E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 76.37
(GIF) Impact Factor: 0.549
IJFAS 2025; 13(2): 178-188

www.fisheriesjournal.com
Received: 10-02-2025
Accepted: 14-03-2025

Mohammad Masroor Zafar
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Mohammed Aasif Sulaiman
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Divya
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Kumar Gaurav
Department of Zoology, Patna University, Patna, Bihar, India

Saima Anjum
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Gopal Sharma
National Dolphin Research Centre, Patna, Bihar, India

Anupma Kumari
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Corresponding Author:
Anupma Kumari
Environmental Biology Laboratory, Department of Zoology, Patna University, Patna, Bihar, India

Documenting the current Ichthyofaunal status of River Ganga in the middle Gangetic plains at Patna, India

Mohammad Masroor Zafar, Mohammed Aasif Sulaiman, Divya, Kumar Gaurav, Saima Anjum, Gopal Sharma and Anupma Kumari

DOI: https://www.doi.org/10.22271/fish.2025.v13.i2c.3062

Abstract
River Ganga supports largest river basin in India and harbours high Ichthyofaunal diversity which is a source of livelihood for millions of fishermen inhabiting its banks. However, the river is deteriorating gradually due to anthropogenic disturbances since last few decades which has negatively affected its biodiversity. The present study was conducted to determine the current Ichthyofaunal status of River Ganga in the Middle Gangetic Plains (MGP) at Patna, India. Fish specimens were collected during pre-monsoon and post-monsoon of 2022 and 2023 and were identified using morphometric and meristic characteristics with relevant literature from four major fish landing sites. Seventy-three fish species belonging to 26 families and 9 order were reported during the study period. Six exotic species were noted namely *Cyprinus carpio, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Ctenopharyngodon idella, Oreochromis niloticus* and *Carrasius auratus*. Cypriniformes was the most dominating order comprising 34% of the total fish specimens whereas Cyprinidae was the most dominant family comprising 25% of the total fish species. Electrofishing was observed at few sites which poses a great risk to existing fish species. Sustainable management plans need to be implemented by the state and central government to promote fisheries and to prevent decline in fish richness.

Keywords: Documentation, electrofishing, ichthyofauna, invasive species, River Ganga

Introduction
Fresh water occupies less than 1% of the world's surface but supports roughly 10% of all known species, including 33% of vertebrates (Parvez *et al*. 2023) [13]. Fish are a crucial vertebrate of aquatic environments, playing a vital role in maintaining ecosystem resilience while also serving as a significant contributor to freshwater ecosystem function (Pownkumar *et al*. 2022) [15]. Inland waters comprise of lakes, rivers, streams, canals, reservoirs, and other land-locked waters that support approximately 20% of all vertebrates including 40% of fish (Lynch *et al*. 2016) [9]. Riverine fish and commercial inland fisheries are considered a central environmental resource of large rivers, providing a protein source and providing sustenance and livelihoods for millions globally.

The diversity of fish faces negative impacts, both in terms of richness and abundance, due to habitat destruction, fragmentation, water abstraction, industrial activities, introduction of exotic species, pollution, and the effects of global climate change (Pandit *et al*. 2023; Makki *et al*. 2023; Sulaiman and Kumari, 2024) [12, 10, 20]. Research findings demonstrate a decline in fish diversity in rivers worldwide (Stefani *et al*. 2024; Buj *et al*. 2023; Xiang *et al*. 2023) [19, 4, 24], including India (Singh 2023; Vishnu *et al*. 2023; Paul *et al*. 2023; Awas *et al*. 2023) [18, 23, 14, 2].

River Ganga, the longest and holiest River in India is facing similar problems that have led to significant biodiversity loss throughout its stretch in recent times (Parvez *et al*. 2023) [13]. Bihar is an important state in Middle Gangetic plains of India where major tributaries join River Ganga (Zafar and Kumari, 2024). Modification of the natural border of river under riverfront development at Patna, capital of Bihar, deteriorated the habitat of fish fauna (Buidco 2017) [17]. Furthermore, ongoing construction of bridges both across and along the river in the Patna stretch has obstructed natural flow of river and might have significantly altered the sediment composition and led to further decrease in fish diversity.

Therefore, the present study aims to fill this knowledge gap and was designed to document the current Ichthyofaunal status of River Ganga in the middle Gangetic plains of Patna, India.

