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Diversity and Conservation Status of Ichthyofauna in the Freshwater Bodies of Uttar Pradesh, India: A review

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Abstract

As the human population continues to expand, India must explore every possible avenue to enhance its food production capacity. Fish are an essential part of many countries' economies and a staple food source for many people. In the present communication, an attempt has been made to review the ichthyofaunal diversity of the important fresh water bodies of Uttar Pradesh. Uttar Pradesh is the most populated state and blessed with vast potential of aquatic bio resources that exhibit rich genetic and vivid freshwater fish diversity. But, at present there are some factors causes the depletion of fish resources like overfishing and illegal fishing, lack of fish policy/laws, alien species invasion, habitat degradation, shrinkage of water bodies, pollution and water quality degradation, and lack of awareness among masses. The main objective of this literature review is to know the threats and conservation status, distribution and to recommend the strategy for the conservation and management of fishes of the state, so that clear-cut idea could be drawn, for further research.

Keywords: Freshwater, Ichthyofaunal diversity, Conservation status, Threats

1. Introduction

Fishes are one of the important elements in the economy of many nations being the stable item in the diet of many people for nutritional security (Talwar and Jhingran 1991). Fish is one of the most important components of food for human beings, because it provides protein, lipids, vitamins, essential amino acids, fatty acids (ω3 polyunsaturated, eicosapentaenoic and docosahexaenoic fatty acids) and minerals for the growth and development of body as well as maintenance of human health by preventing several nutritional deficiency diseases (Verma, 2019; Prakash, 2020a). India has a third large position in fisheries and second in aquaculture (Santosh *et al*., 2024, Mohan *et al*., 2005). India produced 8% of the world's fish. 16.24 million tonnes of fish were produced in 2021–2022, of which 4.12 million tonnes were marine fish and 12.12 million tonnes came from aquaculture (Mukherjee *et al*., 2024).

Uttar Pradesh is the most populated state and blessed with vast potential of aquatic bio resources that exhibit rich genetic and vivid freshwater fish diversity and contributes nearly 14.68% of Indian fish biodiversity and offers considerable scope for inland fisheries development and aquaculture (Lakra, 2010). The fish production plays a significant role in the human economy. Fish is one of the most important sources of animal diet and human diet. Approximately 22,000 fish species are known to exist out of 30,900 vertebrate species (Jayaram, 2010). India is home to 2500 (11%) of the 22,000 fish species that have been identified (Nagma and Khan, 2013). In India, there are 2500 fish species, of which, 930 live in freshwater and 1570 are marine (Kar, 2003). Ichthyofaunal diversity refers to variety of fish species (Johnson *et al*., 2012) fisheries plays a vital part in the socio-economic development of the country, as it is a valuable supply of livelihood for a huge proportion of economically backward population. Additionally, it creates jobs, alternative sources of revenue, and encourages the development of new subsidiary businesses (Goswami *et al*., 2012).

Due to habitat destruction, defragmentation, irrational fishing methods, the introduction of exotic species, and environmental aberrations like decreased water volume, increased sedimentation, water abstraction, and water pollution over time, the state's fish biodiversity has been rapidly declining over the past few decades (Ashok, 2018). A few species have even disappeared from India's freshwater ecosystem, and some are classified as endemic, endangered, or threatened (Sanjay and Prakash, 2020). The quality of aquatic habitats has been deteriorated, resulting in oxygen depletion, fish mortality, and disruption of breeding cycles in numerous fish species of the water bodies reported. These factors include electrical fishing, fishing with fine-mesh nets, poisoning of water bodies, and blasting techniques, especially untreated industrial and agricultural effluents (Mishra, *et al*., 2021). The composition structures, population dynamics, and conservation status of major important rivers and lakes such as Gandak, Sai, Bhuila lake ,Gomti, Rapti, Kuwano and their several tributaries (Srivastava *et al*.,2013; Sanjay & Prakash, 2020; Sahu *et al*., 2024; Ali, 2025; Bihari *et al*., 2025; Chaudhary *et al*., 2025 and Ali, 2026). A huge number of studies have been made by different researchers on ichthyofaunal diversity of various fresh water bodies in India including U.P such as Jayaram (2010), Jhingran (1991), Bhat (2003) and Gowda *et al.* (2015). There is a considerable knowledge gap on the fish diversity patterns in many riverine ecosystems of India.

