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Diversity and Threats of Freshwater Fishes of Yerla River, Northern Western Ghats, Maharashtra, India

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ABSTRACT
The fish fauna of the Yerla River in the Sangli district was studied from 2021 to 2024 to create a comprehensive checklist and identify the significant anthropogenic threats to the river's fish species. Twelve species belonging to two orders, five families, and eight genera were recorded. Cypriniformes was the most dominant order, comprising eight species, followed by Siluriformes with four species. Notably, three of these species are endemic to the Western Ghats, and one is endemic to the Krishna River System. According to the IUCN Red List of Threatened Species, nine species were categorized as Least Concern, two as Endangered, and one as Vulnerable. The fish fauna of the river faces threats from the presence of exotic species such as *Pterygoplichthys pardalis* and *Pangasianodon hypophthalmus* at various sites along the Yerla River, as well as from anthropogenic activities that include the release of agricultural effluents, domestic organic waste, and non-degradable plastic materials due to tourism. This small study area is home to four endemic and three threatened species, making the Yerla River an important habitat for conserving these endemic and endangered fish species.

Key words: Fish diversity, Endemics, Threats, Conservation, Yerla River

INTRODUCTION

The Western Ghats of India is recognized as one of the eight "hotspots" of biological diversity in the world (Myers et al. 2000). This region exhibits a high level of endemism, encompassing 320 species from 11 orders, 35 families, and 112 genera (Dahanukar and Raghavan 2013a). The Krishna River, one of the major perennial rivers in western Maharashtra, originates in the Western Ghats. Key tributaries of the Krishna River include the Wenna, Urmodi, Tarli, Koyna, Yerla, Warana, Panchaganga, Ghataprabha, Malaprabha, Bhima, Tungabhadra, and Musi (Das et al. 2017). In recent years, there has been growing interest in studying the phylogeny and taxonomy of freshwater fishes (Jayaram 2010). Extensive information regarding the diversity, density, threats, and conservation of the freshwater fish fauna in the Krishna River system has been compiled (Arunachalam et al. 2002, Kharat et al. 2003, Dahanukar et al. 2004, Chandanshive et al. 2007, Sarwade and Khillare 2010, Jadhav et al. 2011, Dahanukar et al. 2012, Kharat et al. 2012, Kumbar et al. 2021). Historically, Annandale (1919) studied the fish fauna in Satara district, reporting 18 species in the Yenna River at Medha. Silas (1953) explored the fish fauna of Mahabaleshwar and Wai within Satara district, recording 14 species. Later, Kharat et al. (2012) provided an updated checklist of the fish fauna in the Krishna River at the Wai and Dhom reservoirs, with 51 species. Jadhav et al. (2011) also identified 58 fish species in the Koyna River. Kumbar and Lad (2014) documented 13 species of catfish in the Krishna River in Sangli District, while Kumbar et al. (2021) reported the presence of 73 fish species in the same area. Despite these studies, reviews have highlighted a lack of data on the fish fauna of rivers in the Western Ghats, particularly within the tributaries of the Krishna River system (Kharat et al. 2003, 2012, Dahanukar et al. 2011, 2012). Recently, Bhoi-Kamble and Kumbar (2023) documented 58 fish species in the Yerla River, a significant Krishna River tributary. This ongoing study of the Yerla River aims to fill the gap in knowledge regarding the diversity, density, and anthropogenic threats to the freshwater fish fauna in this region. Therefore, the present study will compile a comprehensive checklist of the fish fauna in the Yerla tributary of the Krishna River in western Maharashtra.

