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Freshwater fish diversity from the major Rivers and their tributaries of the Amravati District, including Melghat, Maharashtra: Ecological perspectives

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Abstract
In Maharashtra, the Amravati district is bestowed with major Rivers and their tributaries which supports diverse aquatic biodiversity. The fish species richness has significantly contributed to the biodiversity of the Amravati district's Riverine ecosystem, including the Melghat. The main purpose of the current research was to assess the assemblage structure of fish fauna in the Rivers of the Amravati district, like the Tapi, Wardha, Purna, and their tributaries, like Sapan, Chandrabhaga, Pedhi, Sipna, Gadga, Khapra, Khandu, Dolar, Bembla, and their correlation towards the major water quality parameters, including both biotic and abiotic parameters. Photographic documentation of fish species and important water quality parameters from the sampling zones of Rivers was done for the period of two and half years from December 2022 to June 2025. The results of the current experimental research work evidently showed that the Amravati district's Riverine system offers the natural habitat of 50 fish species. High evenness across all Rivers indicates balanced species distribution, possibly due to sampling method or habitat uniformity. Fish diversity status was assessed by the software PAST (version 3.0). Cyprinidae was the most dominant family, followed by Channidae, Angullidae, Bagridae, Siluridae, Ambassidae, Belonidae, Cichlidae, Clarridae, Cobitidae, Gobiidae, Heteropneustidae, Mastacembelidae, Nemacheilidae, Notopteridae, Pangassidae, Serrasalmidae. Several physico-chemical parameters i.e, pH, water temperature, total dissolved solids (TDS) and dissolved oxygen (D.O.), and aquatic vegetations which plays several role like food, shelter for the fishes subsidized as key significant environmental factors which directly and indirectly influence the diversity, species richness and distribution of fish population in the Amravati district Riverine ecosystem. Statistical analysis of physico-chemical data from different Rivers revealed significant differences in mean values across Rivers (ANOVA $F = 1200$, $p<0.0001$). These results highlight the distinct water quality profiles of Rivers in the region. Several threats were recorded at the different Rivers which emphasize on the steps to take strong actions for the conservative purpose of the fish diversity and other biota of the Riverine ecosystems. The present research in the Amravati District has provided important insights into the fish diversity and distinctiveness of Riverine ecosystems, with an emphasis on aquatic habitats in consideration with ecological parameters, both biotic and abiotic parameters.

Keywords: Fishes, Tapi River, Wardha River, ecology, physico-chemical parameters, aquatic vegetation

Introduction
India is a mega-diverse nation well known for its biodiversity richness, which is truly reflected in the diversity of marine and freshwater fishes (Gopi, K.C. C *et. al*., 2015) [8].
Fish diversity is often used to measure the health of the biological system of lotic and lentic ecosystems. But habitat loss and environmental degradation cause a rapid decline in biological diversity in aquatic ecosystems, which is a critical challenge to conserve the fish germplasm in natural habitats for the modern era (Malik, D.S. *et. al*., 2015) [20].
Apart from benefits related to food, medicine, other materials, and environmental services supplied by natural ecosystems, there are many more reasons for conserving biodiversity. India has wide ecological and biological diversity and reports about 9.5% of global fish diversity (Trivesh, R. C. S. M, *et. al*., 2022). The potential risks not only affect the biodiversity but also the socio-economic aspects of the human community that depend on the aquatic ecosystem for their sustenance (Kumar, A. B. *et. al.,* 2000) [16].

India is a land of diverse topography, climate, and natural resources. There are 12 major Rivers and 48 lesser Rivers with a total catchment area of 277.6 million ha. Studies on the ecology, environment, and fisheries of five major River systems, in addition to reservoirs and floodplain lake fisheries, have been conducted with greater focus on water quality and less on physical habitat parameters (Ghosh, S.K. *et. al*., 2001) [7].

Aquatic vegetation in the relatively pristine coastal wetlands of eastern Georgian Bay provides critical habitat for a diverse fish community (Midwood, J.D. *et al.*, 2012) [21].

The conservation and management of inland fish and freshwater ecosystems immensely contribute to global sustainable development (Kantharajan, G. *et al.*, 2022) [13]. Concern arises out of the missing elements in current fish habitat research, planning, and management of the resource (Ghosh, S.K. & *et al.* 2001) [7]. Due to a lack of accurate inventories, information on many of the taxa, in particular the freshwater fishes, is inadequate. Though there were some early contributions on freshwater fish fauna, most of these were patchy or restricted to a particular group. These include studies on diversity and distribution (Kumar, M. A. *et. al*., 2016) [17].