2. Ichthyofaunal Diversity in Uttar Pradesh

Water habitats of Uttar Pradesh support a varied range of fish species. Several studies have documented this review. Ichthyofaunal diversity of district Faizabad (Uttar Pradesh), India was reported by Kumar *et al*. (2013). They reported the district has 62 fish species of 41 genera, 20 families and 9 orders.. The orders with the greatest diversity are Cypriniformes (35.48%) and Siluriformes (32.25%). Labeo rohita and Cyprinus carpio are some of the important species in culture ponds of the locality (Kumar *et al*., 2013).

In Gandak River, 54 fish species were reported by Srivastava (2013). Out of these, 45% were low risk (near threatened), 26% were vulnerable, 11% were least concern, 11% were not evaluated, and 7% were endangered. Cyprinidae (33%), followed by Tetradontidae (5%), Bagridae (11%) and Channidae (9%). A detailed survey of Sai River revealed 39 fish species of 8 orders, 16 families and 28 genera (Bihari *et al*., 2025). The dominant order was Cypriniformes and the main family was Cyprinidae. Shannon's Index (3.56), Simpson's Index (0.96) and Evenness Index (0.90) indicated that diversity was high and evenly distributed in the fish community. The winter and pre-monsoon seasons had the highest species richness.

During the survey of the Rapti River in the districts of Shravasti and Balrampur a total of 46 species from 30 genera, 19 families and 9 orders were discovered, as reported by Sanjay and Prakash (2020). The largest number of fish species belongs to the family Cyprinidae with 13 species. The next groups of species are those in the order Ophiocephalae, with 4 species and the family Bagridae, with 6 species. A survey of this division revealed 58 species of fish, belonging to 36 genera and 21 families, in 9 orders. Cypriniformes (36.20%) and Siluriformes (27.58%) dominated the assemblage (Prakash, 2021). Ichthyofaunal diversity of Bhagda or Bhagta Taal, a wetland of Balrampur, Uttar Pradesh, were explored by Varsha & Prakash (2022). In this wetland they recorded 41 freshwater fish species from 29 genera belonging to 16 families and 8 orders. Freshwater fish species from the Cypriniformes order made up 39.02% of the fish population making Cypriniformes the common order. Freshwater fish species from the family Cyprinidae were the varied with 16 species, followed by freshwater fish species from the family Channidae with 5 species and freshwater fish species, from the family Bagriidae with 4 species.

Ali (2025) was surveyed the river Kuwano in Balrampur district and reported 58 fish species. The reported fish species come from 36 genera, 20 families and 8 orders. Among those fish species 24 fish species, which is 41.38 percent of all fish species belong to Cypriniformes; the next common fish species are Siluriformes making up 27.59 percent of all fish species. Of all fish species 51 fish species are listed as least concern and 5 fish species are near threatened.

In the Basti district 14 fish species, from three orders, six families and seven genera were reported by Chaudhary *et al*. (2025). It turns out that one fish species is endangered three fish species are vulnerable and seven fish species are near threatened.

The Gomti River is a tributary of the Ganga. It is home to 76 fish species, including 70 species and 6 foreign ones. These fish belong to 56 taxa, 32 families and 12 different orders (Sahu *et al*., 2024). Three of these species were discovered in this area for the time. Sixty-four of the species are classified as Concern meaning they are not, at risk of extinction.

Recently, Ali (2025) studied the Ichthyofaunal diversity and conservation status of the River Rapti, Uttar Pradesh, India and reported a total of 61 fish species belonging to 39 genera, 22 families, and 9 orders. Among these, the order Cypriniformes was the most dominant, comprising 24 species (39.34%), followed by Siluriformes with 18 species (29.50%), Perciformes with 7 species (11.48%), Ophiocephaliformes with 4 species (6.56%), Synbranchiformes with 3 species (4.92%), Osteoglossiformes with 2 species (3.28%), and Clupeiformes, Beloniformes, and Tetraodontiformes, each represented by a single species (1.64%). He also reported, the majority of the recorded species (54) fall under the Least Concern (LC) category. Five species *Notopterus chitala*, *Hypophthalmichthys molitrix*, *Ompok bimaculatus*, *Ompok pabda* and *Ailia coila* were identified as belonging to the Near Threatened (NT) category, while two species *Bagarius bagarius* and *Wallago attu* were classified as Vulnerable (VU).

