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ARTICLE

Fish diversity and conservation status across habitat guilds in the river Rupnarayan, West Bengal, India

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Abstract: The Rupnarayan River, a major tributary of the Hugli in West Bengal, extends approximately 75 km and exhibits distinct hydrological and morphological characteristics, including tidal influence, dynamic salinity gradients, and a meandering channel. The river transitions from a freshwater system upstream to a brackish estuarine environment downstream, supporting diverse floodplain habitats, fisheries, nutrient cycling, and sediment transport. A comprehensive assessment of ichthyofaunal diversity recorded 55 fish species belonging to 31 families, based on field surveys, fishers' interviews, and secondary literature. Cyprinidae and Bagridae were the most species-rich families. The highest Shannon diversity index (H' = 3.28) was recorded at the Denan canal confluence, indicating spatial variation in fish community composition. The assemblage included freshwater, brackish, and euryhaline species, reflecting the river's transitional salinity regime and ecological connectivity. The river also provides important habitat for migratory fishes, including the anadromous Hilsa Shad *Tenualosa ilisha* and Toli Shad *Tenualosa toli*, and the catadromous Indian Mottled Eel *Anguilla bengalensis*. Several native species, such as catfishes and snakeheads, contribute to ecosystem regulation by preying on insect larvae, including mosquitoes, thereby offering natural pest control services. Fish species showed varied spatial distributions, with some restricted to specific microhabitats and others widely distributed throughout the river. Assessment against IUCN Red List categories indicated that while most recorded species were classified as Least Concern (LC), several were categorised as Near Threatened (NT), Vulnerable (VU), Data Deficient (DD), or Not Evaluated (NE). The co-occurrence of native, migratory, and exotic species highlights the complex conservation challenges associated with environmental change, fishing pressure, and species introductions. These findings provide an important baseline for developing evidence-based conservation and management strategies to maintain fish diversity, ecological integrity, and the livelihoods of communities dependent on the Rupnarayan River.

Keywords: Aquatic biodiversity, biodiversity assessment, community structure, estuarine fish, freshwater conservation, fish assemblages, inland fisheries, ichthyofauna, threatened species, tidal river ecology.

সারসংক্ষেপ: রূপনারায়ণ নদী পশ্চিমবঙ্গের হুগলি নদীর একটি প্রধান উপনদী যা প্রায় ৭৫ কিলোমিটার দীর্ঘ। এই নদীতে জোয়ার-ভাটা, লবণাক্ততার তারতম্য এবং সর্পিল বা আঁকাবাঁকা গতিপথের মতো সুনির্দিষ্ট বৈশিষ্ট্য দ্রষ্টব্য। নদীটি জোয়ারের সময় উৎসের দিকে মিঠাজল থেকে ক্রমশ নোনাজল মোহনা-পরিবেশে রূপান্তরিত হয়। ফলে উর্বর পলিমাটি যুক্ত প্লাবনভূমি তৈরি হয় যা পুষ্টি চক্রায়ণ, পলি পরিবহন এবং মৎস্য-নির্ভর জীবিকার মতো গুরুত্বপূর্ণ পরিষেবা প্রদান করে। এই গবেষণাপত্রে পূর্ববর্তী গবেষণার তথ্য, প্রাথমিক সমীক্ষা এবং মৎস্যজীবীদের সাক্ষাৎকারের মাধ্যমে রূপনারায়ণের মৎস্য বৈচিত্র্য মূল্যায়ন করা হয়েছে। ৩১টি গোত্রের মোট ৫৫টি প্রজাতির উপস্থিতি নথিভুক্ত হয়েছে, যার মধ্যে সর্বাচ্চ বৈচিত্র্য পাওয়া গেছে *Cyprinidae* ও *Bagridae* গোত্রে। নদীর বিভিন্ন অংশে মাছের বৈচিত্র্য আলাদা। উদাহরণস্বরূপ দেনান খালের সঙ্গমস্থল সর্বাধিক বৈচিত্র্যময় (শ্যানন সূচক H' = ৩.২৮)। এই নদীতে মিঠাজলের মাছ, নোনাজলের মাছ এবং নোনা সহনশীল (euryhaline) মাছ – সব ধরনেরই দেখা মেলে, যা নদীর পরিবর্তনশীল লবণাক্ততা এবং বাস্তুতান্ত্রিক সংযোগের প্রতীক। এই নদী পরিযায়ী মাছেদের জন্যও একটি গুরুত্বপূর্ণ বাসস্থান। সমুদ্র থেকে নদীতে গমনকারী (anadromous) মাছেদের মধ্যে রয়েছে ইলিশ (*Tenualosa ilisha*) এবং চন্দনা ইলিশ (*Tenualosa toli*), আবার নদী থেকে সমুদ্রে গমনকারী (catadromous) মাছেদের মধ্যে রয়েছে ভারতীয় বাইন মাছ (*Anguilla bengalensis*)। শিং, মাগুরের মতো ক্যাটফিশ এবং শোল জাতীয় মাছ মশা-সহ নানা পোকামাকড়ের লার্ভা খেয়ে প্রাকৃতিক কীটনাশকের ভূমিকা পালন করে, যা নদীর বাস্তুতন্ত্রের ভারসাম্য বজায় রাখে। কিছু প্রজাতি নদীর নির্দিষ্ট অংশেই সীমাবদ্ধ থাকে, আবার কিছু প্রজাতি গোটা নদী জুড়েই বিচারণ করে IIUCN রেড লিস্টের মানদণ্ড অনুযায়ী বেশিরভাগ প্রজাতিই ন্যূনতম উদ্বেগজনক (Least Concern) শ্রেণিতে পড়লেও, উল্লেখযোগ্য সংখ্যক প্রজাতি প্রায়-বিপন্ন (Near Threatened), সংকটাপন্ন (Vulnerable), তথ্য-অপ্রতুল (Data Deficient) অথবা এখনও মূল্যায়ন-না-হওয়া (Not Evaluated) শ্রেণিতেও রয়েছে। পরিবেশগত পরিবর্তন, মাছ ধরার চাপ এবং নতুন প্রজাতির অনুপ্রবেশের পরিপ্রেক্ষিতে বিভিন্ন ধরণের (দেশীয়, পরিযায়ী এবং বহিরাগত) মাছের উপস্থিতি সংরক্ষণের কাজটিকে জটিল করে তুলেছে। এই গবেষণায় প্রাপ্ত তথ্য রূপনারায়ণ নদীতে মাছের বৈচিত্র্য রক্ষা, নদীর পরিবেশগত ভারসাম্য বজায় রাখা এবং নদীর উপর নির্ভরশীল স্থানীয় মানুষদের জীবিকা টিকিয়ে রাখার মতো কাজে তথ্য ভিত্তিক সংরক্ষণের পরিকল্পনায় ও তার বাস্তবায়নে গুরুত্বপূর্ণ ভূমিকা নেবে।

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INTRODUCTION

Freshwater ecosystems are among the most biodiverse yet highly threatened habitats on Earth. In India, riverine systems play a pivotal role in sustaining ecological processes, supporting biodiversity, and promoting human well-being. Despite covering only 2.7% of India's geographical area, the state of West Bengal contributes 13.6% of the country's total inland fisheries production, recording 1.652 million tonnes in 2021–22 (Department of Fisheries 2022). This disproportionately high contribution underscores both the ecological productivity of West Bengal's freshwater systems and the intensive anthropogenic dependence on fish resources. While inland fisheries form the economic backbone of many rural and riverine communities, increasing exploitation pressures necessitate a transition from production-oriented approaches to long-term conservation and sustainability frameworks.

