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The Documentation and Identification of Economically Freshwater Fishes of Gomti River at Sultanpur District

Divya Dubey[1]; Archana Yadav[2]

[1,2]Department of Zoology Kmala Nehru Institute of Physical and Social, Sciences, Sultanpur, (U.P.) India-228118

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Abstract: The Gomti River, an essential tributary of the Ganga, supports a diverse array of fish species, serving as a crucial resource for aquatic biodiversity and local livelihoods in Uttar Pradesh. However, anthropogenic activities such as pollution, habitat degradation, and overfishing have increasingly threatened its ecological health. This study conducted a year-long assessment of fish diversity in the Sultanpur stretch of the Gomti River, documenting 52 species from 22 families, including culturally and economically significant species such as Rohu (*Labeo rohita*), Mangur (*Clarias batrachus*), and Pabda (*Ompok pabda*). Using biodiversity indices like the Shannon-Weiner Index and Simpson's Diversity Index, the study highlights significant impacts of anthropogenic pressures, including urban effluents, agricultural runoff, and unregulated fishing. Recommendations for sustainable river management include pollution mitigation, habitat restoration, and regulated fishing practices. These findings provide a foundation for targeted conservation efforts to preserve the river's biodiversity.

Keywords: *Gomti River, Fish Biodiversity, Anthropogenic Impacts, Freshwater Ecosystems, Habitat Restoration, Conservation Strategies.*

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I. INTRODUCTION

Fish diversity plays a crucial role in maintaining the balance of aquatic ecosystems. Fishes, being highly diverse, can be classified based on various characteristics such as their feeding habits, visual abilities, body shape, movement styles, and even toxicity. As cold-blooded animals, fishes are uniquely adapted to aquatic life, typically possessing a streamlined body that aids in efficient movement through water. They represent nearly half of all vertebrate species. While the majority of fish species have already been identified and documented, approximately 250 new species continue to be discovered annually (Das et al., 2011)[9]. As of September 2020, FishBase reported that around 34,300 fish species had been described—surpassing the total number of all other vertebrate groups combined, including amphibians, reptiles, birds, and mammals. In aquatic ecosystems, most higher vertebrates rely heavily on fish as a primary food source (Groombridge, 1992)[15]. The conservation of biodiversity holds particular significance in developing countries, where communities depend directly on natural resources like forests and fisheries for their sustenance and livelihood (Mishra et al., 2021b)[26].

The river supports diverse aquatic flora and fauna, with fish biodiversity serving as an indicator of ecological health (Dudgeon et al., 2006). Fish not only play a vital role in maintaining ecosystem balance but are also a primary source of livelihood for local fishing communities (Sarkar et al., 2012). Rivers are critical components of freshwater ecosystems, providing essential ecological services, sustaining biodiversity, and supporting human livelihoods (Vannote et al., 1980).

The Gomti River, a prominent tributary of the Ganga, originates from Madhoganj in Uttar Pradesh and traverses' multiple districts, including Sultanpur, before merging with the Ganga River. However, the ecological integrity of the Gomti River is under significant threat due to increasing anthropogenic pressures, including industrialization, urbanization, agricultural practices, and habitat degradation (Gupta et al., 2018). Sultanpur, a critical stretch of the river, experiences intensive human activity, leading to pollution, overfishing, and habitat destruction, which adversely impact fish biodiversity.

River water serves various purposes in both sustainable and unsustainable agricultural practices. However, unsustainable agriculture can have numerous adverse effects, disrupting the ecological equilibrium (Mishra, 2014a)[23]. Water is an essential natural resource for all forms of life and is considered a valuable environmental asset (Mishra and

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Dikshit, 2021a)[25]. Freshwater resources are extensively used for activities such as irrigation, urban and industrial water supply, hydropower generation, sewage and industrial waste disposal, and the harvesting of edible fish (Verma, 2016)[35]. While these water bodies support a rich and diverse fish fauna, their ecological health and biodiversity are increasingly threatened by water pollution. Major pollutants include toxic waste spills such as oil and petroleum products, industrial effluents, pesticides, fertilizers, thermally polluted water from industrial discharge, low dissolved oxygen levels, and acidic runoff from coal mines all of which severely compromise water quality and fish diversity (Wolter et al., 2000)[37].

Among aquatic organisms, fishes are the most well-known and are unique in being the only food resource extensively harvested from natural populations. Positioned at or near the top of the aquatic food chain, fishes also serve as vital indicators of a well-balanced ecosystem (Dutta Munshi and Srivastava, 1988)[11]. Fish diversity encompasses both species richness—the number of species present in a specific area—and species abundance, which refers to the relative population size of each species. In the current scenario, managing fish diversity and their habitats poses a significant challenge. Proper evaluation of the impacts of habitat changes and other disturbances on fish populations necessitates thorough surveys conducted both before and after such changes occur (Mishra, 2014a)[24]. The diversity, community structure, and species assemblages of fishes in streams and rivers are closely influenced by a range of abiotic and biotic factors (Bhakta and Bandyopadhyay, 2008)[4]. These factors collectively shape the success or failure of species assemblages within the spatial limits of their distribution in riverine systems (Verma, 2017)[36].

