Indian Journal of Ecology (2026) 53(2): 000-000
Journal homepage: http:/www.indianecol.org
DOI: https://doi.org/10.55362/IJECOL/2026/0025

Manuscript Number: 0000

Spatial and Seasonal Dynamics of Ichthyofaunal Diversity in the Upper Subarnarekha River, Jharkhand, India

Preeti Kumari
Department of Zoology, Dr. Shyama Prasad Mukherjee University, Ranchi, Jharkhand
*Corresponding Author Email: preeti170298@gmail.com

Received: January 27, 2026 Revision Submitted: March 19, 2026 Accepted: March 21, 2026

Abstract: Five stations across a 40 km stretch of the upper Subarnarekha River, Ranchi district, Jharkhand, were sampled monthly from January to December 2021. Sampling covered three seasons: pre-monsoon (January-May), monsoon (June-September), and post-monsoon (October-December). Across 60 sampling events, 62 fish species were recorded, belonging to 38 genera, 19 families, and 9 orders. Cyprinidae dominated, accounting for 28 species — 45% of total richness. The highest diversity was at Tatisilwai (Site 4; $H' = 3.21$, $1\text{-}D = 0.89$, $J' = 0.84$), where mixed rocky-muddy substrate and well-developed macrophyte beds support a notably even assemblage. Namkum (Site 3; $H' = 2.36$, $1\text{-}D = 0.79$) recorded the poorest diversity; domestic sewage from Ranchi city enters this reach visibly and consistently. Post-monsoon was the richest season across all five stations (repeated-measures ANOVA, $F(2,8) = 9.23$, $p = 0.008$), driven by improved discharge, better oxygen conditions, and the appearance of monsoon-season recruits. Sensitive species — *Tor tor*, *Bagarius bagarius*, and *Chitala chitala* — were confined to the two least disturbed upstream stations. NMDS ordination (Bray-Curtis; stress = 0.11) separated the impacted stations (3 and 5) sharply from the intact ones (1 and 4), with sand mining and effluent discharge the primary drivers. The dataset gives a repeatable baseline for managing fish communities in this stretch of the river.

Keywords: Ichthyofaunal diversity, Subarnarekha River, Species richness, Seasonal variation, Habitat heterogeneity, Invasive species, Freshwater conservation.

1. INTRODUCTION

Freshwater fishes are among the most threatened vertebrate groups on the planet, yet they receive far less conservation attention than mammals or birds. More than 15,000 species have been described (Froese & Pauly, 2019; Dudgeon et al., 2006), but habitat loss, pollution, and invasive species are shrinking that number faster than the literature can track. In Asia, the situation is acute. The Mekong, Ganges, and Yangtze basins together hold a disproportionate share of global freshwater fish diversity (Nelson et al., 2016; Pusey & Arthington, 2003), and India alone records over 2,500 freshwater species (Pinder et al., 2019)- a figure that would surprise most people outside the field.

The Subarnarekha starts near Ratu in Ranchi district, at roughly 610 m on the Chotanagpur Plateau, and runs about 395 km eastward through Jharkhand, West Bengal, and Odisha before reaching the Bay of Bengal (Singh & Giri, 2018; Banerjee et al., 2022). Its catchment covers around 19,500 km². The Kharkai, Roro, and Kanchi rivers are its main tributaries in the Jharkhand section. In that upper stretch, the river crosses rocky plateau terrain with shallow riffles, deep pools, and patches of intact riparian forest — conditions that favour a diverse fish fauna. Local tribal communities have fished here for generations, mostly using traditional gear, and the river still holds good populations of commercially valuable species (Saba & Sadhu, 2017).

What the river holds is worth listing plainly. Major carps - *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala* - are present throughout. Catfishes, including *Clarias batrachus* and *Heteropneustes fossilis*, dominate slower sections. The clear, fast reaches near the source still carry rheophilic species: *Mastacembelus armatus*, *Ompok bimaculatus*, and, where conditions allow, *Tor tor* - a species that has become genuinely scarce across much of its range.

That scarcity has causes. Industrial activity near Jamshedpur, unregulated sand extraction, the Chandil Dam, and domestic sewage from Ranchi have all damaged the river at different points. *Oreochromis mossambicus* has established itself in disturbed reaches and is displacing native species. Populations of *Tor tor*, *Bagarius bagarius*, and *Gudusia chapra* have declined noticeably (Bera, 2022). The pressures are not abstract - they are visible at the water's edge.

Available online: April 14, 2026

Most published work on the Subarnarekha's fish fauna covers the West Bengal and Odisha sections (Bera, 2022). The upper Jharkhand reach, which is ecologically quite different from the lowland stretches, has received comparatively little attention. Devi & Pandit (2018) documented 41 species from this general area, but their survey was shorter in duration and covered fewer stations. The present study sampled five stations monthly for a full year, with the aim of documenting spatial and seasonal variation in assemblage structure and relating that variation to measurable habitat and anthropogenic gradients. The results are compared against earlier records from this and other Indian river systems.

