



ICHTHYOFAUNAL DIVERSITY OF FISHES IN DISTRICT MUNGELI , CHHATTISGARH, INDIA

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ABSTRACT

The present study was carried out during September 2020 to August 2022 diversity of freshwater fish species of Mungeli district (C.G.) in different ponds, Rahan river, Maniyari river, Aagar river, Khudiya dam and Madku dweep. The collection of fish samples the fisherman hired , active gear, cast net and drag nets were used for collection during 9.00 am to 12.00 pm. A total of 46 fish species belonging to 9 orders, 18 families and 38 genera were recorded during the study. The order Cypriniformes was the most dominant group, representing 21 species. This was followed by Siluriformes, Perciformes, Anabantiformes, Osteoglossiformes, Synbranchiformes, Gobiiformes, Beloniformes, Characiformes respectively. In present study, a total of 34 common, 10 scanty and 2 rare species were found in the study area. As per the values of Shannon (2.77–3.24 and 2.63–3.10) and Simpson's diversity (0.90-0.95 and 0.89- 0.94) indices, the fish community of the district Mungeli is diverse. The range of species richness indices 27-36 was obtained. The evenness index is 0.77–0.91 and 0.75-0.87, respectively. The study also revealed that the pond, river, dam are stressed due to man-made activities, industrial, chemical, agricultural runoff, and other forms of pollution, as well as overexploitation of fishes throughout the year. There is a need to make people aware of the importance, diversity, conservation, and fish productivity of these fish sources.

Key words Mungeli district, fish diversity, distribution, conservation.

Introduction

Fish diversity essentially represents the fish faunal diversity, occurrence, distribution, abundance, and conservation of a rich variety of fish species. Fresh water resources in India have been utilized mainly for economic purposes^[11]. Biodiversity is essential for stabilizing ecosystems, protecting overall environmental quality, and understanding the intrinsic worth of all species on earth^[4]. The reservoirs are an important component of the inland aquatic resources of India, known for their rich biogenic production potential^[18]. The fish diversity is not only the wealth of the district, but it also has serious implications on fisheries. According to the IUCN, 868 species are found in the freshwater ecosystem of India, out of which 192 species are endemic and 327 species are in threatened category^[8]. Natural calamities, anthropogenic activities, and pollution may destroy or modify the habitat of freshwater fishes^[12]. These are the major threats to aquatic ecosystem^{[1] [9]}. Overfishing or indiscriminate fishing (use of mosquito net, dynamite, and electrofishing) causes mass mortality of fish species and a huge reduction of their population size^{[13], [16]} and the introduction of exotic fish may cause the introduction of new diseases and parasites in new habitats. They also increase the conflict between exotic and indigenous fishes, and finally, the introduced exotic fishes may reduce the population size of indigenous fish species^[17]. The three major rivers of the district Mungeli are Rahn, Maniyari, and Aagar. The interesting aspect of the Shivnath river (Bilaspur district) is that it has Madku Dweep (Mungeli district) in its course, where water remains stagnant throughout the year. The only dam in the district is Khudiya Dam, which is known as Rajiv Gandhi Reservoir. The water storage area of this dam is up to 854.50 square kilometres. The forest range Khudiya comes under the Achanakmar Tiger Reserve. There are an abundance of small and large ponds in the district. Mungeli district has its own unique ecological identity and great diversity of biological species. India contributes to about 7.7% of global fish diversity, of which 1668 species are marine and 1027 are freshwater^{[6],[5]}. The number of fish species known in Chhattisgarh is about 165.

Some of these fish species are commercially important. Therefore, the present study was conducted on fish diversity in the Mungeli district of Chhattisgarh.

