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An Annotated Checklist of Freshwater Fishes of the Ulhas River, Western Ghats, India: Diversity Patterns, Habitat Associations and Conservation Implications

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ABSTRACT

Background: The freshwater ecosystems of the Western Ghats are recognised as one of India's most biodiverse riverine systems, which are facing escalating threats to their existence.

Methods: This study presents a comprehensive assessment of fish diversity, assemblage structure and conservation status within the freshwater section of the Ulhas River in Maharashtra, India. Ichthyofaunal surveys were conducted at five sites along the river continuum, spanning from June 2024 to November 2025. Experimental fishing and a local fishery-dependent sampling technique were used in the data collection.

Result: A total of 59 fish species, belonging to 11 orders, 21 families and 42 genera, were identified. The most common fish orders and families were Cypriniformes (n = 28), followed by Siluriformes (n = 10), Anabantiformes (n = 5), Cyprinidae (n = 19) and Danionidae (n = 7), respectively. According to the IUCN Red List of Threatened Species, 48 species fall under Least Concern, 4 are Vulnerable, 3 are Data Deficient, 3 are Near Threatened and one is Endangered. Seven exotic species were reported, viz., *Amphilophus trimaculatus*, *Oreochromis mossambicus*, *Oreochromis niloticus*, *Cyprinus carpio*, *Clarias gariepinus*, *Pterygoplichthys pardalis* and *Pangasianodon hypophthalmus*. Spatial variation in species composition was evident, with the highest diversity recorded at S5 (Apati, Ambarnath), likely reflecting greater habitat heterogeneity and reduced anthropogenic pressure.

Key words: Conservation, Diversity, Fish abundance, Fish checklist, Ulhas river.

INTRODUCTION

Globally, approximately 37,189 fish species have been documented, of which 18,948 inhabit freshwater ecosystems (Fricke *et al.,* 2025). In India, an estimated 2,743 fish species are found, of which around 1,072 live in freshwater habitats (Froese and Pauly, 2025). Degradation of riverine ecology and changes in aquatic ecosystems made many fish species vulnerable and threatened (Alam *et al.,* 2013). The Western Ghats of India, recognised as one of the world's biodiversity hotspots (Myers *et al*., 2000), are characterised by exceptionally high endemism, encompassing 320 fish species belonging to 11 orders, 35 families and 112 genera (Dahanukar and Raghavan, 2013). Biodiversity in freshwater ecosystems is declining faster than in terrestrial or marine systems, raising serious concern (Postel and Richter, 2012). Recent assessments indicate that nearly 24% of freshwater species are at a high risk of extinction, primarily due to pollution, dam construction, water abstraction, agricultural intensification and the presence of alien species (Sayer *et al.,* 2025). Anthropogenic pressures further aggravate biodiversity loss, decline in fish populations and other declines in aquatic biota within riverine ecosystems (Angeler *et al.,* 2014). The Western Ghats ecosystem is considerably fragmented and faces numerous threats, viz., mining, industrial agriculture, persistent deforestation, poaching, human-wildlife conflict, artificial obstacles (such as dams and check dams), rapid urbanisation, overpopulation and tourism (Durairaja *et al.,* 2022).

A large number of endemic species necessitates in-depth research into both biotic and abiotic factors, which may influence species assemblages, community structure

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and diversity in lotic environments (Minns, 1989). Variability in abiotic factors such as flow, depth, substrate and water quality, as well as various physicochemical parameters, can considerably alter both the fish assemblage structure and resource availability in freshwater ecosystems (Johnson *et al.,* 2012). Ulhas River, a west-flowing river originating from the northern valleys of the Rajmachi hills in the Raigad district of Maharashtra, drains the northern slopes of the Western Ghats, covers an area of approximately 4,390 km² river basin, extending across the districts of Thane, Raigad and Pune, with the river flowing for nearly 122 km before discharging into the Arabian Sea near Thane and Vasai Creek (Doke, 2019).

