International Journal of Bio-resource and Stress Management https://ojs.pphouse.org/index.php/IJBSM

Crossref

IJBSM September 2025, 16(9): 01-08

Article AR6302

Research Article

Natural Resource Management

DOI: HTTPS://DOI.ORG/10.23910/1.2025.6302

Seasonal Variations in Fish Diversity and Community Structure in Urban Freshwater Reservoirs: A Case Study of Bhadrakali and Waddepally in Warangal, Telangana

L. S. Jarupala[1], G. Ganesh[2], P. Subhashini[1], G. Suhashini[1] and P. Raju[3]

[1]Dept. of Zoology, Pingle Government College for Women (A), Waddepally, Hanmakonda, Telangana (506 370), India
[2]Dept. of Aquaculture, Krishi Vigyan Kendra, Mamnoor, Warangal, Telangana (506 166), India
[3]Dept.of Zoology, SKNR Government Arts and Science College, Jagitial, Telangana (505 327), India

Open Access

Corresponding lakansinghjarupala@gmail.com

0009-0002-8376-6708

ABSTRACT

The present study was conducted over a two-year period from (June, 2022 to May, 2024) at Warangal District, Telangana, India to investigate the seasonal diversity of freshwater fishes in two urban reservoirs Bhadrakali and Waddepally located in Warangal district, Telangana, India. Despite the region's prominence in inland fish production, systematic documentation of its ichthyofaunal diversity remains limited. This study aimed to address this gap by examining fish species composition in relation to seasonal variations and physico-chemical water quality parameters. Monthly sampling was conducted with the assistance of local fishermen using traditional seine nets. Collected fish specimens were preserved using standard formalin-based techniques and identified based on morphological features, including body shape, fin structure, coloration and distinctive surface markings. Local nomenclature and ecological observations were also recorded to support species identification and understand habitat-specific diversity. Seasonal changes significantly influenced the presence and abundance of different species, highlighting the dynamic nature of these urban aquatic ecosystems. The results underscored the reservoirs roles not only in supporting regional fish production but also in sustaining aquatic biodiversity. This study provided essential baseline data for future ecological assessments, conservation planning and sustainable fisheries development in the region. Furthermore, it emphasized the importance of protecting urban freshwater bodies, which were increasingly threatened by pollution, encroachment and unregulated resource exploitation. The findings contributed to better understanding and management of aquatic biodiversity in urban settings and could guide policy interventions for long-term ecological sustainability.

KEYWORDS: Fish diversity, seasonal variation, ichthyofaunal, reservoir, conservation, sustainability

***Citation* (VANCOUVER):** Jarupala et al., Seasonal Variations in Fish Diversity and Community Structure in Urban Freshwater Reservoirs: A case Study of Bhadrakali and Waddepally in Warangal, Telangana. *International Journal of Bio-resource and Stress Management,* 2025; 16(9), 01-08. HTTPS://DOI.ORG/10.23910/1.2025.6302.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 21st April 2024 RECEIVED in revised form on 27th August 2025 ACCEPTED in final form on 09th September 2025 PUBLISHED on 22nd September 2025

1. INTRODUCTION

Freshwater ecosystems, despite covering only about 1% of the Earth's surface, support over 10% of all known species, highlighting their exceptional contribution to global biodiversity (Sayer et al., 2025). These ecosystems are indispensable for ecological stability, water purification, nutrient cycling and the livelihoods of millions of people. Fish diversity within freshwater systems is a critical bio indicator of ecosystem health, reflecting the impacts of environmental changes and anthropogenic pressures. Moreover, it plays a significant role in enhancing food security, supporting economic livelihoods and preserving the ecological balance of aquatic habitats (Anonymous, 2022).

Urban freshwater reservoirs, in particular, have emerged as vital components of urban infrastructure. Besides supplying water for domestic, agricultural, and industrial purposes, they offer crucial ecosystem services such as groundwater recharge, microclimate regulation and recreational opportunities. Importantly, they also harbor a wide array of aquatic life, thereby supporting biodiversity in rapidly urbanizing regions (Das et al., 2023). However, these urban water bodies are increasingly under threat due to land-use changes, pollution, habitat fragmentation and climate variability all of which can profoundly influence fish diversity and ecosystem health.