Study area

Table No. 1 Sampling sites and their physical attributes :-

Site No.	Name of Area	Name of Site	Land use pattern/Source of Pollution
1	Rahn river	Pacharighat, Chandali (Teh. Lalpur)	Agriculture, Rural
2	Maniyari river	Shivghat (Teh. Lormi)	Agriculture, Rural, Temples, Domestic Sewage

3	Aagar river	Kharraghat (Teh. Mungeli)	Agriculture, Semi urban, Domestic sewage, Industrial sewage
4	Khudiya Dam (Rajiv Gandhi Reservoir)	Khudiya (Teh. Lormi)	Agriculture, Rural, Protected Forest area, Over fishing
5	Madku Dweep (Shivnath river)	Madku dweep (Teh. Pathariya)	Protected Forest area, Agriculture, Rural, Over fishing
6	Ponds	All 688 Ponds in Mungeli District	Agriculture, Rural



Fig. No.1 Showing geographical status of Mungeli District, Chhattisgarh, India



Rahn river



Maniyari river



Aagar river



Khudiya dam



Madku dweep
(Shivnath river)



Ponds
(Pathartal)

Material and methods

Fish samples were collected from September 2020 to August 2022. Samples were collected at regular intervals with the help of local fishermen and by using standard protocols. Samples were taken through a cast net (16 mm., 18 mm., 22 mm.) and drag net (4 mm., 15×3 mtr.) from 9 am. to 12 pm. The collected samples were cleaned thoroughly, and all colours, colour patterns, spots, numbers, and designs have been noted when they are in fresh condition. For taxonomic study and identification confirmation, photographs were snapped. The samples were preserved in a 10% diluted formalin solution. The specimens of fish were identified on the basis of their morphology, fin formula, and morphometric characters. Secondary data were also gathered through observation and questionnaire interviews with fishermen in the study area. The systematic and scientific identification of the fish species was conducted with the help of standard keys provided by standard literature^{[3], [19], and [7]}.

Fish diversity indices

Diversity encompasses two different concepts of variety and variability, viz., richness and evenness. In the present study, diversity has been measured by the number of species (species richness) and by using the two indices, viz., Shannon - Weaver (H) and Simpsons (D) indices.

These are given by

(1) Shannon - weaver index of diversity^[14]

$$H = -\sum p_i \ln p_i$$

Where H - Shannon diversity index

Σ - Sum symbol

p_i - proportion of total sample represented by species - i, divided i by total number of samples

\ln - natural logarithm

$$p_i = n/N$$

n - total numbers of individuals of species

N - total number of individuals of all the species

S - species richness

$$H_{Max} = \ln(S)$$

(Maximum diversity possible)

$$E = H/H_{\text{Max}}$$

E- Evenness, E is constrained between 0 and 1. The less variation in communities between the species, the higher E is.

(2) Simpsons index of diversity^[15]

$$D = 1/(\sum p_i^2)$$

Results and discussion

46 Ichthyospecies belonging to 38 genera, 18 families and 9 orders have been recorded in district Mungeli of Chhattisgarh. The most abundant order was Cypriniformes, contributing 45.6% of the fish fauna followed by Siluriformes 21.7%, Perciformes 13%, Anabantiformes 8.6%, Osteoglossiformes 2.1%, Synbranchiformes 2.1%, Gobiiformes, 2.1%, Beloniformes 2.1% and Characiformes 2.1%. Cypriniformes (45.6%)>Siluriformes (21.7%)>Perciformes (13%)>Anabantiformes (8.6%)>Osteoglossiformes (2.1%)=Synbranchiformes (2.1%)=Gobiiformes (2.1%)=Beloniformes (2.1%)=Characiformes (2.1%). Cyprinids were found to be the most dominant group (20 genera and 21 species) with a wide distribution. Similarly, studies on several Indian rivers also showed that fish communities were dominated by Cyprinidae^[13]. Out of total fish species observed under study 34 common, 10 scanty and 2 were found rare in the area. Out of 46 fish species found in the district Mungeli, 8 belong to the carp Among the Carps, *Labeo rohita*, *Labeo calbasu*, *Catla catla*, *Hypophthalmichthys nobilis*, *Abramis brama*, *Henicorhynchus siamensis*, *Cyprinus carpio*, and *Cirrhinus cirrhosus* have highly commercial as well as economic importance, while the other carps are economically less important. Among the catfish groups, *Mystus tengara*, *Sperata aor*, *Wallago attu*, *Pangasius pangasius*, and *Clarias batrachus* carry high economic value. Among the other group fish *Channa striata* and *Channa punctata* bear high economic importance, while others have moderate to low economic importance. In the present study, five exotic species were recorded. Among these, *Oreochromis mossambicus* and *Oreochromis niloticus* are quite common. *Clarias gariepinus*, which is voracious and carnivorous, feeding habitat in Maniyari, Aagar river and ponds, which become serious threats to the smaller indigenous ichthyospecies.

