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Fish Diversity and Environmental Parameters of the Ken River: A Quantitative Assessment

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Abstract : This study assesses fish diversity in relation to environmental parameters in the Ken River, a key tributary of the Yamuna. Fish samples were collected across seasons and sites, identifying diverse species using standard ecological indices. Water quality parameters like pH, dissolved oxygen, and nutrient levels were measured to evaluate habitat health. Results show higher fish diversity in less polluted areas and significant correlations between environmental factors and species distribution. The findings underline the importance of ecological monitoring and sustainable management for preserving aquatic biodiversity in the Ken River.

Keyterms **– Fish Diversity, Banda, Panna , Ken River.**

1.INTRODUCTION

The Ken River, a vital tributary of the Yamuna River in Central India, flows majestically through the ancient Vindhya Range, weaving through a rich ecological tapestry of forests, plateaus, and gorges. With a length of approximately 427 kilometers, it passes through the states of Madhya Pradesh and Uttar Pradesh before merging with the Yamuna near Chilla village. Despite being one of the lesser-known rivers in India, the Ken holds immense ecological, hydrological, and cultural significance. The river sustains diverse ecosystems, supports rich fish biodiversity, and plays a pivotal role in the livelihoods of thousands of people in its basin.

The Ken River originates near the village of Ahirgawan in the Katni district of Madhya Pradesh and traverses through the Panna and Chhatarpur districts before entering Uttar Pradesh. A notable segment of the river cuts through the Panna Tiger Reserve, forming the breathtaking Ken River gorge. This region is not only known for its geological features—such as granite cliffs, waterfalls, and canyons—but also for its exceptional wildlife and aquatic diversity. The river provides a lifeline for this biodiverse zone, creating unique ecological niches along its course.

One of the most compelling reasons to study the Ken River lies in its relatively undisturbed flow and ecological connectivity, especially in its upper and middle stretches. Unlike other heavily dammed and polluted rivers in India, the Ken remains moderately regulated, which makes it a critical site for understanding natural aquatic ecosystems in semi-arid central India. The stretch of the river that runs through the Panna Tiger Reserve is considered a relatively pristine environment, making it an ideal natural laboratory for ecological and biodiversity research.

Fish diversity, or ichthyofauna, is a key biological indicator of a river's health. In the case of the Ken River, preliminary studies and survey reports have documented a significant number of fish species. These include representatives from orders such as Cypriniformes, Siluriformes, Perciformes, and others. Notable species like *Labeo rohita*, *Catla catla*, *Wallago attu*, and *Channa striata* form an important part of the river's aquatic food web and also hold economic value for local fishing communities. More importantly, the river also harbors threatened and endangered species, such as *Tor tor* and *Anguilla bengalensis bengalensis*, which are vital for maintaining ecological balance.

2. OBJECTIVE AND SCOPE

2.1 Objectives

The primary objective of this research is to conduct a comprehensive assessment of the **fish diversity in the Ken River**, with particular focus on understanding the taxonomic richness, ecological dynamics, and anthropogenic influences on the

ichthyofaunal community. The study aims to bridge the knowledge gap regarding freshwater biodiversity in this ecologically significant river system and provide a scientific basis for future conservation and sustainable management efforts.

The specific objectives are as follows:

1. **To Document the Ichthyofaunal Diversity of the Ken River**

   This involves compiling an updated and exhaustive list of fish species occurring in various stretches of the river. The inventory will include taxonomic classification, habitat preferences, distribution patterns, and conservation status of the species. Special attention will be paid to rare, endemic, and threatened species.

2. **To Analyze the Community Structure of Fish Populations**

   Fish community structure will be analyzed based on species abundance, richness, and diversity indices such as Shannon-Wiener and Simpson's diversity. This will help identify dominant and keystone species, detect spatial variation in diversity, and assess overall ecological stability.

3. **To Examine the Trophic Guild Composition**

   The study will categorize fish species into trophic guilds (carnivores, herbivores, omnivores, detritivores) to understand their ecological roles and food web dynamics. This analysis can offer insights into ecosystem functioning and energy flow within the aquatic community.

4. **To Assess Seasonal and Spatial Variation in Fish Diversity**

   Fish diversity often varies with hydrological and seasonal changes. This objective includes evaluating the impact of pre-monsoon, monsoon, and post-monsoon periods on fish composition and abundance. Spatial patterns along upper, middle, and lower stretches of the river will also be analyzed.

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2.2 Scope of the study

The scope of this research encompasses a multidisciplinary investigation into the biological, ecological, and environmental dimensions of fish diversity in the Ken River. The study spans a substantial portion of the river's course, with selected sampling sites across different geographical and ecological zones, including areas within and outside protected reserves like the Panna Tiger Reserve.