2. MATERIALS AND METHODS

2.1. Study Area

The study covered approximately 40 km of river within Ranchi district, from the source at Ratu downstream to the Silli block (Figure 1). The upper part of this reach is rocky and largely intact; the lower part passes through or near semi-urban areas affected by agriculture, sand mining, and domestic waste disposal. The region has a monsoon climate, with 1,200-1,400 mm of rain falling mostly between June and September. Outside that window, flows drop considerably, and the river character shifts from fast and turbid to slow and clear. Five stations were positioned to capture this gradient (Table 1).

2.2. Fish Sampling

Each station was sampled once per month from January to December 2021, giving 12 visits per station and 60 sampling events in total. At each visit, fish were collected for two hours using cast nets (2 cm and 4 cm mesh), gill nets (3-6 cm mesh), drag nets, and hook-and-line. Gear selection was consistent across visits. In addition to experimental sampling, specimens purchased from local fishermen at each station were examined, identified, and recorded separately; these were cross-checked against field collections to avoid double-counting. Fish were identified to species level using Jayaram (2010) and FishBase (Froese & Pauly, 2019). Specimens that could not be identified reliably in the field were preserved in 10% formalin for laboratory examination. Where possible, fish were returned to the river after identification.

2.3. Water Quality and Habitat

At each sampling event, the following parameters were recorded in situ: water temperature (°C), pH, dissolved oxygen (mg/L), electrical conductivity (µS/cm), and turbidity (NTU), using calibrated field meters (pre-calibrated against standards each morning). Flow velocity was measured at three cross-section transects per station using a current meter. Habitat was described by substrate type (boulder, gravel, sand, silt, mud), estimated riparian canopy cover (%), and presence of macrophytes. These habitat descriptors were noted at each visit and used to contextualise assemblage patterns.

2.4. Diversity Indices

All indices were calculated from individual fish counts (number basis, not weight). Five metrics were computed for each station-season combination: Shannon-Wiener $H' = -\Sigma p_i \ln p_i$; Simpson's 1-D where $D = \Sigma p_i^2$; Margalef's richness $D_{mg} = (S-1) / \ln N$; Pielou's evenness $J' = H' / \ln S$; and Bray-Curtis dissimilarity for pairwise between-station comparisons. Here S is species count, N is total individuals, and p_i is the proportional abundance of species i.

2.5. Statistical Analysis

Differences in species richness among stations were tested with one-way ANOVA, followed by Tukey's HSD to identify which pairs differed. Seasonal effects were tested with repeated-measures ANOVA, with station as the within-subject factor and season as the repeated measure. Pearson's correlation was used to examine the relationship between an

Table 1. Characteristics of the five sampling stations

Site	Location / Coordinates	Substrate	Land use	Main disturbances	Pressure
S1 – Ratu 23.3645°N, 85.2257°E	Rocky upland, river origin	Boulders & gravel	Forest / scrubland	Negligible	Low
S2 – Itki 23.3492°N, 85.3084°E	Shallow reach near village	Sand & silt	Agriculture & settlement	Agricultural runoff, subsistence fishing	Low–Moderate
S3 – Namkum 23.3278°N, 85.3889°E	Slow, urbanised section	Silt & mud	Ranchi city periphery	Domestic effluent, fishing pressure	High
S4 – Tatisilwai 23.3210°N, 85.4663°E	Meandering reach, macrophytes	Mixed rock & mud	Semi-rural, riparian forest	Limited sand mining	Moderate
S5 – Silli 23.2974°N, 85.5510°E	Variable flow, semi-rural	Sand & gravel	Agriculture & settlement	Sand extraction, bathing, fishing	Moderate–High

urban proximity index (ranked by distance from Ranchi city centre) and Shannon H′. Non-metric multidimensional scaling (NMDS) based on Bray-Curtis dissimilarity was used to ordinate station-season samples. All analyses were done in R version 4.2.0 (R Core Team, 2022), with significance set at $p < 0.05$.

3. RESULTS AND DISCUSSION

3.1. Species Composition

Sixty-two species were recorded across all stations and seasons (Table 2). They belong to 38 genera, 19 families, and 9 orders. Cyprinidae was the largest family by species count - 28 species, or 45% of the total (calculated as $28/62 \times 100$). This is consistent with the dominance of cyprinids in other Peninsular Indian rivers (Pinder et al., 2019) and with earlier records from the downstream West Bengal section of this river (Bera, 2022). Bagridae contributed 7 species; Channidae and Siluridae 4 and 3 respectively.

The distribution of sensitive species tells the more important story. *Tor tor* (IUCN: Vulnerable) and *Bagarius bagarius* (IUCN: Vulnerable) were found only at Sites 1 and 2. *Chitala chitala* (IUCN: Near Threatened) appeared at Sites 1 and 4. *Schistura savona* and *Amblyceps mangois* were restricted entirely to Site 1. None of these turned up at Sites 3 or 5. At those impacted stations, *Gambusia affinis* and *Oreochromis mossambicus* were common year-round. That replacement - rheophilic natives giving way to introduced generalists - is the clearest signal of degradation in the data.