Table No. 2 List of Fish species found in District Mungeli of Chhattisgarh

Sl. No.	Order	Family	Species	Local/Common Name	Abundance	Rahn river	Maniyari river	Agar river	Khudiyad dam	Madikudweep (Shivnath river)	Ponds	Economic Importance					IUCN Red List Status	Authority	
												Commercial	Fine Food	Coarse Food	Aquarium fish	Others			
1	Cypriniformes	Cyprinidae	<i>Labeo rohita</i>	Rohu, rehu	C	++	+++	++	+++	+++	+++	Y	Y	N	N	-	LC	Hamilton, 1822	
			<i>Catla catla</i>	Katla	C	++	+++	++	+++	+++	+++	+++	Y	Y	N	N	-	LC	F. Hamilton, 1822
			<i>Osteochilus vittatus</i>	Kutra	C	+++	+++	+++	++	++	++	++	Y	Y	N	N	-	LC	Valenciennes, 1842
			<i>Capoeta capoeta</i>	Tuli	S	-	-	-	++	-	-	-	N	Y	N	N	-	LC	Guldenstadt, 1773
			<i>Hypophthalmichthys nobilis</i>	Bighead carp	S	-	-	-	-	-	-	++	Y	Y	N	N	-	DD*	J. Richardson, 1845
			<i>Rutilus rutilus</i>	Roach	C	+++	+++	+++	+++	+++	+++	+++	N	N	Y	N	-	LC	Linnaeus, 1758
			<i>Abramis brama</i>	Chilhati	C	-	+++	++	+++	++	-	-	N	N	Y	N	-	LC	Linnaeus, 1758
			<i>Henicorhynchus siamensis</i>	Bata	C	+++	+++	+++	+++	+++	+++	+++	N	N	Y	N	-	LC	Sauvage, 1881
			<i>Chela untrahi</i>	Sarangj	C	+++	+++	+++	++	++	+++	+++	Y	N	Y	N	-	LC	Day, 1869
			<i>Parachanna siamensis</i>	Pangya	C	+++	+++	+++	-	-	+++	-	N	N	Y	N	-	LC	Gunther, 1868
			<i>Puntius sophore</i>	Katri	C	+++	+++	+++	+++	+++	+++	+++	Y	N	Y	Y	-	LC	F. Hamilton, 1822
			<i>Barbodes bimotatus</i>	Common barb	C	+++	+++	+++	+++	+++	+++	+++	Y	N	Y	N	-	LC	Valenciennes, 1842
			<i>Amblypharyngodon mola</i>	Mohrali	C	+++	+++	+++	++	++	+++	+++	N	N	Y	N	-	LC	Hamilton, 1822
			<i>Natropis atherinoides</i>	Emerald shiner	C	+++	+++	+++	+	+	+++	+++	N	N	Y	N	-	LC	Rafinesque, 1818
			<i>Pethia conchanius</i>	Chhati katri	C	+++	+++	+++	+++	+++	+++	+++	Y	N	Y	Y	-	LC	F. Hamilton, 1822
			<i>Cyprinus carpio</i>	Petli	C	+++	++	++	+	+	+++	+++	Y	Y	N	Y	GF	VU*	Linnaeus, 1758
			<i>Hemigrammocypnis rastroella</i>	Darwa	C	++	++	+++	-	-	++	-	N	N	Y	N	-	NE	Fowler, 1910
			<i>Labeo calbasu</i>	Kari	C	-	+++	++	-	-	+++	+++	Y	N	N	N	-	LC	F. Hamilton, 1822
			<i>Cirrhinus cirrhatus</i>	Mirgal	C	++	++	+++	-	-	+++	+++	Y	Y	N	N	-	VU	Bloch, 1795
			<i>Barbonymus gonionotus</i>	Katri	C	+++	+++	++	++	+++	+++	+++	N	Y	Y	N	-	LC	Bleeker, 1850
<i>Misgurnus anguillicaudatus</i>	Ludwa, ginwa	C	+++	+++	+++	-	-	++	+++	N	N	Y	N	-	LC	Cantor, 1842			
