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# Freshwater fish diversity in and around Vadodara district: A focus on small indigenous species

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Abstract

The present investigation aimed to document fish diversity in freshwater ecosystems located in and around the Vadodara region, based on surveys conducted from October 2020 to the June 2023. The study specifically examines Ichthyofaunal composition in freshwater lakes and reports a total of 31 fish species distributed across 10 orders, 16 families, and 29 genera. The assemblage was dominated by members of the family Cyprinidae, contributing the highest number of species, followed by Ambassidae, while several other families such as Xenocyprididae, Bagridae, Siluridae, and Cichlidae showed moderate representation, and the remaining families were represented by single species. Conservation assessment based on IUCN categories revealed that most species fall under the Least Concern category, with a smaller proportion classified as Near Threatened and Vulnerable, along with one Data Deficient species and a few yet to be evaluated. This study provides the first consolidated account of freshwater fish diversity in the Vadodara region and underscores the ecological and socio-economic importance of small indigenous fish species. These findings contribute valuable baseline information for biodiversity conservation, sustainable fisheries management, aquaculture development, and enhancement of nutritional security and livelihood opportunities for local communities.

Keywords: Cyprinidae, Ichthyofaunal diversity, Small Indigenous Fish species (SIF)

## Introduction

India has been identified as a significant region of freshwater fish biodiversity with high levels of endemism, which contribute significantly to global biodiversity. The study of fish communities is vital for efficient management of ecosystems and rational utilization of these resources (Mogalekar et al., 2017; Sarma et al., 2017). Freshwater bodies, especially lakes, harbor rich fish communities, which are vital for inland fisheries as well as local economies. Efficient management of these resources depends on a proper understanding of species composition, distribution, and availability (Goswami and Mankodi, 2010). Fish act as efficient bio-indicators of environmental health, besides serving as a vital source of protein, micronutrients, and livelihood support for rural communities (Niraj, 2012; Bera et al., 2014; Delgado, 2003). India, identified as a megadiverse country (Nelson et al., 2016), harbors over 3,231 species of fish, with 800 species of freshwater fishes (Froese and Pauly, 2022; Gopi and Mishra, 2015; Bhattacharya et al., 2020). Researchers have studied Ichthyofaunal diversity in numerous bodies of water around the nation (Jinghran et al., 1969; Rema Devi, 1996; Jayaram, 1999; Vijayalaxmi et al., 2010; Murugan and Prabaharan, 2012; Silambarasan and Senthilkumaar, 2014).

Gujarat is situated on 5 the western coast of India. The state is rich in fishery resources; however, the scientific study 20 on the diversity of freshwater fish is still in the early stages due to the focus on marine fishery resources and lack of scientific information (Sharma et al., 2016; Sarma et al., 2017). The information on the number of fish species is variable due to the complexity of the subject and lack of scientific information on the subject (Hoagland, 1996). Previous studies on the subject have reported varying degrees 25 of freshwater fish diversity in Gujarat state (Sen and Banerjee, 2000; Devi and Indra, 2012; Dholakia, 2004; Goswami and Mankodi, 2010; Gohil and Mankodi, 2010; Banyal et al., 2019). 15 Small Indigenous Fish species, measuring 25-30 cm in length, are found in all freshwater fish habitats. They are rich in nutritional value and play 5 an important role in the food security of the people living in the region (Sarkar and Lakra, 2010; Mohanty et al., 2013). Fish diversity is an indicator of the health of the ecosystem, hence an important

parameter in the assessment of the environment (Hamzah, 2007).

## Methodology

The study area comprises freshwater resources within Vadodara and its surrounding regions. Vadodara district (Fig. 1) is located in the central part of Gujarat, India, between 21°30′ to 22°30′ N latitude and 72°45′ to 74°30′ E longitude. The district covers an area of approximately 7,548.50 km² (Vadodara District Report, 2001).

The collection of fish samples was carried out through systematic fishing activities, in order to determine species diversity. Three individuals of each species were collected in order to ensure proper identification of species. In this regard, preliminary identification of species was carried out in the field using standard taxonomic keys and identification guides. Later, these samples were subjected to further analysis in the laboratory. From three individuals of a particular species, one individual was preserved in 10% formalin, while two individuals were preserved at −20 °C for further molecular analysis. Detailed taxonomic identification was carried out using standard reference books, such as those written by Francis Day (1958), Jayaram (1999) and Rainer Froese and Daniel Pauly (2022). All species were preserved for future reference.