Fish in West Bengal hold not only nutritional and economic value but also deep-rooted cultural and social significance, particularly among Bengali communities (Thapa et al. 2025). Beyond their human utility, fish serve as fundamental components of aquatic food webs, sustaining higher trophic levels including piscivorous birds, otters, riverine reptiles, and freshwater cetaceans (Bashir et al. 2010; Khan et al. 2014; Iglesias et al. 2023). Fish diversity in the Rupnarayan River plays a pivotal role in maintaining ecosystem integrity and supporting species of high conservation significance. A diverse and stable fish community forms the primary prey base for threatened taxa such as the Ganges River Dolphin *Platanista gangetica*, India's National Aquatic Animal, the Irrawaddy Dolphin *Orcaella brevirostris*, and the Critically Endangered Gharial *Gavialis gangeticus*. It also sustains a range of piscivorous birds, including cormorants and other waterbirds, whose foraging success is closely linked to fish availability. Fish also contribute to key ecosystem processes, including nutrient cycling, sediment bioturbation, and the regulation of algal and benthic communities (Matthews 1998; Moore 2006; Vanni et al. 2006). Furthermore, their migratory behaviours enhance ecological connectivity and facilitates nutrient flows across ecosystem boundaries (Cederholm et al. 1999; Flecker et al. 2010).

In this context, conserving fish diversity is integral not only to maintaining aquatic biodiversity but also to sustaining the health and resilience of freshwater ecosystems and the livelihood of fishers. Ecosystem-based conservation efforts help stabilise food webs, protect threatened species, and uphold the services these ecosystems provide to human societies. The Rupnarayan River, a significant tributary of the lower Ganges Basin in eastern India, is a crucial habit supporting a rich diversity of fish and serving as a critical migratory corridor for anadromous and catadromous species. Despite its ecological value and role in supporting inland fisheries, the river faces significant challenges due to pollution, habitat degradation, and invasive species. Notably, shifts in fish catch composition and declining yields have been observed by local fishers, indicating ecological imbalance and socio-economic vulnerabilities. Given this context, a comprehensive understanding of species diversity and conservation status across habitat guilds is essential for effective ecosystem-based management. This study, therefore, aims to document the diversity and conservation status of fish species in the river Rupnarayan, an important tributary of the river Hugli in West Bengal. Some limited literature exists on the fish diversity of the Rupnarayan, based on studies conducted at different times (Ghorai 2018; Dey & Panigrahi 2023), which recorded 30 to 38 fish species separately. The present study compiles all previously available data and additionally reports 11 fish species recorded for the first time from the river Rupnarayan. The findings are based on field data collected during the "Pinger project," conducted between November 2023 and January 2024 at Harishpur, Paschim Medinipur. By consolidating new and existing data, this paper seeks to enhance our understanding of fish assemblages in the Rupnarayan and to support informed conservation planning for this ecologically significant river system of Rupnarayan-Hugli.

Study area

The Rupnarayan River is a major spring-fed tributary of the river Hugli. It originates from the confluence of two rain-fed rivers, Shilabati and Dwarakeswar, which both flow from the Chhota Nagpur Plateau in Purulia (Das 2024). The confluence is located at coordinates 22.671° N, 87.777° E, approximately 6 km downstream of Ghatal City in Paschim Medinipur. The Rupnarayan River flows through four districts in West Bengal: Paschim Medinipur, Purba Medinipur, Hooghly, and Howrah (WII-GACMC 2022). It travels around 75 km from its origin to the Hugli River confluence near Geonkhali in Purba Medinipur, at 22.202° N, 88.032° E. Thirteen tributaries contribute to the River Rupnarayan during its course from origin to end, major tributaries are Dwarakeswar, Shilabati, and Mundeswari (Das 2023).

The Rupnarayan River is an ecologically significant system that supports a rich assemblage of aquatic