Several studies have documented ichthyofaunal diversity in river systems of the Western Ghats. Jadhav *et al.* (2011) recorded 58 fish species from the Koyna River at Koynanagar and Patan. Mohite and Samant (2013) studied the fauna of the Warna River and recorded 42 species. Similarly, Wagh and Ghate (2002) studied the Mula and Mutha River, which recorded 62 fish species. Katwate *et al.* (2012) conducted an extensive study along the Raigad district, recording 66 fish species across six rivers. Kumbar *et al.* (2021) studied the Krishna River in Sangli District, Maharashtra and recorded 73 fish species. Furthermore, limited studies have been carried out, focusing on the estuarine section of the Ulhas River (Rathod and Patil, 2017; Lal *et al.,* 2020). The ichthyofaunal diversity of the Ulhas River has not been comprehensively studied to date; in this context, we provide a comprehensive checklist of the fish fauna, encompassing its freshwater stretch in the Western Ghats, Maharashtra.

MATERIALS AND METHODS

Seasonal fish surveys and diversity assessment were conducted in the freshwater stretch of Ulhas River (excluding tidal influence zone) from June 2024 to November 2025, covering the monsoon, post-monsoon and pre-monsoon seasons (Fig 1). Fish samples were collected fortnightly from five sampling sites along the river continuum: Kondhewadi (S1), Tamnath (S2), Karjat (S3), Neral (S4) and Apati weir (Ambernath) (S5). Site selection was based on local fisher perception and consideration of habitat variability.

Experimental fishing was conducted using various gears, including cast nets and gill nets of different mesh sizes (10, 20, 30 and 50 mm), to capture fish of different species and size classes for a soaking period of 6-8 hours. Loaches and small-sized *Puntius* species were captured using traditional methods, *viz*., gamcha and mosquito nets. The scooping method, specifically targeting these species, is carried out by identifying fish-congregated areas for approximately 2 hours. In addition to experimental sampling, fish markets (Karjat, Neral, Vangani, Ambernath and Badlapur) associated with specific river stretches were surveyed to supplement species occurrence records and account for locally exploited taxa.

Freshly collected fish specimens were preliminarily identified, photographed using a digital camera and preserved in 10% formalin for detailed laboratory-based taxonomic analysis at ICAR- Central Institute of Fisheries Education, Mumbai. Length and weight of the specimens were measured using a digital vernier calliper (SKADIOO) and an electronic weighing balance (Aczet CY 513c), respectively. Species-level identification was achieved using standard taxonomic keys and online published literature, including Talwar and Jhingran (1991), Vishwanath *et al.* (2009) and Jayaram (2010). Latest nomenclature validity was confirmed using the Catalogue of Fishes (Fricke *et al.,* 2025) and vernacular names from local fishermen.

Conservation status of each species was assessed following the IUCN Red List of Threatened Species (2025). Trophic guild classification for each species was assigned based on information available in FishBase, facilitating functional interpretation of the fish assemblage. Relative

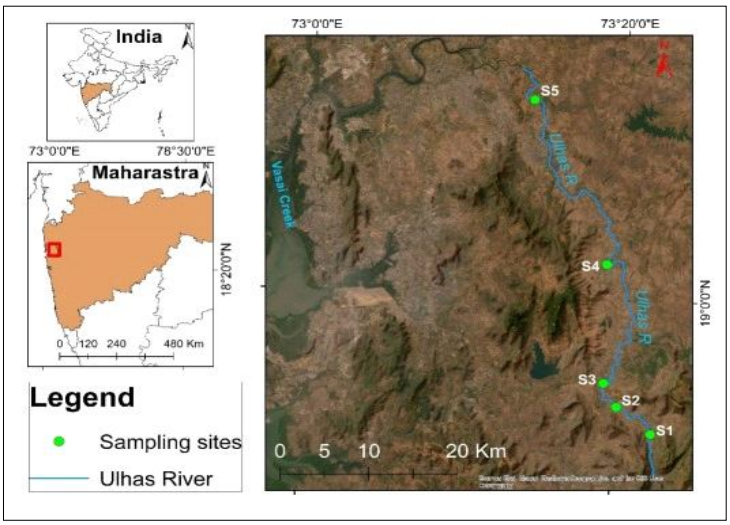


Fig 1: Map depicting sampling sites along the Ulhas River in Maharashtra.

Table 1: The Comprehensive checklist of freshwater fish collected from the Ulhas River, Raigad District, Maharashtra.