The hope for the future is increasing public awareness on the need for better resource management and environmental conservation. In the backdrop of the learning from implementation of the eco-restoration programmes, the task appears to be not only challenging but also demanding in terms of participation of stakeholders, commitment of resources, backup of research support, monitoring of environmental standards, enforcement of regulations and setting up of priorities in terms of conservation of the natural assets (Ghosh, S. K. *et.al*., 2001) [7].

A comprehensive study has been conducted on fish diversity and conservation status, nor has there been consideration of species diversity and the ecological characteristics of the habitat. The objective of this study was to analyze the species composition and diversity of the fish fauna in the Amravti district, and explore the correlation of environmental factors and fish diversity. By quantifying the association between fish species and habitat features, this study contributes to a better understanding of mechanisms structuring fish communities in changing environments.

Materials and methods

Study area

Amravati district lies between (20° 32' and 21° 46' NL) and (76° 37' and 78° 27' EL). It occupies an area of 12,149.7 sq. Km. this district is situated right in the center of the northern border of Maharashtra State. The study was conducted season-wise from the month of December 2022 to June 2025 in the different Rivers of the Amravti district. The study area was major Rivers like the Tapi, Wardha and Purna and their tributaries like the Sipna, Gadga, Khapra, Khandu, Dolar, Sapan Chandrabhaga, Pedhi and Bembla from the Amravati district, including Melghat region. All the Rivers were studied on the basis of actual field investigations.

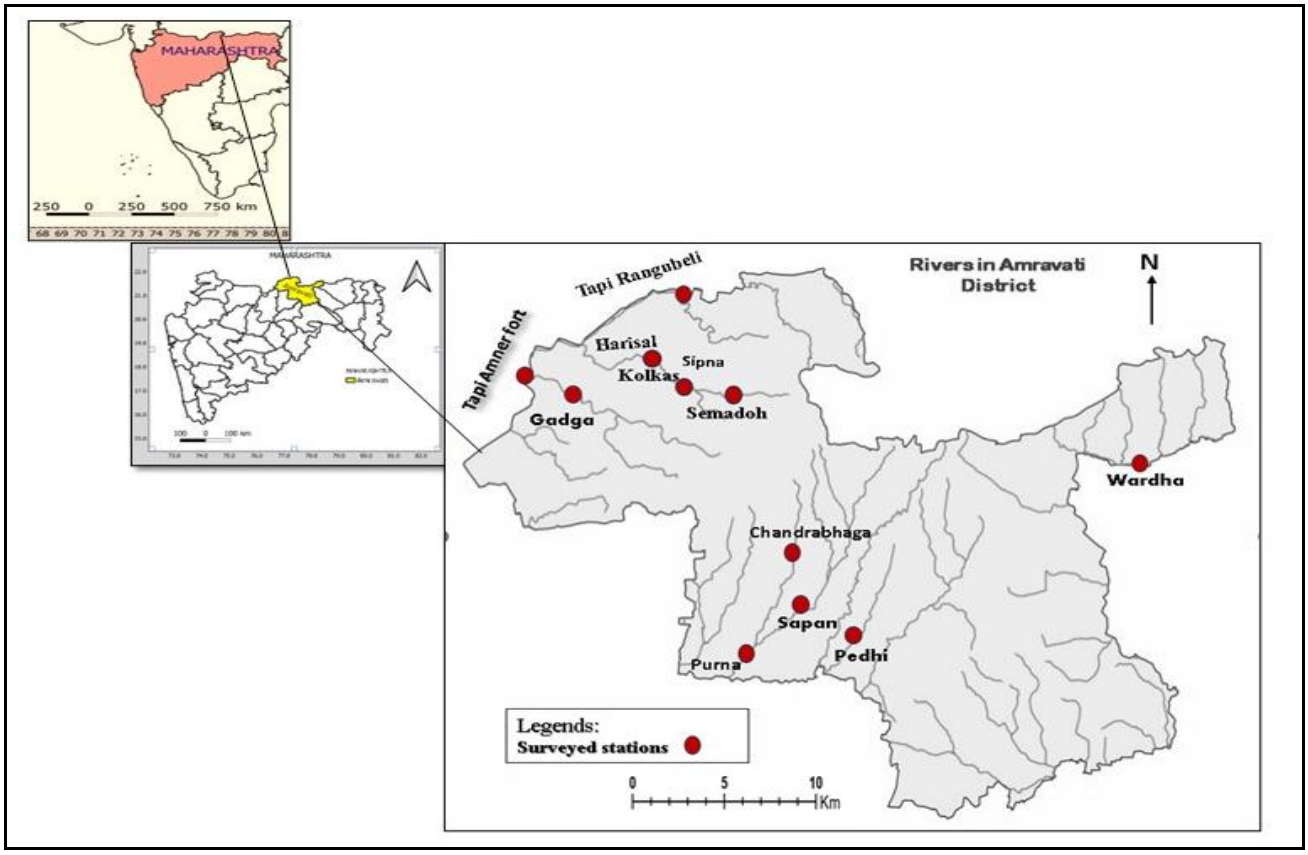

Fig 1: Map showing surveyed stations in the Rivers of the Amravati district, including Melghat

