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RESEARCH ARTICLE

Ichthyofaunal diversity of Tulshi Reservoir, Dhamod, Kolhapur, Maharashtra, India

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Abstract

This study explores the fish diversity of the Tulshi Reservoir, identifying 29 species across five taxonomic orders. *Perciformes* is the most dominant, comprising four families and 13 species, accounting for 44.82% of the total diversity. Native species such as *Tor khudree, Labeo rohita,* and *Wallago attu* highlight the reservoir's ecological importance, whereas the presence of exotic species like *Oreochromis mossambicus* and *Cyprinus carpio* raises concerns about potential ecological disruptions. The identification of *Hypselobarbus kolashi*, an endemic species classified as Data Deficient, underscores the need for focused conservation efforts. However, human-induced pressures, including overfishing, agricultural runoff, and habitat degradation, threaten the reservoir's biodiversity and ecological balance. The study emphasizes the importance of habitat restoration, controlling invasive species, and adopting sustainable aquaculture practices to minimize adverse impacts. Regular monitoring of water quality and community-driven conservation initiatives are recommended to protect native fish populations. These findings contribute to the understanding of reservoir ecosystems in the Western Ghats and highlight the need for proactive conservation strategies.

Key Words: Fish Diversity; IUCN; Invasive species; Tulshi Reservoir.

1. Introduction

India's freshwater ecosystem, includes river, lakes, wetland and aquifer, are vital role for biodiversity conservation and the provision of essential ecosystem services. These habitats are home to significant portion of the world's freshwater species, including may that endemic or threatened. The recent study emphasis the need for urgent conservation due to growing threats such as habitat loss, pollution and overexploitation. A study conducted in 2024 highlighted the inadequacy of current measures and proposed actionable strategies to migrate biodiversity loss, emphasizing integration of science and policy for effective outcomes (De and Dwivedi, 2024). The western ghats, recognized as a USNESCO world Heritage site, are a critical region for India's freshwater biodiversity. This biodiversity hotspots supports a wide range of endemic species and provide essential resources to millions of people. However, this region faces challenges from anthropogenic pressure, including deforestation and resources extraction. Conservation efforts in Western Ghats are essential to protect the unique freshwater ecosystem and their species (Molur et al., 2011). Despite this efforts, freshwater ecosystem in India remains under severe threats, with over 70% of water surface and groundwater heavily polluted due to industrial waste and untreated sewage. Pollution control measures and sustainable management practice may be prioritized to safeguard biodiversity and human health. Collaborative efforts from government and non- government organization, along with active community participation, are key to achieving these goals (The nature conservancy, 2020).

Fish account for somewhat more than half of the total vertebrates, with 34300 species, according to Froese and Pauly (2020). Fish rank as the fifth largest agricultural resources among vertebrates and serves as a key source of protein for more than one billion peoples worldwide (Ahmed et al., 2019). Freshwater reservoirs play a critical role in maintaining biodiversity, providing habitats for a multitude of aquatic species, including diverse fish communities that are essential to ecological balance, fisheries, and local economies. Reservoirs, being human-made structures, alter natural ecosystems, resulting in unique assemblages of species in freshwater reservoirs is environments. The diversity of fish species in freshwater reservoirs is influenced by a range of aspects, including water quality, habitat heterogeneity, depth, temperature, and anthropogenic activities like overfishing and pollution. In recent years, studies have increased our understanding of fish diversity in various reservoirs worldwide, revealing critical insights into the effects of environmental changes on fish communities. Fish diversity in reservoirs typically includes native and introduced species, with native species being for ecosystem stability, while introduced species being essential for the ecosystem, may sometimes outcompete local fish, leading to biodiversity loss. The Tulshi Reservoir, located in Dhamod, is a vital manmade reservoir that supports a rich and diverse array of fish species.

This Reservoir plays a crucial role in the local economy and sustenance of surrounding communities through fishing activities. Understanding the fish diversity within the Tulshi reservoir is essential for effective conservation and management strategies to ensure the sustainability of fisheries resources in the region. As a natural water body, the reservoir supports a diverse array of fish species, which are not only essential for the local community's food security but also vital for maintaining the delicate balance of the aquatic ecosystem. The fish diversity of Tulshi Reservoir is a reflection of the region unique geographical, climatic, and ecological characteristics. The reservoir is fed by several tributaries, which contribute to the diverse habitat types and nutrient inputs that support a wide range of fish species (Patil and Satam, 2020).