Species name	Common name	Vernacular name	IUCN status	Trophic level	Relative abundance (%)				
					S1	S2	S3	S4	S5
Order: Anabantiformes									
Family: Channidae									
1 *Channa gachua* (Hamilton, 1822)	Red seam snakehead	Murrel	LC	3.8	-	R	R	-	-
2 *Channa marulius* (Hamilton, 1822)	Great snakehead	Murrel	LC	4.5	-	-	-	-	VR
3 *Channa punctata* (Bloch 1793)	Spotted snakehead	Murrel	LC	3.8	R	F	C	F	F
4 *Channa striata* (Bloch, 1793)	Striped snakehead	Murrel	LC	3.6	-	-	-	-	VR
Family: Nandidae									
5 *Nandus nandus* (Hamilton 1822)	Gangetic leaffish	Jitada	LC	3.9	-	-	R	R	F
Order: Beloniformes									
Family: Hemiramphidae									
6 *Hyporhamphus limbatus* (Valenciennes, 1847)	Congaturi halfbeak	Ganna	LC	3.1	-	-	-	-	F
Family: Belonidae									
7 *Xenentodon cancila* (Hamilton 1822)	Freshwater garfish	Ganna	LC	3.9	F	F	F	R	VR
Order: Cichliformes									
Family: Cichlidae									
8 *Amphilophus trimaculatus* (Günther, 1867)	Three-spot cichlid	Kal Charu	LC	3.4	-	-	VR	-	-
9 *Oreochromis mossambicus* (Peters 1852)	Mozambique tilapia	Phuntus	VU	2.2	-	-	VR	-	-
10 *Oreochromis niloticus* (Linnaeus, 1758)	Nile tilapia	Phuntus	LC	2	-	-	VC	F	C
11 *Pseudetroplus maculatus* (Bloch, 1795)	Orange chromide	Paplet	LC	2.7	-	-	-	F	F
Order: Cypriniformes									
Family: Cyprinidae									
12 *Bhava vittata* (Day 1865)	Greenstripe barb	Kumbharni	LC	2	-	-	-	-	VR
13 *Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	Mrigal	LC	2.3	-	-	-	-	VR
14 *Cirrhinus reba* (Hamilton, 1822)	Reba carp	Arja, Lal pari	LC	2.5	-	-	-	-	VR
15 *Cyprinus carpio* Linnaeus, 1758	Common carp	Kumbhar bachhi	VU	3.1	-	-	-	-	VR
16 *Dawkinsia filamentosa* (Valenciennes 1844)	Blackspot barb	Kumbharni	LC	2.6	VC	C	C	VC	-
17 *Garra mullya* (Sykes 1839)	Sucker fish	Mallya	LC	2	VC	VC	VC	VC	C

Table 1: Continue.....

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18 *Labeo calbasu* (Hamilton, 1822)	Orangefin labeo	Kanusha	LC	2	-	-	-	VR	VR
19 *Labeo catla* (Hamilton, 1822)	Catla	Katla	LC	2.8	-	VR	R	-	VR
20 *Labeo dussumieri* (Valenciennes, 1842)	Common labeo	-	LC	2	-	-	-	VR	-
21 *Labeo rohita* (Hamilton, 1822)	Rohu	Rohu	LC	2.2	-	-	-	-	VR
22 *Osteobrama vigorsii* (Sykes, 1839)	Bheema osteobrama	Paplet	LC	2.8	-	-	-	-	R
23 *Osteobrama cotio* (Hamilton, 1822)	Cotio	Paplet	LC	2.9	-	-	-	R	F
24 *Pethia lutea* Katwate, Katwate, Raghavan, Paingankar and Dahanukar, 2014	Citron barb	Kumbharni	VU	2.7	R	-	-	-	-
25 *Puntius amphibius* (Valenciennes, 1842)	Scarlet-banded barb	Kumbharni	DD	2	C	C	VC	VC	C
26 *Puntius parrah* Day 1865	Parrah barb	Kumbharni	LC	2.5	F	F	F	F	F
27 *Puntius sophore* (Hamilton 1822)	Pool barb	Kumbharni	LC	2.6	C	C	VC	F	C
28 *Systomus sarana* (Hamilton 1822)	Olive barb	Kholi	LC	2.9	C	VC	VC	VC	VC
29 *Tor khudree* (Sykes, 1839)	Deccan mahseer	Varshi	LC	3.1	-	-	-	-	VR
30 *Tor tor* (Hamilton, 1822)	Tor barb	Varshi	DD	2.6	VR	VR	-	R	VR
Family: Cobitidae									
31 *Lepidocephalichthys thermalis* (Valenciennes 1846)	Common spiny loach	Muri	LC	2.9	C	-	C	F	R
Family: Danionidae									
32 *Amblypharyngodon mola* (Hamilton, 1822)	Mola carplet	Motka	LC	3.3	-	-	F	VR	C
33 *Devario aequipinnatus* (McClelland 1839)	Giant danio	Banderki	LC	2.9	C	C	R	C	F
34 *Devario malabaricus* (Jerdon 1849)	Malabar danio	Banderki	LC	3.2	C	F	F	C	F
35 *Rasbora daniconius* (Hamilton 1822)	Slender rasbora	Dandi	LC	3.1	VC	C	C	C	C
36 *Salmostoma bacaila* (Hamilton 1822)	Large razorbelly minnow	Haleti	LC	3.2	F	F	R	R	R
37 *Salmostoma boopis* (Day 1874)	Boopis razorbelly minnow	Haleti	LC	3.2	C	F	F	C	R
38 *Salmostoma novacula* (Valenciennes 1838)	Novacula razorbelly minnow	Haleti	LC	3.2	-	-	-	-	F
Family: Nemacheilidae									
39 *Schistura denisoni* (Day, 1867)		Muri	LC	3	F	-	F	F	R
Order: Cyprinodontiformes									
Family: Aplocheilidae									
40 *Aplocheilus lineatus* (Valenciennes, 1846)	Striped panchax	Tikka	LC	3.8	-	-	R	-	VR

