Asian Journal of Biology

Volume 21, Issue 1, Page 17-25, 2025; Article no. AJOB.129529
ISSN: 2456-7124

Diversity of Ichthyofauna and their Abundance in Ghaghara River, Siwan District, Bihar, India

Jay Prakash Sharma [a*] and D. K. Paul [a]

[a] Department of Zoology, Patna University, Patna, Bihar-800005, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ajob/2025/v21i1472

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/129529

Original Research Article

Received: 05/11/2024
Accepted: 07/01/2025
Published: 11/01/2025

ABSTRACT

The Ghaghara River, a significant tributary of the holy River Ganga, travels across northern India., providing essential water resources for agriculture, communities and biodiversity. The river's fish diversity is vital for maintaining local ecological balance and supporting livelihoods. Fish biodiversity and different diversity indices were evaluated in the study area from August 2021 to July 2022. Data was collected from four locations namely Darauli (S-1), Rakauli (S-2), Phulwariya (S-3) and Semariya (S-4) of the Ghaghara River and we found 61 species belongs to 47 genera, 21 families and 07 orders. Cypriniformes were the most common order, accounting for 42% of fish species, followed by Siluriformes (31%), and Perciformes (18%). The most prevalent family is Cyprinidae, which accounts for 39.3% of the fish fauna (24 species), followed by Bagridae (06 species) and Sisoridae (4 species). Total number of individuals, relative abundance (percentage catch), minimum and maximum size of each species were calculated. However, the river's aquatic ecosystems, particularly its fish populations are increasingly under threat due to human activities, including

**Corresponding author: E-mail: jayprakash.hathua@gmail.com;*

Cite as: *Sharma, Jay Prakash, and D. K. Paul. 2025. "Diversity of Ichthyofauna and Their Abundance in Ghaghara River, Siwan District, Bihar, India". Asian Journal of Biology 21 (1):17-25. https://doi.org/10.9734/ajob/2025/v21i1472.*

habitat degradation, pollution, overfishing and the construction of hydropower projects. This study aims to assess the fish diversity of the Ghaghara River and explore the current conservation challenges and opportunities.

Keywords: Ghaghara river; ichthyofauna; species composition; Bihar.

1. INTRODUCTION

Beginning with genes and progressing through species richness and complexity, functional roles, and spatial patterns ranging from biological communities to ecosystems, regions, and beyond, life on Earth is diversified on many levels (Colwell, 2009). Diversity, in a broader sense, is the variation in the genetic makeup of living things as well as the variety of environments in which they thrive. Great biodiversity is a result of many different physical and climatic variables. Many perspectives on biodiversity have emerged from the insights of specialists in different fields. The terms "life" and "wilderness" have been used interchangeably. Even for organisms that are well-known to science, it is challenging to quantify patterns of diversity at the species level because to the underlying complexity of the environmental template and the difficulty of detecting unusual species. Populations, species, groups and ecosystems are all considered to have varying degrees of genetic and biological variety, which is referred to as biodiversity (Winter and Hughes, 1997). According to Rahbek and Colwell (2011), biodiversity is essential for ecosystems to provide goods and services like nutrient cycling and clean water and it also impacts the capacity of biological systems to adapt to changes in their environment. Bihar has great potential for the development of aquaculture and inland fishing and it also has a significant potential for aquatic bioresources. According to Lakra (2010), the state is home to around 14.68% of the total variety of fish in the country. There are about 28,500 km of rivers and canals, over 1,38,000 acres of ponds and tanks, over 1,33,000 acres of floodplain lakes, and untapped water as part of the aquatic resources. According to the state's fisheries website (www.fisheries.bihar.nic.in), annual fish output for 2009–2010 was 3.93 million tonnes. The state's fish biodiversity has been drastically decreasing over the past few decades due to human activities like pollution, urbanization, water abstraction for irrigation and power generation, and the introduction of exotic fish species (Dwivedi and Nautiyal, 2010; Pathak et al, 2011). As a result, many freshwater fish species have suffered greatly as rivers and other natural water sources have been overwhelmed (Lakra, 2010). This study set out to record the present ichthyofaunal variety and give the first thorough description of fish inhabiting the Ghaghara River in the Siwan district of Bihar.