3. Taxonomic Patterns and Community Structure

a. Order-Level Dominance

Across all the surveyed freshwater ecosystems in Uttar Pradesh, Cypriniformes is the most specious order for fish. It is the most successful freshwater fish group in the rivers of India, utilizing habitats and food resources most efficiently. This order dominates the majority of surveyed ecosystems, with comparable abundance in the rivers of different sizes, wetlands, and lakes. However, in the largest rivers, Siluriformes is the second most specious order.

b. Family-Level Diversity

Cyprinidae is the most specious family of fish in all the surveyed freshwater ecosystems in Uttar Pradesh. This family is remarkably diverse, as it unites herbivorous, omnivorous, and carnivorous species of small and large size. Other fish families that are frequently encountered in different rivers are Bagridae, Channidae, and Siluridae. Such a diversity of families demonstrates the ability of fish to utilize different types of water areas and food resources found in riverine ecosystems.

c. Species Richness Gradients

The number of fish species in different water areas greatly varies from 14 species in small lakes to 76 species in the Gomti River. The variations in species richness can be explained by the differences in the size and habitat heterogeneity of water bodies and human impact. Thus, large rivers and lakes with well preserved vegetation have the highest number of fish species, while small isolated lakes and reservoirs often have a low number of species due to human impact.

4. Major Anthropogenic Threats

Various human activities threaten fish diversity in the freshwater ecosystems. These includes:

a. Overfishing and Illegal fishing activities

Fish stocks are directly removed from their natural habitat either through excessive or harmful fishing resulting in a lesser number of fish harvested for human consumption. Ali (2025) reported that the Kuwano river experiences extreme illegal fishing in the region, threatening the existence of fish species within the river. In Gomti River, irrational fishing of juveniles and brooders using advanced fishing gears has significantly impacted the fish population in the region (Sahu et al., 2024).

b. Habitat degradation

Increased anthropogenic activities have significantly altered and degraded fish habitats in riverine ecosystems. Sahu et al. (2024) reported that the water pollution and water weeds invasion affecting the aquatic ecosystem. Kuwano river experiences siltation and human activities (Ali, 2025).

c. Alien species invasion

The combination of the introduction of new alien species and anthropogenic activities in Sai river has threatened fish biodiversity (Bihariet al., 2025). Sahu et al. (2024) were recorded six alien species in Gomti River. These species poses a significant threat to other native species within the river ecosystem. This invasion results in reduced population size and local extinction of some species (Sanjay & Prakash, 2020; Yadav, 2019). The introduction of common carp Cyprinus carpio in Ganga and Mozambique tilapia, Oreochromis mossambicus in Yamuna river has caused adverse effects to the native fish species (Singh et al., 2010 and Ganie, 2013). These species usually thrive in their invaded habitat resulting in higher competition over the native species, thus eliminating them since they occupy the niche of the local fish species, rendering them unfit for commercial purposes (Ganie, 2013).

d. Pollution and water quality

Pollution from various industries and waste disposal results in water toxicity and poor water quality that subsequently harms fish species (Ali, 2025).

5. Threats and Conservation Status

The state of conservation of fish species in Uttar Pradesh shows an alarming trend of species at risk. In each of the surveyed systems, the conservation status categories usually appear in the following abundance:

- 51-75% of the species are classified as Least Concern (LC) and are therefore relatively safe.
- 5-15% of the species are classified as Near Threatened (NT) and are therefore of conservation concern.
- 02-07 % of the species are vulnerable (VU).
- 1-7% of species are classified as endangered (EN).

This distribution implies that while most species maintain sustainable populations, a large proportion suffer increasing challenges, which require monitoring and action.

6. Conservation Stretagies

a. Adoption of Fishing Limits

Implementing fishing restrictions or quotas is one of the main sustainable fishing methods. By limiting the quantity of fish that can be captured, these limitations assist ensure that fish populations can rebound. Enforcing fishing quotas is essential in areas like Uttar Pradesh to save overfished species like catla (*Catla catla*) and rohu (*Labeo rohita*), which have been negatively damaged by overfishing (Gautam *et al*., 2018 and Alam *et al*., 2017).

b. Seasonal Fishing Bans

Seasonal fishing prohibitions are put in place during important breeding seasons to prevent interfering with fish populations' ability to procreate. Species like the mrigal (*Cirrhinus mrigala*), which require specialized environmental conditions for effective reproduction, this method is especially crucial. In India, including Uttar Pradesh, seasonal fishing bans are intended to preserve fisheries resources and secure small-scale fisheries (Gunakar *et al*., 2017).

