



Fish diversity and distribution of two freshwater bodies (Minimata Dam and Khudia Dam) of Chhattisgarh central India

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Abstract

This study examines the diversity of fish fauna in two freshwater bodies (Minimata dam and Khudia dam) of Chhattisgarh. Two freshwater bodies viz; Minimata dam and Khudia dam of Chhattisgarh were sampled for assessment of fish faunal diversity. Sampled freshwater bodies of Chhattisgarh were surveyed and the fish species were caught in nets by using boats. Different diversity indices were evaluated to examine the difference in the diversity, richness, evenness and relative abundance of fishes found in the sampled freshwater bodies of Chhattisgarh. The results reveal that a total of 49 fish species belonging to 09 orders, 18 families, and 34 genera were reported from Minimata dam and Khudia dam of Chhattisgarh. Cyprinidae (42.85%), Bagridae & Clariidae (8.16%), Siluridae (6.122%), Schilbeidae, and Centropomidae & Anabantidae (4.08%) were the most dominated families. *Labeo rohita* was the most abundant (6.182%) freshwater fish species in the sampled freshwater bodies of Chhattisgarh. The average species richness of Minimata dam was 49.00 ± 2.64 and Khudia dam was 43.0 ± 3.51 . The Simpsons index(D) reported a similar trend with highest values recorded by Minimata dam and lowest values recorded by Khudiyam dam. The Shannon's diversity index (H) recorded highest average values in Minimata dam (2.90 ± 0.09) lowest in Khudia dam (2.36 ± 0.08) respectively. Despite the low fish diversity in the sampled freshwater bodies of Chhattisgarh, the Shannon's index (H) varies from 2.36 ± 0.08 to 2.90 ± 0.09 . The results of the present study confirm that the Minimata dam of Chhattisgarh have higher diversity, richness, evenness and relative abundance of fishes than Khudiyam dam. These results can be utilized for the management of fish resources and of the sampled freshwater bodies of Chhattisgarh.

Keywords: Fish diversity, seasonal variation, freshwater bodies

Introduction

Freshwater ecosystems, encompassing rivers, lakes, wetlands, dams, reservoirs, and ponds, represent biodiversity hotspots, harboring a disproportionately large fraction of the world's fish species. Fish, constituting approximately half of all vertebrate species, exhibit remarkable diversity in morphology, physiology, and behavior, reflecting their adaptation to a wide range of ecological niches (Sharma, *et al.*, 2021) [27]. These aquatic environments are not only critical for maintaining global biodiversity but also provide essential ecosystem services, including water purification, nutrient cycling, and food provision for human populations (Ferreira, *et al.*, 2024). The ecological roles of fish within freshwater ecosystems are multifaceted, ranging from primary consumers to apex predators, influencing food web dynamics and energy flow (Nayak, *et al.*, 2025) [19]. Understanding the patterns of fish diversity in freshwater ecosystems is therefore crucial for effective conservation management and sustainable utilization of these resources (April, *et al.*, 2011) [1]. However, freshwater ecosystems are facing unprecedented threats from human activities, including habitat destruction, pollution, overfishing, and climate change (Capon, *et al.*, 2021) [5]. These anthropogenic stressors have resulted in significant declines in fish populations and loss of biodiversity in many regions around the world (Linke, *et al.*, 2019) [14]. Thus, it's essential to have proper information on the freshwater fish species across the globe. Once we have the information of freshwater fish species, then it will be easy to conserve them.

India, a land of remarkable biodiversity, boasts a rich and varied Ichthyofauna, reflecting its diverse aquatic ecosystems ranging from the icy Himalayas to the tropical waters of the Indian Ocean. The rich number of freshwater bodies of India is blessed by different types of fish species. Across different states, Chhattisgarh is blessed by various freshwater bodies. The state is a central Indian state. This state is regarded as herbal state of India and is blessed by rich biodiversity. Freshwater bodies of Chhattisgarh are blessed with rich aquatic biodiversity including fishes. There are number of reports which have reported the diversity of fishes in different freshwater bodies of Chhattisgarh. There is a need to replicate these studies to provide updated reports on the fish diversity of different freshwater bodies of Chhattisgarh. Keeping in view the need and importance of studies on fish diversity the present study was conducted to examine the diversity and distribution of fish species in two freshwater bodies of Chhattisgarh. The results of the present study will be utilized for the management of fish resources of the sampled freshwater bodies of Chhattisgarh.