3.2. Spatial Variation in Ichthyofaunal Diversity

Species richness ranged from 22 at Site 1 during pre-monsoon to 47 at Site 4 during post-monsoon (Table 3; Figure 1). One-way ANOVA confirmed the between-station differences are real ($F\ (4,20) = 5.87$, $p = 0.002$); Tukey's HSD identified Site 4 as significantly richer than Sites 1 and 3. Annual diversity indices are given in Table 3 and Figure 2.

Site 4 - Tatisilwai - is the most diverse station by every measure ($H' = 3.21$, $1\text{-}D = 0.89$, $Dmg = 6.18$, $J' = 0.84$; Figure 2). It is a broad, meandering reach with pools of varying depth, mixed rocky and muddy substrate, and well-established macrophyte beds along the margins. That structural variety allows multiple guilds to coexist: rheophilic species use the rocky runs, benthic feeders work the muddy pools, and macrophyte beds shelter juveniles and small cyprinids. Habitat complexity and fish diversity are tightly linked in Indian riverine systems (Barton & Anderson, 2016; Jackson et al., 2001), and this station fits that pattern exactly.

Site 1 - Ratu - needs some explanation. It is ecologically intact, yet it records lower total richness (maximum 28 species) than the disturbed mid-reach stations. This is not a contradiction. Site 1 holds only sensitive rheophilic species, most present at low densities. The tolerant generalists and invasive species that inflate cumulative counts at Sites 3 and

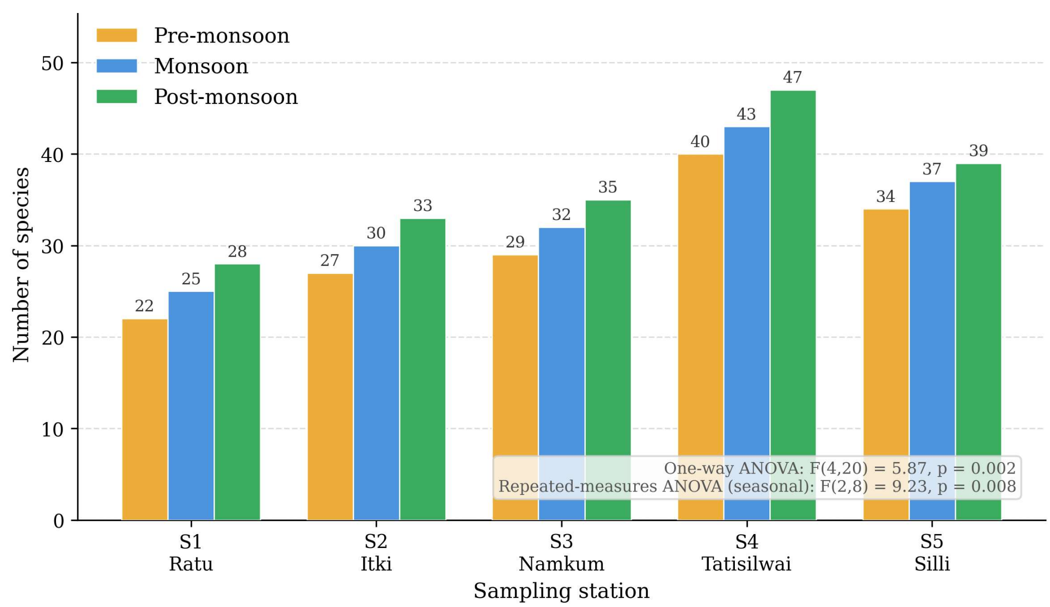

Figure 1. Seasonal species richness at each station (pre-monsoon, monsoon, post-monsoon). Data labels give species count. One-way ANOVA: $F(4,20) = 5.87$, $p = 0.002$. Repeated-measures ANOVA for seasonal effect: $F(2,8) = 9.23$, $p = 0.008$

Table 2. Fish species recorded from the upper Subarnarekha River (January–December 2021)