The exotic species in freshwater ecosystems have become a significant concern for biodiversity conservation, particularly in reservoir environments. Species such as *Oreochromis mossambicus* (Mozambique tilapia), *Cyprinus carpio* (common carp), and *Hypophthalmichthys molitrix* (silver carp) have been widely introduced into Indian reservoirs for aquaculture purposes.

Table 1. The systematic list, endemic and threatened status as per IUCN of fishes collected from Tulasi reservoir, Dhamod. Kolapur, Maharashtra, India.

SN	Order	Family	Scientific Name	Common Name	IUCN	Endemic Status
1	Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	Mola Carplet	Least Concern	Endemic
2			*Esomus danricus*	Flying Barb	Least Concern	Endemic
3			*Salmostoma spp.*	Razorbelly Minnows	Least Concern	Endemic
4			*Tor khudree*	Khudree Mahseer	Least Concern	Endemic
5			*Salmostoma boopis*	Boopis Razorbelly Minnow	Least Concern	Endemic
6			*Garra mullya*	Mullya garra	Least Concern	Endemic
7			*Hypselobarbus kolashi*	Kolashi Barb	Data Deficient	Endemic
8			*Osteobrama cotio*	Cotio	Least Concern	Endemic
9	Notopteriformes	Notopteridae	*Notopterus notopterus*	Bronze Featherback	Least Concern	Endemic
10	Perciformes	Ambassidae	*Parambassis lala*	Elongate Glassy Perchlet	Least Concern	Endemic
11		Channidae	*Catla catla*	Catla	Least Concern	Endemic
12			*Labeo rohita*	Rohu	Least Concern	Endemic
13			*Cirrhinus mrigala*	Mrigal	Least Concern	Endemic
14			*Ctenopharyngodon Idella*	Grass Carp	Least Concern	Exotic
15			*Hypophthalmichthys molitrix*	Silver carp	Least Concern	Exotic
16			*Cyprinus carpio*	CommonCarp	Vulnerable	Endemic
17			*Puntius sophore*	Pool Barb	Least Concern	Endemic
18			*Puntius ticto*	Ticto Barb	Least Concern	Endemic
19			*Channa striata*	Striped Snakehead	Least Concern	Endemic
20			*Channa punctata*	Spotted Snakehead	Least Concern	Endemic
21		Cichlidae	*Oreochromis mossambicus*	Mozambique Tilapia	Vulnerable	Exotic
22		Gobiidae	*Glossogobius giuris*	Tank Goby	Least Concern	Endemic
23	Siluriformes	Bagridae	*Mystus vittatus*	Striped Dwarf Catfish	Least Concern	Endemic
24			*Rita rita*	Rita Catfish	Least Concern	Endemic
25		Clariidae	*Clarias batrachus*	Walking Catfish	Near Threatened	Exotic
26		Heteropneustidae	*Heteropneustes fossilis*	Stinging Catfish	Least Concern	Endemic
27		Siluridae	*Ompok bimaculatus*	Butter Catfish	Near Threatened	Endemic
28			*Wallago attu*	Freshwater Shark	Near Threatened	Endemic
29	Synbranchiformes	Mastacembelidae	*Mastacembelus armatus*	Tire Track Eel	Least Concern	Endemic

Table 2. Composition of the fish community classified by order.

SN	Taxa	Number of Families	Species Count	Percentage %
1	Perciformes	4	13	44.82
2	Siluriformes	4	6	20.68
3	Cypriniformes	1	8	27.58
4	Notopteriformes	1	1	3.46
5	Synbranchiformes	1	1	3.46
Total		11	29	100

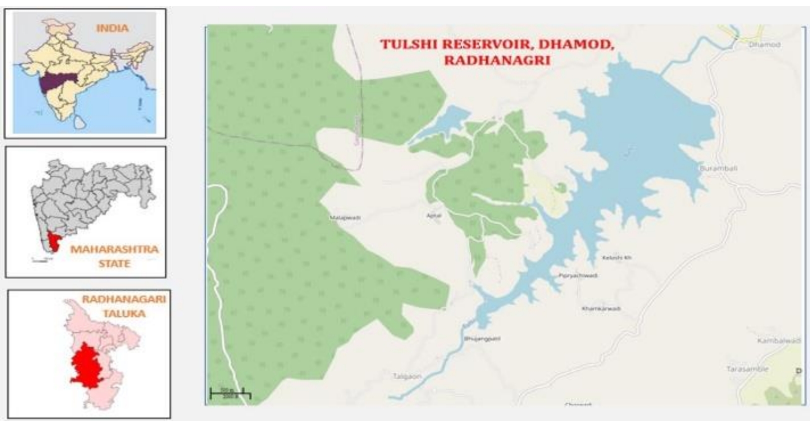

Figure 1. Map showing Tulshi Reservoir,Dhamod, Radhanagri.