Materials and Methods

The fish samples were collected from a 36 km stretch of River Ganga between Digha Ghat and Triveni Ghat during the pre-monsoon and post-monsoon of 2022 and 2023. Fish specimens were collected from four major fish landing sites, namely Digha Ghat, Ghagha Ghat, Gai Ghat, and Triveni Ghat, but the collection was not restricted solely to these sites in the stretch. Each site was visited once a week for two months during each season from 4.00 am to 8.00 am (Biswas 1991) [3]. The samples were identified by morphometric and meristic characteristics using relevant literature such as Talwar and Jhingran (1991) [21], Francis and Dey (1876) [8], and Das *et al*. (2020) [5].

Results and Discussion

A total of 73 fish species belonging to 26 families and 9 order were reported from the 36 km stretch of River Ganga in the middle Gangetic Plains at Patna, Bihar (Table 1). Figure 1 exhibits the pictures of the fish specimen whereas figure 2 shows the pie chart for the order of fish species of River Ganga. Cypriniformes was the most dominating order comprising 34% of the total fish specimens followed by Siluriformes (29%), Perciformes (19%), and Clupeiformes (6%). Cyprinidae was reported to be the most dominant family comprising 25% of the total fish species followed by Bagridae (8%), Sisoridae (8%), Aillidae (7%), Danionidae (5%). Sixty-seven fish species were native while six were exotic namely *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis*, *Ctenopharyngodon idella*, *Oreochromis niloticus* and *Carassius auratus*.

Comparing previous research findings reveals a significant decrease in fish diversity at Patna, dropping from 106 to 73 species over the past two decades, marking a 31% decline (Hassan, 1999). In another study by Sinha *et al*. (2010) [16], variations in the Ichthyofaunal status of River Ganga in Bihar were noted. Patna exhibited the highest richness with 100 species, followed by Munger with 68 species and Bhagalpur with 48 species. Das conducted a survey of the entire River Ganga stretch from 2016-2020, reporting only 68 fish species from Patna. The decreasing trend in fish richness extends beyond Bihar and is observable along the entire stretch of the River Ganga. In Uttarakhand, Malik *et al*. (2022) [11] found only 31 fish species, predominantly belonging to Cyprinidae, followed by Balitoridae, Sisoridae, Schilbidae, Mastacembelidae, and Salmonidae. Similar situation was noted for River Gomti, an important tributary of River Ganga in Uttar Pradesh where 56 fish species from 21 families and 9 orders were recorded (Singh *et al*. 2016) [17]. Parvez *et al*. (2023) [13] conducted a comparison of fish richness in the lower reaches of River Padma (Ganga) in Bangladesh over four decades and reported a notable decline in 28 fish species, of which 16 were nationally threatened. Invasive fish species pose a serious threat to native fish fauna competing for various resources and further contribute to decline in fish diversity. *Cyprinus carpio* and *Oreochromis niloticus* dominated the annual fish catch at Allahabad comprising 15.5% and 14.6% of the total fish catch respectively (Tripathi *et al*. 2017) [22]. Alam *et al*. (2019) [1] conducted a detailed study on exotic fish species in the River Ganga at Allahabad and reported the increasing abundance of *Cyprinus carpio* and *Oreochromis niloticus* as a major cause for the declining trend in the growth of major carps. A significant increase of exotics in the percentage catch in River Ganga can be attributed to change in river ecology such as reduced flow and lower depth due to construction of dams and barrages which have played key role in altering the micro and macrohabitat and establishment of species such as *Cyprinus carpio* and *Oreochromis niloticus* (Das *et al*. 2013) [7]. Additionally, other anthropogenic disturbances noted in the studied stretch include sand mining, bridge construction and domestic sewage disposal. Both bridge construction and sand mining activities disturb the river bed sediment, a potential habitat for large number of fish species. Untreated domestic wastes deteriorate the river water quality when dumped thus affecting fish assemblage (Zafar and Kumari, 2024). Overfishing is another important factor contributing to decline in fish diversity. Electrofishing practices have been introduced and several incidents of conflicts among fishermen due to practise of electrofishing have been observed during the study.