Species	Family	Common name	IUCN	Abundance	Sites	Tolerance	Order
Labeo rohita	Cyprinidae	Rohu	LC	+++	1–5	Moderate	Cypriniformes
Catla catla	Cyprinidae	Catla	LC	+++	1–5	Moderate	Cypriniformes
Cirrhinus mrigala	Cyprinidae	Mrigal	LC	+++	1–5	Moderate	Cypriniformes
Labeo bata	Cyprinidae	Bata	LC	++	1–5	Moderate	Cypriniformes
Puntius sophore	Cyprinidae	Pool barb	LC	++	1–5	Moderate	Cypriniformes
Puntius ticto	Cyprinidae	Two-spot barb	LC	++	2–5	Moderate	Cypriniformes
Tor tor	Cyprinidae	Mahseer	VU	+	1, 2	Low	Cypriniformes
Barilius bendelisis	Cyprinidae	Hamilton barila	LC	+	1, 2	Low	Cypriniformes
Salmostoma bacaila	Cyprinidae	Large razorbelly	LC	++	1–3	Low–Moderate	Cypriniformes
Rasbora daniconius	Cyprinidae	Slender rasbora	LC	++	2–5	Moderate	Cypriniformes
Chagunius chagunio	Cyprinidae	Chaguni	LC	+	1, 2	Low	Cypriniformes
Garra mullya	Cyprinidae	Torrent fish	LC	+	1	Low	Cypriniformes
Devario devario	Cyprinidae	Sind danio	LC	+	1–3	Low–Moderate	Cypriniformes
Esomus danrica	Cyprinidae	Flying barb	LC	++	3–5	High	Cypriniformes
Amblypharyngodon mola	Cyprinidae	Mola carplet	LC	+++	2–5	High	Cypriniformes
Puntius conchonius	Cyprinidae	Rosy barb	LC	++	3–5	High	Cypriniformes
Puntius chola	Cyprinidae	Swamp barb	LC	++	3–5	High	Cypriniformes
Pethia phutunio	Cyprinidae	Spottedsail barb	LC	+	3–5	Moderate	Cypriniformes
Laubuca laubuca	Cyprinidae	Indian glass barb	LC	+	2–4	Moderate	Cypriniformes
Osteobrama cotio	Cyprinidae	Pearly razorbelly	LC	+	2–4	Moderate	Cypriniformes
Aspidoparia morar	Cyprinidae	Morar	LC	+	2–4	Moderate	Cypriniformes
Salmophasia sardinella	Cyprinidae	Small razorbelly	LC	++	2–5	Moderate	Cypriniformes
Danio dangila	Cyprinidae	Moustached danio	LC	+	1, 2	Low	Cypriniformes
Crossocheilus latius	Cyprinidae	Scale-lip	LC	+	1, 2	Low	Cypriniformes
Rohtee ogilbii	Cyprinidae	Ogilby's rohtee	LC	+	1–3	Low–Moderate	Cypriniformes
Schistura savona	Nemacheilidae	Stone loach	LC	+	1	Low	Cypriniformes
Lepidocephalichthys guntea	Cobitidae	Guntea loach	LC	+	1–3	Low–Moderate	Cypriniformes
Bagarius bagarius	Sisoridae	Goonch catfish	VU	+	1	Low	Siluriformes
Pseudolaguvia shawi	Sisoridae	Rock catlet	NE	+	1	Low	Siluriformes
Gagata cenia	Sisoridae	Indian gagata	LC	+	1–3	Low	Siluriformes
Mystus tengara	Bagridae	Tengara catfish	LC	++	1–4	Moderate	Siluriformes
Mystus vittatus	Bagridae	Striped catfish	LC	++	2–5	Moderate	Siluriformes
Rita rita	Bagridae	Rita catfish	LC	+	1–3	Low	Siluriformes
Sperata seenghala	Bagridae	Giant river catfish	LC	+	1, 2	Low	Siluriformes
Amblyceps mangois	Amblycipitidae	Torrent catfish	NE	+	1	Low	Siluriformes
Clarias batrachus	Clariidae	Walking catfish	LC	++	2–5	High	Siluriformes
Heteropneustes fossilis	Heteropneustidae	Stinging catfish	LC	++	3–5	High	Siluriformes
Ailia coila	Schilbeidae	Gangetic ailia	LC	+	2–4	Low–Moderate	Siluriformes
Wallago attu	Siluridae	Wallago	LC	+	1–3	Low	Siluriformes

Cont...

Table 2. Fish species recorded from the upper Subarnarekha River (January–December 2021)

Species	Family	Common name	IUCN	Abundance	Sites	Tolerance	Order
Ompok bimaculatus	Siluridae	Glass catfish	LC	+	1, 2	Low	Siluriformes
Chitala chitala	Notopteridae	Clown knifefish	NT	+	1, 4	Low	Osteoglossiformes
Notopterus notopterus	Notopteridae	Grey featherback	LC	+	2–4	Moderate	Osteoglossiformes
Gudusia chapra	Clupeidae	Indian river shad	LC	++	2–4	Moderate	Clupeiformes
Hilsa ilisha	Clupeidae	Hilsa shad	LC	+	4, 5	Moderate	Clupeiformes
Channa striata	Channidae	Snakehead murrel	LC	++	2–5	High	Anabantiformes
Channa punctata	Channidae	Spotted snakehead	LC	++	3–5	High	Anabantiformes
Channa marulius	Channidae	Great snakehead	LC	+	1, 2	Low	Anabantiformes
Mastacembelus armatus	Mastacembelidae	Tyre-track eel	LC	+	1, 2	Low	Synbranchiformes
Mastacembelus pancalus	Mastacembelidae	Striped spiny eel	LC	+	2–4	Low–Moderate	Synbranchiformes
Macrognathus aculeatus	Mastacembelidae	Lesser spiny eel	LC	+	4, 5	Moderate	Synbranchiformes
Monopterus cuchia	Synbranchidae	Cuchia eel	LC	+	3–5	High	Synbranchiformes
Glossogobius giuris	Gobiidae	Tank goby	LC	++	3–5	High	Gobiiformes
Rhinogobius flumineus	Gobiidae	River goby	LC	+	1–3	Low	Gobiiformes
Mugil cephalus	Mugilidae	Flathead mullet	LC	+	4, 5	Moderate	Mugiliformes
Nandus nandus	Nandidae	Gangetic leaffish	LC	+	2–4	Moderate	Perciformes
Ambassis nama	Ambassidae	Burmese glassy fish	LC	+	3–5	High	Perciformes
Parambassis ranga	Ambassidae	Indian glassy fish	LC	+	3–5	High	Perciformes
Xenentodon cancila	Belonidae	Freshwater garfish	LC	+	2–4	Moderate	Beloniformes
Colisa fasciata	Osphronemidae	Banded gourami	LC	+	3–5	High	Anabantiformes
Gambusia affinis	Poeciliidae	Mosquitofish	LC	+++	3, 5	Very High	Cyprinodontiformes
Oreochromis mossambicus	Cichlidae	Mozambique tilapia	LC	+++	3, 5	Very High	Cichliformes
Colisa lalia	Osphronemidae	Dwarf gourami	LC	+	3–5	High	Anabantiformes