India, as one of the world's mega-diverse nations, is endowed with rich freshwater biodiversity. The state of Telangana, located in south-central India, hosts numerous freshwater bodies that serve as habitats for a variety of fish species adapted to different ecological conditions (Jayaram, 2010). Among these, the Bhadrakali and Waddepally reservoirs in the Warangal district are notable urban freshwater systems. These reservoirs face growing ecological challenges due to seasonal hydrological changes, anthropogenic disturbances, eutrophication, and fluctuating water quality (Subhashini et al., 2023).

Seasonal fluctuations in physico-chemical parameters such as water temperature, dissolved oxygen (DO), pH, turbidity and nutrient levels have a direct impact on fish community structure, influencing species richness, abundance, and breeding behaviors (Boyd, 1990; Welch, 1952). These changes affect the reproductive cycles and migratory patterns of fish and may lead to habitat degradation if not properly managed. With increasing urbanization, these reservoirs are experiencing altered ecological dynamics, which necessitates regular monitoring and scientific assessment (Rathore et al., 2022; Kumar and Shukla, 2021).

Although several studies have underscored the role of environmental variables in shaping fish diversity, there remains a lack of long-term, site-specific research focusing on seasonal trends in urban reservoirs. Studies conducted in similar habitats such as the Mongra Reservoir in Central India and the Sundarbans estuarine canals have emphasized the importance of monitoring seasonal diversity patterns to understand habitat functioning and guide conservation efforts (Das et al., 2023; Sarkar and Saha, 2022).

In this context, the present study aims to assess and document the seasonal diversity of fish species in the Bhadrakali and Waddepally reservoirs over a two-year period (June, 2022 to May, 2024). The study seeks to correlate species richness, abundance, and composition with seasonal variations in physico-chemical parameters. This research will fill a critical gap in existing literature and generate valuable baseline data to support biodiversity conservation, sustainable reservoir fisheries, and informed environmental policy-making. Standardized fish sampling techniques and statistical tools will be used to analyze ecological patterns and trends (Singh et al., 2021; Joshi and Gupta, 2020).

Ultimately, this study contributes to the growing body of research necessary for effective urban freshwater ecosystem management, especially in the face of rapid urbanization and climate change impacts (Kumar et al., 2022; Sharma et al., 2024). The findings are expected to support evidence-based strategies for biodiversity conservation and adaptive resource management in Telangana and similar ecological settings.

2. MATERIALS AND METHODS

The present study was conducted over a two-years Period (June, 2022 to May, 2024) in two prominent urban fresh water reservoirs in Bhadrakali Reservoir and Waddepally Reservoir located in Warangal district, Telangana, India.

2.1. Study area

The present study was conducted in two prominent urban freshwater reservoirs Bhadrakali Reservoir and Waddepally Reservoir located in Warangal district, Telangana, India. Bhadrakali Reservoir (17°58'48.0"N 79°35'24.0"E) spans approximately 125 ha, while Waddepally Reservoir

Figure 1: Study area

(17°59'30.0"N 79°31'25.0"E) covered about 100 ha (Figure 1). Both reservoirs were perennial water bodies and played crucial roles in urban water supply, fisheries and recreation (Table 1 and 2).

2.2. Study duration and sampling period

Ichthyofauna sampling was carried out seasonally (pre-monsoon, monsoon, post-monsoon and winter) over a period of two years period (June, 2022 to May, 2024) to document seasonal variation and species diversity. Samples were collected during the early morning hours (6:00 am to 9:00 am), ensuring minimal disturbance (Figure 2 and 3).

2.3. Fish sampling and duration

Fish specimens were collected using traditional fishing gears like cast nets, gill nets and drag nets with varying mesh sizes. Collected fishes were initially identified in the field using field guides (Talwar and Jhingran, 1991; Jayaram, 2010). Further confirmation was made by comparing morphological features with standard taxonomic keys and databases such as Fish Base (Froese and Pauly, 2024).

The identified species were preserved in 10% formalin for lab-based identification when required. Scientific names were validated following the International Code of Zoological Nomenclature (ICZN) (Figure 4 and 5).

