

Fish biodiversity of Tighra reservoir of Gwalior, Madhya Pradesh, India.

Vikash Dhakar*

Department of Fisher Science, Jiwaji University, Gwalior, Madhya Pradesh, India

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Abstract

The present study was conducted at Tighra Reservoir for a period of one year (January 2023-June 2023). The fishes were collected with the help of local fishermen by using various active and passive gears. During the course of study 52 species of fishes were identified belonging to seven orders, 17 families and 36 genera. As far as number of species contributed by different orders is concerned the most dominant orders was *Cypriniformes* (26 species), followed by *Siluriformes* (12 species), *Perciformes* (eight species), *Osteoglossiformes* and *Synbranchiformes* (two species each) and *Clupeiformes* and *Beloniformes* (one species each). As per IUCN (2018) out of 52 species, 40 species are of Least Concern (LC) category with a contribution of 76.92%, five species are Near Threatened (NT) with contribution of 9.62%, four species are Not Evaluated (NE) and contributed 7.69%, two species are data deficient (3.85%) and one species is Vulnerable with 1.92% contribution.

Keywords: Tighra reservoir, Fish diversity, Species, Sank river.

Introduction

Fish diversity depends on geographical position, varied aquatic ecological conditions, health of aquatic bodies, optimum exploitation of the commercial fish species, enforcement of laws, rules and regulations, and their implementation and fish habitat restoration programs. Rich biodiversity of any ecosystem is absolutely essential in order to maintain their stability for proper functioning of their food chains.

Reservoirs are the future untapped resources of horizontal expansion boosting the impetus of blue revolution in Indian aquaculture. They are fondly called the “sleeping giants” owing to their vast expansion (31, 53, 366 Ha) and yet untapped exploitation status (national average production being ~20 kg/Ha). Being an important feature of a river basin, they present a threat towards the native biodiversity provided some contingent measures are not adopted well in advance. The contingent plans need an inventory to start with and for the ecosystem, the first step is to acknowledge and document the ichthyofaunal biodiversity of the water body. Madhya Pradesh, with its 763 nos. 0.46 million ha of reservoirs, has the maximum water spread under man-made lakes of all Indian States. Gandhisagar reservoir is the second largest reservoir (in area) in the country, next only to the Hirakud of Orissa. Tighra reservoir, a medium-major reservoir earthen reservoir constructed on Sank river, a tributary of Chambal river in the year 1914 is situated near Tighra village in Gwalior district of Madhya Pradesh, India.

Fish constitute almost half of the total number of vertebrates in the world 21,723 living species of fish out of 39,900 species of vertebrates are so far recorded. In India, there are about 2,500 species of fishes, of which 930 freshwater and 1,570 marines, are estimated. Fishes have been found to exhibit enormous

diversity in their morphology, habitat and their biology. They live in almost all conceivable aquatic habitats. India is one of the mega biodiversity countries in the world and occupying ninth position in terms of freshwater biodiversity. Fish diversity of undivided India and various Indian states has been described by and many others.

Dams, reservoirs and diversions are a persistent threat to freshwater biodiversity and ecosystem functioning. Dams cause habitat fragmentation and lead to altered hydrological and water quality regimes that compromise the structure and function of freshwater ecosystems. Ecological impacts of dams are widespread, ranging from nutrient declines, loss or change in biodiversity, and the complete reshaping of food webs and energy pathways. Dams are also major barriers to species movement.

Freshwater fish are the most diverse group of vertebrates, playing a number of important roles in freshwater ecosystems, while concurrently rapidly declining across the world. Fragmentation and river regulation by dams remain a central threat to fish biodiversity by altering downstream environmental conditions and blocking migratory paths. In addition to the local extinction of many fish species after dam construction is the establishment and spread of aquatic invasive species. Changes in fish community structure resulting from species gains and losses can subsequently alter river ecosystem function. Therefore, understanding how dam construction affects fish biodiversity is crucial to inform freshwater management strategies.