While these species have economic value, their presence often leads to competition with native fish species, the alteration of trophic dynamics, and habitat degradation. Exotic species can outcompete local species for food and space, leading to a decline in native biodiversity. Studies such as by Arunachalam et al (2000) and Sugunan (2000) have highlighted the detrimental impact of invasive species on the ecological balance of freshwater ecosystems. For instance, *Oreochromis mossambicus,* known for its aggressive reproductive and feeding habits, has been reported to displace native fish species in several reservoirs across India, such as those in Kerala and Tamil Nadu, by altering the food web structure and degrading water quality (Kiruba-Sankar et al., 2018). Invasive species greatly endanger the survival of native fish populations, especially those that are endemic or threatened.

Water quality parameters, such as dissolved oxygen (DO), pH, temperature, and nutrient concentrations, are critical factors influencing fish diversity and health in aquatic ecosystems. Variations in these parameters, often due to anthropogenic activities such as agriculture and urbanization, can drastically alter fish community composition. For example, eutrophication driven by nutrient enrichment from agricultural runoff has been shown to reduce oxygen levels, favouring species tolerant of low oxygen conditions, often those that are invasive (Sugunan, 2000). Similarly, studies by Arunachalam (2000) and Kiruba-Sankar et al. (2018) have emphasized the importance of stable water conditions in supporting diverse fish populations. Altered flow regimes resulting from dam construction or water diversion can disrupt spawning cycles and migration patterns, further stressing fish communities.

Such hydrological changes lead to the fragmentation of habitats and reduced species richness, as seen in studies on the Sharavathi and Kali rivers (Dahanukar et al., 2011). Understanding these factors is crucial for effective management and conservation strategies, particularly in reservoirs where both native and exotic species interact under fluctuating environmental condition.

2. Materials and methods

Study Area

The Study site is situated at Tulashi Reservoir in Dhamod, Radhanagari, Kolhapur, Maharashtra, positioned at 16.515589°N latitude and 74.015457°E longitude. It is a part of Western Ghats Biodiversity Hotspot, also called as Sahyadri.

Collection of Fish

The research was carried out on a weekly basis throughout each month July 2022 to July 2024. The fish sample were captured with the help of local skilled fisherman and authorised by irrigation department of Kolhapur. Gill net, floating gill net, cast net, hooks, trap nets or basket traps were used for capturing fishes. Fish species offered for sale in the local market, as well as those caught by fishermen from the reservoir, were procured for the study. All fishes were photographed immediately with the help of digital camera, and were preserved in 10% formaldehyde solution for identification to genus and species. Fish identification and classified with help of standard key (Mishra, 1959; Day, 1988; Jhingran, 1991; Jayaram, 1999; Shrivastava, 1998; Talwar and Jhingran, 1999).

3. Result

The fish species identified in the study include *Parambassis lala, Mystus vittatus, Rita rita, Catla catla, Labeo rohita, Cirrhinus mrigala, Ctenopharyngodon idella, Hypophthalmichthys molitrix,* and *Cyprinus carpio*. Other species recorded include *Puntius sophore, Puntius ticto, Channa striata, Channa punctata, Oreochromis mossambicus*, and *Clarias batrachus* (Table 1). Smaller fish species such as *Amblypharyngodon mola, Esomus danricus, Salmostoma spp., Tor khudree*, and *Salmostoma boopis* were also present (Table 1). Additionally, the study noted species like *Garra mullya, Hypselobarbus kolashi, Osteobrama cotio, Glossogobius giuris, Heteropneustes fossilis, Mastacembelus armatus, Notopterus notopterus, Ompok bimaculatus,* and *Wallago attu* belonging to 26 genera of 13 different families and five orders were found in Tulasi reservoir (Table 2). The order Cypriniformes formed the largest fish group in the reservoir with 16 species, Synbranchiformes and Notopteriformes only one species recorded during the study period.