Table 1: Continue.....

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Order: Elopiformes									
Family: Megalopidae									
41 *Megalops cyprinoides* (Broussonet, 1782)	Indo-Pacific tarpon	Kateri	DD	3.5	-	-	-	-	VR
Order: Gobiiformes									
Family: Gobiidae									
42 *Awaous grammepomus* (Bleeker, 1849)	Scribbled goby	Kharbi	LC	3.3	-	-	-	R	F
43 *Glossogobius giuris* (Hamilton, 1822)	Gobby	Kharbi	LC	3.7	R	R	F	C	F
Order: Osteoglossiformes									
Family: Notopteridae									
44 *Notopterus notopterus* (Pallas, 1769)	Bronze featherback	Chalat, Pholi	LC	3.5	-	-	-	-	VR
Order: Ovalentaria									
Family: Ambassidae									
45 *Chanda ranga* Hamilton, 1822	Indian glassy fish	Paplet	LC	3.5	-	-	F	R	R
46 *Pseudambassis lala* (Hamilton 1822)	Highfin glassy perchlet	Paplet	NT	3.2	-	-	-	-	VR
47 *Chanda nama* Hamilton, 1822	Elongate glass-perchlet	Paplet	LC	3.6	-	-	F	F	R
Order: Siluriformes									
Family: Bagridae									
48 *Mystus malabaricus* (Jerdon 1849)	Jerdon's Mystus	Shingte	NT	3.3	R	C	C	C	F
49 *Mystus bleekeri* (Day, 1877)	Day's mystus	Shingte	LC	3.3	-	-	VR	-	F
50 *Mystus cavasius* (Hamilton, 1822)	Gangetic mystus	Shingte	LC	3.4	-	VC	C	VR	C
51 *Sperata lamarrii* (Valenciennes 1840)		Aor, Sheengala	LC	-	-	-	-	-	VR
Family: Clariidae									
52 *Clarias gariepinus* (Burchell, 1822)	North African catfish	Mangur	LC	3.8	-	-	VR	-	R
Family: Heteropneustidae									
53 *Heteropneustes fossilis* (Bloch, 1794)	Stinging catfish	Nar shingala	LC	3.6	-	-	R	-	F
Family: Loricariidae									
54 *Pterygoplichthys pardalis* (Castelnau, 1855)	Amazon sailfin catfish	Helicopter	LC	2	-	-	-	-	VR
Family: Pangasiidae									
55 *Pangasianodon hypophthalmus* (Sauvage, 1878)	Striped catfish	Bhaikhi	EN	3.1	-	-	-	-	VR
Family: Siluridae									
56 *Ompok bimaculatus* (Bloch, 1794)	Giant river-catfish	Valji	NT	3.9	-	-	VR	R	F
57 *Wallago attu* (Bloch and Schneider 1801)	Wallago	Shivda	VU	3.7	-	R	R	F	C

Table 1: Continue.....

Table 1: Continue.....