Table 1: Stations covered during the study

Rivers	Surveyed Stations	GPS coordinates
Tapi	Rangubeli	77.14015°N and 21.71775°E
	Amner fort	76.78457°N and 21.52881°E
Sipna	Semadoh	77.31222°N and 21.497444°E
	Kolkas	77.17418°N and 21.50213°E
	Harisal	77.124218°N and 21.523066°E
Gadga	Amner fort	76.78457°N and 21.52881°E
Dolar	Dhakna	77.05934°N and 21.433778 °E
Wardha	Uppar Wardha	78.022228°N and 21.30918°E
Purna	Asegaon Purna	77.569182°N and 21.1267°E
Pedhi	Walgaon	77.70328°N and 20.99899°E
Sapan	Sawali	77.485433°N and 21.310439°E
Chandrabhaga	Wadgaon	77.438672°N and 21.279106°E
Bembla	Bhuikhed	78.014722°N and 20.664186°E

Sampling, data collection and analysis

Sampling and data were collected for two and half years, December 2022-June 2025. Physico-chemical characteristics of water were studied seasonally through standard methods (APHA, 1995) [1], and aquatic vegetation was recorded for the study duration. The fish were collected using secondary data collection from the fishermen available at the River sites and from the fish market. The species-wise numbers were recorded during each sampling. The length and weight were measured for the collected fish. The identification was done using standard identification keys. Care was taken after obtaining the specimens so as not to kill them. Certain ambiguous fish species were brought to the college research laboratory for taxonomic identification and confirmation. The rest were released back into the waters immediately after identification. The collected specimens were preserved in formalin and deposited in the Departmental museum, Department of Zoology, Shri Shivaji Science College, Amravati. During each survey, ecological parameters of the Rivers have been recorded and photographic documentation of aquatic vegetation has been done to obtain the correlation between them and fish. With that, several physico-chemical parameters have been recorded seasonally from the surveyed Rivers to study the quality of the Rivers. The data were processed, and graphs were plotted using the Analytical Package of Microsoft Excel. The diversity indices were carried out using the software PAST.

Results

A total of 50 distinct fish species belonging to 17 distinct families were recorded during the survey, comprehensively conducted in the Rivers of the Amravati district, encompassing the Melghat area, covering its abundance, pattern of occurrence, and IUCN status. The Cyprinidae family was discovered to be the most numerous 27 among these species. Notably, *Oreochromis mossambicus* was listed as Vulnerable (VU). The Tapi River was recorded with a maximum number of 22 species of fish. The Upparwardha reservoir of the Wardha Rivers with 21 species of fish. The Pedhi River has 19 fish species. The Chandrabhaga River with 15 species of fish, Purna and Sapan Rivers with 14 species of fish, and Sipna and Gadga River was found with a record of 12 species of fish. Significant variations in fish populations were found across several Rivers in the research area, according to the statistical analysis using ANOVA. The conventional ANOVA test resulted in a p-value of (2.585×10^{147}), indicating that at least one group mean differs significantly from the others and indicating the existence of unique variances among the fish populations in various Rivers of the Amravati district. 31 fishes belongs to Least concern (LC) category of IUCN status, 9 fishes belongs to the Vulnerable (VU), 2 fishes belongs to the critically endangered (CR), 3 fishes belongs to the near threatened (NT). *Barilius bendelisis, Channa orientalis, Devario equipinnatus, Pangasius pangasius, Rasbora doniconius, Schistura savona, Thynnichthys sandkhol, Tor remadevii, Wallago attu* falls under Vulnerable (VU) category, Tor khudree, Xenentodon cancila falls under category critically endangered (CR) category, *Anguilla bengalensis, Notopterus notopterus, Systomus sarana* falls under category near threatened (NT) category.

The study found considerable seasonal differences in the physicochemical parameters of many Rivers in the Amravati District, demonstrating the influence of both seasonal changes and the particular Rivers on these ecological factors, establishing the basis for the specific results. Data analysis showed significant seasonal and River-specific variations in important variables such as pH, TDS (Total Dissolved Solids), dissolved oxygen (D.O.), and temperature. As the temperature rises in the warmer seasons the pH and D.O. decline, and TDS increases considerably. Statistical analysis of physico-chemical data from different Rivers revealed significant differences in mean values across Rivers (ANOVA $F = 1200$, $p<0.0001$). These results highlight the distinct water quality profiles of Rivers in the region. 22 different vaeities of aquatic vegetations have been listed from the study sites which supports the survival of the fishes.