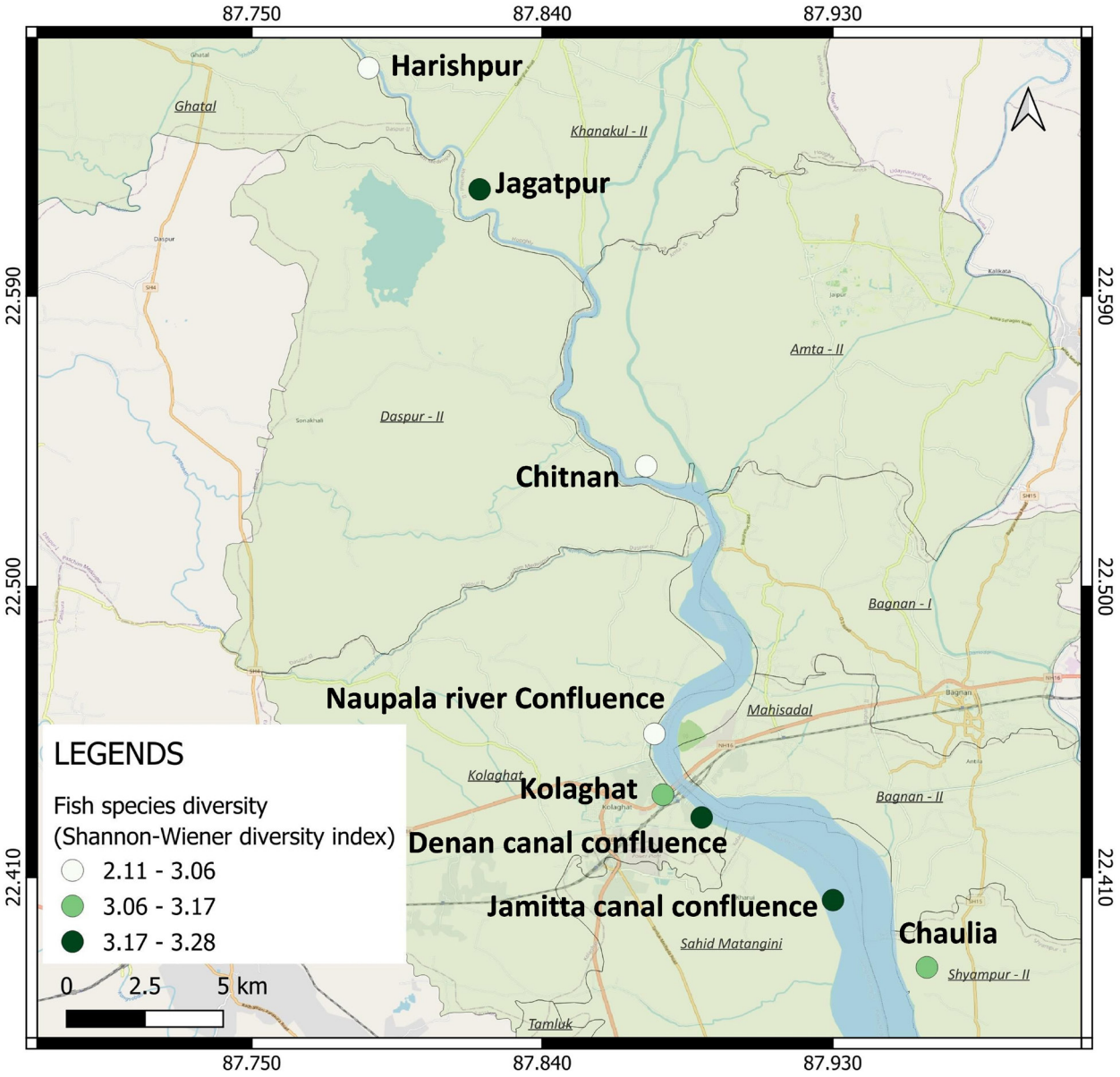

Image 1. Fish species diversity at different locations along river Rupnarayan, West Bengal, India.

and semi-aquatic taxa. Its diverse habitats, including deep channels, sandbars, mudflats, and riparian zones, provide critical feeding, breeding, and resting/nesting or basking grounds for a wide range of species. The Rupnarayan River is a recognised hotspot for the Ganges River Dolphin population, with occasional records of the 'Critically Endangered' Gharial and Northern River Terrapin *Batagur baska*, as well as the 'Endangered' Irrawaddy Dolphin and 'Vulnerable' Indo-Pacific Humpback Dolphin *Sousa chinensis* (WII-GACMC 2022; Qureshi et al. 2024; George et al. 2025). Beyond these flagship species, the river functions as an ecologically significant habitat supporting a diverse assemblage of aquatic and semi-aquatic taxa. Its dynamic habitats sustain a wide range of waterbirds, including cormorants, herons, and migratory species, as well as semi-aquatic fauna such as the Common Water Monitor *Varanus salvator* and other riverine reptiles. Collectively, these attributes underscore the importance of the Rupnarayan River as a critical biodiversity refuge and an integral component of the region's riverine ecosystem.

The river is also essential for the West Bengal Power Development Corporation Limited (WBPDCL), a thermal power plant situated on the riverbank at Kolaghat. The river is famous for its Hilsa Fish *Tenualosa ilisha*, which is a popular fish in Bengali cuisine. The river is very

unique owing to its origin as a smaller spring-fed stream that traverses through a narrow-embanked gorge in the upstream stretch and turns into the mighty river downstream, influenced by extreme tidal cyclic changes and frequent mixing of fresh and brackish water in tidal reaches. The tidal variation, in terms of water level fluctuations and salinity changes, is noticeable along the entire length of the river (Das 2023). As a result, both freshwater and brackish water fish species are found in the river Rupnarayan. Although the river stretch in the upper reaches is narrower, the embanked gorge makes it deeper, forming a congenial habitat for river dolphins.

METHODS

Data collection

Method of fish sampling: The fish sampling took place daily from 21 November 2023 to 31 January 2024 at Harishpur (22.660° N, 87.786° E) in Paschim Medinipur, West Bengal. Situated just downstream of the confluence of the Shilabati and Dwarakeswar rivers, where the Rupnarayan River originates, the Harishpur sampling site represents the river's uppermost reach. Previous studies of the Rupnarayan's ichthyofauna have been restricted to its lower stretches, leaving this upper section largely unexplored. Owing to its considerable distance from the estuary, the site experiences minimal tidal influence and considering the confluence habitat, we therefore hypothesised that fish diversity at this location would differ significantly from that of the lower reaches.

A nylon monofilament gill net with a mesh size of 40 mm, a length of 50 m, and a width of 2 m was used, following local fishing practices. The net was deployed in the river cross-section with the assistance of local fishers and was retrieved and cleaned each morning (0500–0600 h) and evening (1730–1830 h). When the net was retrieved, the local fishers collected the fish catch, and a researcher recorded the data on the number of species. Since the fish sampling was conducted only in the winter months, the interviews of 12 local fishers were undertaken to include the number of fish species that may be found in the river during other seasons (such as summer and monsoon). They were asked about the species of fish found in the river during the summer and monsoon months of the year.

Literature review: A systematic literature review to gather, evaluate, and summarize all available empirical evidence on fish species occurrence and diversity in river Rupnarayan was conducted. We made an exhaustive effort using the Google search engine to include all relevant studies published to date on Rupnarayan fisheries. However, there is very limited information on the fisheries of river Rupnarayan, with almost all relevant studies conducted after 2014. Therefore, we reviewed secondary data available on fish occurrence and diversity in river Rupnarayan from the last decade, specifically between 2014 and 2024, which includes research papers focusing on seven river sites, namely Jagatpur, Chitnan, Naupala river confluence, Kolaghat, Denan canal confluence, Jamitta canal confluence and Chaulia. Eight river sites, including Harishpur, collectively represent the fish diversity of the entire river. Harishpur served as the primary data collection site, while secondary information for the remaining nine sites was gathered through a literature review.

Data analysis

The fish species were listed according to the Talwar & Jhingran (1991) taxonomic classification, which is based on an evolutionary sequence, and taxonomic discrepancies were also resolved using the FishBase database (Froese & Pauly 2010). The fish number data, comprising primary data for Harishpur and secondary data for the remaining nine river sites, were used to calculate the fish diversity index using the Shannon diversity index approach (Image 1). Each recorded and reported fish species conservation status category based on the IUCN Red List was collated. The species were also categorised into the habitat guilds. Based on reports and records from the river site, species distribution was categorised into Clumped, Aggregate, Random, and Hyperdispersed (Khan et al. 2013). Species reported/recorded only from one or two sites were categorised into clumped with only 25% of all sites usage, species found in 3–4 sites were labelled as aggregate distribution with 26–50 % of available monitored sites usage, similarly, species with a usage of 5–6 sites were categorised as random distribution with 51–75 % of available sites use while the species using more than 75% of the sites were categorised into random distribution with 76–100 % usage of available habitat.

