

# Fish diversity and abundance at the Satpura Dam and Tawa River region in Sarni, Madhya Pradesh, India.

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#### Abstract

The goal of the current study was to determine the variety and abundance of fishes in the river Tawa at the Satpura dam in Sarni, close to the Thermal Power Station in Madhya Pradesh, for a period of one year, from January 2022 to December 2022. In total, 52 species from 10 orders and 16 families were counted. Family *Cyprinidae* had the most species with 25, followed by *Bagridae, Siluridae*, and *Ophiocephalidae* with 4 each. Site 4 had the highest observed number of species (47 species), followed by Site 2 (45 species), Site 3 (42 species), and Site 1. Two diversity indices—the Shannon and Simpson indexes—were combined to measure diversity. Simpson index values ranged from 0.01 to 0.03 whereas Shannon index values exhibited a similar trend and ranged from 2.77 to 3.78. When the current statistics were compared to the previously published data, it was discovered that while overall diversity is still retained, the number of specific species has drastically decreased. Therefore, it is urgently necessary to execute laws against illicit fishing, manage aquatic resources scientifically, expand research on activities that affect biodiversity, and adopt new procedures and protocols for their long-term preservation.

Key Words: Tawa River, Satpura dam, fish, Diversity, species

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### Introduction

Of all the different types of ecosystems on Earth, freshwater habitats have the greatest diversity and wealth. Freshwater habitats are home to more than 10% of animal species, 25% of all vertebrates, and 6% of all species. Fish are the primary source of protein for more than a billion people and the fifth-largest agricultural resource among vertebrates. There are 32,500 species of fish in the world, according to estimates. When you consider that freshwater may make up less than 0.3% of the total amount of water on Earth, it is astounding that there are about 15,000 different types of freshwater fish. Even while marine communities have a greater overall diversity of species, freshwater ecosystems are far more diverse per unit of habitat volume. Freshwater fish species are found here at a rate of one every 15 km3 of water, as opposed to one per 100,000 km3 of seawater. This is a sign of freshwater ecosystems' productivity, physiographic diversity, and isolation. According to Pir et al. (2019), freshwater fish, which make up about 25% of all vertebrates, are an important component of the world's biodiversity. Only 6 of the 515 taxonomic families, or 30% of the total, contain 7,956 fish species. Unexpectedly, 6,100 (77%) of the species in these representative families are freshwater-based. India is home to 868 of the 15000 freshwater fish species that are known to exist worldwide (Leveque et al. 2008), or 5.75% of the total number of freshwater fish species. It contains 192 indigenous species and the 327 species listed by the IUCN as endangered in India. With freshwater fisheries, India has 45,000 kilometers of rivers, 1,26,334 kilometers of canals, ponds, and tanks, 2.36 million hectares, and 2.05 million hectares of reservoirs. Aquatic ecosystems are reportedly particularly concerned about biodiversity loss, especially those brought on by human activity. Freshwater fishes are one of the taxonomic groups that are most at danger because to their high sensitivity to qualitative and quantitative changes in aquatic habitats as well as limits in the physiology, morphology, and life history of species brought on by environmental constraints. Fish communities and particular species serve as reliable indicators of the

biological and ecological integrity of an area since they are constantly exposed to water conditions. Fish show a variety of biotic reactions, such as changes in growth, distribution, and abundance in response to water pollution, the destruction of important habitats, eutrophication, organic enrichment, chemical toxicity, thermal changes, and food availability, all of which can cause forced extinction. Programs for monitoring ecosystems should put a lot of emphasis on these reactions. Due to the characteristics of their life cycle, fish are also suited as indicators of the resilience and recovery of natural ecosystems and as early-warning indications of anthropogenic stress on their dynamics. Poor and insufficient conservation efforts to decrease the impact of pressures on today's fish variety and associated habitats are leading to the rapid extinction of many species. The introduction of exotic species, unauthorized and unreported fishing, irrigation needs, industrial and private use, pollution, habitat fragmentation and destruction, landuse patterns (such as abandonment and intensified use of natural resources), habitat fragmentation and destruction, and effects of global climate change are the main causes of the decline. Freshwater species have decreased more quickly during the past 30 years than terrestrial or marine species. Sadly, mounting data point to the likelihood that this tendency will persist in the future. To enable efficient management of freshwater biodiversity and ultimately reverse its decline, it is necessary to develop accurate estimates of fish species losses under plausible climate change, distribution patterns, and water consumption scenarios. N.P. Shrivastava and Archan Kanti Das. 2013.