Abundance: + Rare (1–2 individuals per sampling event); ++ Common (3–10); +++ Abundant (>10). IUCN: LC Least Concern; NT Near Threatened; VU Vulnerable; NE Not Evaluated

Table 3. Species richness and diversity indices by station and season

Parameter / Season	S1	S2	S3	S4	S5	H′ (annual)	1–D (annual)	J′ (annual)
Richness – Pre-monsoon	22	27	29	40	34	2.14	0.79	0.68
Richness – Monsoon	25	30	32	43	37	2.68	0.83	0.74
Richness – Post-monsoon	28	33	35	47	39	2.89	0.87	0.77
H′ (Shannon–Wiener, annual)	2.04	2.51	2.36	3.21	2.78			
1–D (Simpson's, annual)	0.72	0.81	0.79	0.89	0.84			
Margalef's Dmg	3.82	4.73	4.12	6.18	5.44			
Pielou's J′	0.60	0.72	0.71	0.84	0.79			

5 are simply absent here. Low species richness at a pristine headwater station is not a failure - it reflects natural zonation. The species that are there - *Tor tor*, *Schistura savona*, *Amblyceps mangois* - cannot be found anywhere else in the survey reach.

Site 3 recorded the lowest diversity among the mid-reach stations (H′ = 2.36, 1-D = 0.79, J′ = 0.71). The reduced evenness index is telling: it is not that species are absent, but that a handful of tolerant species dominate numerically while the rest are barely represented. That pattern is typical of enriched, degraded urban river sections, where organic loading suppresses dissolved oxygen and eliminates the more sensitive taxa (Allan & Castillo, 2007; Poff et al., 2010). The negative correlation between urban proximity and H′ across stations ($r = -0.76$, $p = 0.01$) confirms the direction of this gradient.

3.3. Seasonal Variation in Ichthyofaunal Diversity

Post-monsoon was the richest season at every station (Table 3; Figure 4). Repeated-measures ANOVA confirmed this seasonal effect is consistent rather than site-specific ($F(2,8) = 9.23$, $p = 0.008$; $F(2,8)$ representing 2 seasonal contrasts and 8 error degrees of freedom). Pre-monsoon was consistently the poorest season, with monsoon intermediate.

Three things happen in October-December that push richness up. River levels drop to moderate flows after the monsoon flood pulse, increasing habitat diversity and making sampling more efficient across gear types. Dissolved oxygen rises as water temperature falls and turbulence increases, which allows oxygen-sensitive species to reoccupy areas they vacated during the warm, turbid monsoon period. And the monsoon breeding season is followed by juvenile recruitment: fish hatched in July-September appear in the catch as small but catchable individuals by October. Shrestha et al. (2013) documented the same post-monsoon pattern in Nepali rivers; Dahanukar et al. (2004) found comparable trends in Deccan Plateau systems.

The monsoon season itself presents a sampling paradox. Productivity in the river is highest at this time - runoff delivers nutrients, invertebrate biomass is elevated, and food availability is good. But high discharge, elevated turbidity, and fast flows reduce catch efficiency with passive gear and push many species into marginal habitats not covered by fixed sampling stations. So the catch is lower, but that does not mean fish abundance is lower. Pre-monsoon low-flow conditions simply concentrate fish into remaining deep pools, which actually makes them easier to sample - yet total richness is lowest then, because many species that move into the river from floodplain areas during the monsoon have not yet arrived.