RESULTS

A total of 55 fish species, belonging to 13 orders and 31 families, were documented in the Rupnarayan River. One additional shellfish species, the Giant River Prawn *Macrobrachium rosenbergii*, was also recorded but excluded from finfish analyses. Data were compiled

through direct sampling, fisher interviews, and literature review. Several species identified during the study are of conservation concern. These include the 'Near Threatened' — Butter Catfish *Ompok bimaculatus*, Indian Mottled Eel *Anguilla bengalensis*, and Pabdah Catfish *Ompok pabda* (Table 1). Additionally, three species— Mozambique Tilapia *Oreochromis mossambicus*, Toli Shad *Tenualosa toli*, and Wallago *Wallago attu*, are listed as 'Vulnerable' according to the IUCN Red List. Although Mozambique Tilapia is classified as VU globally. It is native to Africa, specifically the Mozambique region, and is considered an exotic species in the Indian river systems (Table 1). The Olive Flathead-gudgeon *Butis humeralis* and Philippine Catfish *Clarias batrachus* are also non-native species found in the Rupnarayan River. The Spotted Catfish *Arius maculatus* is categorised as 'Data Deficient', indicating insufficient information to assess its conservation status. The Olive Flathead-gudgeon *Butis humeralis* and Goldspot Mullet *Planiliza parsia* were the two species that are not assessed by the IUCN (Table 1). One fish species of *Synbranchidae* family was reported as *Amphipnous* sp., indicating that the exact species within that genus- *Amphinous* is unknown/ unidentified.

The fish population is dominated by the presence of five species each from the Cyprinidae and the Bagridae families. Both families are commercially important fish families (Image 2). Notably, a comprehensive sampling at Harishpur identified 20 fish species, while local fishermen specifically reported nine different species found in the Rupnarayan River at Harishpur (Table 1). This makes up the list of 29 species from the Harishpur site. Of these 29 species of fish, 11 species were not reported from the river Rupnarayan, namely Indian Glassy Fish *Chanda ranga,* Long-whiskered Catfish *Sperata aor,* Olive Flathead-gudgeon *Butis humeralis,* Toli Shad *Tenualosa toli,* Rosy Barb *Pethia conchonius,* Large Razorbelly Minnow *Salmophasia bacaila,* Spiny Eel *Mastacembelus armatus,* Gangetic leaffish *Nandus nandus,* Garua Bachcha *Clupisoma garua,* Oriental Sole *Brachirus orientalis*, and Crocodile-tooth Pipefish *Microphis cuncalus*. Among these newly recorded species, Toli Shad is classified as 'Vulnerable'.

The Giant River Prawn *Macrobrachium rosenbergii* (locally known as *Chingri*) was recorded during the present study and has also been previously reported from the river by Ghorai (2018). These authors included the species in their ichthyofaunal diversity index calculations. However, as a shellfish rather than a finfish, this species was excluded from the species list and subsequent analyses in the present study.

The fish diversity index of the Harishpur site was calculated as 2.113 (Shannon diversity index, Image 1). The fish diversity of the Rupnarayan River was found to vary from 2.1 (Shannon diversity index) in Harishpur (the highest point covered during the present study) to 3.09

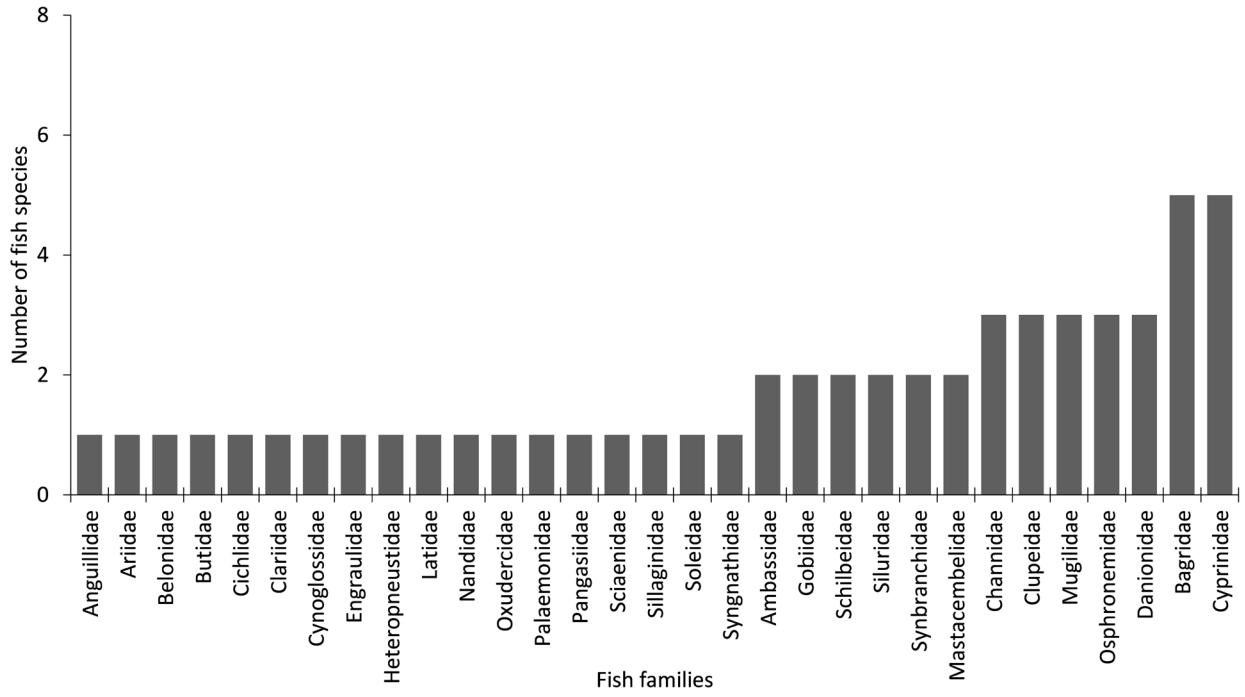

Image 2. Family-wise number of fish species found in the Rupnarayan River, West Bengal, India.

Table 1. Fish species composition, conservation status and distribution in the river Rupnarayan, West Bengal, India.