## Result

The present study is based on a primary survey of commercially important freshwater lake fisheries in Vadodara, Gujarat. To date, no comprehensive documentation on fish diversity from this region has been reported. During the survey, all recorded species were identified using their common and scientific names, along with their respective order, family, and IUCN conservation status, as presented in Table 1. A total of 31 fish species belonging to 10 orders, 16 families, and 29 genera were documented. The family Cyprinidae was the most dominant, comprising 10 species, which aligns with patterns commonly observed in inland freshwater ecosystems (Jhingran, 1991 and 1969; Talwar and Jhingran, 1991; Battul et al., 2007). This was followed by the family Ambassidae with three species. Families such as Xenocyprididae, Bagridae, Siluridae, and Cichlidae were each represented by two species. In contrast, Danionidae, Leuciscidae, Pangasiidae,

Channidae, Gobiidae, Belonidae, Mastacembelidae, Notopteridae, Serrasalmidae, and Osphronemidae were represented by a single species each. The survey exclusively recorded bony fishes (Class: Osteichthyes), indicating their dominance in the freshwater lake ecosystems of the study area.

The graphs show the percentage distribution of the different fish species by taxonomic order, along with the IUCN status of each order. Of the total of 31 recorded species, 68% fall in the Least Concern category, followed by 13% Not Evaluated, 10% Near Threatened, 6% Vulnerable, and 3% Data Deficient (IUCN, 2022). The large representation of the order Cypriniformes, specifically the family Cyprinidae, emphasizes the ecological and economic value of the family in the area of interest. Fish such as the silver carp, grass carp, and other exotic carps are commonly cultivated depending on the aquaculture practices in the area (FAO, 2020; IUCN, 2022).

The wild species of fishes of the families Bagridae, Siluridae, Cichlidae, Channidae, Belonidae, Mastacembelidae, and Serrasalmidae are dominant in the water bodies. The small indigenous fish species (SIF) recorded in the study (Table 2), showed that the order Cypriniformes is dominant compared to other orders such as Ovalentaria, Siluriformes, Anabantiformes, Gobiiformes, and Osteoglossiformes. Small indigenous fish species (SIF), although less emphasized in most studies and practices, are of high nutritional and socioeconomic value. The nutritional value of small indigenous fish species is high due to the presence of high-grade protein, essential fatty acids, and vitamins and minerals. The consumption of these fishes is also advantageous since these are consumed whole (Sarkar and Lakra, 2010; Mohanty et al., 2013; Thilsted, 2012). Small indigenous fish species are also of high socioeconomic value for food security (FAO, 2014).

Discussion

Fish play a crucial role in both ecological balance and economic development, making the conservation and sustainable management of fish diversity essential. A comprehensive understanding of Ichthyofaunal diversity is fundamental for sustainable fisheries

development, long-term resource utilization, and effective conservation planning (Goswami and Mankodi, 2010). Biodiversity documentation is equally important for assessing ecosystem structure and function (Gohil and Mankodi, 2010).

Field observations indicate that the order Cypriniformes dominates the study area, contributing 45% (14 species), followed by Siluriformes (16%) and Ovalentaria (10%). The family Cyprinidae emerges as the most abundant group, likely due to the availability of favorable freshwater habitats (Fig. 3). Additionally, an evaluation of the Ichthyofaunal diversity based on the IUCN conservation status (updated 2021) highlights the presence of several threatened species in the region (Fig. 4; Table 1), emphasizing the urgent need for scientifically informed conservation strategies.

Existing literature suggests that studies on the status and utilization of small indigenous fish species (SIF) in India remain limited. However, previous research has demonstrated the potential of small-scale aquaculture involving species such as Amblypharyngodon mola, Puntius sophore, Osteobrama cotio, Cirrhinus reba, and Labeo bata (Roos et al., 2003; Jena et al., 2008; Sarkar and Lakra, 2010). Therefore, integrating SIF with Indian Major Carps (IMCs) through polyculture practices could enhance both productivity and sustainability.

## Conclusion

Most of the species observed were common and widely distributed across the studied lakes, with Cypriniformes being the dominant order, indicating significant aquaculture potential, particularly for Indian major and exotic carps. In contrast, Small Indigenous Fish species (SIFs), though ecologically and nutritionally important, remain insufficiently explored and utilized. Additionally, there is a lack of comprehensive information on Ichthyofaunal diversity in both lotic and lentic ecosystems in the region. Hence, this study aims to document the Ichthyofaunal diversity of major freshwater resources in and around Vadodara district, with emphasis on species composition, abundance, and the prospects for culture and conservation of SIFs.

## Declarations

Funding statement

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors' Contribution

GS: Data collection and Manuscript preparation; PM: Research guidance and supervision.

Data Availability

The above result is a part of doctoral research work. Hence the data is available with the corresponding author and will be presented as and when required.

AI usage Statement

Generative AI tools were used solely for language editing, including grammar correction, paraphrasing, and improving clarity. No AI was used for data analysis, interpretation, or generation of scientific content.

Tables and Figures

SN

27 Family

Scientific Name

Common Name

IUCN Status

Level of Abundance

Order: Cypriniformes

1.

Cyprinidae

Catla catla (Hamilton, 1822)

Catla

LC

+++

2.

Labeo rohita (Hamilton, 1822)

Rohu

LC

+++

3.

Cirrhinus mrigala (Hamilton, 1822)

Mrigal carp

LC

+++

4.