3.4. Assemblage Patterns: NMDS and Community Structure

NMDS ordination (Bray-Curtis, stress = 0.11) produced a clear pattern (Figure 3). Sites 1 and 4 group together despite being 14 km apart. The similarity is not accidental: both stations have complex habitat structure, low-to-moderate disturbance, and sustain sensitive and moderately sensitive species. Sites 3 and 5, by contrast, cluster on the opposite side of the ordination, driven by the dominance of *Gambusia affinis* and *Oreochromis mossambicus* at both

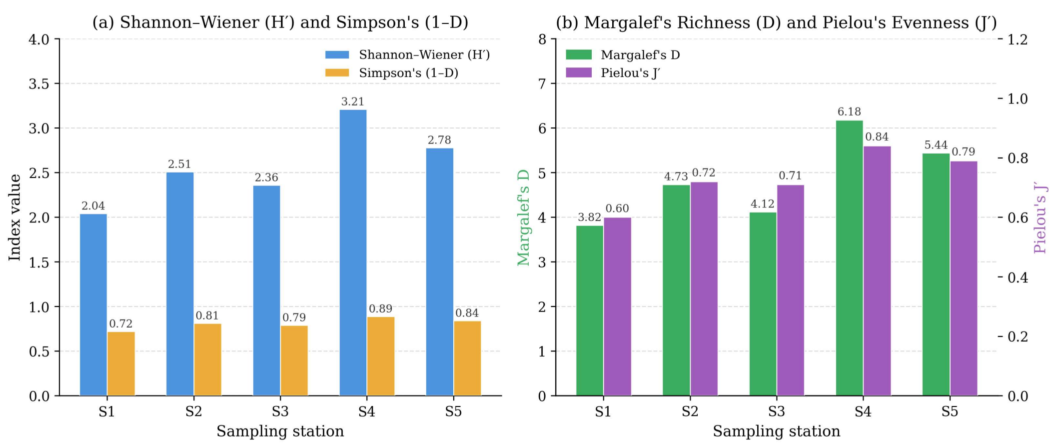

Figure 2. Annual diversity indices by station. Left panel: Shannon–Wiener H′ and Simpson's 1–D. Right panel: Margalef's D (left axis) and Pielou's J′ (right axis)

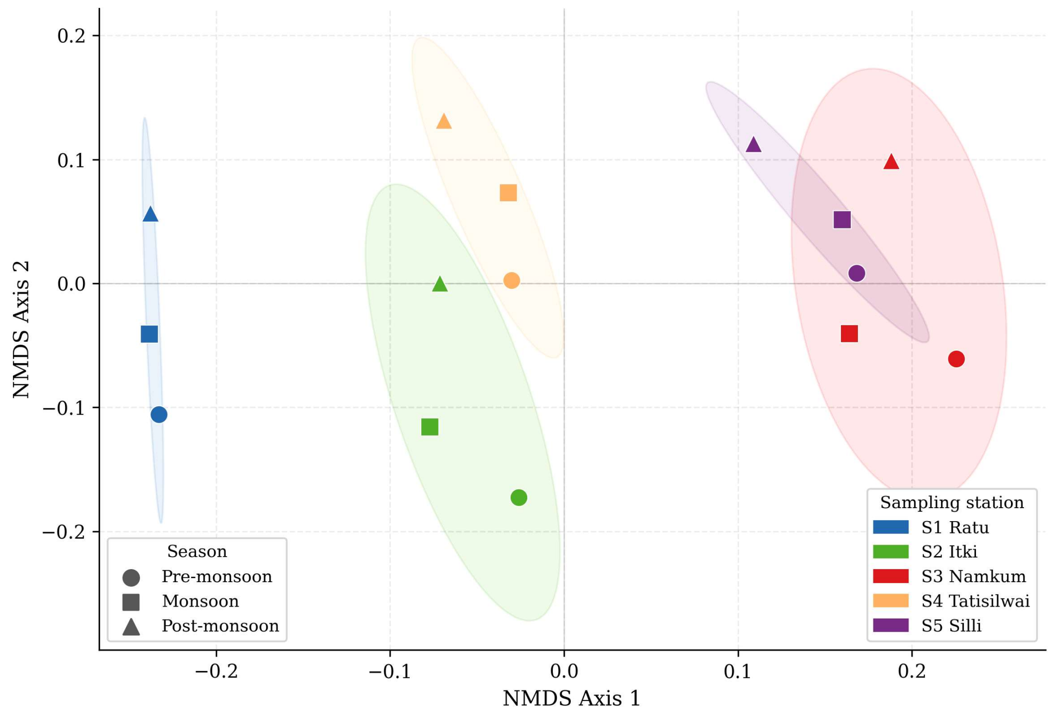

Figure 3. NMDS ordination based on Bray–Curtis dissimilarity (stress = 0.11). Each point is one station–season combination. Shaded ellipses mark per-station groupings. Symbols: circle = pre-monsoon; square = monsoon; triangle = post-monsoon