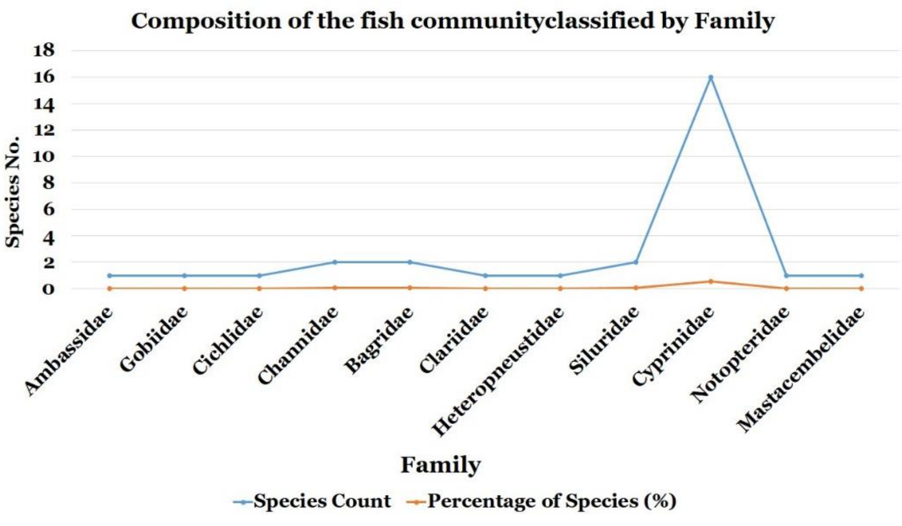

Figure 2. Composition of the fish community classified by family.

The fish species of IUCN conservation status reflect the different environmental pressures they face. *"Tor khudree"* species have been classified as least concern; such a status would indicate a very high risk of extinction, highlighting the need for immediate conservation actions. On the other hand, 23 species, like *Catla catla, Labeo rohita, Cirrhinus mrigala*, etc., are listed as Least Concern, meaning they have stable and widespread populations and are not currently at significant risk. Their adaptability and high reproductive rates help maintain their numbers. *Kolashi Barb* species is endemic to the Western Ghat categorized region as Data Deficient, indicating that there is not enough information available to assess their conservation status accurately. Their survival is jeopardized by challenges like habitat degradation, excessive fishing, and competition from invasive species, emphasizing the urgent need for conservation measures to safeguard their numbers. *Wallago attu* and *Ompok bimaculatus* are classified as Near Threatened, which means it is at risk of becoming threatened in the near future. Although not immediately at risk, it faces challenges like overfishing, habitat loss, and pollution. Continuous monitoring and proactive management are essential to prevent further decline. These varying IUCN statuses highlight the need for targeted conservation efforts to preserve the fish diversity and ecological health of the Tulshi Reservoir.

The fish diversity of Tulshi Reservoir consists of 29 species categorized under five taxonomic orders. *Perciformes* is the most dominant group, comprising four families and 13 species, making up 44.82% of the total fish population. *Cypriniformes* follows with a single family containing eight species, contributing 27.58%. *Siluriformes* includes four families and six species, representing 20.68% of the diversity. In contrast, *Notopteriformes* and *Synbranchiformes* are the least represented, each with a single species, accounting for 3.46% each. The prevalence of *Perciformes* and *Cypriniformes* suggests that the reservoir provides suitable ecological conditions for their growth and sustainability as shown in Figure 2.

The survey recorded 29 species, with 25 being native to India and 4 classified as exotic. Endemic species such as *Tor khudree* (Mahseer), *Labeo rohita* (Rohu), and *Wallago attu* (Freshwater shark) play critical roles in maintaining ecological balance and supporting local fisheries. However, the presence of exotic species like *Clarias batrachus* (Walking Catfish), *Hypophthalmichthys molitrix* (Silver carp), *Cyprinus carpio* (Common carp), and *Oreochromis mossambicus* (Mozambique tilapia) raises ecological concerns. Non-native species, frequently introduced for aquaculture purposes, are known to compete with native species for resources such as food and habitat, which can result in a reduction of biodiversity. Their aggressive feeding and reproductive strategies can disrupt local ecosystems, impacting water quality and displacing indigenous species.

To mitigate these impacts, strict monitoring of exotic species populations is essential. Policies should focus on regulating their introduction and spread while promoting the conservation of native fish. Habitat restoration, coupled with public awareness campaigns, can help protect endemic biodiversity. Additionally, sustainable aquaculture practices emphasizing native species can reduce the ecological pressure caused by exotic. Proactive measures are crucial to maintain ecological balance and ensure the long-term sustainability of aquatic resources in the region.

4. Discussion

The present study provides an in-depth analysis of the fish diversity in Tulshi Reservoir, revealing a composition of 29 species from 13 families and five orders. This aligns with trends observed in other reservoirs across the Western Ghats (WG) and peninsular India, though the proportional representation of orders and families varies.