	Family	Scientific name	English name	Bengali name	Conservation status[1]	Harishpur[2]	Jagatpur[3]	Chitnan[3]	Naupala River confluence[4]	Kolaghat[5]	Denan Canal confluence[6]	Jamitta Canal confluence[4]	Chaulia[3]
1	Anguillidae	*Anguilla bengalensis*	Indian Mottled Eel	--	NT	-	-	-	+	-	+	+	-
2	Clupeidae	*Tenualosa ilisha*	Hilsa Shad	Ilish	LC	-	+	+	+	+	+	+	+
3		*Gudusia chapra*	Indian River Shad	Khoira	LC	+	+	+	+	+	+	+	+
4		*Tenualosa toli*	Toli Shad	Khoka Ilish/ Chandana-Ilish	VU	+	-	-	-	-	-	-	-
5	Engraulidae	*Setipinna phasa*	Gangetic Hairfin Anchovy	Phasa/Phansa	LC	+	+	+	+	+	+	+	+
6	Cyprinidae	*Pethia ticto*	Ticto Barb	Tituputi	LC	-	+	+	+	+	+	+	+
7		*Puntius vittatus*	Green-stripe Barb	--	LC	-	+	+	+	+	+	+	+
8		*Systomus sarana*	Olive Barb	Selim Puti/ Sar Puti	LC	+	+	+	+	+	+	+	+
9		*Labeo bata*	Minor Carp	Bhangan Bata	LC	+	-	-	-	-	-	-	-
10		*Pethia conchonius*	Rosy Barb	Deshi Puti/ Kanchan Puti	LC	+	-	-	-	-	-	-	-
11	Danionidae	*Chela cachius*	Silver Hatchet Chela	--	LC	-	+	+	+	+	+	+	+
12		*Amblypharyngodon mola*	Mola Carplet	Mourala	LC	-	+	+	+	+	+	+	+
13		*Salmophasia bacaila*	Large Razorbelly Minnow	Chela/Swui	LC	+	-	-	-	-	-	-	-
14	Bagridae	*Sperata seenghala*	Giant River-Catfish	Aoyeer	LC	-	+	+	+	+	+	+	+
15		*Mystus tengara*	Tengara Catfish	Bajri Tengra	LC	-	+	+	+	+	+	+	+
16		*Mystus vittatus*	Striped Dwarf Catfish	Lal Tengra	LC	-	+	+	+	+	+	+	+
17		*Mystus cavasius*	Gangetic Mystus	Tengra	LC	+	+	+	+	-	-	+	+
18		*Sperata aor*	Long-Whiskered Catfish	Aar	LC	+	-	-	-	-	-	-	-
19	Siluridae	*Ompok bimaculatus*	Butter Catfish	Pabda	NT	+	+	+	+	+	+	+	+
20		*Wallago attu*	Wallago	Boyal/Boyali	VU	+	+	+	+	+	+	+	-
21		*Ompok pabda*	Pabdah Catfish	--	NT	-	+	+	+	+	+	+	+
22	Schilbeidae	*Silonia silondia*	Silond Catfish	Farse/Silon	LC	+	+	+	+	+	+	+	+
23		*Clupisoma garua*	Garua Bachcha	Bachi/Ghaura	LC	+	-	-	-	-	-	-	-
24	Pangasiidae	*Pangasius pangasius*	Pangas Catfish	Pangas	LC	-	+	-	+	+	+	-	+

	Family	Scientific name	English name	Bengali name	Conservation status[1]	Harishpur[2]	Jagatpur[3]	Chitnan[3]	Naupala River confluence[4]	Kolaghat[5]	Denan Canal confluence[6]	Jamitta Canal confluence[4]	Chaulia[3]
25	Clariidae	*Clarias batrachus*	Philippine Catfish	Magur	LC	-	+	+	+	+	+	-	+
26	Heteropneustidae	*Heteropneustes fossilis*	Stinging Catfish	Singee	LC	-	+	+	+	-	+	+	-
27	Ariidae	*Arius maculatus*	Spotted Catfish	--	DD	-	+	+	+	+	+	+	+
28	Belonidae	*Xenentodon cancila*	Freshwater Garfish	Gang Dhara(Kankle)	LC	+	+	-	+	-	-	-	+
29	Syngnathidae	*Microphis cuncalus*	Crocodile-tooth Pipefish	Daton Kathi	LC	+	-	-	-	-	-	-	-
30	Synbranchidae	*Amphipnous sp*		--	---	-	-	-	+	-	+	+	-
31		*Monopterus cuchia*	Gangetic Mudeel	Kuchia	LC	-	+	-	+	+	+	+	+
32	Ambassidae	*Chanda nama*	Elongate Glass Perchlet	Chanda	LC	+	+	+	+	+	+	+	+
33		*Chanda ranga*	Indian Glassy Fish	Chanda	LC	+	-	-	-	-	-	-	-
34	Sillaginidae	*Sillaginopsis panijus*	Flathead Sillago	Tool-belle	LC	-	-	-	-	+	-	-	-
35	Sciaenidae	*Johnius coitor*	Coitor Croaker	--	LC	+	+	+	+	-	+	+	+
36	Nandidae	*Nandus nandus*	Gangetic Leaffish	Ledus/Nadus	LC	+	-	-	-	-	-	-	-
37	Cichlidae	*Oreochromis mossambicus*	Mozambique Tilapia	--	VU	-	+	+	+	+	+	-	+
38	Mugilidae	*Rhinomugil corsula*	Corsula	Tarui/ Kharsula/Urul	LC	+	-	-	-	-	-	-	-
39		*Planiliza parsia*	Goldspot Mullet	--	NE	-	+	+	+	+	+	+	+
40		*Mugil cephalus*	Flathead Mullet	Ain	LC	-	-	-	+	-	+	-	-
41	Polynemidae	*Polynemus paradiseus*	Paradise Thread fin	Tapsee-machh	LC	-	+	+	+	+	+	+	+
42	Gobiidae	*Odontamblyopus rubicundus*	Red Eel Goby	Lal Chengo	LC	+	-	-	-	-	-	-	-
43		*Glossogobius giuris*	Bareye Goby	Sada Bhola/ Belay	LC	+	+	+	+	+	+	+	+
44	Oxudercidae	*Apocryptes bato*	--	Sada Chengo/ Cheeng	LC	+	-	-	-	-	-	-	-
45	Butidae	*Butis humeralis*	Olive Flathead-gudgeon	Kalo Bhola	NE	+	-	-	-	-	-	-	-
46	Osphronemidae	*Trichogaster chuna*	Honey Gourami	--	LC	-	+	+	+	+	+	+	+
47		*Trichogaster fasciata*	Banded Gourami	Kholisha	LC	+	-	-	+	-	+	+	-