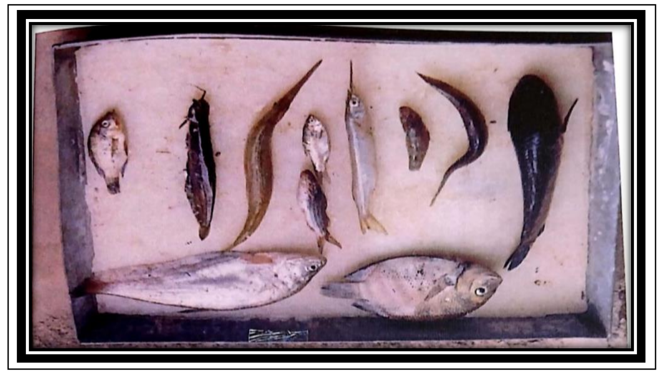

Figure 2: Different fish species collected from Waddepally reservoir

2.4. Data analysis

The diversity and abundance of fish species were evaluated using standard ecological indices, namely the Shannon-Wiener Diversity Index (H'), Simpson's Diversity Index

Table 1: Diversity of fishes from Bhadrakali freshwater reservoir

Sl. No.	Order	Family	Species name	Local name
1.	Acanthopterygh (Ophocephaliformes)	Rhynchobdellidae (Mastacembelidae)	*Mastocembelus armatus armatus*	Papera
			Mastocembelus pancalus	Budda papera (Chinnapapera)
		Gobidae	*Glossogobius giuris*	Uskedonthi
		Ophiocephalidae (Chennidae)	*Channa marulius*	Palachapa (or) Poomeenu
			Channa orientalis	Mala pankidi
			Channa punctatus	Mottapilla
			Channa Straiatus	Bomma cheap (Korrameenu)
		Chromides (Cichlidae)	*Etroplus suratensis*	Pearl spsot
2.	Physostomi (Cypriniformes)	Cyprinidae	*Labeo potail*	Bochee
		(Cyprininae)	*Labeo rohita*	Rahu
		(Cyprinidae)	*Cirrhinus mrigala*	Merical
		Anguillidae	*Anguilla biclor biclor**	Mulugubelu*
		Belonidae	*Xenentodom* sp.	Nainikantham
		Cobitidae (Cobitinae)	*Lepidocephalichthys* sp.	Ulshe
		Bagridae	*Mystus sp.*	Guddijella
3.	Mastacembeliformes	Mastacembeliadae	*Macrognathus* sp.	Shibbidikam (Sibbidkam)
4.	Siluriformes	Schilbedaie (Schilbeinae)	*Neotropius* sp.	Gangajella
		Bagridae	*Rita* sp.	
5.	Osteoglossiformes (Clupeformes)	Notopteridae	*Notopterus chitala*	Wallenka

Table 2: Diversity of fishes from Waddepally freshwater reservoir

Sl. No.	Order	Family	Species name	Local name
1.	Acanthopterygh (Ophocephaliformes)	Rhynchobdellidae (Mastacembelidae)	*Mastocembelus armatus armatus*	Papera
			Mastocembelus pancalus	Budda papera (Chinnapapera)
		Gobidae	*Glossogobius giuris*	Uskedonthi
		Ophiocephalidae (Chennidae)	*Channa marulius*	Palachapa (or) Poomeenu
			Channa orientalis	Mala pankidi
			Channa punctatus	Mottapilla
			Channa Straiatus	Bomma cheap (Korrameenu)
		Chromides (Cichlidae)	*Etroplus suratensis*	Pearl spsot
2.	Physostomi (Cypriniformes)	Cyprinidae	*Labeo potail*	Bochee
		(Cyprininae)	*Labeo rohita*	Rahu
		(Cyprinidae)	*Cirrhinus mrigala*	Merical
		Belonidae	*Xenentodom* sp.	Nainikantham
		Cobitidae (Cobitinae)	*Lepidocephalichthys* sp.	Ulshe
3.	Mastacembeliformes	Mastacembeliadae	*Macrognathus* sp.	Shibbidikam (Sibbidkam)
4.	Osteoglossiformes (Clupeformes)	Notopteridae	*Notopterus chitala*	Wallenka

(D), and the Evenness Index (E). These indices were computed seasonally to capture temporal variations in species richness and distributional evenness, following the methodology described by Magurran (2004). The relative abundance of each species was expressed as a percentage of the total seasonal catch, offering insights into species dominance patterns and fish community structure dynamics.