Material and Methods

1. Selection of Freshwater Bodies

To fulfill the objectives of present work two freshwater bodies (Minimata dam and Khudia dam) were randomly selected (through simple random sampling technique) from Chhattisgarh of India to conduct this study. The morphometric features of selected freshwater bodies are given in Table-1. The study was carried out for two complete years from 2019 to 2021.

Table 1: Morphometric features of sampled two freshwater bodies of Chhattisgarh, Central India

S. No	Morphometric features	Minimata Dam	Khudia Dam
01	Latitude Longitude	22°36' 15'' N 82° 36' 05''E	22°34' 56'' N 81°33' 33''E
02	Toposheet No.	64J//1 & J//5	64/F/15&16, 64/J/3&4
03	Full storage level (m)	348.7M	268.00M
04	Dead storage level (m)	335.4M	266.00M
05	Catchment area (km ²)	6730km ²	82.87 Km ²
06	Gross storage capacity (x 106m ³)	11120.00Mcft	1000.20Mcft
07	Dead storage capacity (x 106m ³)	244.81	132.50Ha
08	Water spread area at FRL (ha)	2128Ha	650Ha
09	Mean depth (m)	15.00M	6.00M
10	Length of shore line(km)	333.00Km	40.00Km

2. Assessment of Fish Biodiversity

To assess the fish diversity of freshwater bodies of Chhattisgarh a boat was hired and the sampled dams were visited and the fish samples were collected carefully throughout the study period. Thereafter different types of fish catching nets like cost net, gill nets, scoop net and a circular net with varying sizes (10mm to 200mm) were used to catch the fishes for further study. All the fish specimens were identified based on morphometric and meristic characters following Rahman (2007 and 2005) [24, 25] and Talwar and Jhingran (1991) [29]. Identified species were classified based on the classification system of Nelson (2006) [20]. Scientific names and authorities follow those of Froese and Pauly (2021) [9]. The abundance of different fish species was estimated in terms of individuals collected. Then the relative abundance of each identified fish species was calculated by the formula given by Rafiu, *et al.*, (2025) [23]. Different diversity indices like; Shannon-Wiener Index of Diversity (H) was calculated by using equation of Shannon and Wiener (1949) [26], Species Richness (d) was evaluated by using equation of Margalef, (1958) [15], Simpsons Diversity Index (c) was calculated by using equation of Simpson, (1951) [28] and Species Evenness (e) was calculated by the formula given by Pielou, (1966) [16].

3. Data Analysis

The data were tabulated and statistically analyzed by the analyses of variance (ANOVA) and the treatment means were compared using the Duncan Multiple Range Test (Duncan, 1965) [7] at ($P \leq 0.05$) level of significance. The SPSS version 16.0 software was used to analyse the data.

Results and Analysis

In the present study a comprehensive approach was used to carry out this study. All the precautions were followed to

reach on reliable results. The sampled freshwater bodies (Minimata dam and Khudia dam) were surveyed for their fish faunal diversity. Table-2 shows the detail of different fish species encountered in the present study. The sampled four freshwater bodies of Chhattisgarh were composed of 09 orders, 18 families, 34 genera and 49 fish species. Across different sampled Dams; Minimata dam reported 49 fish species, followed by Khutaghat dam (47 fish species), Kori dam (44 fish species) and Khudia dam (43 fish species). Cyprinidae (42.85%), Bagridae & Clariidae (8.16%), Siluridae (6.122%), Schilbeidae, and Centropomidae & Anabantidae (4.08%) were the most dominated families. *Labeo rohita* was the most abundant (6.182%) freshwater fish species, followed by *Labeo bata* (5.63%), *Oxygaster bacalica* (5.20%), *Amblypharyngodon mola* (4.72%), *Mystus tengara* (4.27%), *Rasbora daniconius* (3.79%), *Ompok pabda* (3.57%), and others in the sampled freshwater bodies of Chhattisgarh respectively. *Tilapia mossambicus* (0.018%) has reported its abundance as lowest across all the reported fish species in the sampled freshwater bodies.