Order: Synbranchiformes										
Family: Mastacembelidae										
58 *Macrognathus pancalus* Hamilton 1822	Barred spiny eel	Bam	LC	3.5	R	F	F	F	C	F
59 *Mastacembelus armatus* (Lacepède 1800)	Zig-zag eel	Bam	LC	2.8	VR	F	F	F	C	F

Note: Relative abundance: VR: Very rare; R: Rare; F: Few; C: Common; VC: Very common, IUCN: Status: LC: Least concern; VU- Vulnerable, NT- Near threatened; EN- Endangered.

abundance of each fish species was calculated following Kumbar *et al*. (2021) and categorised into five classes: Very Rare (VR), Rare (R), Few (F), Common (C) and Very Common (VC). Habitat characteristics for each site were recorded based on the habitat's parameters, including substrate composition (%), such as bedrock, boulders, cobbles, gravel, coarse sand and fine sand, following standard river habitat assessment protocols (Arunachalam, 2000). These parameters were used to understand the relationships between habitat and fish assemblage within the river system.

RESULTS AND DISCUSSION

Fish diversity and conservation status

A total of 59 fish species, belonging to 11 orders, 21 families and 42 genera, were recorded from the freshwater stretch of the Ulhas River (Table 1; Fig 2a-c). Dominant fish order recorded was Cypriniformes (47%), with 28 species, followed by Siluriformes (17%), with 10 species, Anabantiformes (9%), with five species and Cichliformes (7%), with four species, respectively (Fig 3). The family Cyprinidae (19) was recorded as dominant, followed by Danionidae (7), Bagridae (4) and Chichlidae (4). Katwate *et al.* (2012) recorded 66 fish species across six rivers in Raigad district, with the highest richness in the Kundalika River (66 species), followed by the Savitri (64 species), Amba (61 species) and the Patalganga (45 species). Wanjari *et al.* (2025) documented 47 fish species representing 32 genera, 17 families and 10 orders in the Wainganga River, noting that Cypriniformes was the most prevalent order. Similarly, Mudoi *et al.* (2022) recorded 49 fish species across 36 genera, 20 families and 10 orders from the Umtrew River in Meghalaya and Assam, India. Their findings reported Cypriniformes (42%) as the dominant order, followed by Siluriformes (24%). Likewise, studies by Kumbar *et al.* (2021) and Eldho and Sajeevan (2022) reported Cypriniformes, Siluriformes and Anabantiformes as the dominant taxonomic orders in the Krishna River (Sangli district) and the Chimmony Wildlife Sanctuary in the Western Ghats, respectively. These river systems in the Western Ghats have shown comparable levels of richness, strengthening the region's global reputation as a biodiversity hotspot. However, differences in species composition among rivers indicate that local habitat structure, flow regimes and anthropogenic pressures all have a significant impact.

Based on the IUCN Red List of Threatened Species, 81% (48 species) were categorised as Least Concern. Vulnerable species constituted 7% (4 species) *Pethia lutea*, *Wallago attu*, *Cyprinus carpio* and *Oreochromis mossambicus*, while 5% (3 species) *Tor tor*, *Puntius amphibius* and *Megalops cyprinoides* were listed as Data Deficient. Another 5% (3 species), *Mystus malabaricus*, *Ompok bimaculatus* and *Pseudambassis lala* were classified as Near Threatened and 2% (1 species), *Pangasianodon hypophthalmus* was categorised as Endangered. Local fish species face a multi-faceted threat from destructive fishing methods,

growth and recruitment overfishing, establishment of invasive species, compromising the ecological integrity of the river system (Sarkar *et al.,* 2012). A total of seven exotic fish species were recorded from the Ulhas River, namely *Amphilophus trimaculatus*, *Oreochromis mossambicus*, *Oreochromis niloticus*, *Cyprinus carpio*, *Clarias gariepinus*, *Pterygoplichthys pardalis* and *Pangasianodon hypophthalmus*. The invasion and establishment of exotic species pose a significant risk to indigenous fishes by disturbing natural habitats and threatening native populations through predation, competition and competitive displacement (Raghavan *et al.,* 2008; Knight, 2010; Sarkar *et al.,* 2010; Kumbar *et al.,* 2021).