An essential river in central India, the River Tawa, is home to a wide variety of fish that are a significant source of food and livelihood. Sadly, rigorous research on the fish diversity in the River Tawa has been ignored, and there is little or outdated information available. With in mind, the investigation was carried out. The diversity of fish, their uses by humans, and their conservation status in the middle stretch of the river are the main topics of this contribution. According to the current study, 57 fish species from 35 genera, 13 families, and 6 orders have been discovered thus far. In addition, the river sustains 17 aquaculture fish and 25 ornamental fish, totaling 43.85% of the total fish population. Along with the foregoing, the trophic structure showed that herbivores dominated the fish population, accounting for 19 species (33.33%), followed by carnivores with 15 species (26.31%), and omnivores with 16 species (28.07%), with 4 species (7.01%) not being assessed. Four species are listed as near threatened (NT) on the red list of endangered species, while one is listed as vulnerable. Several groups of fish species, including major carps, catfishes, murrels, eels, and featherbacks, were also created.

#### Materials and Methods Summary of the Study Area

The "lifeline of Madhya Pradesh" refers to the Satpura Dam on the Tawa River, a man-made lake created as a reservoir for the power plant. The reservoir is surrounded by hills and dense vegetation. A path weaves around a nearby slope to reach the lake. Locals stroll and take leisurely hikes along this road. Tourists frequently picnic around the dam. Sarni is a town in the Betul District of Madhya Pradesh. It is the second-largest municipal council area in Madhya Pradesh. (2011) Nagar Palika The four towns that are managed by the Sarni Municipal Council are: Sarni, Pathakhera, Shobhapur Colony, and Bagdona. In Sarni, people are familiar with the Satpura Thermal Power Plant and the WCL Pathakhera Area Coal Mines. The Gondwana Tract region, where Sarni is located, bears the name of the tribe that once dominated this area and practiced shifting cultivation. (2018 Census of India) shown in the Figure 1



Figure 1. Study Area Satpura dam Sarni

Invading this Gonds region in the fourteenth and fifteenth centuries, the Rajputs succeeded in reclaiming a portion of the Narmada valley for agricultural purposes by the time the Mughals arrived. To continue their ad hoc farming and hunting, the Gonds were compelled to relocate to higher plateaus and hills. The battle between the Marathas and the Mughals caused turmoil in this region during the seventeenth and eighteenth centuries. In 1818, British rule in the area officially began. Despite the fact that Sarni experiences good weather all year long, the monsoon is the best time to travel since the wet season brings out the best in the environment and brings the mountains, valleys, and waterfalls to life. The coldest month is January, and the hottest is May. The average month annual precipitation in the city is 1069.2 mm. The highest temperature here can reach 42.5 °C, and the lowest temperature can reach 5.4 °C.

## Sampling

The chosen locations were examined on foot, and some pointers were also obtained from the neighborhood fisherman. With the assistance of local fisherman, fish were caught using cast nets of various sizes. Three efforts were undertaken at each site to reduce the mistake during collection, which was done at 5-meter intervals. Very little fish were collected using adapted techniques, like cloths and bottles. 1  $m \times 0.6$  m and 1 m x 0.45 m squares of cloth were employed as traps by setting them at the bottom of the river at the stream's edge to mimic natural substratum. Fish were retrieved after a predetermined amount of time, and the cloth was gently raised above the water's surface by being held at its four corners. Plastic bottles were occasionally utilized for collection as well. The number was tallied and documented after collection. After asking the fishermen, local names were also documented. for species identification and biometric research (morphometric and meristic). Each kind received between two and three samples from each station. The gathered specimens were maintained in airtight plastic vials and preserved in 4% formalin solution. Standard length, total length, and body measurements were made as part of the morphometric investigation utilizing measuring scales,

*Vernier calipers*, and pan balance. Fish identification was accomplished via keys created by data evaluation Using Microsoft Excel 2013, the distribution of species, including the number of species overall, the average yearly fluctuations with SD and SE, and the average variations, were calculated. incidence rate in percentage of occurrence: Diversity indices were utilized, including the ones listed below. Index Shanon-Weiner Simpson index:D = 1/pi2 H = piInPi Results A total of 52 species from 10 orders and 16 families were seen during the current investigation.