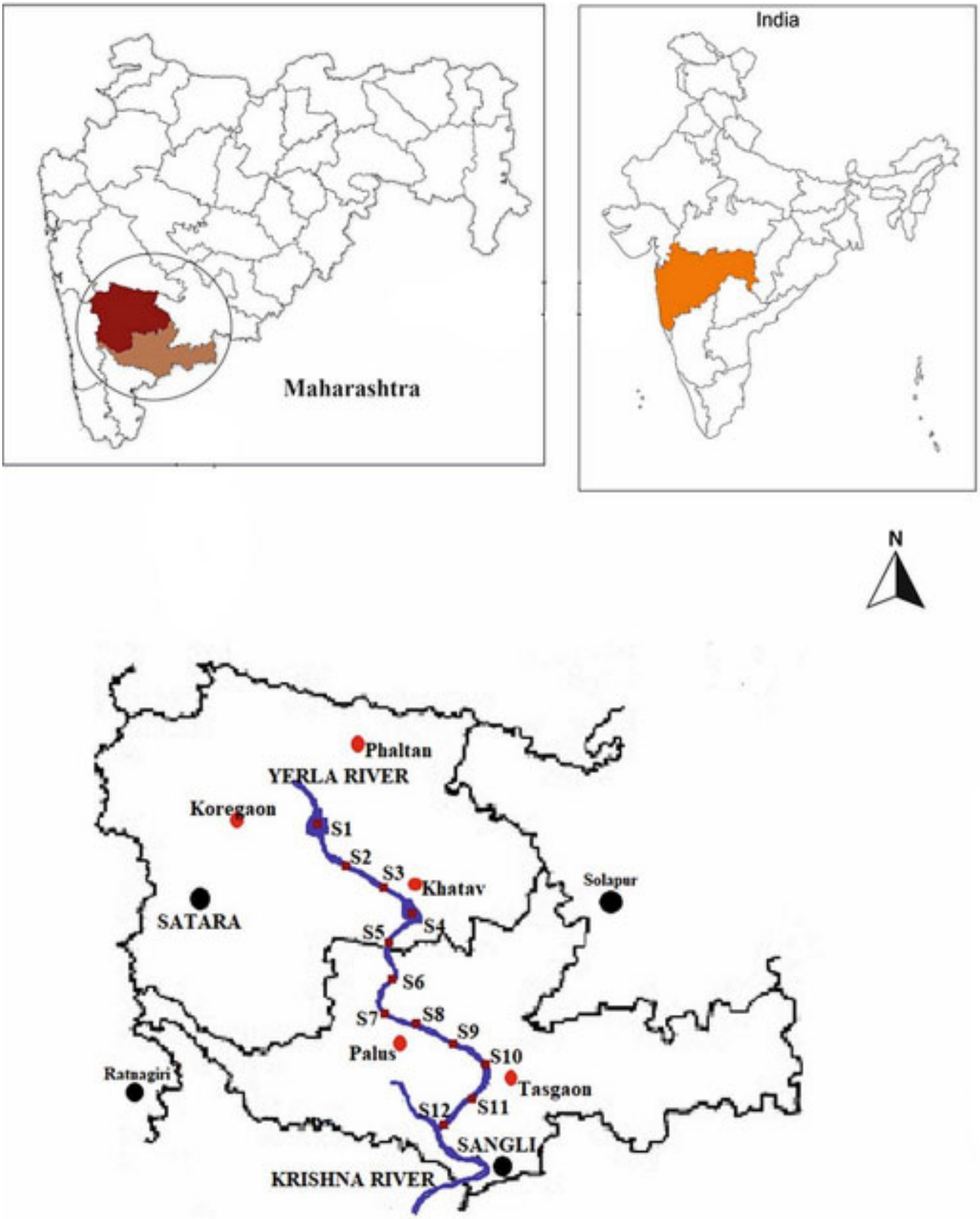

Figure 1. Study area map with sampling sites

MATERIAL AND METHODS

The Yerla River is a tributary of the Krishna River, originating near Manjarwadi village (17.86º N, 74.27º E) on Solakhnath Hill, approximately 29 km north of Vaduj village. The river stretches about 120 km in length (Fig. 1). It flows through the villages of Mol, Diskal, Lalgun, Khatav, Vaduj, Nimsod, and Chitali within the Khatav Tahsil, eventually joining the Krishna River near Bramhanal village. Fish species were collected from 12 sampling sites from 2021 to 2024 (Table 1). The samples were gathered using various methods, including cast nets, gill nets, hand nets, hooks, and lines. The collected specimens were categorized based on the classifications established by Dahanukar et al. (2012): abundant (76-100% of total catch), standard (51-75% of total catch), moderate (26-50% of total catch), and rare (1-25% of total catch). A 4% formalin solution was used to preserve the collected fish. The species identification and labelling were referenced from existing literature (Menon 1987, 1992, Talwar and Jhingran 1991, Jayaram and Das 2000, Jayaram and Sanyal 2003, Jayaram 1991, 2006, 2010). Dr Shrikant Jadhav, Scientist-E at the Freshwater Biology Regional Centre, Zoological Survey of India, Hyderabad, confirmed the identified species. All identified specimens have been deposited at the Department of Zoology, Arts, Commerce, and Science College, Palus, Sangli District, Maharashtra, with accession numbers ZID 59 to 70, following the taxonomic status outlined by Fricke et al. (2023). The Shannon diversity index was calculated using the method established by Shannon and Weaver (1949).

Table 1. Sampling sites on the Yerla River

Code	Sampling sites	GPS locations
S1	Ner Dam	17°44’50.4"N 74°18’24.9"E
S2	Khatgun	17°42’04.2"N 74°20’47.0"E
S3	Wakeshwar	17°36’09.0"N 74°25’14.1"E
S4	Yeralwadi Dam	17°32’03.5"N 74°29’10.7"E
S5	Chitali	17°25’14.3"N 74°29’45.7"E
S6	Tupewadi	17°20’38.8"N 74°28’28.2"E
S7	Vadiye-Raibag	17°16’50.9"N 74°25’57.3"E
S8	Rampur	17°10’42.4"N 74°25’50.3"E