Fish are very diverse animals and can be categorised in many ways. This study paper is an overview of some of ways in which fish are categorised. Although most fish species have

probably been discovered and described, about 250 new ones are still discovered every year. According to Fish Base about 34,800 species of fish had been described as of February 2022

Study of fish fauna in Madhya Pradesh started with the work of and was followed by. Therefore, the present communication deals with the biodiversity of fish, their IUCN status and measures of conservation of Tighra reservoir.

Literature Review

Water is a prime and basic natural resource for all living organism and a precious natural asset. It is essential for sustaining all forms of life, food production and economic development for general well-being; hence its use needs appropriate planning, development and management. Of all renewable resources of planet, water has the unique place [1].

Fish and other aquatic organisms live in water, thus it is no surprise that water quality determines to a great extent the presence and abundance of species in a particular aquatic environment [2].

Freshwater fishes are one of the most threatened taxonomic groups, because of their high sensitivity to quantitative and qualitative alteration of aquatic habitats. As a result they are often used as bio-indicators for assessment of water quality.

Fish constitutes half of the total number of vertebrates in the world and they live in almost all conceivable habitats. Fishes are one of the most important elements in the economy of many nations as they have been a stable item in the diet of many people.

Several renowned workers studied the freshwater fishes of rivers, ponds, lakes, dams and reservoirs of the country. The fish fauna of Madhya Pradesh was studied by Hora, Hora and Nair, Dubey and Mehra, Malviya, Paunikar et al., Sharma, Soni, Srivastava et al., Swarup, and others. In the present investigation period, an attempt has been made to explore the fish diversity of Harsi Reservoir and to assess the status of these fish species as per and red list.

Fishes were collected from the reservoir with the help of local fishermen by using different types of nets including drag net (Maha Jaal, gill net (Fande or Fasla jaal, cast net (Ghumaua Jaal, dip net (Pilna etc. Fishes were washed in clean tap water, gutted if necessary and preserved in 5% formalin for subsequent analyses. Systematic identification of the fishes was done with the help of standard keys prepared by day [3].

Biodiversity is a concept to ecology and its measurements is essential to ecosystem health 24; due to wide variations of ecosystems in distribution, abundance, dominance and biodiversity levels [4]. In a functional diversity context; richness is understood to increase or enhance community functionality and complexity (increases in productivity [5]. Species richness in sub-lakes was assumed to be positively associated with water depth and aquatic habitat availability with connectivity; in all which increase in wet season.

Biodiversity is a term that refers to the variety and variability of life on earth. It includes variation among genes, species and

functional traits. Among life forms, it is commonly measured in terms of richness, evenness and heterogeneity. Noss recognized composition, structure and function as main attributes of biodiversity and bolstered those attributes hierarchically into nested form by including other organization levels: regional landscape, community-ecosystem, population species and genetic. Biodiversity can be measured as to genetic diversity, species characteristics (individuality, number and accumulation), biotic communities, their processes and structure [6].

Fish are cold-blooded aquatic chordates resides in seas, river, lakes, canals, reservoirs, estuaries etc., and have a pharyngeal gill for respiration. Fish contributes faintly more than one half of the total vertebrates with 34300 species. India contributes to about 7.7% of global fish diversity, of which 1,673 are marine and 994 are freshwater and also in various ways to the diversity of the aquatic ecosystem. Coad and Murray estimated more than 32,000 valid species of fish on earth included in 85 orders and 536 families and 43% of fishes are freshwater fishes.

Earth's surface freshwater encompasses only a small share but involves a large number of fish species. Fishbase classifies fish species of fresh and brackish water into the following categories

- Exclusively freshwater.
- Occurring in fresh and brackish waters.
- In fresh, brackish and marine waters.

An extensive study on the taxonomy and biology of the freshwater fishes in India has been achieved. Scientific study on Indian freshwater fishes started with Hamilton. Moreover, several magnificent contributions to Indian fish fauna were made by Talwar and Jhingran, Menon and Jayaram.