Hypophthalmichthys molitrix (Valenciennes, 1844)

Silver carp

NT

++

5.

Barbonymus gonionotus (Bleeker, 1849)

Silver barb

LC

++

6.

Puntius sophore (Hamilton, 1822)

Pool barb

LC

+++

7.

Osteobrama cotio (Hamilton, 1822)

-

LC

+++

8.

Vimba vimba (Linnaeus, 1758)

Vimba bream

LC

+++

9.

Tor tor (Hamilton, 1822)

Tor barb

DD

-

10.

Pethia ticto (Hamilton, 1822)

Ticto barb

LC

-

11.

Danionidae

Rasbora daniconius (Hamilton, 1822)

Slender rasbora

LC

+

12.

Leuciscidae

Alburnus alburnus (Linnaeus, 1758)

Bleak

LC

++

13.

Xenocyprididae

Ctenopharyngodon idella (Valenciennes, 1844)

Grass carp

NE

+

14.

Culter alburnus (Basilewsky, 185)

-

NE

++

Order: Siluriformes

15.

Bagridae

6 Mystus cavasius (Hamilton, 1822)

Gangetic mystus

LC

-

16.

Sperata seenghala (Sykes, 1839)

Giant river-catfish

LC

+

17.

Siluridae

Wallago attu (Bloch and Schneider, 1801)

Wallago

VU

+

18.

Ompok bimaculatus (Bloch, 1794)

Butter catfish

NT

+++

19.

Pangasiidae

10 Pangasius pangasius (Hamilton, 1822)

Pangus catfish

LC

++

Order: Cichliformes

20.

Cichlidae

Oreochromis mossambicus (Peters, 1852)

Mozambique tilapia

VU

+++

21.

Oreochromis niloticus (Linnaeus, 1758)

Nile tilapia

LC

-

Order: Ovalentaria

22.

Ambassidae

Chanda nama (Hamilton, 1822)

Elongate glass-perchlet

LC

+++

23.

6 Parambassis ranga (Hamilton, 1822)

Indian glassy fish

LC

+++

24.

Parambassis lala (Hamilton, 1822)

Highfin glassy perchlet

NT

-

Order: Anabantiformes

25.

Channidae

Channa striata (Bloch, 1793)

Striped snakehead

LC

+++

26.

Osphronemidae

Trichogaster lalius (Hamilton, 1822)

Dwarf gourami

LC

-

Order: Gobiiformes

27.

Gobiidae

Glossogobius giuris (Hamilton, 1822)

Tank goby

LC

+

Order: Beloniformes

28.

Belonidae

10 Xenentodon cancila (Hamilton, 1822)

Freshwater garfish

LC

+++

Order: Synbranchiformes

29.

Mastacembeleidae

Macrognathus aculeatus (Bloch, 1786)

Lesser spiny eel

NE

++

Order: Osteoglossiformes

30.

Notopteridae

Notopterus notopterus (Pallas, 1769)

Bronze featherback

LC

++

Order: Characiformes

31.

Serrasalmidae

Piaractus brachypomus (Cuvier, 1818)

Pirapitinga (Paca)

NE

+

Table 1. List of freshwater fishes with their order, family, scientific name, common name, IUCN status and level of abundance (+ = Present, ++ = Common, +++ = Abundant, - = Rare; VU-Vulnerable; LC- Least concern; DD-Data Deficit; NE- Not evaluated, NT-Near threaten)

S. N.

Order

Family

Species

1.

Cypriniformes

Cyprinidae

Puntius sophore (Hamilton, 1822)

2.

Osteobrama cotio (Hamilton, 1822)

3.

Pethia ticto (Hamilton, 1822)

4.

Danionidae

Rasbora daniconius (Hamilton, 1822)

5.

Leuciscidae

Alburnus alburnus (Linnaeus, 1758)

6.

Xenocyprididae

Culter alburnus (Basilewsky, 185)

7.

Siluriformes

Bagridae

13 Mystus cavasius (Hamilton, 1822)

8.

Siluridae

Ompok bimaculatus (Bloch, 1794)

9.

Ovalentaria

Ambassidae

Chanda nama (Hamilton, 1822)

10.

Parambassis ranga (Hamilton, 1822)

11.

10 Parambassis lala (Hamilton, 1822)

12.

Anabantiformes

Osphronemidae

Trichogaster lalius (Hamilton, 1822)

13.

Gobiiformes

Gobiidae

Glossogobius giuris (Hamilton, 1822)

14.

Osteoglossiformes

Notopteridae

Notopterus notopterus (Pallas, 1769)

Table 2. List of Small Indigenous Fish species (SIF) with their order, family, scientific name

Fig. 1. Map of the study area

Fig. 2. Illustrates the netting activity

Fig. 3. Order wise percentage distribution of the species

Fig. 4. 14 Categorization of available fish species depending on IUCN-threatened status (Updated 2021)

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