Several threats were recorded during the survey, such as sand extraction at the Tapi River, Gadga River, Melghat, and at the Purna River, Asegaon. With the immersion of idols at the Pedhi River, Walgaon, last rites at the Gadga River, Melghat, and litter disposal at the Upper Wardha reservoir, Morshi, decreases the quality of water, affecting the fish growth, and some contaminants could lead to bioaccumulation in them. Another human activity, like washing clothes, seasonal crop cultivation, like watermelon and the use of water for irrigation purposes in summer seasons, leads to depletion of the water level in Rivers at the Tapi River, Melghat. Meadow was formed by locals at the shallow dry plains of the Tapi River in the middle of the River for cattle grazing.

Discussion

In Maharashtra, Amravati district affords natural potential for developing inland fisheries as Major Rivers flow through the district, like the Tapi River, Purna River, and Wardha River, and their tributaries afford habitat facilities for fish life and growth. However, the resources afforded by these Rivers are exploited to a beneficial extent (Kuralkar V.S *et al.*, 2024) [18, 19]. In total, 50 species have been reported from the various Rivers studied from the Amravati district including Melghat with a comprehensive study of ecological parameters considering both biotic factors like aquatic vegetation and abiotic parameters like physico-chemical parameters of Rivers like pH, Dissolved oxygen (D.O.), Water temperature, Total dissolved solids (T.D.S.), water flow, etc.

This work builds on prior research by Yadav B.E. (2005) which was within the area by reporting a remarkable 96 species belonging to 52 genera and 19 families within the Melghat landscape. Wankhade V. R. (2015) [25] documented 36 species from 11 different groups within the Amravati district, respectively. The research done by the Western Regional Centre of the Zoological Survey of India (ZSI) in Pune has significantly contributed to growing awareness of the aquatic life in the area. In this larger setting, this research added a novel species to the ichthyofauna of the Amravati District, the Olive barb (*Systomas sarana*) locally known as Doddhad by the Melghat tribal people and found in the Tapi River.

According to FishBase data from June 2024, Australia has the highest fish diversity with 5,214 species 400 freshwater, followed by Indonesia 5041 species, 1292 freshwater, Brazil 4,967 species, 3668 freshwater, Japan 4322 species, 322 freshwater, China 3850 species, 1707 freshwater, the Philippines 3764 species, 362 freshwater, Taiwan 3166 species, 190 freshwater, the United States 3140 species, 993 freshwater, Papua New Guinea 2991 species, 367 freshwater, and India in 10th place with 2,904 species 1081 freshwater (Sreeraj, C. R., *et al.* 2025) [24]. A total of 22 new species were recorded that were previously not reported in the area, totaling 50 species across 17 families from several Rivers within the Amravati district. This shows a changing aquatic biodiversity that calls for more investigation. One more significant result has been recorded from the Wardha River in which Red bellied piranha (*Pygocentrus nattereri*) has the noticeable feature of dentition which is a exotic species. Such a type of research based on the fish diversity in the Amravati district with ecological parameters, considering both biotic and abiotic parameters and threats considerations, has been done for the first time in the Amravati district.

The ichthyofaunal diversity of the important Indian Rivers such as Ganga, Brahmaputra, Mahanadi, Godavari, Krishna, Cauvery, Tapti, Narmada, Yamuna reported with 126 fishes, 148 fishes, 104 fishes, 131 fishes, 146 fishes, 29 fishes, 78 fishes, 143 fishes respectively (Koushlesh, S. M. N. S. K *et al.*2021) [15]. This research has centered on the idea of the pattern of distribution of fish, which refers to species that are exclusive to a particular River. The study carried out thorough biological habitat studies, paying special attention to the physicochemical properties of the Rivers, which were examined seasonally, to support our fish diversity findings. By examining the difference between the physicochemical properties such as pH, temperature, dissolved oxygen, total dissolved solids, and other details of the habitat, we can gain essential information that supports the assertion that some fishes are specific to their distinct Rivers. This research highlights the dynamic character of Riverine ecosystems and the need for continued studies to track and explore the fish diversity in the Rivers and protect the distinctive biodiversity of the Amravati district. Aquatic vegetation supports fish for their survival and existence. Ecological insights of the Wardha, Tapi, Chandrabhaga, and Pedhi are ecologically healthier Rivers, showing high diversity and low dominance. Sipna and Gadga may be under ecological stress, indicated by low richness and high dominance. High evenness across all Rivers indicates balanced species distribution, possibly due to sampling method or habitat uniformity. Aquatic vegetations were found at the Tapi River, Sipna River, Gadga River, Pedhi River, and the Chandrabhaga River. They play a very important role, like habitat and shelter, breeding grounds, food source, oxygen production, and enhancing water quality.