2. MATERIALS AND METHODS

The present study focused on the Ghaghara River, a significant tributary of the Ganga River system in northern India. The river rises in the Mapchachungo glaciers on Tibet's southern Himalayan slope at an elevation of around 3,962 metres. This river spans 1,080 kilometers until it joins the Ganges near Revelganj in Bihar This article investigated fish biodiversity and different diversity indices from August 2021 to July 2022. Data was collected from four locations: Darauli (S-1), Rakauli (S-2), Phulwariya (S-3), and Semariya (S-4) of the river. GPS was used to accurately record the positions of sampling stations.

2.1 Study Area

The Ghaghara River, also known as the Karnali River in Nepal, flows through northern India and Nepal. The river is a significant tributary of the Ganges River, covering an area of about 507 km in India (Jain S.K et al, 2007). It serves as a vital ecological resource, supporting a rich diversity of fish species and providing livelihood opportunities to local communities.

2.2 Sampling of Fishes and Collection of Data

Experimental fishing was carried out using the experience of local and competent fisherman. Fish were captured using various nets and photographs were taken before 10% Formaldehyde preservation. Specimens were fixed in separate glass jars. Smaller fish were immersed directly in the formalin solution, whereas bigger fish were fixed by an incision on the belly to allow the preservative to penetrate more thoroughly. The glass bottles/jars that were used to collect fish specimens were labelled with proper serial numbers, locality, date of collection and local name of fish used in that region.

Geographical location of Ghaghara River

Darauli (S1 – Site 1)	Rakauli(S2 – Site 2)	Phulwariya (S – Site 3)	Semaria (S4 – Site 4)
26°04'41.3" N 84°07'18.8" E	26.03'38.4" N 84.22'01.3" E	25°89'56.9" N 84°49'24.7" E	25.79'59.0" N 84.62'25.9" E

