar & Vishwanath, 2013	-	0	+
29	*Garra gotyla gotyla* (Gray, 1830)	*Garra gotyla*	+	0
30	*Garra kempi* Hora, 1921	-	+	0
31	*Garra lissorhynchus* (McClelland, 1842)	-	+	0
32	*Garra mcclellandi* (Jerdon, 1849)	-	+	0
33	*Labeo dero* (Hamilton, 1822)	*Bangana dero*	+	+
34	*Labeo pangusia* (Hamilton, 1822)	-	+	+
35	*Puntius chola* (Hamilton, 1822)	-	+	0
36	*Puntius conchonius* (Hamilton, 1822)	-	+	+
37	*Puntius sarana sarana* (Hamilton, 1822)	*Puntius sarana*	+	0

	Family/Species	Revised nomenclature	Dikrong River (Nath & Dey 2000)	Dikrong River (present study)
38	*Puntius sophore* (Hamilton, 1822)	-	+	+
39	*Puntius ticto* (Hamilton, 1822)	*Pethia ticto*	+	+
40	*Rasbora daniconius* (Hamilton, 1822)	-	+	0
41	*Rasbora elanga* (Hamilton, 1822)	-	+	0
42	*Rasbora rasbora* (Hamilton, 1822)	-	+	0
43	*Salmostoma bacaila* (Hamilton, 1822)	-	+	0
44	*Schizothorax richardsonii* (Gray)	-	+	0
45	*Semiplotus semiplotus* (McClelland, 1839)	-	+	+
46	*Tor putitora* (Hamilton, 1822)	-	+	+
47	*Tor tor* (Hamilton, 1822)	-	+	0
	ix. Family: Danionidae			
48	*Barilius barna* (Hamilton, 1822)	*Opsarius barna*	+	+
49	*Barilius bendelisis* (Hamilton, 1807)	*Opsarius bendelisis*	+	+
50	*Brachydanio rerio* (Hamilton, 1822)	*Danio rerio*	+	0
51	*Danio aequipinnatus* (McClelland, 1839)	*Devario aequipinnatus*	+	+
52	*Danio dangila* (Hamilton, 1822)	-	+	0
53	*Danio devario* (Hamilton, 1822)	*Devario devario*	+	0
	x. Family: Clariidae			
54	*Clarias batrachus* (Linnaeus, 1758)	-	+	0
	xi. Family: Siluridae			
55	*Ompok pabda* (Hamilton, 1822)	-	+	0
56	*Ompok pabo* (Hamilton, 1822)	-	+	0
57	*Silurus afghana* (Günther, 1864)	*Pterocryptis indica*	+	0
58	*Somileptes gongota* (Hamilton, 1822)	*Canthophrys gongota*	+	0
59	*Wallago attu* (Bloch & Schneider 1801)	-	+	0
	xii. Family: Bagridae			
60	*Mystus bleekeri* (Day)	-	+	0
61	*Mystus cavasisus* (Hamilton, 1822)	-	+	0
62	*Mystus montanus* (Jerdon, 1849)	-	+	0
63	*Mystus vittatus* (Bloch, 1794)	-	+	0
64	*Olyra longicaudata* (McClelland, 1842)	-	+	0
	xiii. Family: Amblycipitidae			
65	*Amblyceps apangi* (Nath & Dey, 1989)	-	+	0
66	*Amblyceps arunachalensis* (Nath & Dey)	-	+	0
67	*Amblyceps mangois* (Hamilton, 1822)	-	+	0
	xiv. Family: Heteropneustidae			
68	*Heteropneustes fossilis* (Bloch)	-	+	0
	xv. Family: Sisoridae			
69	*Bagarius bagarius* (Hamilton, 1822)	-	+	0
70	*Glyptothorax trilineatus* Blyth, 1860	-	0	+
71	*Pseudolaguvia vespa* Praveenraj et al., 2021	-	0	+
	xvi. Family: Mastacembelidae			
72	*Macrognathus aral* (Bloch & Schneider)	-	+	0
73	*Macrognathus pancalus* (Hamilton, 1822)	-	+	0
74	*Mastacembelus armatus* (Lacépède)	-	+	0
	xvii. Family: Chaudhuriidae			
75	*Pillaia indica* Yazdani, 1972	-	+	0