2	Sturiformes	Bagridae	<i>Mystus tengora</i>	Tengna	C	++	+++	++	+++	++	+++	N	N	Y	N	-	LC	Hamilton, 1822	
			<i>Sperato aor</i>	Singar	S	-	-	-	++	-	-	N	Y	N	N	-	LC	F. Hamilton, 1822	
			<i>Mystus nigriceps</i>	Tengna	C	-	-	++	+++	+++	+++	N	N	Y	N	-	LC	Valenciennes, 1840	
		Siluridae	<i>Belodontichthys dinema</i>	Banspatri	S	-	++	++	-	-	-	N	N	Y	N	-	LC	Bleeker, 1851	
			<i>Wallago attu</i>	Padhina	C	++	++	++	++	+++	+++	Y	Y	N	N	GF, PFF	VU	Bloch & Schneider, 1801	
		Pangasidae	<i>Pangasius kumyt</i>	Pangash, pagaj	S	-	-	-	++	-	-	++	Y	Y	N	N	-	LC	Pouyaud, Teugels & Legendre, 1999
			<i>Pangasius pangasius</i>	Sawall	C	-	-	++	+	-	-	++	Y	Y	N	N	-	LC	Hamilton, 1822
Clariidae	<i>Clarias batrachus</i>	Mangur	C	++	++	++	-	-	-	+++	Y	Y	N	N	-	LC	Linnaeus, 1758		
	<i>Clarias gariepinus</i>	Kewai	C	-	++	++	-	-	-	+++	Y	Y	N	N	-	LC	Burchell, 1822		
Loricariidae	<i>Pterygoplichthys pardalis</i>	Kai, dragon	R	-	+R	+R	-	-	-	-	N	N	N	Y	-	NE*	Castelnau, 1855		
3	Anabantiformes	Anabantidae	<i>Anabas testudineus</i>	Koi	C	+++	+++	+++	+++	+++	+++	Y	N	Y	N	-	DD	Bloch, 1792	
			<i>Channa punctata</i>	Demchul, dewa	C	+++	+++	+++	++	+++	+++	+++	Y	Y	N	Y	BT	LC	Bloch, 1793
			<i>Channa striata</i>	Khoksi, chingli	C	+++	+++	+++	++	+++	+++	+++	Y	N	Y	Y	LV	LC	Bloch, 1793
4	Perciformes	Ambassidae	<i>Chanda nama</i>	Chandaini	C	++	+++	+++	+++	+++	+++	N	N	Y	Y	-	LC	F. Hamilton, 1822	
			<i>Chanda rigida</i>	Chandaini	C	+++	+++	+++	+++	+++	+++	+++	N	N	Y	Y	-	LC	F. Hamilton, 1822
			<i>Oreochromis mossambicus</i>	Tilapia	C	-	++	++	-	-	-	+++	Y	Y	N	Y	GF	NT*	W. K. H. Peters, 1852
		<i>Oreochromis niloticus</i>	Nile tilapia	S	-	-	-	-	-	-	++	Y	Y	N	N	GF	NE*	Linnaeus, 1758	
		<i>Nandus nandus</i>	Bhedo	R	-	-	-	+R	+R	-	-	N	N	Y	N	-	LC	Hamilton, 1822	
<i>Pseudorasbora parva</i>	Lal chandaini	S	-	-	-	++	++	-	-	N	N	Y	Y	-	NT	Hamilton, 1822			
5	Ostogobiohermes	Notopteridae	<i>Notopterus notopterus</i>	Patola	S	-	-	-	++	++	-	Y	N	Y	Y	-	LC	Pallas, 1769	
6	Synbranchianes	Macrobrachidae	<i>Macrobrachium siamensis</i>	Bami	C	+++	+++	+++	++	+++	+++	N	Y	N	Y	-	LC	Gunther, 1861	
7	Gobiiformes	Gobiidae	<i>Glossogobius giuris</i>	Dhesra	C	+++	++	++	++	+++	+++	Y	Y	N	Y	-	LC	F. Hamilton, 1822	
8	Belontiiformes	Belontiidae	<i>Xenentodon cancila</i>	Sorhiya	S	-	-	-	++	-	-	N	Y	N	N	-	LC	F. Hamilton, 1822	
9	Characiformes	Tetraodonidae	<i>Piaractus brachipomus</i>	Roopchand	S	-	-	-	-	-	++	Y	Y	N	N	-	NE	G. Cuvier, 1818	