	Family	Scientific name	English name	Bengali name	Conservation status[1]	Harishpur[2]	Jagatpur[3]	Chitnan[3]	Naupala River confluence[4]	Kolaghat[5]	Denan Canal confluence[6]	Jamitta Canal confluence[4]	Chaulia[3]
48	Channidae	*Channa striatus*	Striped Snakehead	Shoal	LC	-	-	+	-	+	+	+	+
49		*Channa marulius*	Great Snakehead	Sal/Gajal	LC	+	-	-	-	-	-	-	-
50		*Channa punctata*	Spotted Snakehead	Lata	LC	-	+	-	+	+	+	+	+
51	Mastacembelidae	*Mastacembelus armatus*	Spiny Eel	Baim/Ban	LC	+	-	-	-	-	-	-	-
52		*Macrognathus pancalus*	Barred Spiny Eel	Baim	LC	-	+	+	+	+	+	-	+
53	Cynoglossidae	*Cynoglossus cynoglossus*	Bengal Tonguesole	Kukur Jiv	LC	+	+	+	+	+	+	+	+
54	Soleidae	*Brachirus orientalis*	Oriental Sole	Kathal Pata	LC	+	-	-	-	-	-	-	-
55	Latidae	*Lates calcarifer*	Barramundi	Bhetki	LC	-	+	+	+	+	+	-	+

*—Not identified at species level | [1]LC—Least Concern | VU—Vulnerable | NT—Near Threatened | DD—Data Deficient | NE—Not Evaluated | [2]—Present study | [3]—Dey & Panigrahi 2023 | [4]—Ghorai 2018 | [5]—Dey & Panigrahi 2023 | [6]—Ghorai 2018.

(Shannon diversity index) in Kolaghat (approximately the middle section of the river) and 3.28 Shannon diversity index at Chaulia (lowest assessment point in the river) (Image 1, Table 2).

The majority of fish species in the River Rupnarayan, as recorded at the Harishpur site and reported in the literature and by fishers, are categorised as 'Least Concern' by the IUCN Red List of Threatened Species. Between 6.1% and 10% of the species are classified as 'Near Threatened', while 3.1% to 6.7% are categorised as VU across the sites. There are 1.9% of species with DD status, and 3.7% of fish species are not assessed for their conservation status by the IUCN Red List (Table 1, Image 3).

The fish population of the river Rupnarayan is primarily composed of species that inhabit freshwater and brackish water habitats. Approximately 18.2% of the population consists of exclusive freshwater fishes, 52.7% live in freshwater and brackish waters, and 29.1% fish species, capable of surviving in various salinity levels, including freshwater, brackish water, and marine water (Image 4). This distribution of fish habitat guild composition was consistent across all sites in the river Rupnarayan (Image 4).

An analysis of habitat distribution revealed that 17 species exhibited highly clumped distribution, utilising only 25% of the available habitats (Image 5). Four fish species demonstrated aggregate distribution by utilising up to 50% of the available habitat (Image 5). Additionally, 10 fish species exhibited random distribution by utilising 51–75 % of the available habitat, while 24 species were widely dispersed, utilising 76–100 % of the available habitat across sites (Image 5).

DISCUSSIONS

The Rupnarayan River supports a diversity of 55 fish species, which is comparable to other tributaries of the river Hooghly within West Bengal, such as the Damodar River (68 species; Das et al. 2013) and the Churni River (64 species; Das et al. 2014). Although the tidal freshwater stretch of the Hooghly estuary reports a higher diversity (155 species; Roshith et al. 2013), this includes a broader estuarine influence and migratory species. Thus, within the context of West Bengal's riverine systems, the Rupnarayan River exhibits a moderately high level of fish diversity, underscoring its ecological significance among similar river stretches in the region. These findings suggest that the Rupnarayan River plays a vital role in maintaining regional fish diversity

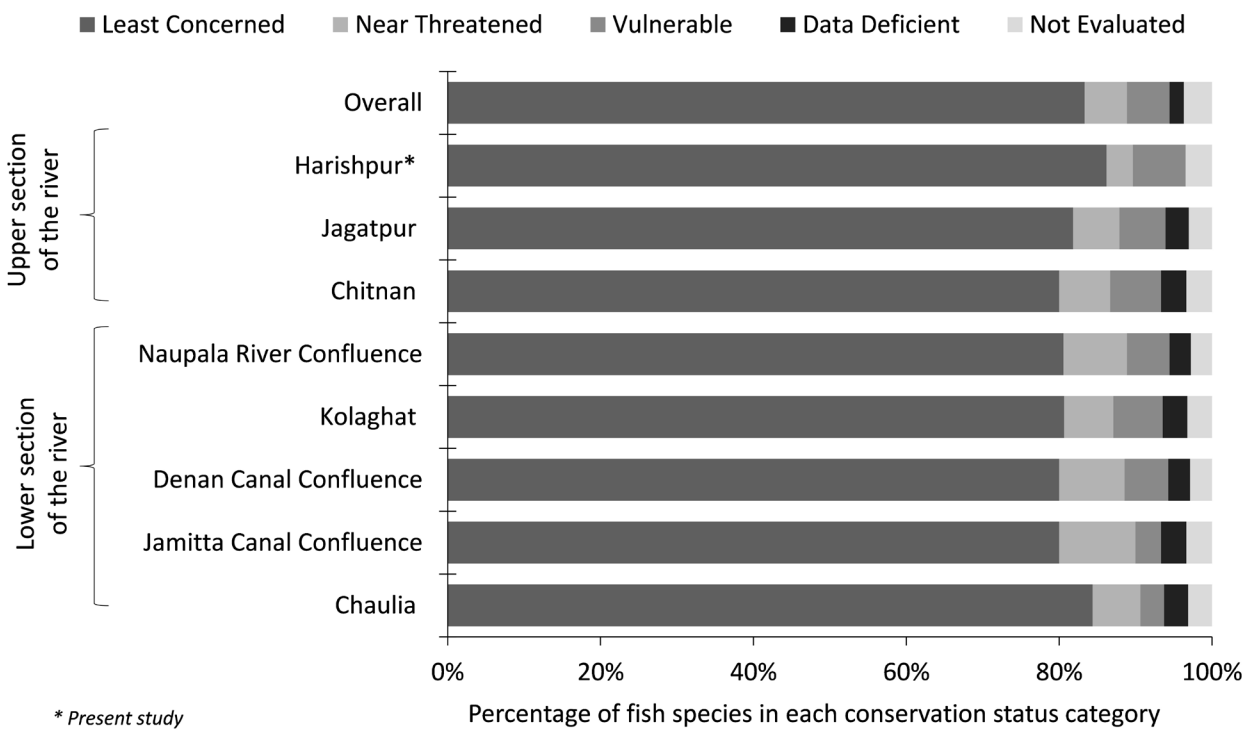

Image 3. Conservation status of the fishes of Rupnarayan River, West Bengal, India.