Relative abundance and community structure

Overall fish relative abundance analysis revealed *Garra mullya* (27.39%) as the most abundant fish species, followed by *Systomus sarana* (9.98%), *Puntius amphibius* (6.81%), *Puntius sophore* (6.33%), *Mystus cavasius* (6.12%), *Dawkinsia filamentosa* (5.69%) and *Rasbora daniconius* (5.53%). The dominance of these species suggests favourable habitat conditions, including suitable substrate composition, microhabitat availability and optimal physicochemical conditions for survival and reproduction in the Ulhas River. In the low-order streams of the Pamba River, Thomas and Thomas (2025) observed the dominance of *Garra mullya* (42.63%), attributing its prevalence to the abundance of riffle habitats characterised by fast-flowing, oxygen-rich conditions that favour rheophilic species.

Lowest fish relative abundance was recorded for *Pseudambassis lala*, *Labeo dussumieri*, *Megalops cyprinoides*, *Sperata lamarrii* and *Tor khudree*, with values of 0.01% for each species. Notably, the abundance of Indian Major Carps (IMC) was relatively lower compared to catfish species, suggesting that habitat modification and altered flow regimes may favour benthic and opportunistic taxa. Kumari *et al.* (2025) highlighted variability in fish abundance due to differences in microhabitats and the availability of suitable substrates at sampling sites within the riverine ecosystem.

Trophic-level community analysis revealed dominance by omnivorous species (53%), followed by carnivores (38%), herbivores (7%) and insectivores (2%). The low

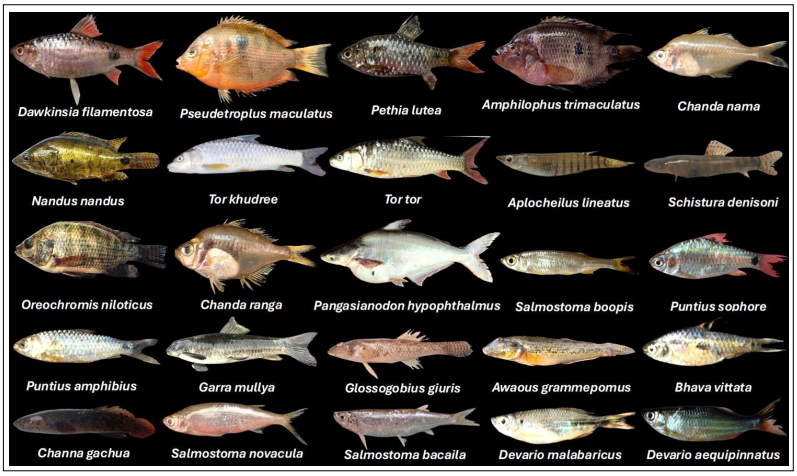


Fig 2a: Fish species recorded from the Ulhas River, Maharashtra.

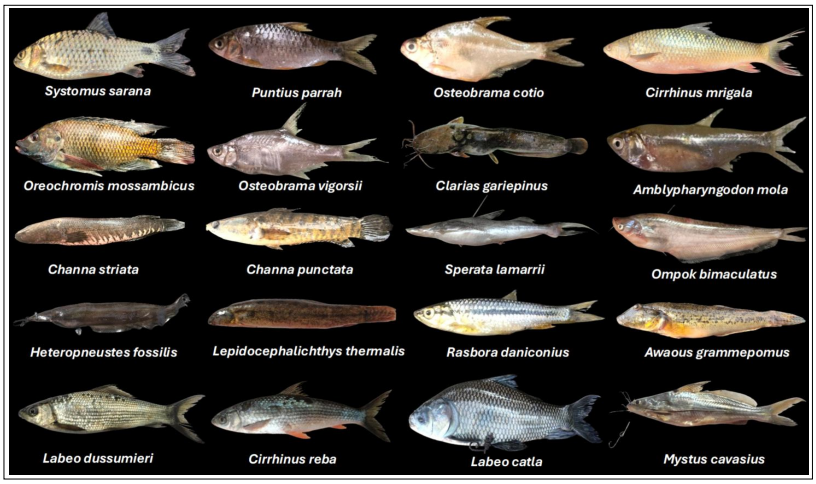


Fig 2b: Fish species recorded from the Ulhas River, Maharashtra.