PPF - Predatory Food Fish C - Common +R - Rarely found - Not found DD - Data Deficient
 GF - Game Fish S - Scanty - Low abundance Y - Yes NE - Not Evaluated
 LV - Larvivorous Fish R - Rare ++ - Medium abundance N - No LC - Least Concern VU - Vulnerable
 BT - Bait * - Exotic +++ - Rich in species NT - Near Threatened

The Shannon diversity index of the different sampling sites showed considerable variation and ranged from 2.63 to 3.24. Table (2). Shannon index (H) is the value that combines species diversity and evenness, where >3.99 is considered no impact, 3.00–3.99 slightly impact, 2.00–2.99 moderately impact, and <2.00 severally impact^[10]. Based on this scale, all sites studied are classified as slightly and moderately impacted. The higher diversity index shows the existence of a balance between total species and total individual of every species. The evenness index varied between years 2020–21 (0.77–0.91) and 2021–22 (0.75–0.87), with the highest at site–6 (year 2020–21), and the lowest at 0.75 (site–4, year 2021-22) , 0.77 (site–3, year 2020–21), indicating the frequencies of dominant species present at this site. The species richness in six sampling sites of the district Mungeli showed considerable variation, and the highest richness was recorded in site -3, Aagar River (36 species). The diversity of fish species is high due to the availability of favourable conditions such as sufficient oxygenated water and resources. The second richest site was site -6 (35 species), while lower species richness was recorded at sites -2 (34 species), site -4 (33 species), site -5 (31 species) and site -1 (27 species), respectively. Low species richness at site -1 may also be correlated with low water depth and water scarcity due to low rainfall. The decreased species richness in the sites (site -5, site -4, site -2 and site -6) may be related to the reduction of aquatic vegetation. High fishing intensities were noticed in site -4 and site -5 and this could be the reason for the low species richness.

Table No. 3 Site wise data of species diversity, Shannon diversity index, species richness, evenness.
Year 2020-21

Parameters	Sampling sites					
	Site-1	Site-2	Site-3	Site-4	Site-5	Site-6
Species diversity (Richness)	27	34	36	33	31	35
Abundance (N)	865	759	1060	962	809	2331
Shannon diversity index (H)	2.79	2.92	2.77	3.02	2.81	3.24
Simpson index of diversity (1-D)	0.91	0.90	0.90	0.93	0.90	0.95
Evenness index	0.84	0.82	0.77	0.86	0.81	0.91

Table No. 4 Site wise data of species diversity, Shannon diversity index, species richness, evenness.
Year 2021-22

Parameters	Sampling sites					
	Site-1	Site-2	Site-3	Site-4	Site-5	Site-6
Species diversity (Richness)	27	34	36	33	31	35
Abundance (N)	690	920	1048	1376	1079	2496
Shannon diversity index (H)	2.76	2.82	2.89	2.63	2.65	3.10
Simpson index of diversity (1-D)	0.91	0.90	0.92	0.89	0.89	0.94
Evenness index	0.83	0.80	0.80	0.75	0.77	0.87

Site 1- Rahn river, Site -2 Maniyari river, Site -3 Aagar river, Site- 4 Khudiya dam, Site - 5 Madku dweep, Site- 6 Ponds.