	Family/Species	Revised nomenclature	Dikrong River (Nath & Dey 2000)	Dikrong River (present study)
	Family: Synbranchidae			
76	*Monopterus cuchia* (Hamilton, 1822)	*Opichthys cuchia*	+	0
	xviii. Family: Anabantidae			
77	*Anabas testudineus* (Bloch, 1792))	-	+	0
	xix. Family: Channidae			
78	*Channa marulius* (Hamilton, 1822)	-	+	0
79	*Channa orientalis* (Schneider)	-	+	0
80	*Channa punctatus* (Bloch, 1793)	*Channa punctata*	+	0
81	*Channa striatus* (Bloch)	-	+	0
	xx. Family: Nandidae			
82	*Nandus nandus* (Hamilton, 1822)	-	+	0
	xxi. Family: Badidae			
83	*Badis badis* (Hamilton, 1822)	-	+	0
	xxii. Family: Belonidae			
84	*Xenentodon cancila* (Hamilton, 1822)	-	+	0
	xxiii. Family: Ambassidae			
85	*Chanda nama* (Hamilton, 1822)	-	+	+
86	*Parambassis baculis* (Hamilton, 1822)	*Chanda baculis*	+	0
87	*Parambassis ranga* (Hamilton, 1822)	*Chanda ranga*	+	0
	xxiv. Family: Gobiidae			
88	*Glossogobius giuris* (Hamilton, 1822)	-	+	0
	xxv. Family: Erethitidae			
89	*Erethistes pussilus* Müller & Troschel, 1849	-	+	0
90	*Hara hara* (Hamilton, 1822)	-	+	0
	xxvi. Family: Notopteridae			
91	*Notopterus notopterus* (Pallas, 1769)	-	+	0
		Total species	**85**	**27**

+—presence | 0—absence | -—valid species (no change).

Table 3. Species diversity indices of the study site (Dikrong River), Papum Pare District, Arunachal Pradesh.

Species richness	27
Evenness (E)	00.608
Shannon-Weiner Index 9H)	2.004
Simpson's Index (D)	00.252
Simpson's Index of Diversity (1-D)	00.748

Table 4. Physico-chemical characteristics of water of the study site (Dikrong River), Papum Pare District, Arunachal Pradesh.

Water quality	Range	Mean ± SD
BOD (mg/L)	3.5–4.5	4.2 ± 1.5
Dissolved oxygen (mg/L)	7.7–8.5	8.08 ± 3.2
TDS (ppm)	25.7–66.7	46.77 ± 17.6
Temperature (°C)	13.3–17.7	15.56 ± 5.8

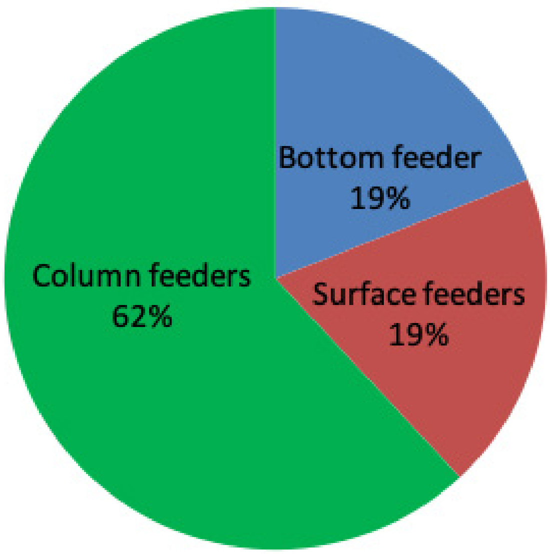

Image 6. Trophic niches of 21 fish species encountered in the present study (Dikrong River).