Table 1: Table representing classification of fish along with their habit, habitat and IUCN status

S. No.	Fish Name	Scientific name	Order	Family	Habit	Habitat	Iucn status
1	Pothiya	*Puntius sophore*	Cypriniformes	Cyprinidae	Omnivore	Surface	LC
2	Pothiya	*Puntius chola*	Cypriniformes	Cyprinidae	Omnivore	Bottom	LC
3	Pothiya	*Pethia phutunio*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
4	Pothiya	*Pethia conchonius*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
5	Mrigal	*Cirrhinus mrigala*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
6	Catla	*Catla catla*	Cypriniformes	Cyprinidae	Herbivore	Surface	LC
7	Calbasu	*Labeo calbasu*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
8	Gurda	*Osteobrama cotio*	Cypriniformes	Cyprinidae	Omnivore	Bottom	LC
9	Bata	*Labeo bata*	Cypriniformes	Cyprinidae	Omnivore	Bottom	LC
10	Ladus	*Cyprinus carpio*	Cypriniformes	Cyprinidae	Omnivore	Bottom	VU
11	Ghehua	*Tariqilabeo latius*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
12	Rohu	*Labeo rohita*	Cypriniformes	Cyprinidae	Herbivore	Surface	LC
13	Kursila Bata	*Labeo gonius*	Cypriniformes	Cyprinidae	Herbivore	Bottom	LC
14	Reba	*Cirrhinus reba*	Cypriniformes	Cyprinidae	Omnivore	Bottom	LC
15	Golden Carp	*Carrasius auratus*	Cypriniformes	Cyprinidae	Omnivore	Bottom	NE
16	Silver Carp	*Hypophthalmichthys molitrix*	Cypriniformes	Cyprinidae	Herbivore	Surface	NT
17	Big Head	*Hypophthalmichthys nobilis*	Cypriniformes	Cyprinidae	Omnivore	Surface	DD
18	Grass Carp	*Ctenopharyngodon idella*	Cypriniformes	Cyprinidae	Omnivore	Bottom	LC
19	Harda	*Cabdio morar*	Cypriniformes	Danionidae	Omnivore	Bottom	LC
20	Chelwa	*Esomus danrica*	Cypriniformes	Danionidae	Carnivore	Bottom	LC