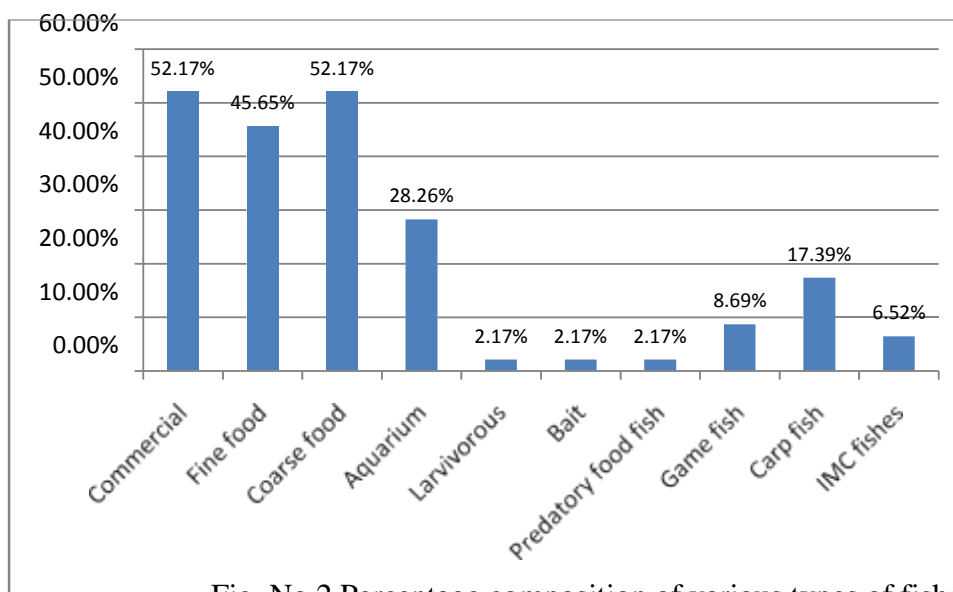


Fig. No.2 Percentage composition of various types of fishes

Table No. 5 – Number and Percentage composition of families, genera and species under various order

Sl.No.	Order	Families	Genera	Species	% of Families in an order	% of Genera in an order	% of Species in an order
1	Cypriniformes	2	20	21	11.1	52.6	45.6
2	Siluriformes	5	7	10	27.7	18.4	21.7
3	Anabantiformes	2	2	4	11.1	5.2	8.6
4	Perciformes	4	4	6	22.2	10.5	13
5	Osteoglossiformes	1	1	1	5.5	2.6	2.1
6	Synbranchiformes	1	1	1	5.5	2.6	2.1
7	Gobiiformes	1	1	1	5.5	2.6	2.1
8	Beloniformes	1	1	1	5.5	2.6	2.1
9	Characiformes	1	1	1	5.5	2.6	2.1
	Total	18	38	46			