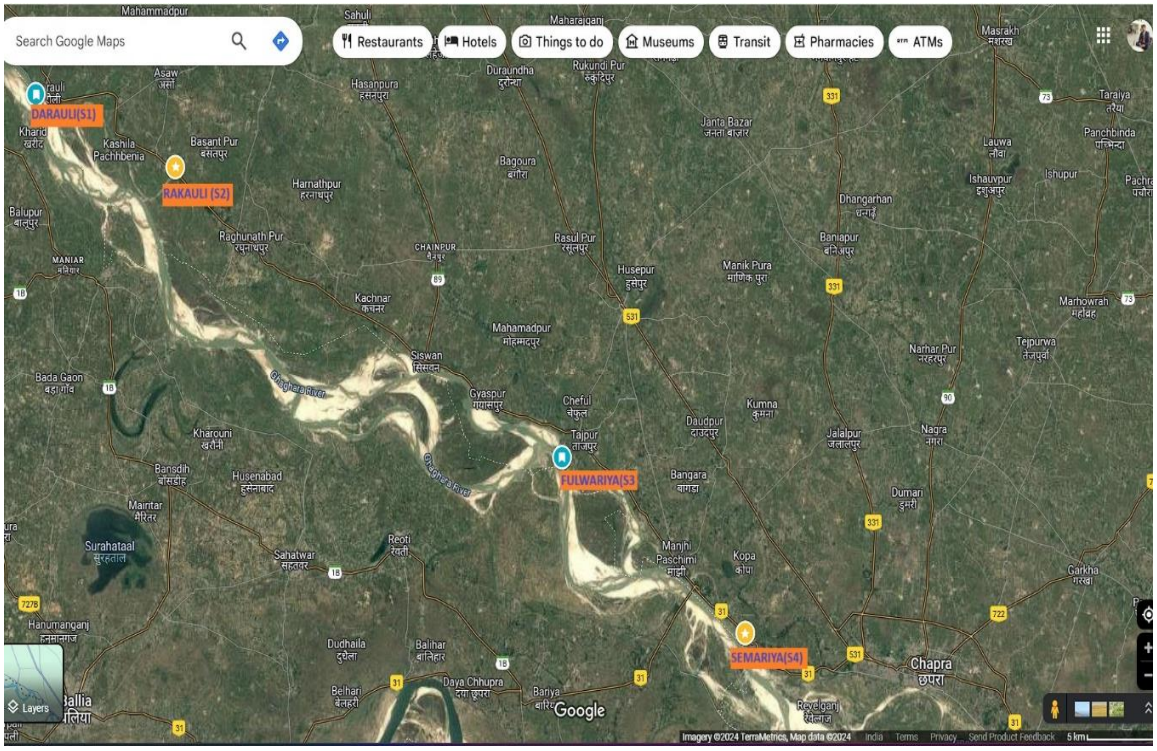

Fig. 1. Map showing Ghaghara River sampling sites

2.3 Data Analysis

One aspect of biodiversity is species' Relative Abundance (RA), which describes how frequent or uncommon a species that is in relation to other species in that particular area or population. Percentage composition of an organism of a specific sort in relation to the overall number of organisms in the region is known as relative abundance (Krebs, C. J. 2016).

> Relative Abudance = Number of Individuals of a Species / Total Number of Individuals of all Species x 100

The Shannon-Wiener Diversity Index is a regularly used index to assess species diversity. It incorporates both species richness and relative abundance of species. (Magurran, A. E. 2004).

$$H' = -\sum_{i=1}^{s}(pi \times \ln(pi))$$

Where

- H' = Shannon-Wiener Diversity Index (species diversity)
- S = Total number of species in a sample
- pi = Proportion of individuals of species iii in the total sample (calculated as the number of individuals of species iii divided by total number of individuals).

The Shannon index provides a measure of diversity that accounts for both the number of species (richness) and their relative abundances. A higher value of H' indicates greater diversity.

3. RESULTS AND DISCUSSION

The distribution pattern of fishes in river Ghaghara showed variations among different sites. Out of 61 species, 15 species were distributed throughout the river from, (S1 to S4). The species viz *Salmostoma bacaila*, *Channa*

panctatus, Puntius ticto, Mastacembelus armatus Mystus cavasius, Cirrhinus mrigala, Clupisoma garua were ranked. Conversely, the *Clarias batrachus, Anabas testudineus, Glyptothorax telchitta, Amblypharyngodon mola, Labeo dero, and Aspidoparia morar* were the scarcest species (occurrence frequency <10%). The common carp (*Cyprinus carpio*)'s dominance as the sole non-native species with a high occurrence frequency (>50%) may be attributed to its adaptation to a variety of environmental circumstances, including damaged habitats, as well as its tolerance for pollution. These characteristics frequently allow non-native species to outcompete native fish, as documented in prior studies (Dwivedi & Nautiyal, 2010). The species *Salmostoma bacaila* and *Puntius ticto* showed higher abundance in each site. Interestingly, some of the species of high conservation importance showed relatively high relative abundance in different sampling sites (*Ompok pabda* and *Channa marulius* from site 2; *Ompok bimaculatus*, *Notopterus notopterus* from site 3; *Sperata aor*, *N. notopterus*, *Labeo calbasu, Sperata aor, N. notopterus* and *Rita rita, S. seenghala* and *Mystus vittatus* from site 4 indicating relatively stable population in spite of heavy fishing pressure and habitat degradation which is esembles with the findings of Pathak et al., 2011. The site wise distribution of families, genera and species in river are presented in the Table given below.