Table 2. Fish diversity table to assess the Shannon index in the river Rupnarayan of present and past studies.

Location	Habitat description	Shannon Index	Reference
Harishpur, Paschim Medinipur (22.66058° N, 87.78616° E)	The site is located approximately 6 km downstream from the confluence point of Dewakeshwar and Shilabati rivers. The river at this site is narrow, about 100 m wide, but deep, reaching 3–4 m at low tide. It remains narrow until it meets the Mundeshwari at Bakshi. The riverbanks are steep and covered with dense vegetation, mostly tall grasses. There is a broad meander near the site. Both banks of the river are embanked and have human settlements.	2.113	Primary study
Jagatpur, Hooghly (22.623° N, 87.8206° E)	The river at the site is narrow, about 100 m wide, and deep, reaching 3–4 m at low tide. The river channel is straight at Jagatpur, with steeply sloped banks, and there are visible signs of soil erosion at a few points. About 1 km upstream of the site, a small canal flows into the river.	3.172	Dey & Panigrahi 2023
Chitnan, Howrah (22.5373° N, 87.87219° E)	The Chitnan area features a narrow river, approximately 300 m wide and 3–6 m deep at low tide. The site is in downstream from where the river Mundeswari meets the river Rupnarayan, the river widens significantly compared to the upper two sites. The riverbanks are characterized by narrow floodplains and dense vegetation, while small mid-channel islands emerge during low tide.	3.040	Dey & Panigrahi 2023
Naupala River Confluence, Howrah (22.45440° N, 87.87476° E)	The river at this site varies in width 500–1,000 m and forms meander, with many small islands visible during low tide. The river's depth is 3–4 m at low tide.	3.052	Ghorai 2018
Kolaghat, Purba Medinipur (22.4352° N, 87.8607° E)	The river at Kolaghat is straight and deep, measuring 3–8 m during low tide. It is approximately 600–700 m wide and embanked on both sides. A mid-channel island emerges during low tide. There are railway and roadway bridges as well as other riverside developmental activities at this location.	3.09	Dey & Panigrahi 2023
Denan canal inlet, Purba Medinipur (22.42851° N, 87.88941° E)	The Denan Canal connects to the river Rupnarayan, and thermal fly ash can be observed mixed in the river water at this location. The river is straight at this point and features a large mid-channel island. In terms of stream habitat, the river width is approximately 550 m and the depth ranges from 3–6 m during low tide.	3.28	Ghorai, 2018
Jamitta canal inlet, Purba Medinipur (22.40293° N, 87.93011° E)	The Jamitta canal connects to the river Rupnarayan, where thermal fly ash can be seen mixed in the river water. The river has a meander at this location. The depth of the river is about 2–3 m at low tide, and the width of the river is 800–850 m.	3.195	Ghorai 2018
Chaulia, Paschim Medinipur (22.3821° N, 87.95920° E)	The river channel splits into two separate channels due to a large mid-channel island. The main channel is approximately 850 m wide and is bordered by extensive flood plains on both banks. The river runs straight and has a depth of 2–4 m during low tide.	3.158	Dey & Panigrahi 2023

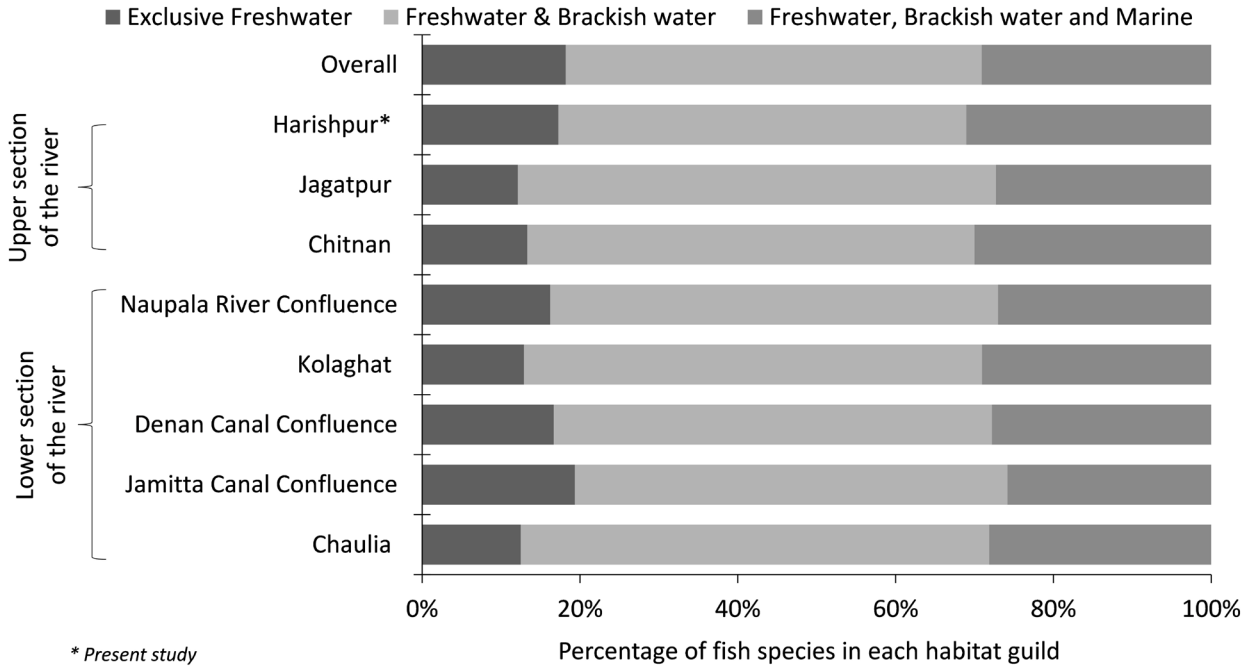

Image 4. Habitat guild of the fishes of Rupnarayan River, West Bengal, India.

and may serve as an important corridor for migratory and estuarine-dependent species. Its conservation is therefore crucial for sustaining the broader ecological integrity of the Hooghly riverine system. The integration of direct observations, local ecological knowledge, and literature synthesis enabled a robust understanding of the ichthyofaunal assemblage within a relatively short study period. However, the diversity also highlights underlying conservation challenges, especially the coexistence of native, migratory, and exotic species. While many species were categorised as LC, this does not imply ecological security. Several species with restricted distribution or facing local pressures—such as habitat degradation, overfishing, and pollution—require urgent conservation attention. The presence of NT and VU species, particularly in tidal zones that act as breeding grounds, calls for immediate protection measures. Notably, the exotic species add another layer of complexity, as their introduction to Indian rivers poses potential ecological risks due to competition for resources with indigenous species, habitat alteration, and potential spread of diseases (Saha et al. 2022). This also illustrates the anthropogenic influence on the river's biodiversity (Milardi et al. 2022).