All over India, freshwater fish diversity is on a decline. Many of them have been lost forever few studies have been carried out so far regarding this aspect. They mainly identified major sources driving extinction which are- over harvesting, completion by newly introduced exotic fishes, pollution and illegal and destructive fishing methods (Lakra and Sarkar, 2007)22. Some other factors are also contributing towards the loss of fish diversity (Flores, et. al., 2009)12. In the irrigation canal when water is stopped in the canals, they are trapped near the gate and fished out (Gibbs, 2000)14. The shallow streams and pools, such as those at the base of waterfalls, fall victim to the easy availability of dynamite ever since quarrying and road construction began on a grand scale in the country (Bunn and Arthington, 2002)6 . The shock waves of the blast destroy all fish in the vicinity. The drastic modification of fresh water habitats by damming streams and rivers siltation leading to reduction in their depth has also profoundly affected fish diversity (Barman, 2007)2 . The overall deterioration of habitat has rendered many fishes susceptible to diseases (Sarkarand Bain, 2007)27. One of the most serious is epizootic ulcerative syndrome disease that brought mass mortalities and extinction of some species in Indian fresh water fishes (Johal, et. al. 2002)21. The present study is an attempt to know the fish diversity and its conservation status in the river Gomti at district Sultanpur, Uttar Pradesh, India**.**

II. METHODOLOGY

➢ *Study Area*

The study area focuses on a specific stretch of the Gomti River flowing through Sultanpur district in Uttar Pradesh. Geographically, Sultanpur is situated at latitude 26.26°N and longitude 82.07°E and Sultanpur river map given bellow. The Gomti River holds significant importance in the region as a vital water resource for agriculture, fishing, and domestic consumption, supporting both local livelihoods and the regional ecosystem. Its strategic location makes it a critical point for analysing anthropogenic impacts on fish biodiversity.

Fig 1 Study Area Sultanpur River Map

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- Site 1 (Upstream): Near rural areas with minimal human interference.
- Site 2 and Site 3 (Urban): Proximity to Sultanpur town, characterized by sewage and industrial effluents.
- Site 4 (Agricultural Zone): Intensive agricultural activity contributing to runoff.
- Site 5 (Downstream): Mixed-use area with industrial, urban, and agricultural impacts.

➢ *Sampling Techniques*

- *Fish Sampling:*

Monthly surveys conducted using cast nets and gill nets sourced both from fieldwork and local fish markets to ensure comprehensive data collection on species diversity and abundance.

- *Surveys and Interviews:*

Local fishers and community members were interviewed to assess their observations on declining fish diversity.

- *Water Quality Assessment:*

A comprehensive evaluation of parameters such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), and nitrate levels was conducted using APHA (2017) protocols. This ensured accurate and standardized measurements essential for assessing the river's ecological health. such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), and nitrate levels were measured following APHA (2017) protocols.

- *Species Identification:*

Fish species were meticulously identified using standardized taxonomic keys to ensure accuracy and were documented alongside their local names, highlighting their cultural and ecological significance.

➢ *Sampling Period*

The study was conducted over six months from January to June 2023, covering both pre-monsoon and monsoon periods.

➢ *Data Analysis*

Data were analysed using biodiversity indices, including Shannon-Weiner Diversity Index and Simpson's Index, to assess species richness and evenness. Water quality parameters were compared with standard permissible limits.

III. RESULTS

The study recorded 52 fish species from 22 families, each with cultural and ecological significance. For example, the locally known Rohu (*Labeo rohita*) and Catla (*Catla catla*) are abundant in urban and upstream areas, while species like Mangur (*Clarias batrachus*) thrive in polluted downstream zones. Sensitive species such as Pabda (*Ompok pabda*) were predominantly found in upstream, less-disturbed environments. The Pool Barb (*Puntius sophore*), known locally as Pothia, was observed across all sampling sites, highlighting its adaptability to varied ecological conditions. By integrating species-specific observations with their local names, the research underscores the interconnectedness of biodiversity with cultural heritage. The findings emphasize how anthropogenic pressures—pollution, overfishing, and habitat alterations—shape fish distribution and diversity in Sultanpur's Gomti River recorded 52 fish species from 22 families. Table 1 provides the scientific names, common names, local names, and their distribution across sampling sites:

Table 1 Diversity, Conservation Status, and Distribution of Freshwater Fish Species in the River Ecosystem.