Our field observations downstream of the Sopo Dam indicated pronounced flow regulation effects. Water releases, typically occurring in the late afternoon (~1700 h), caused rapid increases in water level and were associated with transient increases in catches of *Opsarius bendelisis*, likely due to forced displacement toward river margins. Conversely, prolonged low-flow conditions (December 2025) during mornings and daytime resulted in minimal fish activity and very low catch rates, even in structurally complex habitats beneath boulders. Based on 15 replicate measurements across the study site, river width decreased by 10–56 m (mean ± SD = 29.9 ± 12.6 m) during low-flow periods, compared to 69–150 m (mean ± SD = 92.7 ± 21.8 m) during dam release periods.

Habitat structure, water quality, and anthropogenic pressures

The riverbed substrate composition consisted mainly of boulders, cobbles, pebbles, and gravels, whereas sandy substrates were found beyond the border between Arunachal Pradesh and Assam at Banderdewa. The limited presence of riparian vegetation along the study site can be attributed to low bank stability due to the lack of sufficient vegetation cover in comparison with the upstream sections of the river. Dissolved oxygen concentration (DO: 7.7–8.5 mg/L) and temperature (13.3–17.7 °C) were favorable for hillstream fish species (Table 4). In contrast, high biological oxygen demand (BOD) values (3.5–4.5 mg/L) observed in the area where the Pachin and Dikrong confluence occurs (Image 1) suggest that the water is contaminated by organic domestic waste that originates from the western side through Naharlagun and Itanagar complexes, accounting for about one-quarter of the entire study area. However, before the meeting point, the water is clear because of the sparse human population. In the study site frequent water-level fluctuations likely reduce algal growth and aquatic insect colonization, thereby reducing food availability and compromising spawning habitats. We observed that most of the substratum was clean and showed little to no algal growth throughout the study site. Additional anthropogenic pressures, including intensive quarrying (using heavy machinery, e.g., JCB excavators) and indiscriminate disposal of domestic and market waste, have further degraded habitat quality (image 2). Several studies have reported the existence of heterogeneously contaminated landscapes, where pollution concentrations vary in different connected aquatic habitats. In such conditions, if aquatic organisms can sense contaminants and interpret associated chemical cues (Tierney 2016; Dominoni et al. 2020), they locally shift from polluted water patches and move toward more suitable adjacent habitats (Cairns & Niederlehner 1996; Johnson 2002; Tierney et al. 2011). Such behavioral response reflects the ability of organisms to track spatial variation in habitat quality and relocate when local environmental conditions become unfavorable. A similar pattern has been observed in this study where juveniles *Semiplotus semiplotus*,

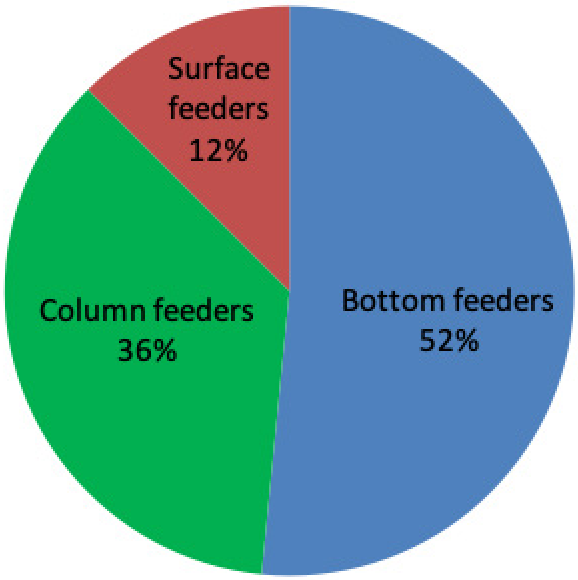

Image 7. Trophic niches of 64 fish species listed by Nath & Dey (2000) that were not recorded in the present study (Dikrong River). Image 4. Trophic niches of 64 fish species listed by Nath & Dey (2000) that were not recorded in the present study (Dikrong River).