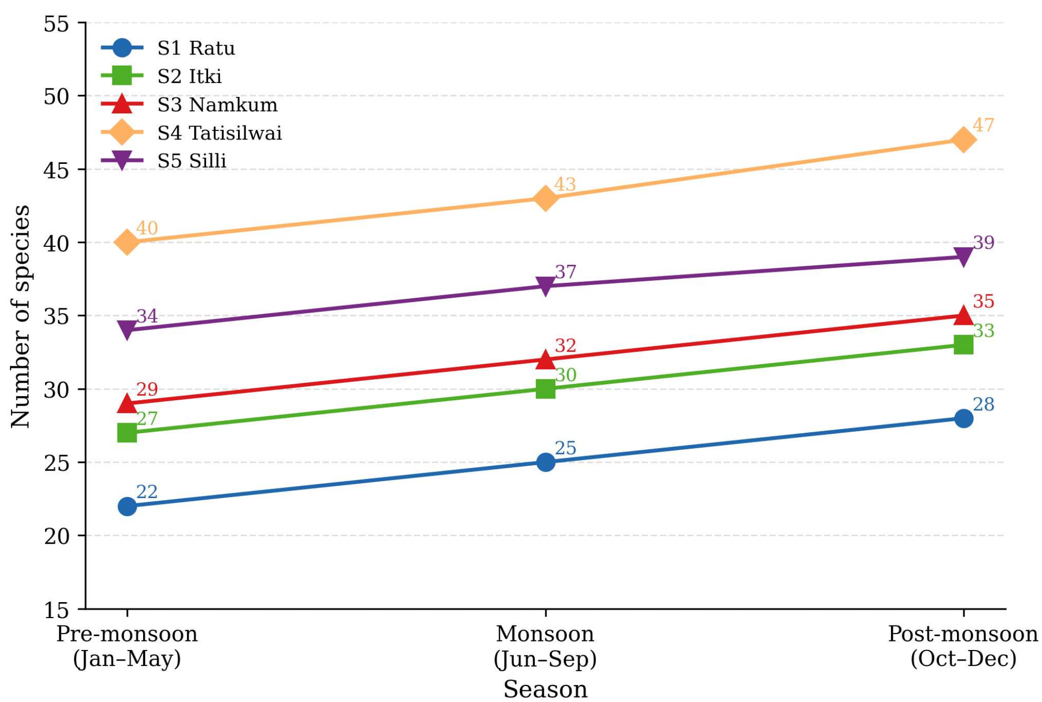

Figure 4. Seasonal trends in species richness across all five stations, showing the consistent post-monsoon peak

locations. Site 2 falls between these extremes, consistent with its transitional character.

Pairwise Bray-Curtis dissimilarity between Sites 1 and 3 was 0.62. Between Sites 3 and 5 it was 0.28 - these two stations are more similar to each other than to any of the upstream stations, even though they are separated by over 20 km of river. Shared disturbance produces convergent communities. The stressors driving that convergence are not limited to urbanisation and agricultural runoff; sand mining at Sites 2 and 5 destabilises substrate and reduces benthic invertebrate availability, and the cumulative effect of these pressures appears to be additive. Moyle & Leidy (2011) and Pinder et al. (2019) make the same point for Indian freshwater systems broadly: it is rarely a single stressor but the combination that matters.

3.5. Comparison with Earlier Work on the Subarnarekha

Bera (2022) recorded 48 species from the Paschim Medinipur section of the Subarnarekha - a lower-elevation stretch with more lentic influence. This survey records 62 species from the upper Jharkhand reach. The difference is largely explained by the Chotanagpur Plateau topography: faster, more heterogeneous flows in this stretch support rheophilic guilds absent from the lowland section. Devi & Pandit (2018) reported 41 species from the upper basin; the gap between that figure and the current 62 reflects a full annual sampling cycle across five stations rather than a shorter-duration survey. Notably, both *Tor tor* and *Bagarius bagarius* appear more regularly in this upper reach than in downstream records, which is consistent with their preference for rocky, fast-flowing water and their sensitivity to organic enrichment.

4. CONCLUSION

Sixty-two fish species were recorded across five stations in the upper Subarnarekha River over a full annual sampling cycle. Site 4 (Tatisilwai) was the most diverse station by all four indices (H′ = 3.21, 1-D = 0.89, Dmg = 6.18, J′ = 0.84); its mixed substrate and macrophyte cover provide the habitat variety that supports a broad species assemblage. Post-monsoon was the richest season at all stations. Site 3 (Namkum), receiving direct domestic effluent from Ranchi, was the poorest in diversity among the mid-reach stations despite sitting downstream of more species-rich locations. Sensitive species including *Tor tor*, *Bagarius bagarius*, and *Chitala chitala* were absent from all impacted stations; their persistence at Sites 1 and 2 depends entirely on those reaches remaining relatively undisturbed.

Three things follow from these results. The headwater reach at Ratu (Site 1) and the Tatisilwai reach (Site 4) are the stations that matter most for conservation. Both support species found nowhere else in this survey; both are under moderate but growing pressure. Designated riparian buffers for these two reaches would be a practical first step. The effluent problem at Namkum (Site 3) is not complicated to diagnose - domestic sewage enters the river visibly - but it has not been addressed. Until it is, Site 3 will continue to act as a barrier between the relatively intact upstream and downstream sections, preventing natural recolonisation. Finally, the invasive species situation at Sites 3 and 5 is manageable now but not indefinitely.

Oreochromis mossambicus spreads quickly once established; active removal and monitoring at these two stations is more cost-effective than attempting to control a river-wide population later. The data presented here provide the baseline needed to track whether any of these interventions actually work.

Acknowledgements

The authors thank field assistants and local fishing communities of the upper Subarnarekha basin for assistance during monthly sampling.