Table 1. Site-wise occurrence of fish species in River Ghaghara

Sl. No	Species	Darauli (S1)	Rakauli (S2)	Fulwariya (S3)	Semariya (S4)
1.	*Ailia coila*				√
2.	*Amblypharyngodon mola*		√		
3.	*Anabas testudineus*			√	
4.	*Aspidoparia morar*		√		
5.	*Bagarius bagarius*				√
6.	*Botia lohachata*			√	
7.	*Catla catla*		√		√
8.	*Chagunius chagunio*				
9.	*Chanda nama*	√	√		
10.	*Channa marulius*	√	√		√
11.	*Channa punctatus*	√	√		√
12.	*Channa striatus*		√		√
13.	*Chela laubuca*				
14.	*Chitala chitala*				√
15.	*Cirrhinus mrigala*	√	√		√
16.	*Cirrhinus reba*		√		√
17.	*Clarias batrachus*			√	
18.	*Clarias gariepinus*			√	
19.	*Clupisoma garua*	√	√		√
20.	*Colisa fasciatus*	√	√		
21.	*Ctenopharyngodaon idellus*				√
22.	*Cyprinus carpio*		√		√
23.	*Devario devario*	√	√		
24.	*Esomus danricus*	√			
25.	*Eutropiichthys vacha*		√		√
26.	*Gagata cenia*		√		
27.	*Glossogobius guiris*		√		
28.	*Glyptothorax Telchitta*		√		
29.	*Gudusia chapra*			√	
30.	*Heteropneustes fossilis*			√	
31.	*Hypophthalmichthys molitrix*				√
32.	*Labeo bata*		√		√
33.	*Labeo boggut*			√	
34.	*Labeo calbasu*	√	√		√
35.	*Labeo dero*		√		
36.	*Labeo gonius*		√		√

Sl. No	Species	Darauli (S1)	Rakauli (S2)	Fulwariya (S3)	Semariya (S4)
37.	*Labeo rohita*	√	√		√
38.	*Lepidocephalus guntea*		√		
39.	*Macrognathus pancalus*		√		√
40.	*Mastacembalus armatus*	√	√		√
41.	*Mystus cavasius*	√	√		
42.	*Mystus tengara*		√		√
43.	*Mystus vittatus*	√	√		√
44.	*Nandus nandus*		√	√	
45.	*Nangra nangra*			√	
46.	*Notopterus notopterus*	√	√		√
47.	*Ompok bimaculatus*		√		√
48.	*Ompok pabda*		√		√
49.	*Osteobrama cotio*		√		√
50.	*Puntius sarana*	√	√		
51.	*Puntius sophore*	√	√		√
52.	*Puntius ticto*	√	√		√
53.	*Rasbora daniconius*	√	√		√
54.	*Rhinomugil corsula*			√	
55.	*Rita rita*				√
56.	*Salmostoma bacaila*	√	√		√
57.	*Sperata aor*				√
58.	*Sperata seenghala*		√		√
59.	*Tetradon cutcutia*			√	
60.	*Wallago attu*	√	√		√
61.	*Xenentodon cancila*	√	√		√

Note: √ sign Indicates presence of a particular fish species.

3.1 Catch Per Unit Effort (CPUE)

Drag nets and Gill nets of different sizes were the most common fishing gear in the Ghaghara River. The capture per unit effort was computed using a gill net. The mean values of CPUE at several sample locations ranged from 0.52 to 2.14 kg/man/hour. Higher CPUE values at specific sites, such as the Ghaghara River Site 4, might indicate more fishing activity, which is sometimes attributed to the ideal circumstances these places provide for huge fish populations. Deep pools, semi-urban and rural environments and low to moderate river velocities provide suitable homes for numerous fish species, making these places popular fishing destinations. These qualities not only support a healthy fish population, but also increase fishing effort, confirming the link between habitat features and CPUE. Studies, such as those evaluating angler capture data from monsoonal rivers, have emphasized the interaction between CPUE and habitat characteristics, providing insights into both biological dynamics and conservation tactics (Pinder et al., 2015).

The various diversity indices were calculated in each selected sampling sites of river Ghaghara which includes: Species richness, Simpson index, Shannon-Weiner index, Species dominance index, Pileous evenness.

3.2 Species Richness

The species richness at four sample sites varied significantly, with higher richness seen in the mid to downstream zones. Sites 3 (53 species), 2 (41 species), and 4 (36 species) had the highest species richness, whereas sites 1 had the lowest (24). The species variety reported at Site 3 of this river, which is ascribed to migratory fish and the confluence with the Daha River (a tributary of Ghaghara River) is consistent with trends observed in other river systems. Confluences, like the addition of tributaries, generate biological niches by modifying hydrodynamics, nutrient availability, and habitat complexity, hence supporting a diversified fish species. Studies on fish migration and confluences, such as the middle Uruguay River, have indicated that these places serve as significant spawning and feeding sites due to increased habitat variability and connectedness (Soares et al., 2022). Reduced fish variety in Site 1 is frequently associated with limited channel width, low water depth, and reduced flow, all of which are less favourable to fish habitats. Similar findings in Himalayan streams have underlined the importance of

stream gradient and water availability in determining fish dispersion (Singh et al., 2014). These data support the importance of hydrological and physical conditions on fish diversity throughout riverine ecosystems.