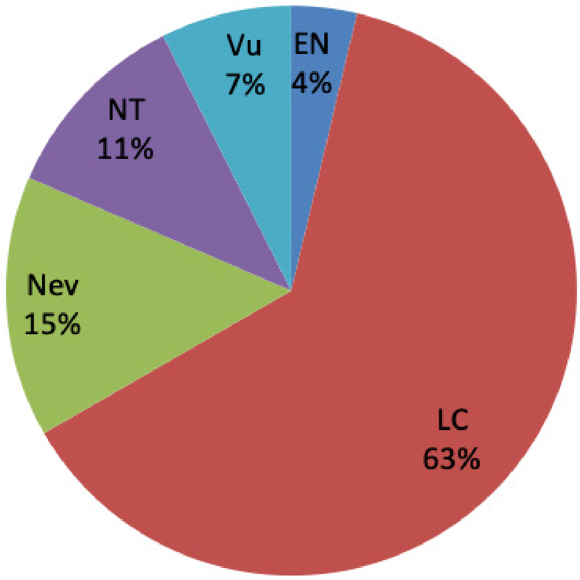

Image 8. IUCN Red List status of fish species recorded in the study site (Dikrong River).

Devario aequipinnatus, and *Opsarius bendelisis* moved into nearby cleaner drainages, indicating behavioral responses to habitat degradation and pollution stress.

Conservation Implications

Most of the known species were categorized as Least Concern (63%) on the basis of the IUCN Red List of Threatened Species (2026); however, the inclusion of Near Threatened (11%), i.e., *Balitora brucei* and *Neolissochilus hexagonolepis*, Vulnerable (7%), i.e., *Semiplotus semiplotus*, and Endangered species (4%), i.e., *Tor putitora*, underscores the conservation value of the Dikrong River (Table 1, Image 8). The local extinction of several species, especially the bottom feeders, underlines the critical necessity for the proper management of flows, rehabilitation of habitats, and control of human activities to preserve the rest of the ichthyofaunal diversity.

CONCLUSION

The present study documents a marked decline in fish diversity in the Dikrong River following the commissioning of the Sopo Dam in 2018 in addition to other anthropogenic activities. Comparison with pre-impoundment records indicates that 64 previously reported species were not encountered, despite the addition of six new records. However, these species are likely to occur upstream beyond Sopo Dam, in other connected drainages and other river systems within the Itanagar Wildlife Sanctuary. This net loss reflects significant ecological alteration of the riverine system as per our limited sampling period of 10 days. Changes in community structure were evident from the strong dominance of a few species, particularly *Opsarius bendelisis*, and the extremely low abundance of most remaining bottom-feeding species (Table 1). Moreover, the trophic guild analysis revealed a pronounced shift from bottom-feeder dominance prior to dam construction to a present-day assemblage dominated by column feeders, indicating degradation of benthic habitats.

Field observations and habitat assessments confirmed that abrupt and irregular water releases from the dam disrupt downstream habitat stability, influencing fish distribution and activity patterns. Although water quality remained generally suitable for hillstream fishes, frequent water-level fluctuations, reduced benthic productivity, organic pollution, quarrying, and waste disposal collectively led to habitat degradation and ecological stress.

The presence of highly threatened species suggests the high conservation priority of the Dikrong River. Our findings highlight an urgent need for ecologically sensitive flow management, the mitigation of anthropogenic disturbances such as regulation on river substrate mining, and long-term monitoring to preserve and restore aquatic biodiversity in dam-regulated Dikrong River systems. Based on our observations, such damage may be too difficult to be rectified through standard mitigation, such as the installation of fish ladders or side-river bypasses.