Rivers flowing through unconsolidated materials in unconstrained valleys create and maintain alluvial floodplains, which provide a variety of productive wetland habitats that enhance the diversity of fluvial species. In general, alluvial habitat, channel size, and discharge increase in a downstream direction, resulting in increasing fish diversity as stream size increases [7].

In combination, temperature, hydrology, geomorphology, and associated riparian vegetation form a habitat "template" that controls the persistence and diversity of species at local and regional scales. Maximum regional diversity is further regulated by historical constraints, including previous climatic bottlenecks and barriers to dispersal. Global changes in climate and land use will modify these regional templates, thereby altering ecosystem processes and patterns of species diversity [8].

Methodology

Study area

Gwalior, an ancient city known for the great musician Tansen, is situated in the north region of Madhya Pradesh, India. The

city is gifted with a number of historical places and tourist places. The Tighra reservoir, the life line of Gwalior, was primarily con Gwalior, an ancient city known for the great musician Tansen, is situated in the north region of Madhya Pradesh, India. The city is gifted with a number of historical places and tourist places. The Tighra reservoir, the life line of Gwalior, was primarily con Gwalior, an ancient city known for the great musician Tansen, is situated in the north region of Madhya Pradesh, India. The city is gifted with a number of historical places and tourist places. The Tighra reservoir, the life line of Gwalior, was primarily con Gwalior, an ancient city known for the great musician Tansen, is situated in the north region of Madhya Pradesh, India. The city is gifted with a number of historical places and tourist places. Tighra dam creates a freshwater reservoir on the Sank River; it plays a crucial role in supplying water to the city and is an important tourism spot of Gwalior [7].

The dam is 24 metres high at its crest, and 1341 m long. The reservoir has a capacity of 4.8 million cubic metres and the spillway structure can pass up to 1274 cubic metres per second.

The Tighra reservoir, the life line of Gwalior, was primarily constructed to full fill the water supply of the city. Besides supplying drinking water, the reservoir is also used to culture fishes by the fisheries department and for irrigation purpose.

The reservoir is situated about 20 km West of Gwalior city, near Tighra village which is in close proximity of SADA Magnet city. It lies on 26° 13' N latitude and 78° 30' E longitude at an altitude of 218. 58 m. The reservoir is surrounded by hills from three sides. The hills on the North and Western side are 300 m high and those on Southern and South east side are about 225 m high. At the South Western side river Sank joins the reservoir through a gorge. About a dozen of small nallahs drain in the reservoir from the hill slopes [8]. In the North east of the reservoir there is a concrete masonry wall. The reservoir is being known as Tighra reservoir, after the name of the village Tighra, near which it is situated (Figure 1).



Figure 1. Tighra reservoir.

Data collection

Fish samples collection and identification: Fish samples were sampled from the population and their morphometric measurements (Standard length and weight) were measured using a measuring tape and a digital weighing balance (Sartorius) to the nearest 0.1 cm and 0.1 g respectively, following the methods explained by. Identification of fish samples to the species level was accomplished using identification keys such as Reeds et al, Olaosebikan and Raji and fishbase.org (identification keys and fish species global glossary) (Table 1) [9].

Table 1. Fishes found in Tighra reservoir and their conservation status.

S. no.	Order	Family	Scientific name	Vernacular name	IUCN status #
1	Cypriniformes	Cyprinidae	<i>Labeo rohita</i>	Rohu	LC
			<i>Labeo calbasu</i>	Kirawat	LC
			<i>Labeo gonius</i>	Kursa	LC
			<i>Labeo bata</i>	Bata	LC
			<i>Catla catla</i>	Catla	LC
			<i>Cirrhinus mrigala</i>	Naren	LC
			<i>Cirrhinus reba</i>	Temri	LC
			<i>Cyprinus carpio</i>	Common carp	LC
			<i>Ctenopharyngodon idella</i>	Grass carp	LC
			<i>Hypophthalmichthys molitrix</i>	Silver carp	LC
			<i>Salmostoma bacaila</i>	BarotiChal	LC