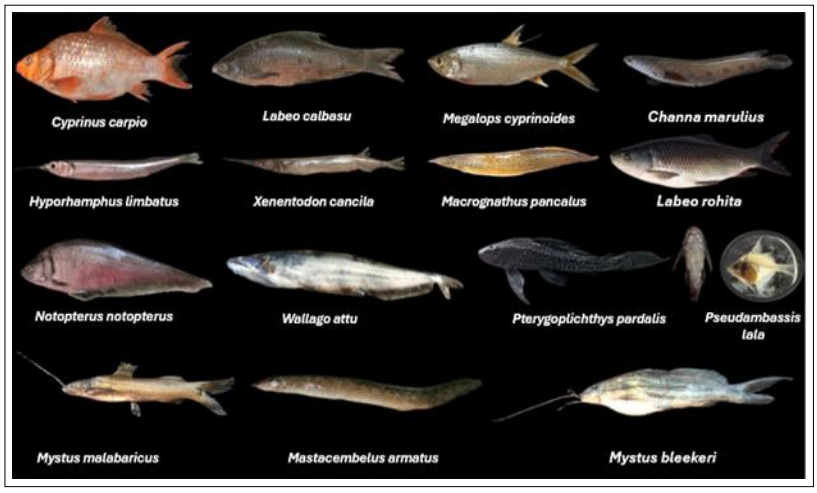


Fig 2c: Fish species recorded from the Ulhas River, Maharashtra.

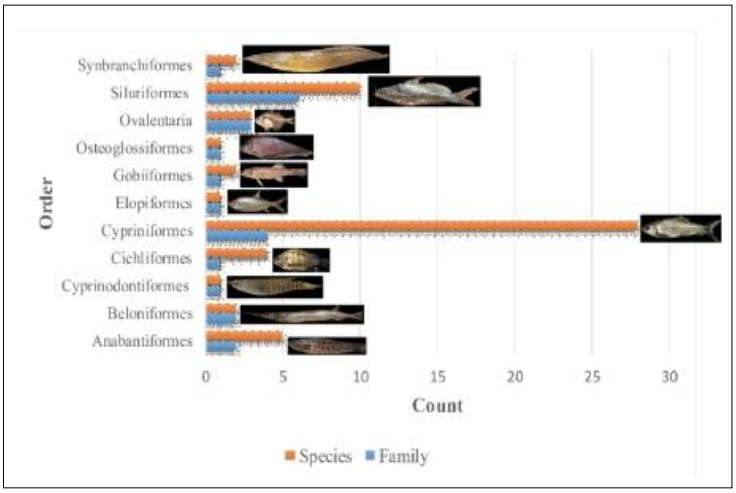


Fig 3: Order-wise composition of fish species recorded from the Ulhas River.

dominance of herbivorous fishes indicates limited autotrophic productivity and a shift toward heterotrophic pathways, such as detritivory and predation, collectively signalling a deterioration in ecosystem health (Noble *et al*., 2007; Heda *et al*., 2009; Sajina *et al.,* 2022). The predominance of omnivores demonstrated their ability to flourish by consuming wide range of food resources were available. Consequently, this increased percentage indicated a degraded ecosystem (Sajina *et al.,* 2022).

Spatial patterns and habitat associations

Habitat characteristics of the Ulhas River were recorded, revealing considerable variability, including microhabitat features such as substrate composition (%). Overall result showed bedrock as the dominant substrate present in all sites, with a range of 25-55%, followed by coarse sand (20-25%), fine sand (10-20%), cobble (5-15%), gravel (5-15%) and boulders (3-5%). Downstream sites (S3, S4 and S5) exhibited greater substrate heterogeneity and more mixed habitat characteristics than upstream sites (S1 and S2). Consequently, higher species richness was recorded at S5 compared to the other sites, owing to greater habitat variability, optimal flow, greater water depth and suitable substrate. The freshwater stretch of the Ulhas River exhibits significant anthropogenic alterations, with sampling site S1 showing habitat degradation due to sand mining, site S3 impacted by domestic wastewater discharge from rural drains and site S4 serving as a solid waste disposal area near the left bank, driven by rapid rural development.

CONCLUSION

The present work is the first comprehensive study of fish diversity, abundance and habitat characteristics from the freshwater zone of the Ulhas River. Checklists of fish species recorded are categorised as near threatened, endangered and vulnerable, calling for the use of conservation aquaculture. The absence of existing data creates a significant and necessary scope for stock assessment, biology and trophic guild studies. Conserving

fish diversity in the Ulhas River is vital for maintaining ecological balance and sustaining local livelihoods.

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Conflict of interest

There is no conflict of interest between authors.

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