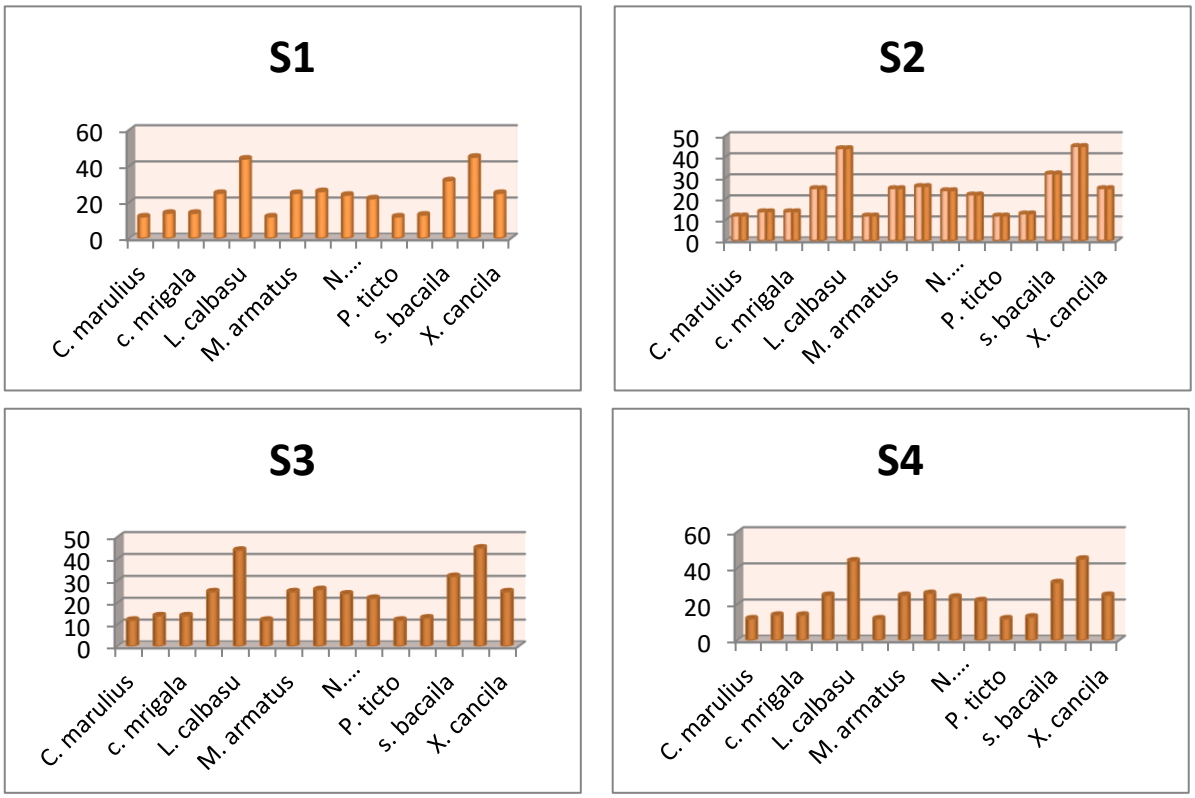

Fig. 2. Site-wise (S1, S2, S3 and S4) relative abundance of fish species.