			<i>Salmostoma clupeioides</i>	Chal	LC
			<i>Puntius sophore</i>	Putiya	LC
			<i>Puntius sarana</i>	Putiya	LC
			<i>Amblypharyngodon mola</i>	Mola	LC
2	Siluriformes	Siluridae	<i>Wallag oattu</i>	Lonch	NT
			<i>Ompok bimaculatus</i>	Pabda	NT
		Heteropneustidae	<i>Heteropneustes fossilis</i>	Singhi	LC
		Clariidae	<i>Claria smagur</i>	Magur	LC
		Bagridae	<i>Sperata seenghala</i>	Singhara	LC
			<i>Mystus cavasius</i>	Kituwa	LC
3	Channiformes	Channidae	<i>Channa marulius</i>	Sol	LC
			<i>Channa striata</i>	Darkasol	LC
			<i>Channa punctatus</i>	Cut soura	LC
4	Osteoglossiformes	Notopteridae	<i>Notopterus notopterus</i>	Patola	LC
5	Synbranchiformes	Mastacembalidae	<i>Mastacembelus armatus</i>	Bam	LC
6	Beloniformes	Belonidae	<i>Xenentodon cancila</i>	Suja	LC
7	Perciformes	Nandidae	<i>Nandus nandus</i>	Dhebari	LC
		Ambassidae	<i>Parambassis ranga</i>	Chanda	LC

Seasonal fish catch and abundance

Environmental factors such as temperature, sediment composition, and inundation are the main factors influencing the distribution of faunal communities in tropical reservoirs. Those factors vary seasonally and alter the faunal composition and total biomass. Generally maximum abundance and diversity occur in the warmest months owing to higher metabolic rate, and low temperature in winter season reduce the biomass, although this is not true at all latitudes. Much of the seasonal fluctuation is more evident for individual species than for the fish community as a whole, and the seasonal appearance and disappearance of migrants can be very marked [10]. The temporal distribution of the species in the study is depicted below:

Round the year: *Labeo rohita*, *Labeo gonius*, *Catla catla*, *Cirrhinus mrigala*, *Labeo calbasu*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Hypophthalmichthys molitrix*.

Winter: *Wallago attu*, *Notopterus notopterus*, *Ompok bimaculatus*, *Xenentodon cancila*, *Parambassis ranga*, *Nandus nandus*, *Mystus cavasius*, *Sperata seenghala*, *Clarius magur*, *Mastacembelus armatus*

Summer: *Labeo bata*, *Cirrhinus reba*, *Heteropneustes fossilis*, *Puntius sarana*, *Puntius sophore*, *Salmostoma bacaila*, *Salmostoma clupeioides*, *Amblypharyngodon mola*, *Channa marulius*, *Channa striata*, *Channa punctate*

The study showed fish production in summer season comprises almost 60-62% of the total catch, which was higher than that of winter season (Table 2). There was no fishing during the rainy season as it is declared as closed season for fishing activities in every year (16th June to 15th August) [11].

Table 2. Seasonal variation of fish production in Tighra reservoir.

S. no.	Season	Fish production (in Kg)/day
1	Summer	800-1000
2	Winter	500-600
3	Rainy season	Closed season

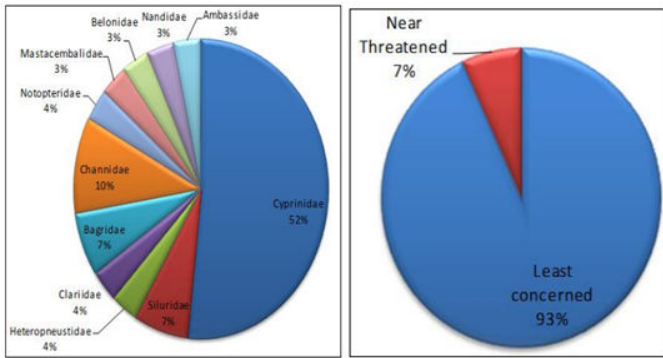


Figure 2. Family wise representation of species in Tighra reservoir and conservation status of fishes.