The different diversity indices were calculated for each sampled freshwater body of Chhattisgarh. Table-3 provides the detail of different diversity indices of fish fauna across different seasons in Chhattisgarh of Central India. An average of 320 ± 31.74 individuals of fish fauna were caught from Minimata dam, and 320 ± 31.74 individuals of fish fauna were caught from Khudia dam. The average species richness of Minimata dam was 49.00 ± 2.64 and Khudia dam was 43.0 ± 3.51 . Similarly, the Simpsons index (D) reported a similar trend with highest values recorded by Minimata dam and lowest values recorded by Khudia dam. The Shannon's diversity index (H) recorded highest average values in Minimata dam (2.90 ± 0.09) and lowest in Khudia dam (2.36 ± 0.08) respectively.

Table 2: Fish species recorded from two freshwater bodies (Minimata dam and Khudia dam) of Chhattisgarh

Order	Family	Species	Local Name	D3	D4	RA
Clupeiformes	Clupeidae	<i>Gudusia chapra</i>	Chapra	+	-	3.2434
Osteoglossiformes	Notopetridae	<i>Notopetereus notopetereus</i>	Patola	+	-	3.1216
Cypriniformes	Cyprinidae	<i>Amblypharyngodon mola</i>	Dhai	+	+	4.7205
		<i>Barilius bendelisis</i>	Chitri	+	+	2.3602
		<i>Catla catla</i>	Catla	+	+	2.6648
		<i>Cirrhinus mrigal</i>	Mrigal	+	+	1.4770
		<i>Cirrhinus reba</i>	Reba	+	-	1.1116
		<i>Crossocheilus latius</i>	Petali	+	-	0.3654
		<i>Cyprinus carpio</i>	Carpio	+	+	0.3350
		<i>Danio devario</i>	Amashaini	+	-	1.1420
		<i>Esomus danricus</i>	Dadia	+	+	2.8475
		<i>Garra gotyla</i>	Butwa	+	+	0.4111
		<i>Labeo bata</i>	Bata	+	+	5.6342
		<i>Labeo calbasu</i>	Calbasu	+	+	2.4364

		<i>Labeo gonius</i>	Gonius	+	+	2.6800
		<i>Labeo rohita</i>	Rohu	+	+	6.1824
		<i>Oxygaster bacaila</i>	Sarangi	+	-	5.2078
		<i>Puntius sarana</i>	Sarna	+	+	1.2486
		<i>Puntius chola</i>	Kotri	+	+	1.5532
		<i>Puntius ticto</i>	Sidhari	+	-	0.9745
		<i>Puntius sophore</i>	Kotri	+	+	2.6039
		<i>Tor tor</i>	Mahasher	+	-	1.1268
		<i>Rasbora daniconius</i>	Dadu	+	+	3.7916
	Cobitidae	<i>Lepidocephalichthys guntea</i>	Gimna	+	+	3.4262
	Nemacheilidae	<i>Nemacheilus botia</i>	Gimna	+	+	1.8120
	Siluridae	<i>Ompok bimaculatus</i>	Lapchi	+	+	2.9389
		<i>Ompok pabda</i>	Pabada	+	+	3.5784
		<i>Wallago attu</i>	Paniha	+	+	1.0202
	Bagridae	<i>Mystus seengala</i>	Tengra	+	+	1.0507
		<i>Mystus tengara</i>	Tangna	+	+	4.2789
		<i>Mystus aor</i>	Bade Tangna	+	+	1.6141
		<i>Rita rita</i>	Kokia	+	+	0.6091
	Sisoridae	<i>Bagarius bagarius</i>	Rechha	+	+	0.4720
	Schilbeidae	<i>Eutropiichthys vacha</i>	Patara	+	+	0.3502
<i>Silonia silondia</i>		Gazza	+	+	0.4263	
Saccobranhidae	<i>Heteropneutes fossilis</i>	Singhi	+	+	1.4770	
Clariidae	<i>Clarias batrachus</i>	Mongri	+	+	1.3095	
Ophiocephaliformes	Channidae	<i>Channa punctatus</i>	Khoksi	+	+	3.1673
		<i>Channa striatus</i>	Khoksi	+	+	2.9084
		<i>Channa gachua</i>	Karajiya	+	+	3.2282
		<i>Channa marulius</i>	Khoksi	+	+	0.5025
Beloniformes	Belonidae	<i>Xenentodon cancila</i>	Sodhia	+	+	1.5684
Perciformes	Centropomidae	<i>Chanda nama</i>	Chandani	+	+	1.2334
		<i>Chanda ranga</i>	Chandani	+	+	1.1268
Gobiiformes	Nandidae	<i>Nandus nandus</i>	Bhedo	+	+	1.3552
	Anabantidae	<i>Anabas testudineus</i>	Rukh Chagha	+	+	1.5227
Mastacembeliformes	Mastacembelidae	<i>Mastacembelus armatus</i>	Baam	+	+	0.7157
		<i>Mastacembelus punctalus</i>	Baam	+	+	0.8832
Cichliformes	Cichlidae	<i>Tilapia mossambicus</i>	Tilapia	+	+	0.1827