Throughout the study period, a total of 2762 fish individuals were discovered on site 1, with the month of December having the highest number with 180 individuals and the month of January having 178 individuals. Lowest 66 persons were noted in the month of July, followed by 68 in the month of June. *Puntius vitatus* had 22 individuals, whereas *Labeo rohita* contributed the most to the total number of observed species with 211.

During the study period, 2198 fish were taken from site 2 in total. The highest number of people (145) and the lowest number (41 people) were recorded in the months of January and July, respectively. Nandus had the fewest number of people (12) and Labeo bata had the most people (141). On site 3 between 2017 and 2018, 2289 fish from 43 different species were gathered. The species with the greatest number of individuals was the Labeobata, which had 156, and the species with the fewest individuals was the Chana gachua, which had 24. The highest number of people (154) and the lowest number of people (24) were recorded in the months of December and July, respectively. On site 4, 2298 fish specimens were gathered, with the month of December recording the largest number—169 specimens-and the month of July the lowest-39 specimens. Osteobrama Cotio had the fewest people, 14, while Labeo Rohita had the most, 189. Cyprinidae family members contributed 58% of all instances, followed by Ophiocephalidae at 9%. The family's lowest contribution was 1% for the years 2107 and 2018.

Two diversity indices—the Shannon and Simpson index—were combined to measure

diversity. Shannon index ranged from 2.77 to 3.78 and displayed a similar pattern. The value on site 1 ranged from 3.72 to 2.85. The month of October saw the highest value, while the month of June saw the lowest value. The value on site 2 ranged from 2.77 to 3.68. On site 3, the values were in the 2.88 to 3.72 range, whereas on site 4, they were in the 2.85 to 3.73 range. The Simpson index was 0.01 to 0.03 and was essentially constant during the trial. A Shannon index value greater than 1 indicates that the Narmada River offers superior fish habitat and has the capacity to support the greatest number of fish.

### **Result and Discussion**

India's fisheries offer a lot of potential to improve the nation's food security.( Lauria V et al., 2018; Mohanty BP et al., 2017) The primary resources used for inland fisheries are reservoirs and lakes, and an important factor in their development and sustainability management is an understanding of fish faunal diversity. the composition of has changed Fish assemblage is a sign of water fluctuation (Jhingran 1983; Kumar and Paul 1990). Nearly half of the vertebrate species that may be found worldwide are fish. (Pradeep Kiran JA, 2019)

#### **Diversity of fish**

One of the key challenges to permitting sustainable use of natural resources is its conservation. (Preena PG et a., 2020; Shao F, Han M, Peng Z, 2019) We attempt to quantify the species and their occurrences in the current study, which is the first of its sort for Satpura Dam on Tawa River. A total of 52 species from 10 orders and 16 families were seen during the current investigation. (Vyas et al., 2009) conducted research on the tributary fish fauna and identified 52 species from 28 genera, 13 families, and 7 orders. From the Middle Stretch of the River Tawa, 57 species from 35 genera, 13 families, and 6 orders have been reported by (Siqueira AC et al., 2021; Bose et al., 2013). In the western section of the Narmada River, 58 different species of fish were found by (Pathak et al., 2014). In the Hoshangabad section of the Narmada, 47 species of fish from 29 genera, 15 families, and 6 orders were discovered, according to (Vyas et al., 2007). (Chouhan et al., 2013) identified 59 fish species at the Narmada's Maheshwar,

Khalghat, and Barwani sites, representing 34 genera, 17 families, and 7 orders. 25 species were found in the family Cyprinidae, followed by 4 in each of the Bagridae, Siluridae, and Ophiocephalidae families. The huge fecundity and tolerance to changes in the physical and biological properties of water body may be the reasons why the cypenidae family has the most species diversity. (Shi Z et al., 2020) According to (Sharma, et al., 2008), the substantially larger population density of Cypriniformes is due to the greater fertility of big carps and favorable environmental conditions. (Manel S et al., 2020)

The presence of diverse fish species demonstrated the variation at distinct study sites. Site 4 displayed the most species, 50, whereas Site 2 displayed the fewest species. The variation in habitat, or the depth and rate of flow, as well as the presence of food availability, account for the difference in the number of species. (Zeiringer, B. et al., 2018) Downstream, habitat heterogeneityincluding depth and flow heterogeneityincreases, creating a variety of niches that may be occupied by a wide range of species (Paudel S et al., 2020). According to (Sarkar and Bain, 2007), the deep depositional habitats of the Gerua River (Uttar Pradesh) were home to the most numerous and diversified group of fish, and the species and life stages discovered occupied a statistically separate subset of the river habitats. Water flow in rivers typically depends on the volume of water present and the depth of the water, and it can affect water chemistry, habitat, population dynamics, and water temperature. According to (Jesse WAM et al., 2018) the habitat structure determines the abundance and diversity of organisms.