Results and Discussion

Documentation of biodiversity has been an interest of biologists and ecological engineers to predict the impact of climate change and increasing anthropological interference in the ecosystem as a whole. Fish biodiversity, in particular being the indicator of healthy aquatic ecosystem, increases the economic success of the ecosystem and implies that the area has become more efficient. Madhya Pradesh, owing to its huge landmass shrouded by forests and dotted with numerous rivers and reservoirs is definitely a hotspot for the biodiversity enthusiasts. Bose et al., surveyed Chambal river basin in central India and documented a total of 56 fish species belonging to 09 orders, 18 families and 39. Group-wise distribution of fishes showed that catfishes were the most dominant (23.21%) and as per total relative abundance of the river was *Glossogobius giuris* (6.84%). The abundance of fishes was found to be highest in winter. Dubey and Chauhan reveal the occurrence of 27 species of fish belonging to six orders, nine families with the dominant family as Cyprinidae in Rangwan Dam Chhatarpur Madhya Pradesh. Mustafa et al., recorded 23 fish species under 6 order and 7 families from Halali reservoir.

The sequence of the species abundance was Cypriniformes>Siluriformes>Perciformes>Anguilliformes>Belontiiformes>Osteoglossiformes.

Similarly, total 51 species were recorded belonging to 33 genera, 16 families and 7 orders by Prakash and 52 species of fishes were identified belonging to seven orders, 17 families and 36 genera at Tighra Reservoir, District Gwalior by Ahad and Rao. In corroboration to previous study, our investigations on the Tighra reservoir recorded 29 species of fishes, belonging to 21 genera, 11 families and 7 orders. The largest representation was recorded from Cypriniformes order comprising of 1 family, 9 genera and 15 species. The IUCN red list includes *Wallago attu* and *Ompok bimaculatus* in the Near Threatened category and the seasonal abundance data showed that these fishes are mostly available in winter catch. It is essential to keep close observation of their recruitment pattern and catch composition for better conservation (Figure 3).

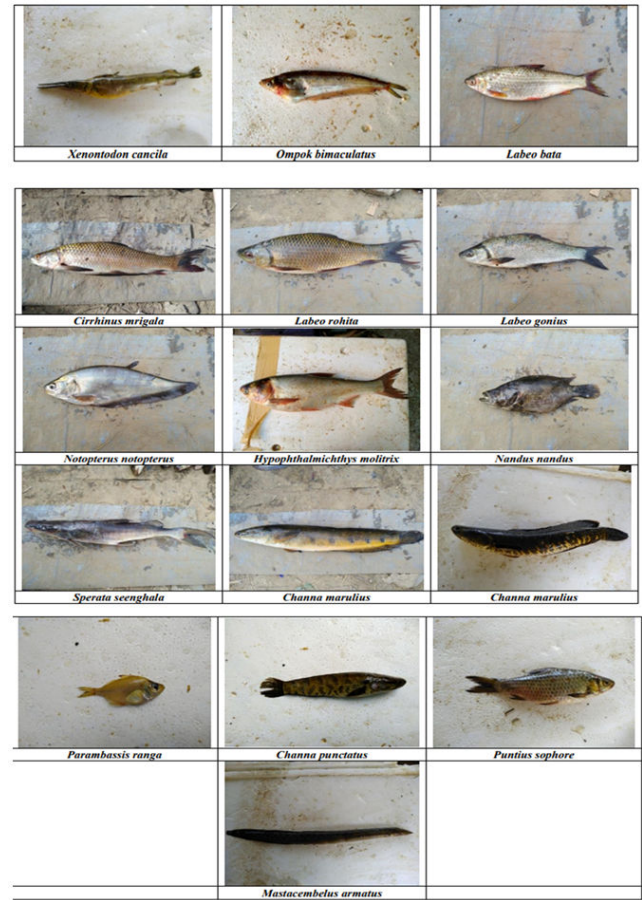


Figure 3. Photographs of commonly available fishes at Tighra reservoir.