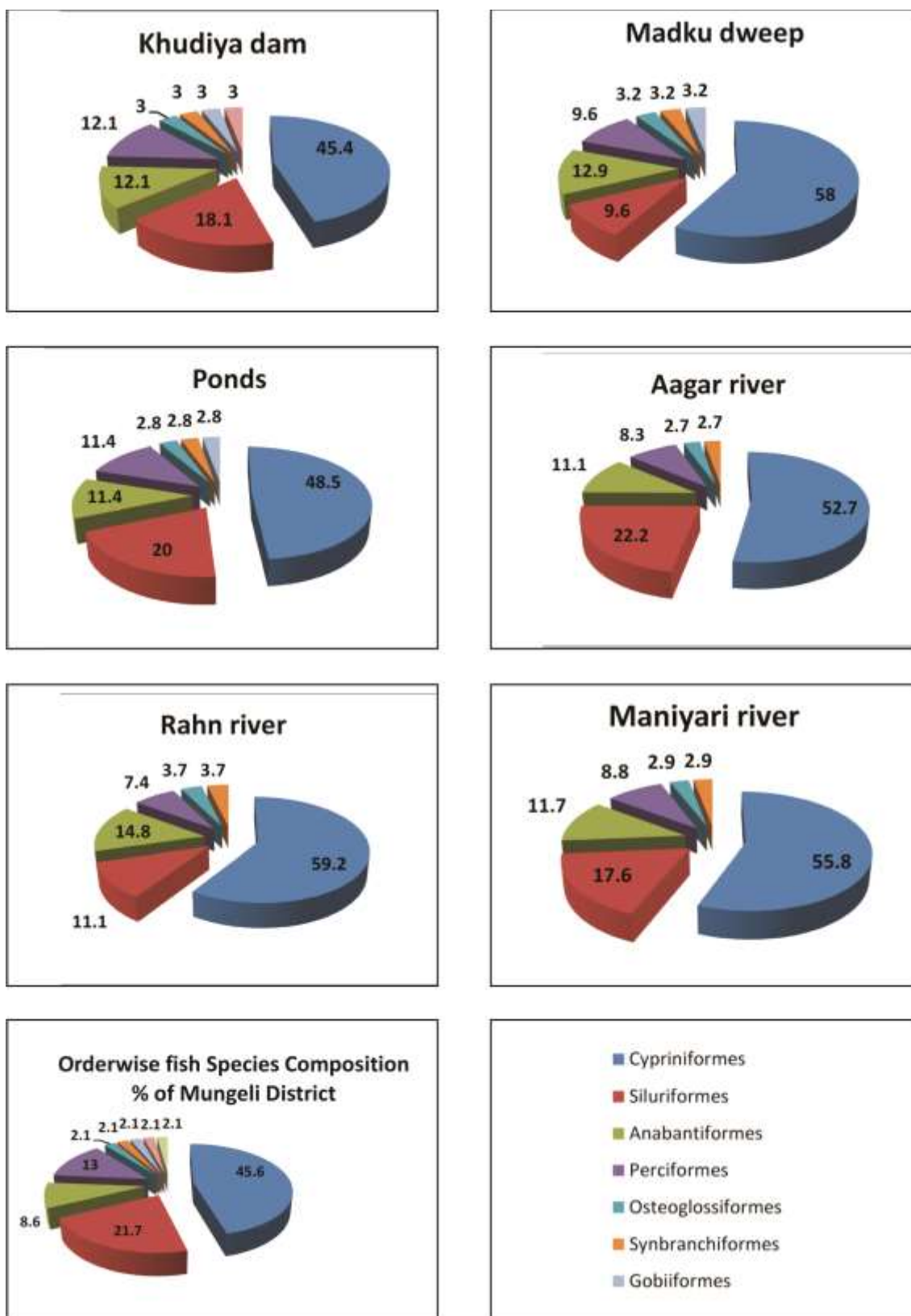


Fig. No. 3 Percentage occurrence of fish orders of Rahn river, Maniyari river, Aagar river, Khudiya dam, Madku dweep (Shivnath river) and Ponds

Distribution

The distribution of fish showed interesting pattern and only 22 species viz. *Labeo rohita*, *Catla catla*, *Osteochilus vittatus*, *Rutilus rutilus*, *Henicorhynchus siamensis*, *Chela untrahi*, *Puntius sophore*, *Barbodes binotatus*, *Amblypharyngodon mola*, *Notropis atherinoides*, *Pethia conchonius*, *Barbonymus gonionotus*, *Mystus tengara*, *Wallago attu*, *Anabas testudineus*, *Channa punctata*, *Channa striata*, *Channa gachua*, *Chanda nama*, *Chanda ranga*, *Macrornathus siamensis*, *Glossogobius giuris*, where found common to all the sites indicating long range of distribution. The distribution of *Capoeta capoeta*, *Sperata aor*, and *Xenentodon cancila* was restricted to the site of the Khudiyia dam. In other hand, the distribution of *Hypophthalmichthys nobilis*, *Oreochromis niloticus*, and *Piaractus brachypomus* was restricted to the ponds.