Scientific Name of Fish	Common/ Local Name	Family	Availability in River	IUCN Status	Order
Gadusia chapra	Suhia	Clupeidae	Moderate	VU	- Clupeiformes
Goniolosa manmina	Majhali Suhia	Clupeidae	Very Rare	VU	
Catla catla	Bhakur	Cyprinidae	Common	LC	Cypriniformes
Cirrhinus mrigala	Nain	Cyprinidae	Common	LC	
Labeo rohita	Rohu	Cyprinidae	Common	LC	
Labeo calbasu	Karaunchar	Cyprinidae	Rare	LC	
Cyprinus carpio	Common Carp	Cyprinidae	Common	VU	
Hypopthalmicthys molitrix	Grass Carp	Cyprinidae	Moderate	NT	
Ctenopharyngodon Idella	Silver Carp	Cyprinidae	Common	NE	
Oxygaster bacaila	Chalhawa	Cyprinidae	Common	LC	
Oxygaster clupeioides	Silhani	Cyprinidae	Common	LC	
Puntius sarana	Darahee	Cyprinidae	Common	LC	
Puntius sophpore	Sidhari	Cyprinidae	Rare	LC	
Puntius ticto	Punti	Cyprinidae	Common	LC	
Puntius javanicus	Japani Punti	Cyprinidae	Rare	LC	
Osteobrama cotio	Gurda	Cyprinidae	Very Rare	VU	
Nemacheilus botia	Carri	Cobitidae	Common	NE	
Notopterus notopterus	Patra	Notopteridae	Common	LC	Osteoglossiformes
Notopterus chitala	Moi/knifefish	Notopteridae	Common	LC	

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Wallago attu	Parhin	Siluridae	Common	VU	
Mystus cavasius	Sutahava Tenger	Bagridae	Rare	LC	
Mystus menoda	Belaund	Bagridae	Common	LC	
Mystus tengara	Tengana	Bagridae	Moderate	LC	
Mystus vittatus	Tengara	Bagridae	Moderate	NE	
Mystus aor	Dariai Tenga	Bagridae	Common	LC	
Mystus seenghala	Dariai Tenga	Bagridae	Common	LC	
Rita rita	Belgagara	Bagridae	Rare	EN	
Ompak bimaculatus	Jalkapoor	Siluridae	Very Rare	NT	
Bagarius bagarius	Gonch	Sisoridae	Rare	EN	
Heteropneustes fossilis	Singhi	Heteropneustidae	Rare	EN	
Pangasius pangasius	Pangus	Pangasidae	Moderate	EN	
Clarias batrachus	Mangur	Claridae	Moderate	LC	
Clarias gariepinus	Bidesi mangur	Claridae	Common	LC	
Xenentodon cancila	Kauwa	Belonidae	Rare	NT	Beloniformes
Channa striatus	Sauri	Channidae	Common	LC	Perciformes
Channa punctatus	Girai	Channidae	Common	LC	
Channa marulius	Saur	Channidae	Rare	LC	
Channa gachua	Chanaga	Channidae	Moderate	LC	
Anabas testudinius	Kawai	Anabantidae	Common	LC	
Chanda baculis	Chanri	Ambassidae	Moderate	LC	
Chanda nama	Chanri	Ambassidae	Moderate	LC	
Oreochromis mossambicus	Chanri	Cichlidae	Moderate	LC	
Sciaena coitor	Patharchatti	Sciaenidae	Rare	NE	
Nandus nandus	Dhebari	Nandidae	Moderate	LC	
Anabas testudinius	Kawai	Anabantidae	Common	LC	
Colisa fasciatus	Khosti	Anabantidae	Common	LC	
Colisa chuna	Kholisa	Anabantidae	Rare	LC	
Glossogobius giuris	Bulla	Gobioidae	Very Rare	NT	
Rhinomugil corsula	Hunra	Mugilidae	Common	EN	Mugiliforme
Mastacembelus armatus	Baam/Zig-Zag eel	Mastacembelidae	Common	LC	Mastacembeliformes
Mastacembelus pancalus	Malga/Spiny eel	Mastacembelidae	Moderate	LC	
Tetraodon	Pufferfish	Tetraodontidae	Moderate	LC	Tetraodontiformes

UCN Red list: LC: Least Concern, VU: Vulnerable, NE: Not Evaluated, EN: Endangered, NT: Near Threatened, DD: Data Deficient.