India's ichthyofauna faces numerous threats and challenges that significantly impact the health of aquatic ecosystems. These challenges stem from both anthropogenic activities and environmental changes, which collectively threaten the sustainability of fish populations and the overall biodiversity, especially of freshwater habitats. One of the primary threats to freshwater fish diversity in India is habitat destruction due to urbanization, industrialization, and agricultural expansion (Sreeraj, C. R. *et. al*., 2025) [24]. Several threats were reported at the study sites, which gives strong emphasis on the conservation of the Riverine ecosystems.

Conclusion

The importance of comprehensive and multifaceted approaches like the study of ecological parameters about fish diversity and related threats to the study of Riverine ecosystems, is emphasized by our research. The diversity of fish in various Rivers of the Amravati district, including Melghat in support of the seasonal physicochemical parameters and biotic parameters like aquatic vegetations, unrevealed the potential of the particular Rivers. Various threats like washing clothes, sand extraction, field formation, immersion of idols, etc, emphasize the need for the conservation of the Riverine ecosystems. The results of our study highlight the value of ongoing investigation and observation to preserve and safeguard the unique fish biodiversity of the Amravati District, including the protected regions like Melghat. The consistent and extensive study will help in the exploration of unreported fish biodiversity of the Amravati district, including the Melghat forest. By showing the existence of a variety of fish species that are only found in certain Rivers in the Amravati region. The findings emphasize the need for local conservation programs and the preservation of these distinctive aquatic habitats.

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Table 2: Showing the occurrence of fish in different Rivers of the Amravati district

Family	Scientific name	TA	GA	SI	WA	PU	SA	CH	PE
Angullidae (2)	*Anguilla bengalensis*	+	-	+	+	+	-	-	-
	Macrognathus pancalus	+	+	-	+	-	+	-	-
Cyprinidae (27)	*Ariza labeo*	-	-	-	+	-	+	+	+
	Amblypharyngodonmola	-	+	+	-	-	-	-	+
	*Barbus barbus**	+	-	-	-	-	-	-	-
	*Barilius bendelisis**	+	-	-	-	-	-	-	-
	*Cirrhinus cirrhosus**	+	-	-	-	+	-	+	-
	Ctenopharyngodon idella	+	+	-	-	-	-	-	-
	Cyprinus carpio	+	-	-	-	-	-	+	+
	*Devario aequipinnatus**	-	-	-	-	+	-	-	-
	Garra mullya	+	-	-	-	-	-	-	-
	*Hypophthalmichthysmolitrix**	-	-	+	-	+	-	+	-
	Labeo boggut	-	-	-	+	-	+	+	-
	Labeo catla	+	-	+	+	-	+	+	-
	Labeo calbasu	-	+	+	-	+	+		+
	Labeo rohita	+	-	+	+	-	+	+	+
	Labeo bata	+	+	+	+	+	-	-	-
	Pethia ticto	-	+	-	-	+	+	+	+
	Puntius sophore	-	-	-	+	+	-	-	-
	*Puntius stigma**	+	+	+	-	-	+	+	+
	*Puntius conchonius**	+	+	+	-	-	-	+	+
	Rasbora doniconius	-	-	-	-	+	-	+	-
	*Systomus sarana**	+	-	-	-	-	-	+	+
	Salmostoma bacaila	+	+	+	-	-	-	+	+
	*Thynnichthys sandkhol**	+	-	+	+	-	+	+	+
	*Tor khudree**	-	+	-	-	-	-	-	-
	*Tor remadevii**	+	-	-	-	-	-	-	-
	Cirrhina mrigala	+	+	+	-	-	-	-	+
	Salmophasia balooki	-	-	-	-	-	+	+	-
Channidae (5)	*Channa punctatus*	-	-	-	-	-	-	-	-
	*Channa marulius**	-	-	-	-	-	-	-	+
	Channa striata	-	-	-	-	-	-	+	+
	*Channa gachua**	-	-	-	-	+	+	+	-
	Channa Orientalis	+	+	-	-	-	+	-	-
Bagridae (2)	*Mystus bleekeri**	-	-	-	-	+	-	-	+
	Mystus cavasius	-	-	-	+	-	-	-	-
Siluridae (2)	*Wallago attu*	+	-	-	+	-	-	-	-
	Ompok bimaculatus	-	-	-	-	+	-	-	-
Ambassidae (1)	*Parambassis ranga*	-	-	-	+	-	-	-	-
Belonidae (1)	*Xenentodon cancila*	-	-	-	+	-	-	-	-
Cichlidae (1)	*Oreochromis mossambius**	-	-	-	+	-	-	-	-
Clarridae (1)	*Clarius batratus*	-	-	-	-	+	-	-	+
Cobitidae (1)	*Lepidocephalichthysguntea**	-	-	-	-	-	-	+	-
Gobiidae (1)	*Glossogobius giuris*	+	-	-	+	-	-	-	-
Heteropneustidae (1)	*Heteropneustes fossilis*	-	-	-	+	-	-	-	-
Mastacembelidae(1)	*Mastacembelus armatus*	+	-	-	+	-	+	+	+
Nemacheilidae (1)	*Schistura savona**	-	-	-	+	-	+	+	+
Notopteridae (1)	*Notopterus notopterus*	-	-	-	+	-	-	-	+
Pangassidae (1)	*Pangasius pangasius**	-	-	-	+	+	-	-	-
Serrasalmidae (1)	*Pygocentrus nattereri**	-	-	-	+	-	-	-	-