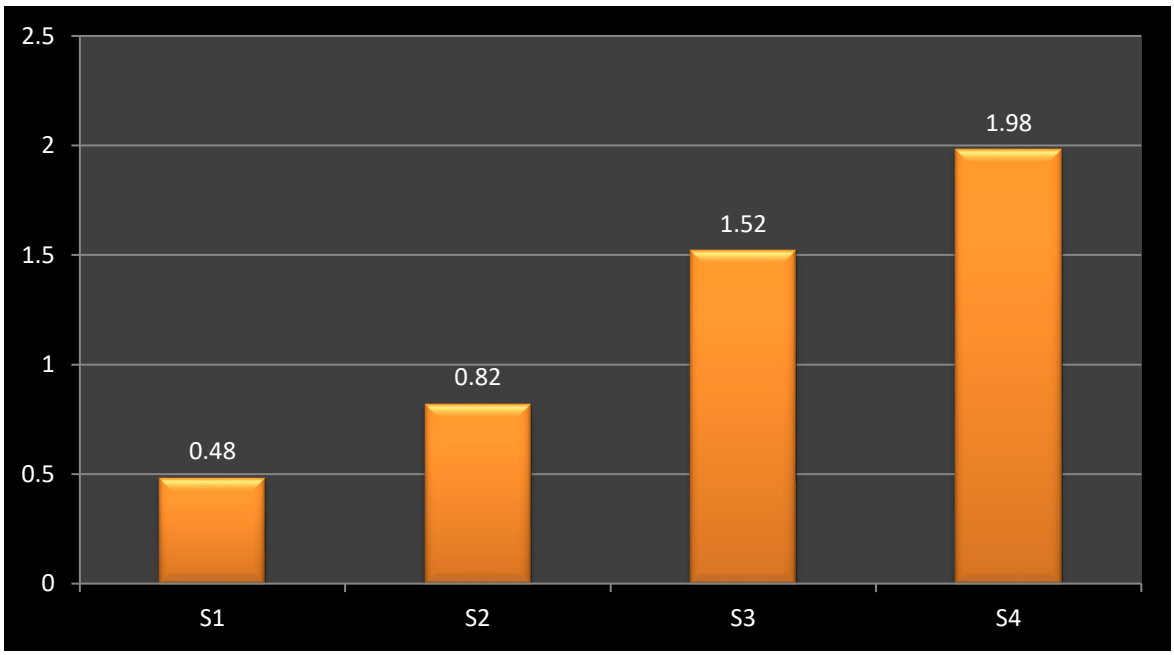

Fig. 3. Mean CPUE of total fish population in different sampling sites of Ghaghara River. Diversity indices

Table 2. Fish diversity indices of Ghaghara River

Diversity indices	Sampling sites			
	S1	S2	S3	S4
Species richness	24	41	53	36
Number of individuals	1339	5386	7877	2282
Shannon- Weiner index (H)	2.69	2.11	3.08	2.55
Simpson index (D)	0.0887	0.0884	0.07264	0.07842
Species dominance index (d)	0.2018	0.1931	0.1753	0.1753
Evenness eˆH/S	0.8486	0.7772	0.775	0.834

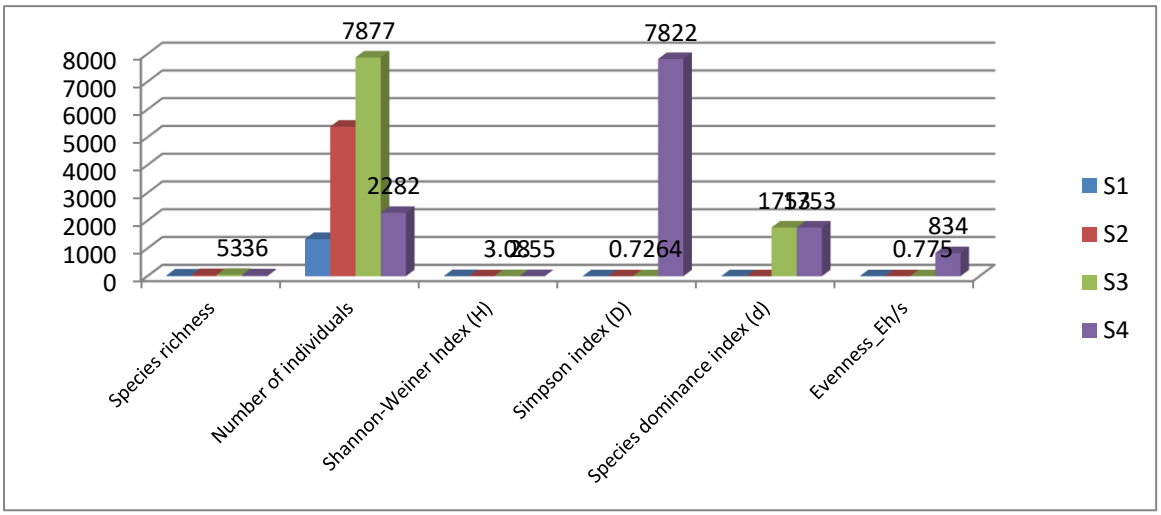

Fig. 4. Diversity index of various sampling sites. Bars havingdifferent superscripts is statistically different (p< 0.05)