c. Community-Based Management

Community involvement in local fisheries management is a common component of sustainable fishing methods (Sharma *et.al*., 2018). Community based management initiatives in Uttar Pradesh give local fishermen the authority to oversee and control their fishing operations, guaranteeing that they follow sustainable methods. These initiatives increase adherence to fishing laws and cultivate a sense of accountability for safeguarding fisheries resources by incorporating local stakeholders (Tyagi *et al*., 2008 and Gautam *et al*., 2017).

d. Encouragement of Fishing Gear Selection

Promoting selective fishing equipment that reduces by catch is another sustainable technique. Conventional fishing techniques frequently result in the accidental decline of fish supplies by capturing non-target species. Fishermen can lessen their influence on non-target species and immature fish by utilizing equipment that targets particular fish types or sizes. In areas like the Ganges Basin, where non-selective fishing practices have contributed to the extinction of native species, this technique is crucial for maintaining fish biodiversity (Kelkar *et al*., 2020 and Riyaz *et al*., 2023).

e. Scientific Research and Monitoring

In order to fully understand fish population dynamics and the causes of their reduction, ongoing scientific research is crucial. Researchers can evaluate the health of aquatic ecosystems and determine which species are at risk by tracking fish population patterns over time. Conservation methods, such as habitat restoration and the implementation of fishing quotas, require ongoing research to determine their effectiveness (Overton, *et al.,* 2024). Researchers use population data to inform management strategies

so that conservation efforts are adaptive and target the most vulnerable species (Miranda, *et al*., 2022).

f. Government Regulations and management

The Indian government has put in place a number of laws to reduce pollution in the Yamuna and Ganges rivers. The National Mission for Clean Ganga, which aims to reduce pollution by processing sewage and industrial effluents before they are released into the rivers, is one of the most important projects.

g. Aquaculture as a Substitute

The people of the region are promoting to sustainable aquaculture as a replacement for wild fishing. Sustainable aquaculture gives a supply of protein and revenue to nearby communities. Meanwhile sustainable aquaculture reduces pressure on fish populations by raising fish in controlled environments. Sustainable aquaculture methods include using feed, managing water resources efficiently and avoiding chemical additives that could damage aquatic ecosystems (Duarah *et al*., 2020 and Prasad *et al*., 2020). Sustainable aquaculture is a way to meet the growing demand, for fish while protecting wild fish populations in areas that are severely overfished.

h. Protection and Restoration of Habitat

Restoring degraded wetlands is a key component of habitat restoration initiatives. Wetlands are essential for maintaining fish biodiversity, but pollution, urbanization, and agricultural growth have seriously damaged them (Behera *et al*., 2012 and Tari *et al*., 2022). Proposal for the establishment of aquatic sanctuaries and the protection of specific river stretches. These measures aim to provide refugia for migratory and sensitive species that are increasingly threatened by habitat loss (Yadav, 2019 and Ali, 2026).

i. Use of Technology in Preserving Fish Species

Advanced technologies like GPS tracking and water quality monitoring systems are being used more and more in fish conservation. Tracking fish with GPS helps scientists learn about their migration paths and where they live. This is especially important for fish that move distances, such, as Hilsa (*Tenualosa ilisha*). These fish depend on environmental conditions to breed. Understanding their movements and habitats helps protect them (Lahoz-Monfort & Magrath, 2021 and Chu, *et al*., 2022). One of these technologies is computer vision. It has received attention lately because it can quickly check large amounts of digital footage from protected areas. It helps people understand what happens when habitats are damaged (Lopez-Marcano, *et al*., 2021).

4. Conclusion

Based on the review study, it is informed that a survey of fish diversity is important for the development of sustainable fishery practices and proper documentation leading to diversity information systems is an urgent need. Fishermen and local people often catch fish. These fish are part of their food. They also sell the fish to earn money. The fishery authorities should manage fishery resources carefully. They must use principles when managing these resources. Unlawful fishing methods must be stopped. These methods can cause fish species to disappear. Fishermen need to trained about fisheries and scientific techniques. Training helps increase fish production. Understanding to how fish species distribution is important. This information helpto make conservation plans. The decline in fish populations in Uttar Pradesh is driven by multiple factors such as overfishing, pollution from industrial and agricultural runoff, habitat destruction, invasive species, and climate change.

Significant biodiversity loss, disturbances in food security, and the decline of traditional fishing methods have resulted from these reasons. To address these issues, conservation initiatives are being carried out, including scientific monitoring, pollution control, habitat restoration, and sustainable fishing methods. In order to stop fish species from going extinct, swift action must be taken in concert. It also helps to know all the water parameters are within permissible limits and show a supportive correlation to the ichthyofaunal diversity.

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