21	Chelua	*Salmostoma bacaila*	Cypriniformes	Danionidae	Omnivore	Surface	LC
22	Dhawai	*Amblypharyngodon mola*	Cypriniformes	Danionidae	Omnivore	Surface	LC
23	Baghwa	*Botia dario*	Cypriniformes	Botiidae	Omnivore	Bottom	LC
24	Garra	*Paracanthocobitis botia*	Cypriniformes	Nemacheilidae	Herbivore	Bottom	LC
25	Garra	*Lepidocephalichthys guntea*	Cypriniformes	Cobitidae	Carnivore	Bottom	LC
26	Rita	*Rita rita*	Siluriformes	Bagridae	Carnivore	Bottom	LC
27	Lmba Tengra	*Sperata seenghala*	Siluriformes	Bagridae	Carnivore	Bottom	LC
28	Nata Tengra	*Sperata aor*	Siluriformes	Bagridae	Carnivore	Bottom	LC
29	Palwa Tengra	*Mystus tengara*	Siluriformes	Bagridae	Omnivore	Bottom	LC
30	Palwa Tengra	*Mystus vittatus*	Siluriformes	Bagridae	Omnivore	Bottom	LC
31	Palwa Tengra	*Mystus cavasius*	Siluriformes	Bagridae	Omnivore	Bottom	LC
32	Ghoshta	*Bagarius yarrelli*	Siluriformes	Sisoridae	Carnivore	Bottom	VU
33	Ghoshta	*Bagarius bagarius*	Siluriformes	Sisoridae	Carnivore	Bottom	VU
34	Tinkatwa	*Gagata cenia*	Siluriformes	Sisoridae	Omnivore	Bottom	LC
35	Hadda	*Gogangra viridescens*	Siluriformes	Sisoridae	Omnivore	Bottom	LC
36	Tilghagra	*Glyptothorax cavia*	Siluriformes	Sisoridae	Omnivore	Bottom	LC
37	Tilghagra	*Glyptothorax telchitta*	Siluriformes	Sisoridae	Omnivore	Bottom	LC
38	Sugwa	*Eutropiichthys murius*	Siluriformes	Aillidae	Omnivore	Bottom	LC
39	Sutri	*Ailiichthys punctata*	Siluriformes	Aillidae	Carnivore	Bottom	LC
40	Baspatta	*Ailia coila*	Siluriformes	Aillidae	Carnivore	Bottom	NT
41	Bachwa	*Eutropiichthys vacha*	Siluriformes	Aillidae	Carnivore	Surface	LC
42	Silan	*Silonia silondia*	Siluriformes	Aillidae	Omnivore	Bottom	LC
43	Boari	*Wallago attu*	Siluriformes	Siluridae	Carnivore	Bottom	VU
44	Pabta	*Ompok bimaculatus*	Siluriformes	Siluridae	Omnivore	Bottom	NT
45	Mangurwa	*Clarias batrachus*	Siluriformes	Clariidae	Carnivore	Bottom	LC
46	Singhi	*Heteropneustes fossilis*	Siluriformes	Heteropneustidae	Omnivore	Bottom	LC
47	Garai	*Channa punctatus*	Perciformes	Channidae	Carnivore	Bottom	LC
48	Sauri	*Channa striata*	Perciformes	Channidae	Carnivore	Bottom	LC
49	Gachua	*Channa gachua*	Perciformes	Channidae	Carnivore	Bottom	LC
50	Cheng	*Channa orientalis*	Perciformes	Channidae	Carnivore	Bottom	VU
51	Bhola	*Johnius gangeticus*	Perciformes	Sciaenidae	Carnivore	Bottom	DD
52	Bhola	*Johnius coitor*	Perciformes	Sciaenidae	Carnivore	Bottom	LC
53	Khasso	*Trichogaster fasciata*	Perciformes	Osphronemidae	Omnivore	Surface	LC
54	Kotri	*Trichogaster lalius*	Perciformes	Osphronemidae	Omnivore	Bottom	LC
55	Chanda	*Parambassis ranga*	Perciformes	Ambassidae	Carnivore	Bottom	LC
56	Channe	*Chanda nama*	Perciformes	Ambassidae	Carnivore	Bottom	LC
57	Dhallo	*Nandus nandus*	Perciformes	Nandidae	Carnivore	Bottom	LC
58	Kawai	*Anabas testudineus*	Perciformes	Anabantidae	Omnivore	Bottom	LC
59	Telpi	*Oreochromis niloticus*	Perciformes	Cichlidae	Omnivore	Bottom	LC
60	Bulla	*Glossogobius giuris*	Perciformes	Gobiidae	Carnivore	Bottom	LC
61	Hashta	*Setipinna brevifilis*	Clupeiformes	Engraulidae	Carnivore	Bottom	DD
62	Phasiya	*Setipinna phasa*	Clupeiformes	Engraulidae	Carnivore	Bottom	LC
63	Khaira	*Gudusia chapra*	Clupeiformes	Clupeidae	Omnivore	Bottom	LC
64	Suia	*Gonialosa manmina*	Clupeiformes	Clupeidae	Omnivore	Surface	LC
65	Gaichi	*Macrognathus pancalus*	Synbranchiformes	Mastacembelidae	Omnivore	Bottom	LC
66	Bami	*Mastacembelus armatus*	Synbranchiformes	Mastacembelidae	Omnivore	Bottom	LC
67	Gaichi	*Macrognathus aral*	Synbranchiformes	Mastacembelidae	Omnivore	Bottom	LC
68	Aruwari	*Rhinomugil corsula*	Mugiliformes	Mugilidae	Omnivore	Bottom	LC
69	Thurri	*Sicamugil cascasia*	Mugiliformes	Mugilidae	Omnivore	Bottom	LC
70	Phalli	*Notopterus notopterus*	Osteoglossiformes	Notopteridae	Omnivore	Bottom	LC
71	Moi	*Chitala chitala*	Osteoglossiformes	Notopteridae	Carnivore	Bottom	NT
72	Kowalol	*Xenentodon cancila*	Beloniformes	Belonidae	Carnivore	Bottom	LC
73	Medhak machli	*Leiodon cutcutia*	Tetraodontiformes	Tetraodontidae	Omnivore	Bottom	LC

Note: LC: Least Concern; NT: Near Threatened; DD: Data Deficient; VU: Vulnerable; NE: Not Evaluated

Pethia phutunio (Hamilton, 1822)

Pethia conchonius (Hamilton, 1822)

Cirrhinus mrigala (Hamilton, 1822)

Catla catla (Hamilton, 1822)

Labeo calbasu (Hamilton, 1822)

Osteobrama cotio (Hamilton, 1822)

Labeo bata (Hamilton, 1822)

Cyprinus carpio (Linnaeus, 1758)

Tariqilabeo latius (Hamilton, 1822)