Recent research underscores the utility of such indices in characterizing fish community structures across diverse aquatic ecosystems. For example, Sarkar and Saha (2021) examined seasonal fluctuations in water quality parameters and their influence on fish biodiversity indices

Figure 3: *Pisodinoplis* sps recorded in Waddepally reservior during summer seasons

Figure 4: Different fish species collected from Bhadrakali reservoir

in Hasadanga Beel, revealing significant correlations between physicochemical variables and biodiversity metrics. Similarly, Hazri et al. (2024) employed PAST software to assess fish diversity in the Pulai River, Malaysia, identifying moderate levels of diversity and evenness, shaped by urbanization and habitat fragmentation.

In the context of Indian estuarine systems, Sreekanth et al. (2023) developed a multi-metric fish index to assess ecological quality in tropical estuaries along India's western coast, demonstrating the applicability of diversity indices in evaluating anthropogenic impacts on ecological health. Additionally, Purusothaman et al. (2016) analyzed seasonal variations in fish assemblages associated with trawl catches

Figure 5: *Etroplus suratensis* recorded in Bhadrakali reservior

along the southeast coast of India, offering important baseline data for fisheries management.

Supporting these findings, Das (2021) applied biodiversity indices to assess macroinvertebrate diversity in the tidal mudflats of the Sunderbans, while Omayio and Mzungu (2019) proposed modifications to the Shannon-Wiener Index to quantify environmental wellness in non-comparative contexts. Together, these studies illustrate the relevance of ecological indices in tracking temporal changes, identifying environmental stressors, and guiding conservation and sustainable fisheries management efforts.

2.5. Physio-chemical parameters

Water quality parameters such as temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS) and alkalinity were measured in situ using portable water quality testing kits (Anonymous, 2017). These parameters were recorded during each sampling event to study their correlation with fish diversity.

3. RESULTS AND DISCUSSION

A total of belonging to 37 fish species 6 orders, 13 families and 26 genera were recorded from the Bhadrakali and Waddepally reservoirs between June 2022 and May 2024. Among these, 32 species were observed in Bhadrakali and 29 in Waddepally with 24 species common to both systems indicating a high degree of community overlap (Table 3 and 4). The dominance of Cypriniformes (18 species; 48.6%), especially Cyprinidae (14 species 37.8%) is characteristic of Indian lentic ecosystems and aligns with patterns noted in large reservoirs and floodplain lakes across the subcontinent (Mishra, 2024; Purusothaman et al., 2016; Sandhya et al., 2024).

Seasonal assessment revealed that the post-monsoon period (October-December) exhibited the highest species diversity. Shannon-Wiener diversity (H') ranged from 2.15 to 3.24 with consistently higher values in Bhadrakali than in Waddepally. These post-monsoon peaks coincided with recharge flows and nutrient inputs, a trend also documented in open estuaries and regulated stream systems (Sreekanth et al., 2023; Fox and Magoulick, 2022).

Species like Catla catla, Labeo rohita and Channa striata were present throughout the year, highlighting their ecological plasticity. In contrast, species such as Ompok bimaculatus and Gudusia chapra were mostly recorded during the monsoon or post-monsoon periods suggesting short-term migrations or spawning-related movements a behaviour similarly observed in central Indian hill streams and small dam systems (Mondal and Bhat, 2020; Shukla and Bhat, 2017).

Seasonal shifts in dissolved oxygen, temperature and pH significantly influenced assemblage composition. Richness was highest during the post-monsoon oxygen peaks, whereas diversity declined in summer months, likely due to water column de-stratification, elevated temperatures and reduced levels patterns corroborated by long-term datasets

Table 3: Seasonal abundance of different species of Fishes (Mean±SE) in Bhadrakali fresh water reservoir during the study period June, 2022 to May, 2024