CRediT Authorship Contribution Statement

Preeti Kumari: Conceptualisation, Methodology, Field data collection, Formal analysis, Writing - original draft, Writing - review and editing.

Conflict of Interest

The author declares no conflict of interest.

Use of AI tools

No AI tools were used in data collection, analysis, or interpretation.

Data Availability Statement

Data generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

REFERENCES

Allan, J.D., & Castillo, M.M. (2007). *Stream ecology: Structure and function of running waters* (2nd ed.). Springer.

Almeida, D., Pinto, M., & Gouveia, C. (2016). Seasonal variation in fish assemblages of an urban stream. *Environmental Biology of Fishes*, *99*(7), 785-794.

Banerjee, S., Roy, A.K., & Alam, A. (2022). Temporal variability of discharge and suspended sediment transport in the Subarnarekha River Basin. In N. C. Jana & R. B. Singh (Eds.), *Climate, environment and disaster in developing countries* (pp. 433-447). Springer.

Barton, D.R., & Anderson, R.W. (2016). Effect of habitat complexity on fish diversity in rivers. *Hydrobiologia*, *781*(1), 19-28.

Bera, S. (2022). Current status of fish diversity of Subarnarekha River in Paschim Medinipur district, West Bengal. *International Journal of Fish and Aquatic Studies*, *10*(2), 116-121.

Dahanukar, N., Raut, R., & Bhat, A. (2004). Distribution, endemism and threat status of freshwater fishes in the Western Ghats of India. *Journal of Biogeography*, *31*(1), 123-136.

Devi, D.N., & Pandit, S. (2018). Ecology of the fish assemblages in the upper Subarnarekha basin. *Journal of Freshwater Biology*, *63*(1), 123-130.

Dudgeon, D., Arthington, A.H., Gessner, M.O., Kawabata, Z.I., Knowler, D.J., Lévêque, C., & Sullivan, C.A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews*, *81*(2), 163-182.

Froese, R., & Pauly, D. (2019). *FishBase*. World Wide Web electronic publication. http://www.fishbase.org

Jackson, D.A., Peres-Neto, P.R., & Olden, J.D. (2001). The influence of environmental factors on riverine fish diversity. *Ecology of Freshwater Fish*, *10*(3), 161-170.

Jayaram, K.C. (2010). *The freshwater fishes of the Indian region* (2nd ed.). Narendra Publishing House.

Legendre, P., & Legendre, L. (2012). *Numerical ecology* (3rd ed.). Elsevier.

Liu, F., Lin, P., Liu, H., & Wang, J. (2021). Spatial and seasonal patterns of fish assemblages in mountain streams of the Ren River, southwest China. *Ecology and Evolution*, *11*(16), 11323-11333.

Moyle, P.B., & Leidy, R.A. (2011). Loss of biodiversity in aquatic ecosystems. In P. L. Fiedler & S. K. Jain (Eds.), *Conservation biology* (pp. 127-169). Springer.

Nelson, J.S., Grande, T.C., & Wilson, M.V.H. (2015). Ecological role of headwater regions in freshwater systems. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *25*(5), 634-642.

Nelson, J.S., Grande, T.C., & Wilson, M.V.H. (2016). *Fishes of the world* (5th ed.). John Wiley & Sons.

Pinder, A.C., Britton, J.R., Harrison, A.J., et al. (2019). Mahseer (Tor spp.) fishes of the world: Status, challenges and opportunities for conservation. *Reviews in Fish Biology and Fisheries*, *29*(2), 417-452.

Poff, N.L.R., Olden, J.D., Merritt, D.M., & Pepin, D.M. (2010). Global environmental changes and freshwater biodiversity. *BioScience*, *60*(4), 264-274.

Pusey, B.J., & Arthington, A.H. (2003). Importance of the riparian zone to the conservation and management of freshwater fish. *Marine and Freshwater Research*, *54*, 1-16.

R Core Team (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Saba, F., & Sadhu, D.N. (2017). Fish diversity of Garga reservoir of Bokaro (Jharkhand). *Life Science Bulletin*, *14*(2), 261-264.

Shrestha, M., Bajracharya, R.M., & Lekhak, H.D. (2013). The role of seasonality in determining the diversity of freshwater fish species in Nepal. *Environmental Biology of Fishes*, *96*(4), 411-421.

Singh, A.K., & Giri, S. (2018). Subarnarekha River: The gold streak of India. In V. R. Sinha & R. B. Singh (Eds.), *The Indian rivers* (pp. 273-285). Springer.

Toman, J., Havel, J.E., & Dlouhá, Š. (2020). The ecological consequences of invasive species in urbanized rivers. *Aquatic Invasions*, *15*(2), 249-265.

Vaughn, C.C., Nichols, S.J., & Spooner, D.E. (2007). The role of freshwater mussels in aquatic ecosystems. *Conservation Biology*, *21*(1), 72-89.

Supplementary Material Link

https://www.indianjecol.org /storage/publication_files/supplementary_IJECOL-26-0025_1774170874.docx