Conclusion

The present study is the first documentation of the ichthyofaunal diversity of the fishes present in the Tighra Reservoir. This study provides a valuable insight towards the documentation of the involvement of the fisheries department, govt. of Madhya Pradesh towards enhancement of the capture fisheries from this reservoir and provides the baseline data for future studies documenting the enhancement in fish production from this reservoir. The study also promotes responsible use of fishing crafts and gears pertinent to the code and conduct of responsible fisheries and desists the use of destructive fishing gears like use of small meshed gill and drag nets, dynamite fishing etc. The proposal of inducting cage culture in this reservoir is a need of the hour welcome step by the fisheries department so that the high value catfishes like *Ompok bimaculatus*, *Clarias magur*, *Heteropneustes fossilis* may be resurfaced in the local markets at an affordable prices to meet the goals of nutritional security in coming days.

It has been found during present investigations that the illegal fishing was widespread even during breeding season despite a ban by the state government. There should be more rigorous implementation of the ban and heavy fines should be imposed on the defaulters to stop illegal fishing. The conservation of fish fauna should be given a priority. A proper vigilance of the reservoir will be a welcome step towards conserving the fish

fauna. Tighra reservoir may be declared as aquatic biodiversity reserve. Involvement of local people should be fostered for the conservation of the environment and fauna of the reservoir. For the biological control of weed, grass carps should be introduced to take care of excessive growth of weeds. Now when the reservoir is under the control of Madhya Pradesh tourism department and Madhya Pradesh forest department, a simple vigilance and watch will do a lot towards the conservation of fish in the reservoir. Brooders and if possible the seeds of endangered species may be transplanted in the late summer and early rainy season to replenish the stock.

Documentation of biodiversity has been an interest of biologists and ecological engineers to predict the impact of climate change and increasing anthropological interference in the ecosystem as a whole. Fish biodiversity, in particular being the indicator of healthy aquatic ecosystem, increases the economic success of the ecosystem and implies that the area has become more efficient. Madhya Pradesh, owing to its huge landmass shrouded by forests and dotted with numerous rivers and reservoirs is definitely a hotspot for the biodiversity enthusiasts. Bose et al surveyed Chambal river basin in central India and documented a total of 56 fish species belonging to 09 orders, 18 families and 39. Group-wise distribution of fishes showed that catfishes were the most dominant (23.21%) and as per total relative abundance of the river was *Glossogobius giuris* (6.84%). The abundance of fishes was found to be highest in winter. Dubey and Chauhan reveal the occurrence of 27 species of fish belonging to six orders, nine families with the dominant family as Cyprinidae in Rangwan Dam Chhatarpur Madhya Pradesh. Mustafa et al., recorded 23 fish species under 6 order and 7 families from Halali reservoir. The sequence of the species abundance was *Cypriniformes*>*Siluriformes*>*Perciformes*>*Anguilliformes*>*Beloniformes*>*Osteoglossiformes*. Similarly, total 51 species were recorded belonging to 33 genera, 16 families and 7 orders by Prakash and 52 species of fishes were identified belonging to seven orders, 17 families and 36 genera at Harsi Reservoir, Bhitwar Tehsil, District Gwalior by Ahad and Rao. In corroboration to previous study, our investigations on the Kotwal reservoir recorded 29 species of fishes, belonging to 21 genera, 11 families and 7 orders. The largest representation was recorded from Cypriniformes order comprising of 1 family, 9 genera and 15 species. The IUCN red list includes *Wallago attu* and *Ompok bimaculatus* in the Near Threatened category and the seasonal abundance data showed that these fishes are mostly available in winter catch. It is essential to keep close observation of their recruitment pattern and catch composition for better conservation.

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*Correspondence to

Vikash Dhakar

Department of Fisheries Sciences,

Jiwaji University,

Gwalior,

Madhya Pradesh,

India

E-mail: vikashdhakar68@gmail.com