According to recent assessments by Lakra and Sarkar (2006) and Lakra et al. (2010), the threat status of 61 fish species in the river Ghaghara is as follows: six species are endangered (EN), 17 species are vulnerable, 27 species are at lower risk, and data on 12 species are insufficient to categorize them. Out of 61 species, about 28 % of species are under threats (either endangered or vulnerable) and 44% under lower risks. The occurrence of more vulnerable fish species at Site 4 (Semariya) in the Ghaghara River than at Site 1 (Darauli) may be due to the different environmental stressors and biological features of these places. Semariya's more complex ecosystem and closeness to human activities like as fishing and urbanization are anticipated to enhance fish species' susceptibility, consistent with patterns reported in ichthyofaunal diversity studies. For example, evaluations of the Ganga River suggest that places with increased anthropogenic influence frequently have a larger proportion of vulnerable species owing to habitat loss, pollution, and overfishing (Das et al., 2023). In contrast, the lesser number of vulnerable species at Darauli can be linked to fewer disturbances, reduced habitat complexity, and probably limited access for intense fishing or other anthropogenic effects.

Biodiversity and conservation are recognized as one of the most important concerns in permitting sustainable use of natural resources. The current study is the first of its sort for the River Ghaghara, and it aims to quantify the species and their distribution. The presence of 61 species suggests a high species diversity in this river. Payne et al. (2004) found 30 fish species in shallow water and 56 fish species in deep water in the Allahabad basin of the Ganga, underscoring the relevance of habitat depth in fish richness and distribution.

4. CONCLUSION

Based on ecological state and land use pattern, the Ganges basin's River Ghaghara supports a diverse array of fish species, including several that are in danger of extinction. This study provides the first report and baseline data for future research to compare and compute species

extinction rates in this river and these areas because no earlier studies were available. Using a complicated and extensive dataset, we found a fish community structure and determined that environmental variables including depth, flow, dissolved oxygen, and substrate were crucial. According to the research, these factors were the most influential habitat variable in determining where fish were discovered. This study's results should be considered when making conservation plans for river fish species that are in danger of extinction, as they provide precise recommendations for channel habitats that include depth ranges, substrate types, and current velocities. In addition, our findings can help direct management and conservation initiatives, as well as restoration efforts for fish habitats, by highlighting the significance of local environmental factors on endangered fish species. When planning management actions, it is important to consider the local fish assemblage in addition to the habitat needs. The Ghaghara River environment plays a crucial role in preserving a wide variety of freshwater species. More study into improving native fish species via localized habitat restoration and species rehabilitation is strongly encouraged. If we want to stop the river's freshwater fish resources from becoming even lower, we need to outlaw the use of illicit fishing techniques here. In order to properly conserve the aquatic biodiversity of this important Ganga basin tributary, the data collected on fish biodiversity, habitat parameters related to fish species distribution and assemblage patterns, and other relevant stakeholders, such as fisher populations, may provide up-to-date information.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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

ACKNOWLEDGEMENTS

The authors are grateful to Prof. Shahla Yashmin, HoD, Department of Zoology, Patna University. Patna for her support, encouragement and suggestions during the investigation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Colwell R K (2009) Biodiversity: Concepts, Patterns, and Measurement, 257-263. (Copyright Document).

Das, B. K., Ray, A., Johnson, C., Verma, S. K., Alam, A., Baitha, R., Manna, R. K., Roy, S., & Sarkar, U. K. (2023). The present status of ichthyofaunal diversity of river Ganga India: 43(2), 254-264. DOI: 10.1016/j.chnaes.2021.10.008.