S9	Andhali	17°08’06.7"N 74°28’55.9"E
S10	Turchi	17°04’08.7"N 74°33’15.7"E
S11	Nandre	16°57’19.3"N 74°32’31.4"E
S12	Bramhanal	16°56’25.8"N 74°30’38.4"E

RESULTS

Twelve species spanning two orders, five families, and eight genera were recorded (Fig. 2). Cypriniformes was the most dominant order, comprising eight species, while the Siluriformes order included four species. Notably, three species - *Cirrhinus fulungee, Hypselobarbus kolus*, and *Labeo potail* - are endemic to the Western Ghats, with *C. fulungee* also being endemic to the Krishna River system. According to the IUCN Red List of Threatened Species, nine species were considered least concerned (Fig. 3). In comparison, *L. potail* and *Pangasianodon hypophthalmus* were deemed endangered, and one species, *H. kolus*, was categorized as vulnerable. Of the twelve fish species collected from the Yerla River, one was identified as common, another as abundant, and five were categorized as moderate and rare (Table 2). Shannon diversity index demonstrated considerable variation, ranging from 1.37 to 2.29, which indicates a robust relationship with overall species richness. The S12 (Bramhanal) sampling site exhibited the highest fish diversity (2.29), and lowest (1.37) at the S2 (Khatgun). The fish fauna of the river faces threats from exotic species such as *Pterygoplichthys pardalis* and *P. hypophthalmus*, which are present at various locations along the Yerla River. Additionally, natural factors like the river’s seasonal drying and anthropogenic actions - including the release of agricultural effluents, domestic organic waste, and non-biodegradable plastics due to tourism activities - pose significant challenges.

DISCUSSION

The fish fauna of the Yerla River is under threat from anthropogenic activities, including the release or dumping of agricultural effluents, industrial sewage, and domestic organic waste into specific stretches of the river near the villages of Ner, Turchi, and Bramhanal. Additionally, the over-exploitation of fish through the use of various-sized gill nets and