Species	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23
Mastacembelus armatus	2.00±0.17	2.10±0.27	2.10±0.17	1.20±0.12	2.10±0.14	2.60±0.19
Mastacembelus pancalus	1.30±0.14	1.40±0.15	1.10±0.13	1.10±0.13	1.10±0.14	1.40±0.13
Glossogobius giuris	1.00±0.14	1.00±0.13	1.10±0.12	1.10±0.14	1.00±0.13	1.10±0.14
Macrognathus aculeatus	1.10±0.13	1.10±0.12	1.00±0.12	0.90±0.11	0.90±0.12	1.00±0.13
Notopterus chitala	1.60±0.14	1.80±0.14	2.50±0.17	2.00±0.14	2.00±0.17	2.00±0.17
Species	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24
Mastacembelus armatus	1.60±0.14	2.10±0.18	1.90±0.17	1.50±0.17	1.10±0.13	1.70±0.15
Mastacembelus pancalus	1.20±0.13	1.40±0.14	1.30±0.14	1.00±0.13	1.10±0.12	1.20±0.13
Glossogobius giuris	1.10±0.14	1.30±0.14	1.20±0.13	1.10±0.13	1.10±0.13	1.20±0.13
Macrognathus aculeatus	1.10±0.14	1.10±0.13	1.10±0.14	1.00±0.13	1.00±0.13	1.10±0.12
Notopterus chitala	2.00±0.15	2.00±0.18	1.90±0.18	1.80±0.17	1.40±0.14	1.40±0.13

Table 4: Seasonal abundance of different species of Fishes (Mean±SE) in Waddepally fresh water reservoir during the study period June, 2022 to May, 2024

Species	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23
Mastacembelus armatus	2.10±0.21	3.10±0.23	3.10±0.21	3.10±0.22	2.60±0.24	2.00±0.21	1.20±0.14	1.10±0.14
Mastacembelus pancalus	1.50±0.15	0.90±0.15	1.00±0.13	2.00±0.16	2.10±0.16	1.50±0.13	1.10±0.11	1.10±0.14
Glossogobius giuris	1.00±0.14	1.00±0.14	0.90±0.15	0.80±0.13	0.70±0.14	1.00±0.13	1.30±0.13	1.30±0.13
Macrognathus aculeatus	1.10±0.13	1.10±0.11	1.00±0.12	1.00±0.12	0.90±0.11	1.30±0.13	1.20±0.13	1.20±0.12
Notopterus chitala	1.20±0.16	1.50±0.17	1.90±0.17	1.90±0.17	2.00±0.18	2.10±0.18	2.10±0.19	2.00±0.19
Species	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
Mastacembelus armatus	1.00±0.15	1.00±0.15	1.50±0.23	2.80±0.25	2.20±0.17	2.30±0.21	2.30±0.21	2.50±0.19
Mastacembelus pancalus	1.00±0.13	1.00±0.12	1.20±0.13	1.60±0.14	1.10±0.14	0.90±0.11	1.10±0.13	1.10±0.13
Glossogobius giuris	1.00±0.13	1.00±0.13	1.20±0.14	1.30±0.14	1.00±0.14	1.00±0.13	1.00±0.13	0.90±0.10
Macrognathus aculeatus	1.00±0.13	1.00±0.12	1.10±0.13	1.10±0.13	1.10±0.14	1.20±0.14	1.00±0.12	0.90±0.10
Notopterus chitala	2.10±0.19	2.10±0.20	2.20±0.21	2.30±0.20	1.80±0.15	2.10±0.12	2.50±0.07	1.90±0.13
Species	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24
Mastacembelus armatus	1.90±0.14	1.70±0.16	1.90±0.15	1.80±0.13	2.20±0.21	1.80±0.16	1.90±0.25	3.50±0.25
Mastacembelus pancalus	1.00±0.14	0.90±0.14	1.00±0.13	1.00±0.13	1.40±0.13	1.00±0.15	1.50±0.14	1.60±0.14
Glossogobius giuris	1.00±0.11	1.10±0.13	1.10±0.11	1.10±0.14	1.20±0.14	1.10±0.13	1.00±0.14	1.10±0.14
Macrognathus aculeatus	0.90±0.11	1.10±0.13	1.10±0.12	1.10±0.13	1.00±0.12	0.80±0.12	0.90±0.11	1.10±0.13
Notopterus chitala	1.90±0.14	1.90±0.11	2.00±0.13	2.10±0.12	2.10±0.13	2.10±0.13	2.10±0.14	2.00±0.13

from floodplain beels and ponds with small indigenous species (Sarkar and Saha, 2021; Roy and Saikia, 2023; Surachita and Palita, 2023).

Anthropogenic pressures also contributed to observed community differences. Bhadrakali, which was adjacent to a major pilgrimage and tourism hub, showed a greater presence of opportunistic omnivores and pollution-tolerant species. In contrast, Waddepally, primarily managed for municipal water supply, had higher species evenness and fewer low-value fish, indicating relatively lower disturbance. Similar anthropogenic signatures have been identified in GIS-based reservoir appraisals, tropical stream assessments and larval fish studies in fragmented impoundments (Gilbert and Pease, 2019; Miranda et al., 2019; Bhandekar et al., 2024).