*Note: D1= Khutaghat Dam, D2 = Kori Dam, D3=Minimata Dam, D4 = Khudia Dam, RA= Relative Abundance

+ = Present

- = Absent

The results for the species evenness were inconsistent to those of Shannon’s diversity index (H). The overall results of the present study uncover that the across all of the sampled two freshwater bodies; Minimata dam has reported

highest fish diversity, species evenness and species richness of fish fauna and Khudia dam has reported lowest fish diversity, species evenness and species richness of fish fauna.

Table 3: Diversity indices of fish species in freshwater bodies of Chhattisgarh, Central India during 2019 -2021

Dam	Diversity Indices	Monsoon	Winter	Summer	Average	ANOVA
1. Minimata dam	Individuals (Mean)	284±5.84 ^c	344±6.96 ^a	332±4.32 ^b	320±31.74	p= 0.0006**
	Richness(S)	49.0±1.05 ^b	51.0±1.38 ^a	47.0±0.97 ^c	49.00±2.64	p=0.0468*
	Simpsons index(D)	0.96±0.02 ^b	0.98±0.03 ^a	0.97±0.02 ^{ab}	0.97±0.02	p=0.0699 ^{NS}
	Shannon’s index(H)	02.80±0.14 ^c	2.98±0.11 ^a	2.94±0.12 ^b	2.90±0.09	p= 0.0417*
	Evenness (E)	0.96±0.02 ^b	0.98±0.01 ^a	0.97±0.02 ^{ab}	0.97±0.02	p=0.0479*
2. Khudia dam	Individuals (Mean)	265±3.67 ^c	325±4.79 ^a	302±5.50 ^b	320±31.74	p=0.0001**
	Richness(S)	42.0±1.30 ^c	45.0±1.50 ^a	45.0±1.10 ^b	43.0±3.51	p=0.0490*
	Simpsons index(D)	0.92±0.02 ^a	0.91±0.01 ^{ab}	0.90±0.02 ^b	0.91±0.01	p=0.0707 ^{NS}
	Shannon’s index(H)	2.48±0.12 ^c	2.60±0.09 ^b	2.67±0.07 ^a	2.36±0.08	p= 0.0482*
	Evenness (E)	0.92±0.02 ^{ab}	0.91±0.01 ^b	0.93±0.02 ^a	0.92±0.01	p=0.0539 ^{NS}

Note: Different letters a, b, and c denotes significant difference (p≤0.05) between the reported mean values.

* Statistically significant at p≤0.05

** Statistically significant at p≤0.001

^{NS} Not Significant at p≤0.05

Table-3 shows the season wise diversity indices of fish species in sampled two freshwater bodies of Chhattisgarh. Highest number of Individuals of fish species were collected in Monsoon season in both Minimata dam and Khudia dam of Chhattisgarh and lowest in summer season. Species richness was highest in winter and lowest in summer season

in both Minimata dam and Khudia dam of Chhattisgarh. Similarly, the Simpsons index(D), Shannon’s index(H) and species evenness (E) of fish species in Minimata dam and Khudia dam was reported in winter season. The results of the present study confirm that the fish diversity of freshwater bodies of Chhattisgarh remain highest in winter

season and lowest in summer season. The Duncan's multiple range tests confirmed that there is a significant variation across mean values obtained for different diversity indices in both Minimata dam and Khudia dam of Chhattisgarh. ANOVA (one way) was subjected to determine the overall variation in individuals collected, species richness(S) Simpsons index(D), Shannon's index(H) and species evenness (E) across different seasons in Minimata dam and Khudia dam of Chhattisgarh. In Minimata dam except Simpsons index(D), all the diversity indices reported a significant variation ($p \leq 0.05$) across different seasons of year. In Khudia dam except Simpsons index (D) and species evenness (E) all the diversity indices reported a significant variation ($p \leq 0.05$) across different seasons of year. These results confirm that population dynamics of fishes in Minimata dam and Khudia dam of Chhattisgarh alters from one season to another season.