Labeo rohita (Hamilton, 1822)

Labeo gonius (Hamilton, 1822)

Cirrhinus reba (Hamilton, 1822)

Carassius auratus (Linnaeus, 1758)

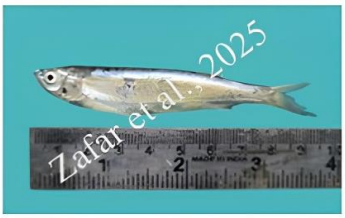
Hypophthalmichthys molitrix (Valenciennes, 1844)

Hypophthalmichthys nobilis (Richardson, 1845

Ctenopharyngodon idella (Valenciennes, 1844)

Cabdio morar (Hamilton, 1822)

Esomus danrica (Hamilton, 1822)

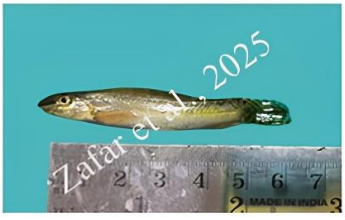


Salmostoma bacaila (Hamilton, 1822)

Amblypharyngodon mola (Hamilton, 1822)

Botia dario (Hamilton, 1822)

Paracanthocobitis botia (Hamilton, 1822)



Lepidocephalichthys guntea (Hamilton, 1822

Rita rita (Hamilton, 1822)

Sperata seenghala (Sykes, 1839)

Sperata aor (Hamilton, 1822)

Mystus tengara (Hamilton, 1822)

Mystus vittatus (Bloch, 1794)

Mystus cavasius (Hamilton, 1822)

Bagarius yarelli (Sykes, 1839)

Bagarius bagarius (Hamilton, 1822)

Gagata cenia (Hamilton, 1822)

Gogangra viridescens (Hamilton, 1822)

Glyptothorax cavia (Hamilton, 1822)

Glyptothorax tilchitta (Hamilton, 1822)

Eutropiichthys murius (Hamilton, 1822)

Ailiichthys punctata (Day, 1872)

Ailia coila (Hamilton, 1822)

Eutropiichthys vacha (Hamilton, 1822)

Silonia silondia (Hamilton, 1822)

Wallago attu (Bloch & Schneider, 1801)

Ompok bimaculatus (Bloch, 1794)

Clarias batrachus (Linnaeus, 1758)

Heteropneustes fossilis (Bloch, 1794)

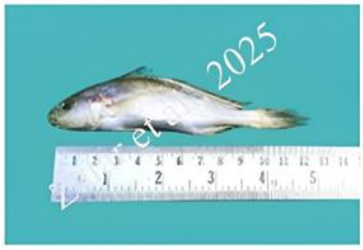
Channa punctatus (Bloch, 1793)

Channa striata (Bloch, 1793)

Channa gachua (Hamilton, 1822)

Channa orientalis (Bloch & Schneide 1801)

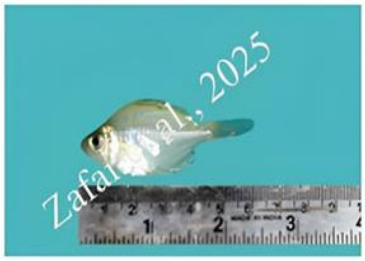
Johnius gangetica (Talwar and Jhingran,, 1991)



Johnius coitor (Hamilton, 1822)

Trichogaster fasciata (Bloch & Schneider,, 1801

Trichogaster lalius (Hamilton, 1822)



Parambasis ranga (Hamilton, 1822)

Chanda nama (Hamilton, 1822)

Nandus nandus (Hamilton, 1822)

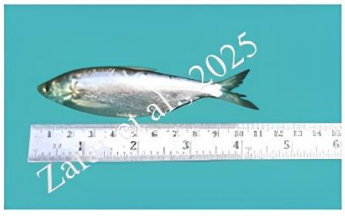
Anabas testudineus (Bloch, 1795)

Oreochromis niloticus (Linnaeus, 1758)

Glossogobius giuris (Hamilton, 1822)

Setipinna brevifilis (Valenciennes, 1848)

Setipinna phasa (Hamilton, 1822)



Gudusia chapra (Hamilton, 1822)

Gonialosa manmina (Hamilton, 1822)