Overall, these findings underscored the importance of season-specific fisheries management strategies. Recommendations included: Post-monsoon stocking to leverage biodiversity peaks, Maintenance of summer refugia to buffer against temperature extremes and Zoning of human activity around vulnerable zones in Bhadrakali.

4. CONCLUSION

Seasonal fish diversity in Bhadrakali and Waddepally reservoirs, identifying 39 species with notable temporal variations. Physico-chemical parameters, particularly dissolved oxygen and temperature, significantly influenced species composition. Monsoon and pre-monsoon seasons supported higher fish abundance. Urbanization and anthropogenic activities appeared to affect ecological balance.

5. ACKNOWLEDGEMENT

I sincerely thank the Department of Zoology, Kakatiya University, Warangal, for their support throughout the course of this research. I am grateful to my supervisor for their valuable guidance and encouragement. Special thanks to the local fishermen and reservoir management teams of Bhadrakali and Waddepally for their cooperation during the study. I also appreciate the help of my colleagues and family for their constant support.

6. REFERENCES

Anonymous 2022. The state of world fisheries and aquaculture 2022. Food and Agriculture Organization of the United Nations 266 p.https://doi.org/10.4060/cc0461en.

Anonymous, 2017. Standard methods for the examination of water and wastewater (23rd Edn.). American Public Health Association, American Water Works Association, Water Environment Federation, Denver. Available From https://www.standardmethods.org.

Bhandekar, R., Jaiswal, P., Thiske, S., Ali, M., 2024. A brief review on impact of physico-chemical parameters on fish diversity. Journal of Dynamics and Control 8(10), 137–145.

Boyd, C.E., 1990. Water quality in ponds for aquaculture. Auburn University Press, 482.

Das, G.K., 2021. Assessing diversity indices for the macroinvertebrates in the tidal mudflat of Hana Char in the Sundarbans, WB, India. International Research Journal of EnvironmentalSciences 10(3), 39–46. https://www.isca.in/IJENS/Archive/v10/i3/5.ISCA-IRJEvS-2021-007.php.

Das, S.K., Srinivasan, N.T., Sarang, N., Das, S.K., Jawahar, A.T., Canciyal, J., Panda, K., Jawahar, A.T., 2023. Effect of environmental drivers of fish assemblage and diversity patterns in temporal scale in Mongra Reservoir: A case study from one of the tributaries of Mahanadi Basin, Central India. Ecohydrology 16(8), e2599. https://doi.org/10.1002/eco.2599.

Fox, J.T., Magoulick, D.D., 2022. Hydrologic and environmental thresholds in stream fish assemblage structure. Ecological Indicators 144, 109500. https://doi.org/10.1016/j.ecolind.2022.109500.

Gilbert, M.D., Pease, A.A., 2019. Use of fragmented reservoir habitats by larval fish assemblages across contrasting hydrological years. Environmental Biology of Fishes 102(6), 857–871. DOI: 10.1007/s10641-019-00875.

Hazri, M.I.N.M., Noor, N.M., Noor, N.M., 2024. Fish diversity assessment in the Malaysian Straits: Insights into climate-change resilience. Aquaculture Research (in press). https://doi.org/10.1155/2024/3913221.

Jayaram, K.C., 2010. The freshwater fishes of the Indian region. Narendra Publishing House, Delhi, 616.

Joshi, R., Gupta, V., 2020. Seasonal variations in fish diversity and water quality in an urban reservoir. Environmental Monitoring and Assessment 192(6), 369. https://doi.org/10.1007/s10661-020-8202-4.

Kumar, P., Shukla, R., 2021. Impact of water quality on fish assemblages in urban reservoirs of northern India. Aquatic Ecosystem Health & Management 24(2), 103–111.

Kumar, R., Soni, K., Patel, A., 2022. Effects of environmental variables on seasonal fish diversity in Indian reservoirs. Aquatic Ecology 56, 765–780.

Miranda, L.E., Martínez-Lanfranco, J.A., Killgore, K.J., 2019. Wetlands and development influence fish diversity in a species-rich small river. Environmental Biology of Fishes 102, 873–886. https://doi.org/10.1007/s10641-019-00874-z.