Dwivedi A C and Nautiyal P (2010) Population dynamics of important fishes in the Vindnyan region, India. Lambert Academic Publication, Germany.

Dwivedi, A. C., & Nautiyal, P. (2010). Fish biodiversity of the river Ganga (India) and its conservation in relation to changing climatic conditions. Aquatic Ecosystem Health & Management, 13(4), 417-424. DOI: 10.1080/14634988.2010.528739.

Jain, S.K.; Agarwal, P.K.; Singh, V.P. (2007). Hydrology and Water Resources of India. The Netherlands: Springer. ISBN 978-1-4020-5179-1

Krebs, C. J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance (7th ed.). Pearson Education, pages 109-110.

Lakra, W. S., & Sarkar, U. K. (2006). Threatened freshwater fishes of India. *National Bureau of Fish Genetic Resources*, Lucknow, India.

Lakra W S (2010) Fish biodiversity of Uttar Pradesh: issues of livelihood security, threats and conservation. In: National Conference on Biodiversity, Development and Poverty Alleviation (May 22, 2010). 40-45. Uttar Pradesh State Biodiversity Board, Lucknow.

Lakra W S, Singh A K and Ayyappan S (2008) Fish Introductions in India: Status, Challenges and Potentials. Narendra Pub. House, New Delhi.

Magurran, A. E. (2004). Measuring Biological Diversity. Blackwell Publishing, pp. 128-132.

Mayank P, Arvind Kumar and Dwivedi A C (2011) Alien fish species Oreochromis niloticus (Linnaeus, 1757) as a powerful invader in the lower stretch of the Yamuna river. Bioved 22, 65-71.

Pathak, V., Tyagi, A., & Sharma, D. K. (2011). Impact of exotic fish species on native fish biodiversity in India. Environmental Biology

of Fishes, 92(3), 367-373.DOI: 10.1007/s10641-011-9856-2.

Pinder, A. C., Raghavan, R., & Britton, J. R. (2015). Efficacy of angler catch data as a population and conservation monitoring tool for the flagship Mahseer fishes (Tor spp.) of Southern India. Aquatic Conservation: Marine and Freshwater Ecosystems, 25(6), 829–838. DOI: 10.1002/aqc.2543.

Payne, A. I., Sinha, R. K., Singh, H. R., & Hughes, J. M. R. (2004). A review of the Ganges Basin: Its fish and fisheries. *Hydrobiologia, 529(1),* 205–218. https://doi.org/10.1007/s10750-004-2923-7.

Rahbek, C., & Colwell, R. K. (2011). Biodiversity: Species loss and the global decline in ecosystem services. Current Biology, 21(9),R331R335.https://doi.org/10.1016/j.cub.2011.03.015

Sarkar U K, Gupta B K and Lakra W S (2010) Biodiversity, ecohydrology, threat status and conservation priority of the freshwater fishes of river Gomti, a tributary of river Ganga (India). Environmentalist 30, 3-17.

Singh A K and Mishra A (2001) Environmental issues of exotic fish culture in BIHAR. J. Environ. Biol. 22, 205-208.

Singh, Y., Chowdhary, A. K., & Bahuguna, S. N. (2014). Ichthyofaunal diversity in Bachan Gad and Kakda streams of the Mid-Himalayan Ganga river system of Garhwal in relation to stream gradient and distance. Journal of Applied and Natural Science, 6(1), 78-83. DOI: 10.31018/JANS.V6I1.419.

Soares, M. da L., Massaro, M. V., Hartmann, P. B., Siveris, S. E., Pelicice, F. M., & Reynalte-Tataje, D. A. (2022). The main channel and river confluences as spawning sites for migratory fishes in the middle Uruguay River. Neotropical Ichthyology, 20(1), e210094. DOI: 10.1590/1982-0224-2021-0094.

Srivastava, G.J. (2002) Fishes of U.P. & Bihar. 9th Edn. Vishwavidyalaya Prakashan, Varanasi (India).

Winter, T. C., & Hughes, D. A. (1997). Biodiversity as the genetic and biological diversity of populations, species, communities, and ecosystems. Journal of the American Water Resources Association, 33(2), 317-327.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/129529