The number of people present at various locations likewise showed wide changes, with the biggest number occurring in November and December and the lowest number occurring in May and June. The following factors may be to blame for the pattern of variation in the number of people. Low diversity in the summer is caused by extreme depth reduction, which ultimately causes an increase in salinity, free CO<sub>2</sub>, and hardness of the water, a decrease in dissolve oxygen, clarity, and pH of the water, and a loss in fish diversity. (Sarkar C, Saha N. C., 2021) In the winter, the situation is the opposite. Due to

this, summertime measurements of fish catch and widespread physical-chemical parameter degradation indicate a low level of variety. (Granzier HL, 2020) The introduction of species, straightforward exotic habitat destruction brought on by human withdrawals for human activities like agriculture, irrigation, exploitation and direct such etc., as impoundments, migration of species, etc. are additional external factors some that contribute to this situation.( Brysiewicz, A et al., 2022)

Two diversity indices-the Shannon and Simpson index—were combined to measure diversity. On site 1, the value of the Shannon index varied from 3.72 to 2.85 and displayed a similar trend, ranging from 2.77 to 3.78. The month of October saw the highest value, while the month of June saw the lowest value. The value on site 2 ranged from 2.77 to 3.68. Sites 3 and 4 both had values between 2.85 and 3.73 and 2.88 to 3.72, respectively, for those that were seen. The Simpson index was 0.01 to 0.03 and was essentially constant during the course of the trial. A Shannon index value greater than 1 indicates that the Narmada River offers superior fish habitat and has the capacity to support the greatest number of fish. The different physico-chemical factors, such as temperature, dissolved oxygen, and habitat depth, may be to blame for the variation in the diversity index. The post-monsoon season is characterized by high depth due to an increase in water level brought on by monsoon rains, mixing of the water brought on by rains, an increase in dissolved oxygen, and the dilution of organic and inorganic pollutants. The summer season is typically characterized by low depth of water, the highest temperature, low dissolved oxygen, and an increase in organic and inorganic pollutants. Each of these elements directly affects the variety and assemblage of fish. The current findings have also been found to be consistent with studies conducted by (Chouhan et al. 2013; Sharma et al., 2011).

## Conclusion

Satpura Dam on Tawa River is discovered to support a remarkably rich fish diversity and

serves as a possible source of income for the local population and the Indian government.

There were 52 species in total, distributed across 10 orders and 16 families. 25 species were found in the family Cyprinidae, followed by 4 in each of the Bagridae, Siluridae, and Ophiocephalidae families. Site 4 (47) had the most species, followed by Site 2 (45), Site 3, which had 42 species, and Site 1. Site 4 has a variety of habitats, such as riffles and ponds, whereas Site 1 has small pebbles, rock beds, and a lot of flora, all of which are ideal for the majority of species' survival and reproduction. On sites 1, 2, 3, and 4, respectively, the Cyprinidae family contributed the highest percentages of occurrence (53%, 56%, 58%, and 53%), followed by the Ophiocephalidae (9%, 6%, and 7%). Site 1 (2798) had the most individuals reported, followed by Site 3 (2289); both sites are of the wide and pond type. Fish are artificially fed by the general public to the fish in Ghats, precious religious sites, and other prohibited areas. Two diversity indices-the Shannon and Simpson indexwere combined to measure diversity. While the Simpson index ranged from 0.01 to 0.03, the Shannon index ranged from 3.09 to 3.66. A Shannon index value greater than 1 indicates that the Narmada River offers superior fish habitat and has the capacity to support the greatest number of fish. The current data, when compared to the data that had previously been disclosed, revealed that the overall diversity is still conserved but there is massive decrease in the number of particular species (Tor tor). The case was already noticed by the working body and a workshop for the management of Mahasheer conservation was also done in the Indore city of Madhya Pradesh. By all this is it is quite evident to recommend here that proper scientific of management the aquatic resource. implementation of laws for illegal fishing, further study regarding the activities effecting the diversity and implementation of new methods and protocols for their sustainable conservation is at crying need.

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