Mishra, R., 2024. Present status of fish diversity and population abundance of selected species in Khudiya Dam, Chhattisgarh, India. Uttar Pradesh Journal of Zoology 45(17), 200–203. https://doi.org/10.56557/upjoz/2024/v45i174362.

Mishra, S.P., Kumar, S., Agarwal, S., 2023. Seasonal fish diversity in the riverine ecosystems of northern India. River Research and Applications 39(3), 393–402. https://doi.org/10.1002/rra.4190.

Mondal, R., Bhat, A., 2020. Temporal and environmental drivers of fish-community structure in tropical Indian streams. PLOS ONE 15(4), e0227354. https://doi.org/10.1371/journal.pone.0227354.

Omayio, D., Mzungu, E., 2019. Modification of Shannon-Wiener Diversity Index towards quantitative estimation of environmental wellness and biodiversity levels under a non-comparative scenario. Journal of Environment and Earth Science 9(6), 1–8. https://www.iiste.org/Journals/index.php

Purusothaman, R.S., 2016. Diversity and seasonal variation of fish assemblages in trawl catches from the southeast coast of India. Regional Studies in Marine Science 6, 29–36. https://doi.org/10.1016/j.rsma.2016.03.012.

Rathore, A., Yadav, M., Meena, M., 2022. Seasonal dynamics of fish biodiversity and water quality in Indian freshwater lakes. Indian Journal of Environmental Sciences 50(5), 72–85.

Roy, S., Saikia, S.K., 2023. Characterization of water-quality parameters in ponds inhabited by small indigenous fish species. European Journal of Aquatic Sciences 2(3), 1–10. https://doi.org/10.24018/ejaqua.2023.2.3.16.

Sandhya, K., 2024. Linking ecological characteristics with fish diversity, assemblage patterns and feeding guilds in a large subtropical reservoir. Journal of Water & Climate Change 15(2), 607–621.

Sarkar, C., Saha, N.C., 2021. Seasonal variation of water-quality parameters and fish biodiversity indices of Hasadanga Beel. Current World Environment 16(1), 23–34. https://doi.org/10.12944/CWE.16.1.03.

Sarkar, C., Saha, N.C., 2022. Fish assemblage pattern, seasonality and their interaction with environmental variables: Insights from canals of Sundarbans, India. Tropical Ecology 63, 626–643. https://doi.org/10.1007/s42965-022-00232-2.

Sayer, C.A., Fernando, E., Jimenez, R.R., Macfarlane, N.B., Rapacciuolo, G., Bohm, M., Darwall, W.R., 2025. One-quarter of freshwater fauna threatened with extinction. Nature 638, 138–145. https://doi.org/10.1038/s41586-024-08375-z.

Sharma, D., Singh, H., Rani, S., 2024. Fish diversity and environmental monitoring in urban freshwater systems of India. Ecological Monitoring Journal 38(1), 115–128.

Shukla, R., Bhat, A., 2017. Environmental drivers of α-diversity in monsoonal tropical streams of the Narmada basin, India. Environmental Biology of Fishes 100, 815–828.

Singh, R., Yadav, P., Gupta, A., 2021.The role of seasonal factors in determining fish diversity in urban reservoirs. Environmental Sciences 28(4), 234–247.

Sreekanth, G.B., 2023. A multi-metric fish index to measure the ecological quality of tropical predominantly open estuaries along the western coast of India. Environmental Monitoring and Assessment 195(1), 1–1.

Subhashini, S., Reddy, P.S., Reddy, P.R., 2023. Environmental fluctuations and their impact on fish diversity in urban reservoirs: A study of Bhadrakali and Waddepally reservoirs, Warangal, Telangana. Environmental Monitoring and Assessment 195(4), 234.

Surachita, S., Palita, S.K., 2023. Effect of physico-chemical parameters on ichthyofaunal diversity of a lentic waterbody in Eastern Ghats, India. Proceedings of the National Academy of Sciences, India B-93(4), 935–944. https://doi.org/10.1007/s40011-023-01492-1.

Welch, P.S., 1952. Limnology. 2nd Edition, McGraw-Hill Book Co., New York. Available at: https://www.scirp.org/reference/referencespapers?referenceid=864141.