A promising opportunity is the development of the ornamental fish trade, which contributes 80% of India's indigenous fish exports from Northeast India, primarily through wild collection (Dhar & Ghosh, 2015) However, wild collection is unsustainable for long run that may lead to biodiversity loss, and is regulated by the Biodiversity Authority of the state and continued reliance on wild harvests is economically and legally risky. The state possesses 52 ornamental fish species (Abujam et al. 2021), it would be highly beneficial to include potential ornamental species such as *Botia rostrata, Channa pomanensis, Aborichthys uniobarensis*, and *Devario aequipinnatus* along with other food fishes like *Tor putitora, Neolissochilus hexagonolepis, Bangana dero, Semiplotus semiplotus,* and *Labeo pangusia* in culture-based fisheries. The establishment of cage culture system over the reservoir of dam and ornamental fish unit nearby would help in providing entrepreneurship as well as proper fishery management. This strategy will further assist in boosting economic upliftment, decreasing unemployment levels, as well as food security of the rural populace for long run.

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Articles

Knowledge and attitude towards wild carnivores among university students: a study from Kargil Trans-Himalaya, India
– Iftikar Ali & Robert John Young, Pp. 29559–29570

Avian community structure in a human-impacted forest landscape: insights from Amangarh Tiger Reserve, Uttar Pradesh, India
– Vijay Pratap Singh, Sajid Reza, Sharad Kumar, Meraj Anwar & Afifullah Khan, Pp. 29571–29582

Long-term dynamics of breeding waterbirds in relation to habitat structures in a tropical irrigation wetland: evidence from Vettangudi Bird Sanctuary, Tamil Nadu, India
– H. Maitreyi, N. Raveendran, Reshmi Vijayan & H. Byju, Pp. 29583–29595

Avifaunal diversity with reference to their feeding guilds of Mahadare Conservation Reserve, Maharashtra, India
– Riya Patil, Gayatri Pawar, Neha Bendre, Aruna Shelar & Sunil Bhoite, Pp. 29596–29605

Nesting colonies and breeding ecology of the Cattle Egret *Bubulcus ibis* (Linnaeus, 1758) in northern and northeastern Bangladesh
– Allama Shibli Sadik, M. Monirul H. Khan, M. Kamrul Hasan, Fahad Hossain Haider & M. Sher-E-Afgan, Pp. 29606–29616

An annotated checklist of the avifauna of Pichavaram Mangrove Forest, southern India: a Ramsar wetland with conservation significance
– I. Jamil Hussain & K. Jahir Hussain, Pp. 29617–29629

Snake diversity based on rescue records in urban Jaipur, Rajasthan, India
– Aadya Kalia, Dharampal Singh & Joy Gardner, Pp. 29630–29638

Assessment of ichthyofaunal diversity of the suborder Cyprinoidei Fitzinger, 1832 (Actinopterygii: Cypriniformes) of western Indian Himalayan Region: present status and conservation - a systematic review
– Nisha Chauhan, Dhyal Singh & Shefalee Singh, Pp. 29639–29652

Post-impoundment changes in fish diversity and community structure of the Dikrong River, Arunachal Pradesh: a comparative assessment between 2000–2001 and 2025–2026
– Minam Siram, Tonya Miroh, Rafia Farooquee & Debangshu Narayan Das, Pp. 29653–29666

An annotated district-wise account of Odonata (Dragonflies and Damselflies) from Uttarakhand, India
– Manoj Kumar Arya & Mayank Mahara, Pp. 29667–29683

Study of Odonata in the coastal-influenced area of Purba Medinipur District with a note on seasonal fluctuations and species composition
– Suvabrata Khatua, Sriparna Jana, Sourav Bar & Sudipta Kumar Ghorai, Pp. 29684–29699

Species richness and distribution of Hymenophyllaceae in Mindanao Island, Philippines
– Aurfeli D. Nietes, Rachel C. Sotto, Analinda C. Manila-Fajardo, Lerma SJ. Maldia, Fulgent P. Coritico, Victor B. Amoroso & Inocencio E. Buot Jr., Pp. 29700–29715