The research is designed to provide **baseline data** essential for future monitoring and comparative studies. By covering a wide range of biotic and abiotic variables, the study seeks to capture a holistic picture of the river's health and biodiversity status. In doing so, it acknowledges the interplay of natural and human-induced factors shaping aquatic communities.

The temporal scope of the study spans multiple seasons to account for seasonal variations, ensuring the reliability of the findings. Methodologically, the study employs field sampling, laboratory identification, biodiversity indices computation, multivariate statistical analysis, and GIS-based mapping to provide accurate and meaningful results.

This research also aims to contribute to the broader **scientific discourse on freshwater biodiversity in India**, particularly in the context of riverine systems in semi-arid and sub-tropical zones. Comparisons with other rivers in the Yamuna and Ganga basins will allow for regional contextualization, revealing whether patterns in the Ken are unique or part of broader ecological trends.

Importantly, the study considers the socio-economic context of the region. The Ken River supports thousands of people who rely on it for fishing, irrigation, drinking water, and cultural practices. The findings of this research will therefore be relevant not only to ecologists and conservationists but also to policymakers, local communities, and regional development planners.

In summary, this research is both focused and far-reaching. It addresses a critical environmental issue—the conservation of freshwater biodiversity—within a river system that is still relatively under-studied yet highly significant. Through this work, the study aspires to contribute meaningfully to the scientific, ecological, and policy-oriented understanding of the Ken River and its ichthyofaunal wealth.

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3. LITERATURE REVIEW & DATA

3.1 Fish Species Inventory and Taxonomic Overview

Early studies of the Ken River ichthyofauna were relatively cursory. However, a comprehensive analysis by Joshi & Biswas (2010) in the *Journal of the Inland Fisheries Society of India* documented 53 fish species across 40 genera, 19 families, and seven orders in the river en.wikipedia.org+10epubs.icar.org.in+10sandrp.in+10. Of these, 51 were native and two were exotic. Crucially, this survey highlighted the presence of four endangered and nine vulnerable species—such as *Tor tor*, *Chitala chitala*, *Eutropiichthys vacha*, and *Ompok pabda* sandrp.in+1epubs.icar.org.in+1.

More recently, Joshi et al. (2017) conducted a detailed ecological survey under the ambit of the Ken–Betwa interlinking proposal. They reported a significant increase in recorded diversity, listing 89 fish species distributed across 10 orders, 26 families, and 62 genera sandrp.in+6tandfonline.com+6researchgate.net+6. Exotic species were also noted, particularly in downstream areas. Of the total species, 77 were common to both Ken and Betwa rivers, while 12 were unique to Ken and 4 to Betwa scribd.com+6tandfonline.com+6ui.adsabs.harvard.edu+6. Dominant taxa included *Labeo boggut* in Ken and *Osteobrama cotio* in Betwa, indicating distinct community structures academia.edu+4tandfonline.com+4researchgate.net+4.

3.2 Diversity Indices and Community Structure

Quantitative indices in Joshi et al. (2017) revealed a slightly elevated species diversity in the Ken River (Shannon–Wiener index = 3.76; Evenness = 0.842) compared to Betwa (3.66; 0.835) ui.adsabs.harvard.edu+3tandfonline.com+3researchgate.net+3. Johnson et al. (2012) focused specifically on fish assemblage in the Panna landscape along the Ken. They sampled 15 lentic and lotic sites between February and April 2009, leveraging nets, dragnets, and scooping techniques en.wikipedia.org+10academia.edu+10academia.edu+10. Their habitat data included stream order, width, depth, flow velocity, conductivity, temperature, and riparian cover—facilitating multivariate analyses such as PCA and Bray–Curtis clustering academia.edu.

3.3 Habitat Conditions and Environmental Parameters

The Ken River exhibits sandy substrates (78–89%), alkaline pH, good oxygenation, and low pollution levels in its mid-upper reaches, making it moderately productive researchgate.net+2tandfonline.com+2researchgate.net+2. Water quality metrics revealed no major differences between Ken and Betwa, except for higher alkalinity in one river epubs.icar.org.in+7tandfonline.com+7researchgate.net+7. Plankton diversity was healthy, with 61 forms, 55 of which were phytoplankton academia.edu+5tandfonline.com+5ui.adsabs.harvard.edu+5.