Conservation

Based on present study, the threat status of the fishes of Mungeli district was categorized into four categories - LC - 76.08%, DD - 4.34%, VU - 6.52%, NE - 8.69% and NT - 4.34%. Increasing pressure on riverine aquatic resources indicate that fish conservation can no longer be treated in isolation and an integrated approach to aquatic resources management is required^[2]. The following are the important factors affecting the diversity of fish - anthropogenic activities, low rainfall, deforestation and siltation, water depth becomes very shallow and discontinuous, exotic species invasion, overfishing, rapid sedimentation, dumping of waste water like sewage, industrial effluents leading to eutrophication, changing land use pattern, land erosion etc. Uncontrolled sand mining and agricultural pesticides have also created a harmful environment for fish life in the river. Through interviewing the local people, it is noticed that some commercial and economically important fishes which are high market value are at present in very threatened condition.

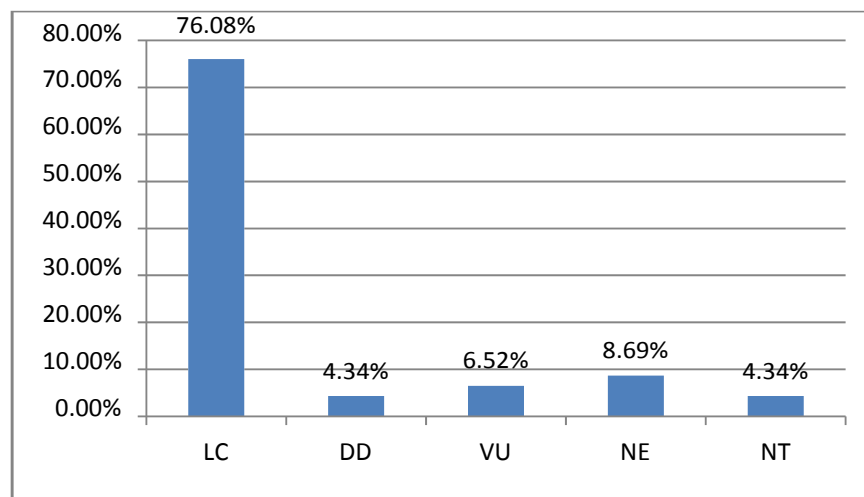


Fig. No. 4 Conservation categorization of fish species.

LC – Least Concern, DD – Data Deficiency, VU – Vulnerable, NE – Not Evaluated, NT – Not Threatened

Conclusion

During the period of investigation (September 2020–21 to August 2021–22), 46 fish species belonging to 18 families and 38 genera were recorded in the Mungeli district. Out of this order, Cypriniformes lead with 20 species of the family Cyprinidae and one species of the family Cobitidae. The decline of fish populations is also marked due to pollution, unconventional methods like poisoning and electric shocks used to kill the fish, urbanization, scarcity of food, shelter, the destruction of habitat, and progressive eutrophication of the water body. The study also revealed that the ponds, rivers, and dams are stressed due to man-made activities, industrial, chemical, and agricultural runoff, and other forms of pollution, including the overexploitation of fish throughout the year. There is a need to raise awareness among the people of the district about conservation of fish, diversity of fish, the importance of ponds, rivers, dams, and islands, fish productivity, and the conservation of rare and endangered fish. This activity can also help raise the social and economic status of the local people.



Fig. No. 5 Diversity of fish in district Mungeli

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