(+) sign indicates presence of fish and (-) sign indicates absence of fish in River (*)- indicates new records to the Amravati district

Table 3: Diversity indices of different fishes recorded during the survey in study area

Rivers	Taxa S	Individuals	Dominance D	Simpson1 -D	Shannon_ H	E Ven Evenness H/S
TA	22	22	0.08333	0.9167	2.485	1
WA	21	21	0.09091	0.9091	2.398	1
PE	19	19	0.05882	0.9412	2.833	1
CH	15	15	0.08333	0.9167	2.485	1
PU	14	14	0.1	0.9	2.303	1
SA	14	14	0.1667	0.8333	1.792	1
SI	12	12	0.5	0.5	0.6931	1
GA	12	12	0.5	0.5	0.6931	1

Abbreviations- TA-Tapi, WA-Wardha, PE-Pedhi, CH-Chandrabhaga, PU-Purna, SA- Sapan, SI-Sipna, GA-Gadga

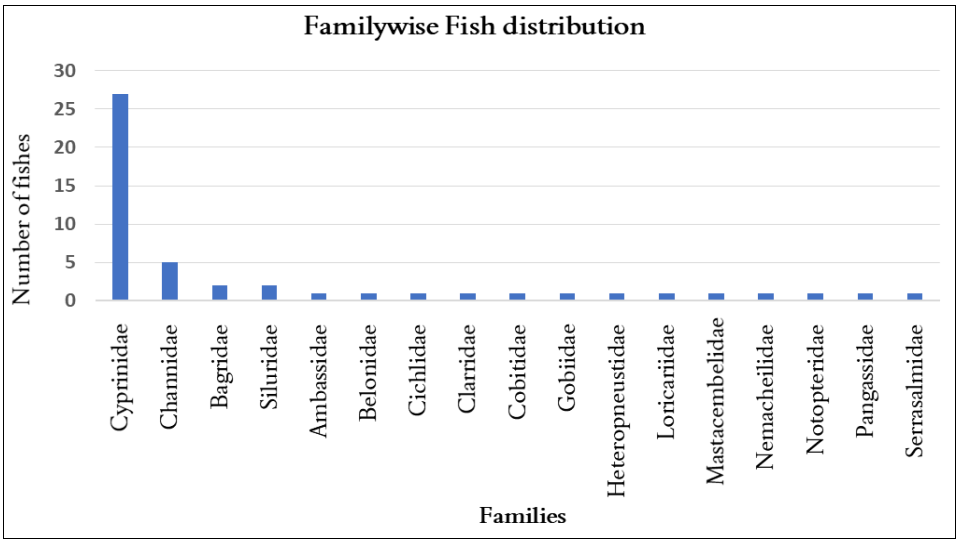


Fig 2: Graph showing number of different families of fishes recorded

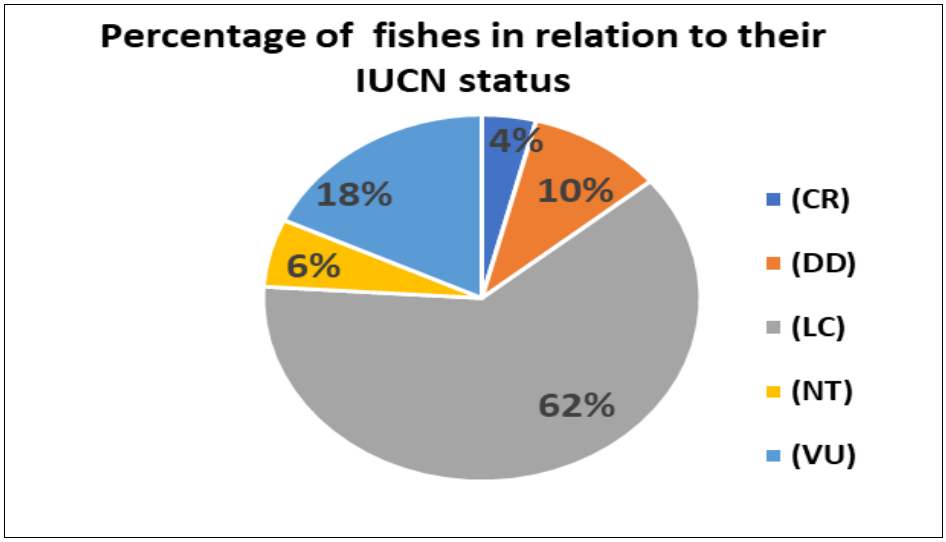


Fig 3: Abbreviations: LC-Least concern, CR- Critically endangered, VU-Vulnerable, NT- Near threatened, DD- Data deficient