Fig 1: Images of fish specimen identified from River Ganga

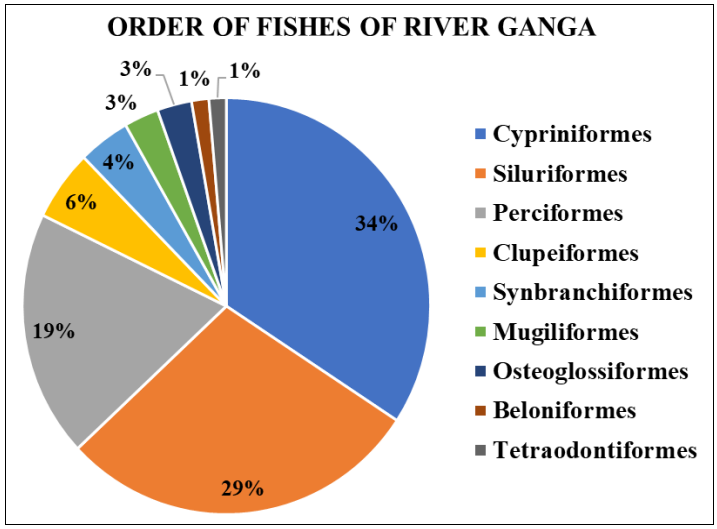


Fig 2: Pie chart representing Order of fishes of River Ganga

Conclusion

The biodiversity of freshwater fishes is declining at a rapid pace when compared to marine fishes but its conservation is not getting enough attention. The present study reported 73 fish species in the 36 km stretch of River Ganga in the middle Gangetic plains at Patna, India. A continuous declining trend in fish richness was observed over the last two decades. The main anthropogenic disturbances in the study stretch include untreated sewage effluent discharge, bridge construction and sand mining activities. Overexploitation of fish resources and the introduction of electrofishing activities mark an even greater risk towards surviving fish species. Proper management plans for fisheries need to be introduced by the state and central government to check the decrease in the yield of Carps and to control the increase in the number of exotic fish species.

Acknowledgements

The authors are thankful to members of Environmental Biology Laboratory, Patna University, Patna along with fishermen (Golu Sahni, Subhash Sahni and Rajendra Sahni).

Funding

The study did not receive any funding

Conflict of interest

The authors declare that there is no conflict of interests

References

1. Alam A, Chadha NK, Chakraborty SK, Joshi KD, Kumar T, Das SCS, *et al*. Studies on the growth and mortality of invasive *Oreochromis niloticus* (Linnaeus, 1758) in sub-tropical river Yamuna, part of Gangetic River system, India. Aquatic Ecosystem Health and Management. 2019;22(4):473-480.
2. Awas M, Ahmed I, Ahmad SM. Habitat ecology and current status of the fish fauna of River Poonch of Pir Panjal Himalayan region of Jammu and Kashmir, India. Tropical Ecology. 2023;64(4):655-670.
3. Biswas SP. Manual of methods in Fish Biology. New Delhi: South Asian Publishers; 1993. 157 p.
4. Buj I, Pleše S, Onorato L, Marčić Z, Mustafić P, Zanella D, *et al*. The Ichthyofauna of the Bednja River, Ichthyological 'Hot Spot' in the Danube Basin—Exceptional Diversity under Strong Threats. Water. 2023;15(2):311.
5. Das BK, Kumar R, Bhor M, Srivastava RS, Mohanty TR, Swain HS, *et al*. Fish Mapping of River Ganga: A GIS perspective. Barrackpore, Kolkata & New Delhi: ICAR-CIFRI and National Mission for Clean Ganga; 2020. 448 p.
6. Das, B. K., Bhakta, D., Kumar, L., Nair, S. M., Koushlesh, S. K., *et al*. Ichthyofaunal diversity of the major Indian rivers: A review. Journal of the Inland Fisheries Society of India. (2021);53(1-2), 22-35.
7. Das BK, Ray A, Johnson C, Verma SK, Alam A, Baitha R, *et al*. The present status of ichthyofaunal diversity of river Ganga India: Synthesis of present v/s past. Acta Ecologica Sinica. 2023;43(2):307-332.
8. Das MK, Sharma AP, Vass KK, Tyagi RK, Suresh VR, Naskar M, *et al*. Fish diversity, community structure and ecological integrity of the tropical River Ganges, India. Aquatic Ecosystem Health and Management. 2013;16(4):395-407.
9. Dey F. The Fishes of India; Being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma, and Ceylon. London: Bernard Quaritch; 1876. Vol. 1, 778 p.
10. Lynch AJ, Cooke SJ, Deines AM, Bower SD, Bunnell DB, Cowx IG, *et al*. The social, economic, and environmental importance of inland fish and fisheries. Environmental Reviews. 2016;24(2):115-121.
11. Makki T, Mostafavi H, Matkan AA, Valavi R, Hughes RM, Shadloo S, *et al*. Predicting climate heating impacts on riverine fish species diversity in a biodiversity hotspot region. Scientific Reports. 2023;13(1):14347.
12. Malik DS, Sharma AK, Kumar S, Kumar R, Kumar R, Kamboj V, *et al*. Anthropogenic impact on fish faunal diversity and their habitat ecology in the Ganga River and its tributaries, Uttarakhand. Environmental Pollution and Natural Resource Management. 2022:53-71.
13. Pandit D, Shefat SHT, Kunda M. Fish Diversity Decline Threatens Small-Scale Fisheries in the Haor Basin of Bangladesh. In: Small in Scale Big in Contributions. Rome: FAO; 2023. p. 268.
14. Parvez MT, Mohsin ABM, Arnob SS, Lucas MC, Chaki N, Khan MAG, *et al*. Fish diversity decline in the lower Gangetic plains: a victim of multiple stressors. Biodiversity and Conservation. 2023;32(1):341-362.
15. Paul TT, Sarkar UK, Das BK. Exploring vulnerabilities