Communications

Assessment of genetic variation for conservation implications in the Critically Endangered Bawean Deer *Axis kuhlii* Temminck, 1836 (Mammalia: Artiodactyla: Cervidae)
– Frank Drygala, Alain C. Frantz, Gono Semiadi, Jörg Mehnert, Agus Ariyanto, Yul Ianto & Wirda Teti, Pp. 29716–29720

First record of interspecific allopreening among *Gyps* vultures in the Aravalli Range, India
– Hemsingh Gehlot, Anil Kumar Sharma & Narayan Lal Choudhary, Pp. 29721–29728

DNA Barcode based species delineation within Freshwater Garfish *Xenentodon cancila* (Hamilton, 1822) (Beloniformes: Belonidae) reveals the existence of multiple lineages under single nominal taxon
– Ranjit More, Jiwan Sarwade, A. Shabnam & K.P. Dinesh, Pp. 29729–29735

Characterization of *Aphelenchoides confusus* Thorne & Malek, 1968 (Nematoda: Rhabditida: Aphelenchoididae) occurring in a marine habitat of eastern India
– Sujit Das & Sudipta K. Ghorai, Pp. 29736–29742

Geo-ecological dynamics of Bhairabkunda Grasslands: flood origins, florican dependence, and conservation need
– Jonmani Kalita, Karishma Sharma Chamlagain, Koushik Rajbongshi & Dhritiman Das, Pp. 29743–29750

Viewpoint

Schedule III of the Wild Life (Protection) Amendment Act, 2022: a new legal shield for India's threatened plant species
– Monalisa Dey & Avishek Bhattacharjee, Pp. 29751–29758

Short Communications

A century-long hiatus: rediscovery of Cadorna's Pipistrelle *Hypsugo cadornae* (Chiroptera: Vespertilionidae) from India
– Uttam Saikia & Gabor Csorba, Pp. 29759–29763

Photographic record of the Painted Bat (Chiroptera: Vespertilionidae: *Kerivoula picta* (Pallas, 1767)) from the Terai Region of Uttar Pradesh, India
– Deval Kadam, Ravi Rohit, Vipin Kapoor Sainy, H. Rajamohan, R. Jagdeesh, Mudit Gupta & Manish Singh, Pp. 29764–29768

New record of the Indian Roofed Turtle *Pangshura tecta* (Gray, 1831) (Reptilia: Testudines: Geoemydidae) from Jaisamand Lake, Rajasthan, India
– Vijay Kumar Koli, Nirbhay Singh Chouhan, Kamal Vaishnav & Rakesh Kumar, Pp. 29769–29771

Observations on the dental morphology of the North African Sandfish *Scincus scincus* (Squamata: Scincidae)
– Shreya Bhattacharya & Indraneil Das, Pp. 29772–29775

New distribution records of two *Lithurgus* bee species (Hymenoptera: Megachilidae) from Jammu & Kashmir, India
– P.M. Osman Javid & Sajad H. Parey, Pp. 29776–29780

Notes

Striped Hyena *Hyaena hyaena* (Linnaeus, 1758) carrying a carcass of a Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) in Rajasthan, India
– Akshay Jain, Debashish Panda, Rajasekar Rajaraman, Sanjeev Sharma, Sugna Ram Jat & Kamlesh K. Maurya, Pp. 29781–29783

Toil in the soil: putative nest excavation by an adult female Panther Chameleon *Furcifer pardalis* (Cuvier, 1829) in moist, clayey soil on Nosy Komba, Madagascar
– Hinrich Kaiser & Przemysław Zdunek, Pp. 29784–29786

***Amomum pauciflorum* Baker (Zingiberaceae), an addition to the flora of Manipur, India**
– Lolia Hepuni, Adani Lokho & A.A. Mao, Pp. 29787–29790

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