Abbreviations: LC-Least concern, CR- Critically endangered, VU-Vulnerable, NT- Near threatened, DD- Data deficient

Table 4: Seasonal variations in physico-chemical parameters in different Rivers during the survey period

Tapi	2022-23	S	7.4	250	6	33.8
		M	7.2	220	8	29.8
		W	8.4	220	7	19.8
	2023-24	S	7.4	255	6	34.4
		M	7.3	220	7	30.2
		W	7.2	220	7	20.9
	2024-25	S	7.3	250	6	32.9
		M	7.2	230	8	30.1
		W	7.1	230	7	22.3
Gadga	2022-23	S	7.1	240	5	36.7
		M	7.4	200	7	28.2
		W	8.75	250	10	24.4
	2023-24	S	7.3	220	6	35.6
		M	7.4	230	7	30.5
		W	8.3	235	9	31.4
	2024-25	S	7.2	218	7	38.7
		M	7.9	235	8	32.2
		W	8.2	242	10	31.4
Sipna	2022-23	S	7.2	250	7	33.0
		M	7.4	230	8	29.9
		W	8.1	230	8	21.0
	2023-24	S	7.3	250	7	35.0
		M	7.5	230	8	31.2

		W	8.1	215	8	31.1
	2024-25	S	7.1	246	7	38.5
		M	7.5	238	8	32.1
		W	7.9	235	9	29.6
Wardha	2022-23	S	7.5	145	7	30.5
		M	8.9	137	8	29.1
		W	9.1	145	9	22.4
	2023-24	S	7.3	170	8	38.3
		M	8.2	155	8	31.6
		W	8.9	150	9	34.2
	2024-25	S	7.2	180	7	39.4
		M	8.4	158	8	32.4
		W	8.7	160	8	32.1
Purna	2022-23	S	7.4	123	7	34.0
		M	9.2	190	8	30.2
		W	8.8	210	10	19.7
	2023-24	S	7.2	210	8	38.0
		M	8.7	230	9	33.2
		W	8.4	230	10	28.3
	2024-25	S	7.4	200	8	40.1
		M	8.5	215	8	38.2
		W	8.6	220	9	33.3
Sapan	2022-23	S	6.1	112	6	33
		M	8.92	110	5	29.2
		W	10.7	117	11	27.5
	2023-24	S	6.5	120	7	39.9
		M	8.6	140	9	33.8
		W	9.8	150	10	32.1
	2024-25	S	7.2	150	8	38.7
		M	8.8	180	9	35.8
		W	9.2	200	9	31.8
Chandrabhaga	2022-23	S	7.2	190	6	32.2
		M	8.19	201	7	31.2
		W	9.24	200	10	27.5
	2023-24	S	7.1	200	7	39.7
		M	8.7	210	8	32.7
		W	9.2	220	9	31.9
	2024-25	S	7.2	210	7	41.2
		M	8.8	225	7	32.8
		W	9.2	230	8	28.0
Pedhi	2022-23	S	7.2	270	7	32.1
		M	8.6	261	8	29.1
		W	8.4	133	9	29.8
	2023-24	S	7.3	220	8	35.8
		M	8.5	240	8	33.2
		W	8.5	250	9	28.4
	2024-25	S	7.4	230	7	39.4
		M	8.1	235	8	34.4
		W	8.9	240	8	32.8

TDS-Total dissolved solids, D.O.- Dissolved oxygen, Temp.- Temperature S-Summer, M-Monsoon, W-Winter