The river's fish community is predominantly composed of species belonging to the *Cyprinidae* and *Bagridae* families, which are commercially important and widely distributed in Indian freshwater systems. The dominance of *Cyprinidae*, with eight identified species, underscores its adaptability to the river's environment. Differences in fish species diversity across sites, with the Shannon diversity index ranging from 2.1 at Harishpur to 3.28 at Denan canal confluence, suggest that environmental conditions, such as water quality, habitat structure, and salinity gradients, influence species distribution. The higher diversity observed at Denan canal inlet and Jamitta canal inlet could be attributed to the river's transition from freshwater to brackish water, providing a more diverse range of ecological niches (Kark 2017).

Species such as Elongate Glass Perchlet *Chanda nama*, Striped Snakehead *Channa striatus*, Great Snakehead *Channa marulius*, Spotted Snakehead *Channa punctata*, Tengara Catfish *Mystus tengara*, Striped Dwarf Catfish *Mystus vittatus*, Gangetic Mystus *Mystus cavasius*, Mola Carplet *Amblypharyngodon mola*, Barramundi *Lates calcarifer*, Spiny Eel *Mastacembelus armatus*, Barred Spiny Eel *Macrognathus pancalus*, Honey Gourami *Trichogaster chuna*, Banded Gourami *Trichogaster fasciata*, Gangetic Leaf-fish *Nandus nandus*, Wallago *Wallago attu*, Pabdah Catfish *Ompok pabda*, and Gangetic Mudeel *Monopterus cuchia* play important ecological roles by controlling insect larvae populations, including vectors of human diseases. These ecosystem services offer indirect public health benefits, further reinforce the need for their conservation (Farswan et al.

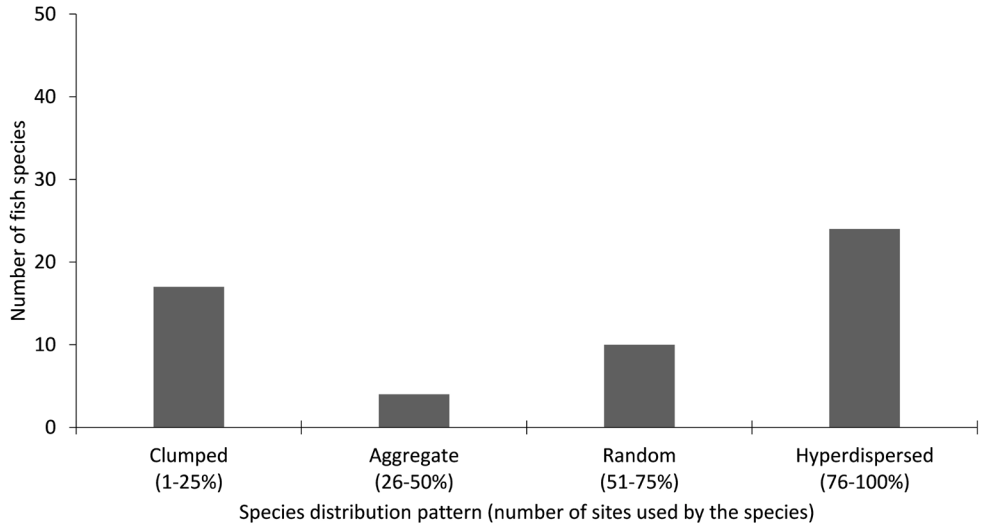

Image 5. Distribution pattern of the fishes of Rupnarayan River, West Bengal, India.

2019).

The species distribution analysis reveals that a substantial proportion of fish species (24 out of 55) are widely dispersed across habitats, indicating ecological adaptability. Conversely, clumped or narrowly distributed 16 species may be more vulnerable to habitat disturbance. The coexistence of freshwater, brackish water, and euryhaline species demonstrates the river's role as a transition zone between different aquatic environments. This ecological connectivity allows for a diverse array of fish species to thrive but also makes the river sensitive to changes in salinity and hydrological dynamics. The high proportion of species that utilise both freshwater and brackish water habitats (52.7%) suggests a reliance on stable salinity conditions, making the ecosystem potentially vulnerable to activities such as dam construction, which could alter natural salinity gradients. Owing to its unique geographical location and habitat due to the ingression of cyclic tide, the river supports many migratory species of fishes. The presence of anadromous migrants such as Hilsa Shad *Tenualosa ilisha*, Toli Shad *Tenualosa toli*, Corsula *Rhinomugil corsula*, and Oriental Sole *Brachirus orientalis* indicates the importance of the River Rupnarayan as a viable breeding ground. Furthermore, the unique habitat of River Rupnarayan also supports a substantial population of various catadromous species, including the Indian Mottled Eel *Anguilla bengalensis*. While the current study provides valuable baseline data, limitations such as taxonomic ambiguities (e.g., *Amphipnous* sp.) and seasonal data gaps must be acknowledged. Genetic barcoding and longer-term monitoring are recommended to improve species resolution and track population trends.

This study underscores the ecological significance of the Rupnarayan River as a biodiversity-rich yet vulnerable freshwater ecosystem. The documentation of 55 fish species, including threatened and exotic taxa, highlights the need for immediate conservation action. Ecosystem-based management approaches that integrate biodiversity protection with sustainable livelihood strategies are essential. Continued research, habitat restoration, and participatory governance involving local communities will be key to securing the future of this vital riverine ecosystem. Changes in fish catch patterns, as reported by local fishers, suggest a declining abundance of certain native and economically important species and an increasing presence of exotics. This shift has direct implications for livelihoods dependent on traditional capture fisheries. Conservation strategies must, therefore, integrate socio-economic perspectives to ensure sustainable fisheries while restoring ecological balance. Management actions could include regulating fishing practices, protect breeding habitats, and establishing community-based monitoring systems. Conservation strategies should consider the management of non-native species, monitoring of fish population trends, and protection of critical habitats to maintain the ecological balance (Britton et al. 2011). Additionally, the presence of species that are either DD or NE for their conservation status further highlights the need for ongoing research to fill knowledge gaps and inform conservation priorities.

Disclaimer

The map used in the article is not a legal description or a reflection of any expression or opinion or advise of any nature and do not warrant correctness, current situation, limitations and accuracy. The depictions are strictly representational.

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