The dominance of the order Perciformes (44.82 %) in our study is consistent with findings from similar studies in Western Ghat reservoirs, such as the Bhadra and Tungabhadra reservoirs, where Cyprinidae often dominates fish assemblages due to their adaptability to varied aquatic habitats and water quality conditions (Sugunan, 2000; Dahanukar et al., 2013). However, reservoirs in peninsular India, like Somasila or Nagarjuna Sagar, exhibit higher proportions of non-native species, often linked to intensive aquaculture practices.

Exotic species formed 13.8% of the total fish species in Tulshi Reservoir, a figure comparable to other reservoirs in the Western Ghat region. However, reservoirs in more intensively managed basins report a higher percentage, with invasive species like *Oreochromis mossambicus* and *Cyprinus carpio* often forming dominant biomass fractions (Arunachalam et al., 2000). Such differences suggest that the Tulshi Reservoir, though impacted by exotic species, retains relatively robust native biodiversity compared to highly manipulated reservoirs.

Exotic species like *Hypophthalmichthys molitrix, Cyprinus carpio*, and *Oreochromis mossambicus* pose significant challenges. Their presence disrupts native ecosystems through competition for food, alteration of trophic dynamics, and habitat modification. Oreochromis mossambicus, for instance, is known for its aggressive colonization and wide ecological tolerance, often resulting in native fish displacement (Gaupale and Sontakke, 2024). Such impacts have been documented in reservoirs such as Aliyar in Tamil Nadu and Pookode Lake in Kerala, where exotics dominate native ichthyofauna. To address these threats, it is critical to regulate the introduction and proliferation of exotic species. Strategies like selective aquaculture, habitat restoration, and community-based conservation efforts can mitigate the adverse effects of invasive species on local biodiversity.

Anthropogenic activities such as overfishing, agricultural runoff, and unregulated tourism are increasingly altering the ecological health of the Tulshi Reservoir. Overexploitation of key species like *Wallago attu* and *Ompok bimaculatus*, classified as Near Threatened, risks their long-term survival. Habitat degradation from agricultural practices introduces nutrients like phosphates and nitrates into the reservoir, fuelling eutrophication and altering water quality. Other studies in the region, such as those on the Kali and Sharavathi river basins, have linked habitat fragmentation, altered hydrological regimes, and sedimentation to declining fish diversity (Arunachalam, 2000; Kiruba-Sankar et al., 2018). Altered flow patterns, in particular, affect breeding cues for endemic and migratory species like *Tor khudree*, further jeopardizing population stability. Endemic species such as *Tor khudree*, *Hypselobarbus kolashi*, and *Garra mullya* represent the unique biodiversity of the WG and serve as indicators of ecological health. However, their populations face multiple pressures from habitat degradation, competition with exotics, and climate variability. *Hypselobarbus kolashi*, categorized as Data Deficient, emphasizes the need for localized studies to fill knowledge gaps and guide conservation strategies.

Water quality parameters such as dissolved oxygen (DO), pH, and turbidity directly influence fish community composition. Studies on reservoirs like the Periyar by Sugunan (2000) and Koyna have shown that fish species richness correlates positively with stable DO levels and lower turbidity. The Tulshi Reservoir's moderate levels of eutrophication indicate the need for continuous monitoring to prevent conditions unfavourable to native species. Further, habitat complexity—including submerged vegetation, rocky substrates, and open water zones—supports diverse fish assemblages. Reservoirs with reduced habitat heterogeneity, often due to sedimentation or vegetation clearance, report declines in native fish populations (Dahanukar et al., 2013).

5. Conclusion

The study of fish diversity in the Tulshi Reservoir has highlighted the rich biodiversity present in this aquatic ecosystem, with 29 species from 13 families and five orders identified. The dominance of native species, particularly within the Cypriniformes order, underscores the ecological significance of this habitat. However, the introduction of exotic species, such as *Oreochromis mossambicus* and *Cyprinus carpio*, raises concerns due to their competitive nature and potential to disrupt local fish populations. The presence of both endemic and threatened species, such as *Tor khudree* and *Wallago attu*, calls for immediate conservation efforts to mitigate human-induced pressures like overfishing, habitat degradation, and pollution.

As the human footprint on aquatic ecosystems intensifies, the need for integrated management strategies becomes increasingly urgent. This includes stringent monitoring of invasive species, habitat restoration projects, and fostering community-based conservation practices. Additionally, regular assessments of water quality and the effects of altered flow regimes are essential to safeguard the long-term health of the reservoir's ecosystem. Only through sustained and proactive efforts can the Tulshi Reservoir's aquatic biodiversity be preserved for future generations.

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