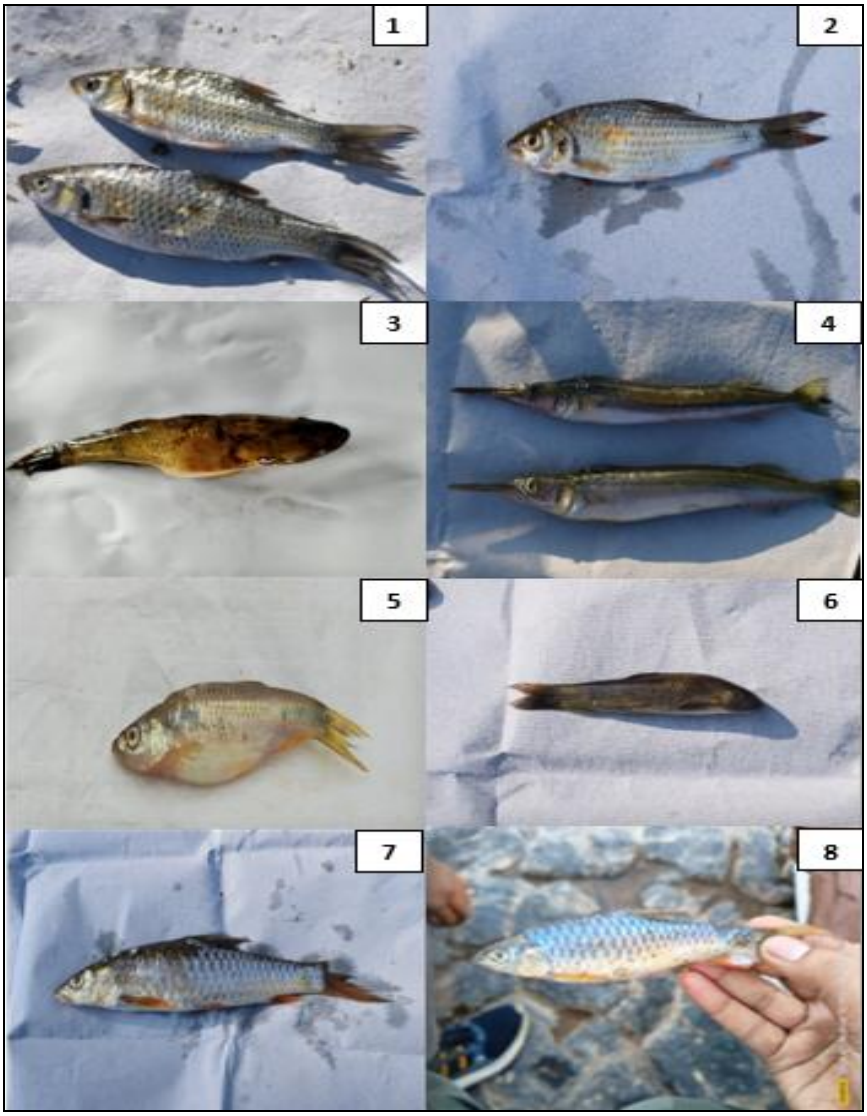
Table 5: Results of the ANOVA test for the Physico-chemical parameters for different Rivers

Source	SS (Sum of Squares)	df	MS (Mean Square)	F	p-value
Between groups	1,634,280	3	544,760	1200	2.585×10^{-147}
Within groups	112,547	248	453.818	-	-
Total	1,746,827	251	-	-	-

Table 6: List of aquatic vegetations recorded during the survey in Rivers of the study area

Scientific name	Common name
Azolla	Water fern
Azolla pinnata	Mosquito fern
Ceratophyllum submersum	Hornwort
Chara	Stonewort
Cyperus difformis	Dwarf umbrella
Eichhornia crassipes	Water hyacinth
Heteranthera dubia	Water stargrass
Hydrilla verticillata	Hydrilla
Hygrophila costator	Glush weed
Ipomea Carnea	Bush Morning Glory

Lemna minor	Common duckweed
lphragmites karka	Wild reed
Ludwigia palustris	Water purslane
Lythrum hyssopifolia	Grass-poly
Microcystis	Water bloom-forming cyanobacteria
Myriophyllum spicatum	Eurasian watermilfoil
Pistia stratiotes	Water lettuce
Potamogeton crispus	Curly-leaf pondweed
Psammophiliella muralis	Cushion baby's-breath
Scirpoides	Roundhead Bulrush
Senna uniflora	Wild reed
Tridax procumbens	Coatbuttons
Typha angustifolia	Narrow-leaf cattail
Typha latifolia	Broad-leaf cattail
Typha species	Bulrush
Urtica dioica	Stinging nettle
Vallisneria spiralis	Tape grass
Wolffia globosa	Watermeal



1) *Barbus barbus 2) Systomus sarana 3) Glossogobius giuris 4) Xenentodon cancila 5) Rasbora doniconius 6) Barilius bendelisis 7) Tor remadevii 8) Tor khudree*

Photoplate 1: Photographic documentation of significant fishes recorded during the survey

1)Ceratophyllum submersum 2) Chara 3) Microcystis 4) Azolla 5) Scirpoides 6) Heteranthera dubia 7) Typha 8) Lythrum hyssopifolia

Photoplate 2: Photographic documentation of some aquatic vegetation recorded during the survey

Abbreviations- 1) Immersion of idols 2) Seasonal crops 3) Meadow formation 4) Use of water for irrigation 5) Litter and sewage 6) Last rites practices

Photoplate 3: Threats recorded during the study

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