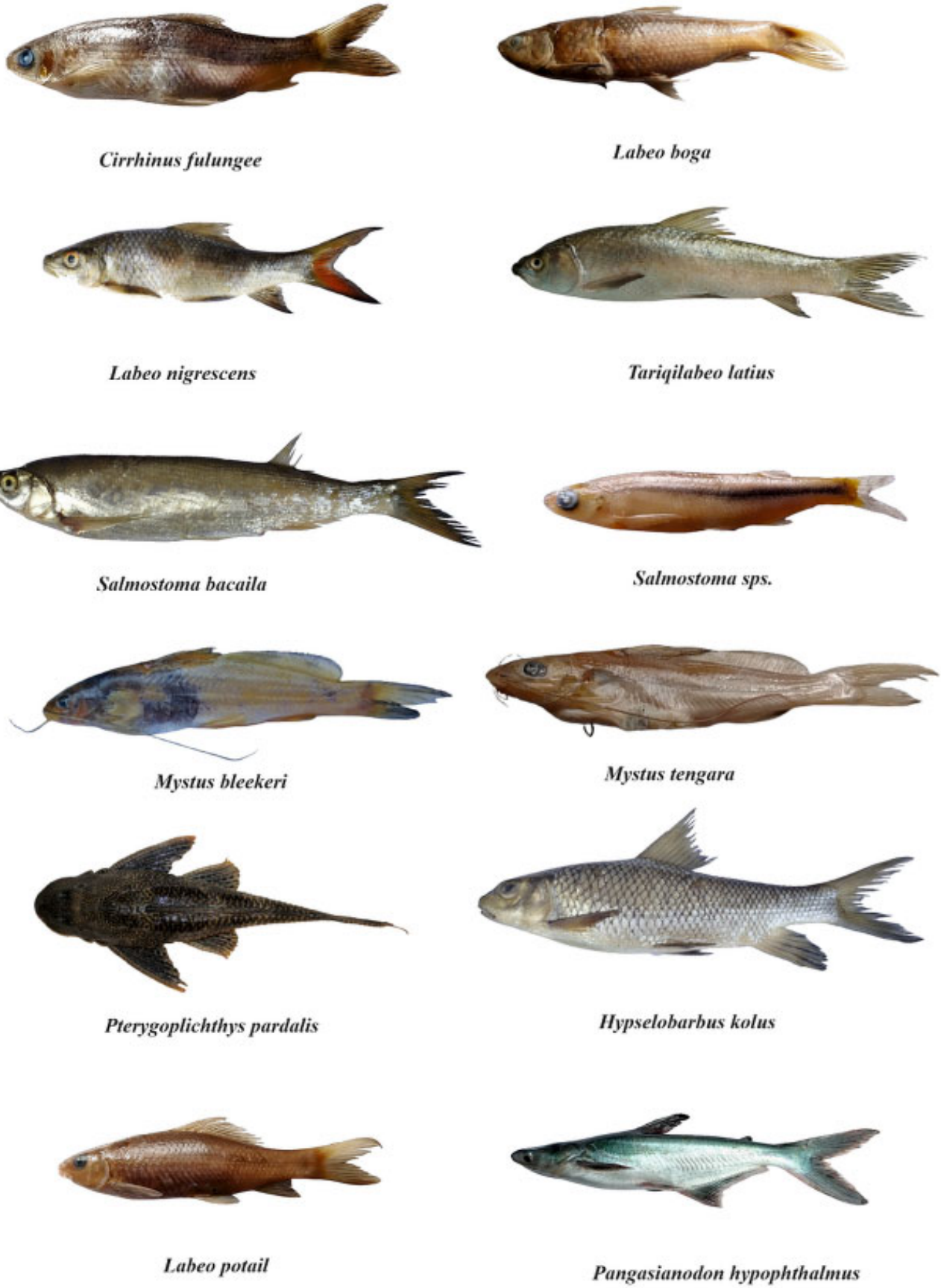

Figure 2. Fish diversity in Yerla River

Table 2. Checklist of freshwater fishes from the Yerla River, Maharashtra

Order	Family	Species	Status	WGE	KRE	IUCN Status
Cypriniformes	Cyprinidae	*Cirrhinus fulungee* (Sykes, 1839)	M	+	+	LC
		Hypselobarbus kolus (Sykes, 1839)	A	+	-	VU
		Labeo boga (Hamilton. 1822)	R	-	-	LC
		Labeo nigrescens (Day, 1870)	R	-	-	LC
		Labeo potail (Sykes, 1839)	M	+	-	EN
		Tariqilabeo latius (Hamilton. 1822)	R	-	-	LC
	Danionidae	*Salmostoma bacaila* (Hamilton, 1822)	C	-	-	LC
		Salmostoma sps.	M			LC
Siluriformes	Bagridae	*Mystus bleekeri* (Day, 1877)	M	-	-	LC
		Mystus tengara (Hamilton, 1822)	M	-	-	LC
	Loricariidae	*Pterygoplichthys pardalis* (Castelnau, 1855)	R	-	-	LC
	Pangasiidae	*Pangasianodon hypophthalmus* (Sauvage, 1878)	R	-	-	EN