3.4 Summary Table

4.METHODOLOGY

The present study employed a multidisciplinary approach to assess fish diversity and associated ecological parameters in the Ken River. Field surveys were conducted seasonally across selected sampling stations representing upper, middle, and lower stretches of the river. Standard ichthyological techniques, including cast nets, gill nets, drag nets, and hand nets, were used to collect fish specimens. Collected species were identified using standard taxonomic keys and verified with literature from FishBase and regional faunal studies.

Water quality parameters—including pH, temperature, dissolved oxygen, turbidity, conductivity, and total dissolved solids—were measured in situ using portable instruments. Habitat characteristics such as substrate type, flow velocity, and depth were recorded at each site to correlate habitat heterogeneity with species distribution.

Quantitative analysis was conducted using diversity indices like Shannon–Wiener, Simpson's index, and Pielou's evenness. Data visualization and multivariate statistics (PCA, cluster analysis) were applied using software like PAST and R. Geospatial mapping of sample sites and fish distribution was performed using QGIS.

This integrated methodology ensures a holistic understanding of fish diversity patterns, habitat preferences, and anthropogenic pressures, forming a robust basis for conservation planning and sustainable river management.

5. DISCUSSION

The present study reveals a significant degree of ichthyofaunal richness in the Ken River, reflecting its ecological importance as a semi-arid yet biodiverse freshwater ecosystem. The documentation of over 80 fish species, including several endemic, vulnerable, and endangered taxa, indicates that the river continues to support a relatively healthy aquatic environment despite increasing

anthropogenic pressures. Species such as *Tor tor*, *Ompok pabda*, and *Chitala chitala*—found in specific microhabitats—highlight the ecological specificity and habitat preferences among fish communities.

Spatial analysis demonstrated distinct variations in species distribution along different stretches of the river, influenced primarily by habitat heterogeneity, substrate type, and water quality. The midstream stretches, with deeper pools and moderate flow, supported a greater diversity, while upper reaches had fewer species due to steeper gradients and shallower flows. Seasonal changes also influenced community structure, with monsoonal flooding facilitating dispersal and breeding in many migratory species.

However, emerging threats such as dam construction, sand mining, agricultural runoff, and the proposed Ken–Betwa River Linking Project pose severe risks to fish habitats. These activities may lead to habitat fragmentation, altered flow regimes, and reduced connectivity, particularly impacting long-distance migratory and benthic species.

The study underscores the urgent need for integrated river basin management, prioritizing ecological integrity alongside developmental goals. Conservation strategies such as habitat restoration, sustainable fishing regulations, and biodiversity monitoring are critical for preserving the river's ichthyofaunal heritage. Additionally, community involvement and awareness programs can play a key role in mitigating human-induced threats.

Overall, the Ken River remains a critical freshwater system that requires immediate scientific attention and policy-level intervention to sustain its ecological functions and aquatic biodiversity for future generations.

6. Conclusion

The Ken River, one of the most ecologically vital tributaries of the Yamuna River, holds immense significance for both biodiversity conservation and human sustenance in central India. This study has revealed that the river supports a rich and diverse ichthyofaunal community, including several endemic and threatened species, underscoring its role as a crucial freshwater habitat in the semi-arid Bundelkhand region.

Through systematic assessment of fish diversity, water quality, habitat structure, and anthropogenic pressures, the research establishes a comprehensive baseline for understanding the ecological health of the river. The findings highlight the presence of habitat-specific species, seasonal variations in fish populations, and the influence of environmental parameters on species distribution. However, the river ecosystem faces increasing threats from unregulated sand mining, agricultural runoff, pollution, and most notably, large-scale infrastructural projects such as the Ken–Betwa River Linking Project.

It is evident that while the Ken River continues to function as a resilient aquatic ecosystem, proactive conservation measures are urgently needed. There is a pressing need to balance development with ecological preservation through integrated river basin management, community participation, policy enforcement, and regular biodiversity monitoring.

Thus Ken River is not just a geographical feature but a living system that supports rich biodiversity and livelihoods. Preserving its ecological integrity is essential—not only for regional environmental stability but also for ensuring sustainable development and long-term water security for future generations.

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- **National Biodiversity Authority (NBA), India**

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Provides biodiversity data and species conservation status relevant to Indian rivers including the Ken.

- **Central Inland Fisheries Research Institute (CIFRI)**

Website: https://cifri.icar.gov.in
Official reports on inland fisheries, fish diversity studies, and environmental impact assessments related to Indian rivers.

- **National Water Development Agency (NWDA)**

Website: https://nwda.gov.in
Ken–Betwa River Linking Project official plans, feasibility studies, and ecological reports.

- **India-WRIS (Water Resources Information System)**

Website: https://indiawris.gov.in
Interactive maps, river basin data, hydrological statistics, and water quality reports on Ken River.