of inland fisheries in Indian context with special reference to climate change and their mitigation and adaptation: a review. International Journal of Biometeorology. 2023;67(2):233-252.
16. Pownkumar V, Ananthan PS, Ekka A, Qureshi NW. Fisheries as ecosystem services: A case study of the Cauvery River basin, India. Frontiers in Environmental Science. 2022;10:892012.
17. Saha, A., Ahmed, S., Das, R., Bhattacharjee, S., Kashyap, S. C., *et al*. A Study on the Fresh Water Fish Diversity of Mora Dhansiri River, Assam, India. 2024.
18. Schletterer, M., Kuzovlev, V. V., Zhenikov, Y. N., Tuhtan, J. A., *et al*. (2018). Fish fauna and fisheries of large European rivers: Examples from the Volga and the Danube. *Hydrobiologia*, 2018;814: 45-60.
19. Sinha RK, Sharan RK. Eco-system in and around Patna (Bihar), India. Patna: 1989. 98 p.
20. Singh SK. Threat Status and Conservation Priority for the Ichthyofauna of the River Gomti in the Lucknow Region. International Journal of Innovations in Engineering Research and Technology. 2016;3(4):1-7.
21. Singh VK. Fish diversity and distribution in the Ganges River basin: a comprehensive study. 2023. [unpublished/in press]
22. Stefani F, Fasola E, Marziali L, Tirozzi P, Schiavon A, Bocchi S, *et al*. Response of functional diversity of fish communities to habitat alterations in small lowland rivers. Biodiversity and Conservation. 2024;33(4):1027-1046.
23. Sulaiman MA, Kumari A. Unveiling the Rising Threat of Cadmium Pollution and Alarming Health Risks Associated with the Consumption of 15 Commercially Important Fish Species in the Middle Stretch of River Ganga, at Patna, India. Biological Trace Element Research. 2024. https://doi.org/10.1007/s12011-024-04164-x
24. Sun, X., Wang, K., Zhang, G., Ren, H., & Yu, H. (2024). Spatial-temporal patterns of fish trophic guilds in a freshwater river wetland ecosystem of northeastern China. Ecology and Evolution, 2024. 14(7), e11711.
25. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. Vol. 2. Boca Raton: CRC Press; 1991. 1158 p.
26. Tripathi S, Gopesh A, Dwivedi AC. Fish and fisheries in the Ganga River: current assessment of the fish community, threats and restoration. Journal of Experimental Zoology India. 2017;20(2):907-912.
27. Vishnu AS, Lal M, Tharian JC, Prabhakaran MP, Ali PA. Diversity, distribution, and conservation status of fish species in Kallar Stream, Achankovil River, Western Ghats of Kerala, India. Journal of Threatened Taxa. 2023;15(5):23164-23189.
28. Xiang T, Dong X, Ju T, Shi L, Grenouillet G. Anthropogenic activities and environmental filtering have reshaped freshwater fish biodiversity patterns in China over the past 120 years. Journal of Environmental Management. 2023;344:118374.