Note: A – Abundant, C – Common, M – Moderate, R – Rare, EN – Endangered, LC – Least Concern, VU – Vulnerable, WGE- Western Ghat Endemic, KRE-Krishna River Endemic

Table 3. Summary of variation in fish species abundance, Shannon index

Study sites	Sampling sites											
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Number of species	08	04	07	10	06	09	11	08	10	08	09	11
Total number of individuals	35	25	31	40	30	37	50	35	35	42	40	47
Shannon Index	2.05	1.37	1.85	2.24	1.76	2.04	2.27	2.04	2.22	2.06	2.07	2.29

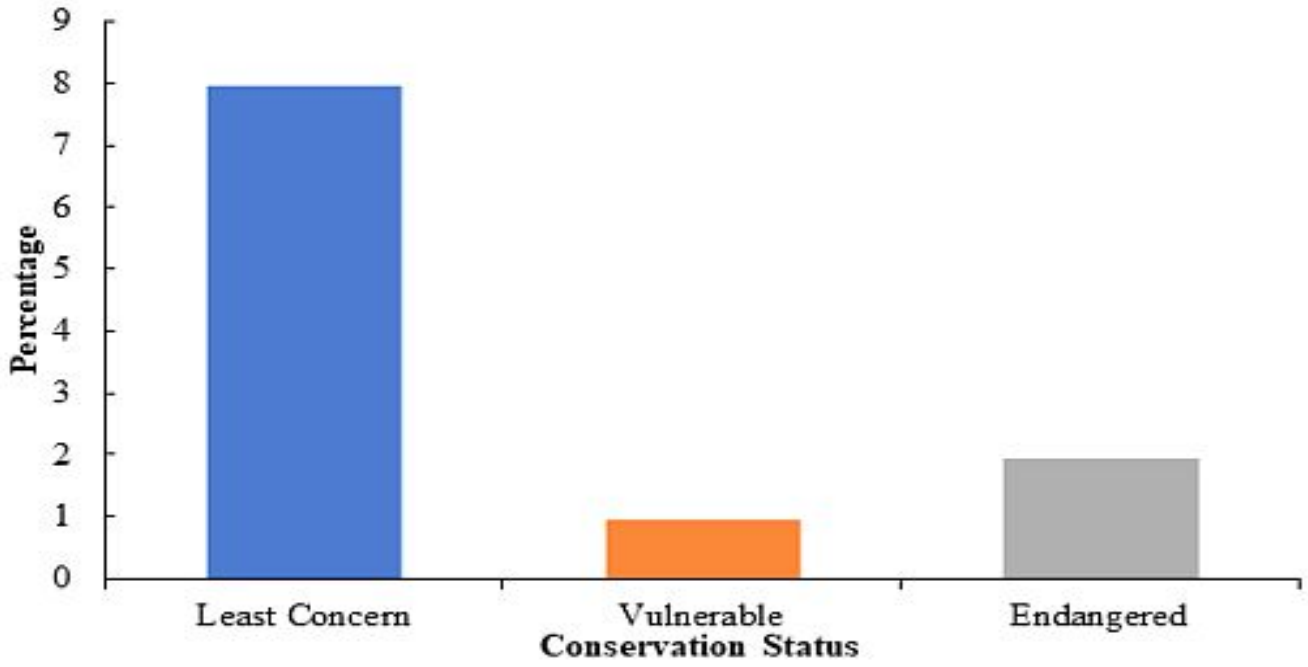

Figure 3. Conservation status (IUCN) of fish fauna

unscientific fishing practices pose significant threats to species of genera such as *Labeo, Cirrhinus, Opsarius, Salmostoma, Hypselobarbus, Mystus,* and *Puntius*. Our previous studies have indicated the presence of eight introduced species in the Yerla River: four transplanted species - *Cirrhinus mrigala, Labeo rohita, L. catla*, and *L. calbasu* - and four invasive species - *Oreochromis mossambicus, Cyprinus carpio, Clarias gariepinus*, and *Ctenopharyngodon idella* (Bhoi-Kamble and Kumbar 2023). These transplanted and invasive species can seriously threaten indigenous fish populations (Kharat et al. 2003, Raghavan et al. 2008, Knight 2010, Kumbar et al. 2021). While studies on the Krishna River in Sangli and nearby areas have documented several alien species (Jayaram 1995), Jadhav et al. (2011) did not find any alien species in the Koyna River, a tributary of the Krishna River. Despite this, the Yerla River supports 15 endemic and four endangered species. The populations of endangered and endemic species such as *Botia striata* and *Puntius fraseri* are declining drastically due to pollution, overfishing for consumption, and competition from introduced carps like *Cirrhinus mrigala, Labeo rohita*, and *L. catla* (Ghate et al. 2002, Kharat et al. 2003, Dahanukar et al. 2012). Similarly, *Hypselobarbus curmuca* has been collected in moderate to small numbers and is assessed as endangered (Dahanukar and Raghavan 2013b). Species such as *L. boga, L. nigrescens, Tariqilabeo latius, Pterygoplichthys pardalis*, and *Pangasianodon hypophthalmus* have been recorded in low numbers. Possible threats to the fish of the Yerla River include overfishing, recreational activities, and river pollution. The decline of Indigenous species such as *Labeo, Cirrhinus, Salmostoma, Hypselobarbus*, and *Mystus* in the Yerla River may be attributed to over-exploitation due to unscientific fishing practices and the presence of exotic species such as *P. pardalis* and *P. hypophthalmus*, along with introduced and invasive species like *C. mrigala, L. rohita, L. catla, L. calbasu, O. mossambicus, C. carpio, C. gariepinus*, and *C. idella* (Bhoi-Kamble and Kumbar 2023). Introducing these species significantly threatens native fish populations (Kharat et al. 2003, Raghavan et al. 2008, Knight 2010, Kumbar et al. 2021, Bhoi-Kamble and Kumbar 2023). Research has shown that species richness, diversity, and abundance tend to increase from upstream to downstream in the Krishna and Panchaganga rivers (Welcomme 1985, Bayley and Li 1994, Lorencio 2000, Patil et al. 2015, Kumbar et al. 2021). The present study demonstrate a similar trend in species richness, with the site at Bramhanal exhibiting higher species richness, diversity, and abundance compared to the middle and upper streams of the Yerla River. Numerous threats impacting the fish assemblage structure of the Krishna River have been observed in the tributaries of the Yerla, including the drying of upper stretches during summer, sand mining, agricultural expansion, and overfishing in many locations. Although the impact of anthropogenic stressors in the Yerla River is less severe compared to other rivers in the district or the tributaries of the Krishna River, the presence of introduced species, as noted in earlier reports, suggests that the presence of eight transplanted. Four exotic fish species (Bhoi-Kamble and Kumbar, 2023) pose a significant risk to indigenous fish. Furthermore, the fish fauna is threatened by the direct release of industrial and agricultural effluents, domestic organic wastes, and non-degradable plastic materials, particularly single-use plastics. If these trends continue, they may lead to habitat loss and a decline in the diverse fish fauna in the Yerla River. Raising awareness among local fishers and communities about reducing pollution and protecting food fish species is essential. The present study results will also be valuable for other researchers studying aquatic life in the Yerla River. Conserving and protecting endemic and threatened species in the Yerla River is crucial.

CONCLUSIONS

In the present study we reported 12 species of fish in Yerla River. Shannon diversity index demonstrated considerable variation, ranging from 1.37 to 2.29. Possible threats recorded include overfishing, recreational activities, and river pollution. It is suggested that conserving and protecting endemic and threatened species in the Yerla River is crucial for sustainable livelihoods of the local fishing community.

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