Discussion

Across different aquatic species, fish species are regarded to be the health indicators of aquatic ecosystem (Li, *et al.*, 2018) [13]. The diversity of fish fauna in an aquatic ecosystem determines the balance between its structure and functioning. Fish provide some fundamental ecosystem services in an aquatic system. The ecological services provided by the fishes are not replaceable by any sort of technology. Thus, the diversity of fish species of a nation has wide economic importance. As per reports, out of the 54000 vertebrate species that exist worldwide, over 35000 are fish species that are found in various aquatic habitats. But till today the complete documentation of fish fauna present in different freshwater bodies of India is lacking. The present study was conducted to examine the freshwater fish faunal diversity in Chhattisgarh of Central India. In this study we found 49 different fish species across four sampled freshwater bodies of Chhattisgarh, Central India. Some authors have reported that 96 fresh water fish species exist in Chhattisgarh (Patel, *et al.*, 2016) [21]. The results illustrated that Cyprinidae (44.87%) was most dominated families and *Labeo rohita* was the most abundant (6.182%) freshwater fish species in the freshwater bodies of Chhattisgarh. The dominance of these families could be in relation to their prolific breeding capabilities and high adaptation to varying environmental conditions (Mustapha, 2010; Araoye, 1999) [2, 18]. The results of the present are in consistent with those of Oyewo, (2005), Atile, *et al.*, (2016) [3] and Daramola, *et al.*, (2007) [6].

In the present study we have observed that highest number of individuals of fish species, fish species richness(S) Simpsons index(D) of fish species, Shannon's index(H) of fish species and fish species evenness (E) were reported in winter season and lowest in summer. Fish species may appear more in winter than summer because cold water holds more dissolved oxygen, which is essential for fish respiration (Bulbul Ali and Mishra, 2022) [4]. Aquatic species need dissolved oxygen for breathing. As solubility of gases decreases with increases of temperature, less oxygen is available in summer in the lakes (Jain, *et al.*, 2013) [10]. Hence, they feel more comfortable in winter (low temperature) when the solubility is higher. Also, some fish migrate to deeper, colder waters during the summer months thus they don't appear at surface water (Jonsson, 1991) [11]. Lai, *et al.*, (2022) [12] reported that the fish species and fish diversity was highest in winter and lowest in winter.

The results of the present study were also inconsistent with those of Morales-Marín, *et al.*, (2019) [17]. The results of the present study can be used by the authorized department for the management of fish resources in the freshwater bodies of Chhattisgarh. In addition to this the results of this study can be used by the policy makers in laying out proper conservation strategies for the management of the freshwater bodies of Chhattisgarh. Future studies are required to be conducted which will determine the pollution status of the freshwater bodies of Chhattisgarh and how this pollution affect the diversity and distribution of aquatic fauna.

Conclusion

This research work was conducted to examine the diversity of fish fauna in two freshwater bodies (Minimata dam and Khudia dam) of Chhattisgarh, Central India and its association with some environmental attributes. The results reveal that the sampled four freshwater bodies of Chhattisgarh were composed of 09 orders, 18 families, 34 genera and 49 fish species. Across different sampled Dams; Minimata dam reported 49 fish species and Khudia dam recorded 43 fish species. Cyprinidae (42.85%), Bagridae & Clariidae (8.16%), Siluridae (6.122%), Schilbeidae, and Centropomidae & Anabantidae (4.08%) were the most dominated families. *Labeo rohita* was the most abundant (6.182%) and *Tilapia mossambicus* (0.018%) has reported its abundance as lowest across all the reported fish species in the sampled freshwater bodies. The overall results of the present study uncover that among two freshwater bodies; Minimata dam has reported more diversity, evenness and richness of fish species and Khudia dam has reported lowest diversity, evenness and richness of fish species. The present study recorded a significant variation fish faunal diversity across different seasons of year, with highest diversity of fishes occur in winter season and lowest in summer season in both freshwater bodies of Chhattisgarh. The results of the present study can be used to monitor the current status of the sampled fresh water bodies of Chhattisgarh.

Conflict of Interest

Author don't have any conflict of interest regarding the publication of this manuscript.

Ethical Issues of Manuscript

Not Required

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.

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