➢ *Categorization of Fish Species Based on IUCN Status*

In the present study, a total of 57 unique freshwater fish species were identified from the surveyed river ecosystem. These species were classified based on their conservation status as per the International Union for Conservation of Nature (IUCN) Red List categories. The distribution across five major IUCN categories—Least Concern (LC), Vulnerable (VU), Near Threatened (NT), Endangered (EN), and Not Evaluated (NE)—was assessed to determine the conservation outlook of the ichthyofaunal diversity in the region. The analysis revealed that the majority of the fish species (59.65%) belonged to the Least Concern (LC) category, suggesting that these species are currently at low risk of extinction and maintain relatively stable populations within the ecosystem. However, the presence of 10.53% species categorized as Vulnerable (VU) indicates a subset of the ichthyofauna facing heightened threats that could lead to population decline if not managed properly. Additionally, 8.77% of species were classified as Near Threatened (NT), implying that although these species are not currently endangered, they are likely to be considered threatened in the near future if environmental pressures persist. An equal proportion (8.77%) fell under the Not Evaluated (NE) category, highlighting gaps in current data and the need for comprehensive studies to assess the conservation status of these species. Of particular concern is the identification of 7.02% of species as Endangered (EN), signaling a critical risk of extinction for these taxa in the wild. These species warrant immediate conservation attention and policy intervention to ensure their protection and to mitigate the factors contributing to their population decline. Overall, the distribution of fish species across different IUCN categories emphasizes the necessity of sustained monitoring, ecological management, and conservation strategies. Special focus should be placed on species listed as Vulnerable, Endangered, and Near Threatened to preserve the aquatic biodiversity and ecological balance of the riverine habitat (figure 1).

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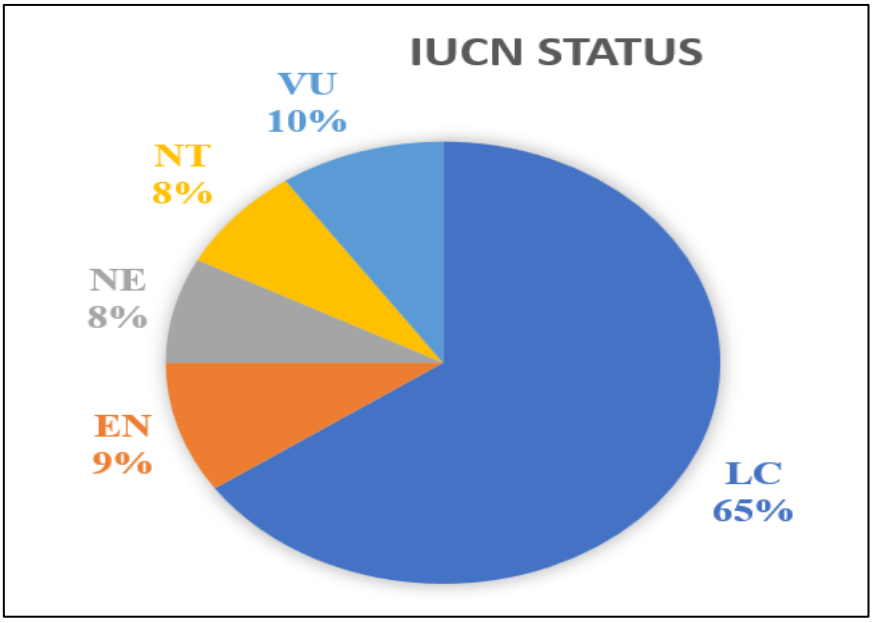

Fig 1 Percentage Distribution of Freshwater Fish Species Across IUCN Conservation Status Categories in the Surveyed River Ecosystem.

➢ *Categorization of Fish Species Based on their Abundance*

The classification of fish species according to their abundance in riverine ecosystems provides valuable insight into the ecological health and biodiversity of freshwater habitats. Fish species were categorized into four abundance levels: common, moderate, rare, and very rare. Common species, such as *Catla catla* (Bhakur), *Labeo rohita* (Rohu), *Mystus seenghala* (Dariai Tenga), *Channa striatus* (Sauri), and *Anabas testudinius* (Kawai), were frequently observed, indicating stable populations and favorable ecological conditions. Moderately abundant species, including *Gadusia chapra* (Suhia), *Hypopthalmichthys molitrix* (Grass Carp), *Pangasius pangasius* (Pangus), and *Oreochromis mossambicus* (Chanri), were observed consistently but less frequently, suggesting transitional habitats or moderate ecological pressures. Rare species, such as *Labeo calbasu* (Karaunchar), *Rita rita* (Belgagara), *Heteropneustes fossilis* (Singhi), and *Channa marulius* (Saur), appeared sporadically and in low numbers, often due to habitat loss, pollution, or overexploitation. Very rare species, including *Goniolosa manmina* (Majhali Suhia), *Osteobrama cotio* (Gurda), *Ompak bimaculatus* (Jalkapoor), and *Glossogobius giuris* (Bulla), were found in extremely low numbers, signifying vulnerable or potentially endangered populations requiring immediate conservation attention. This classification framework supports targeted management strategies to preserve aquatic biodiversity and maintain ecological balance in riverine environments (Figure-2).

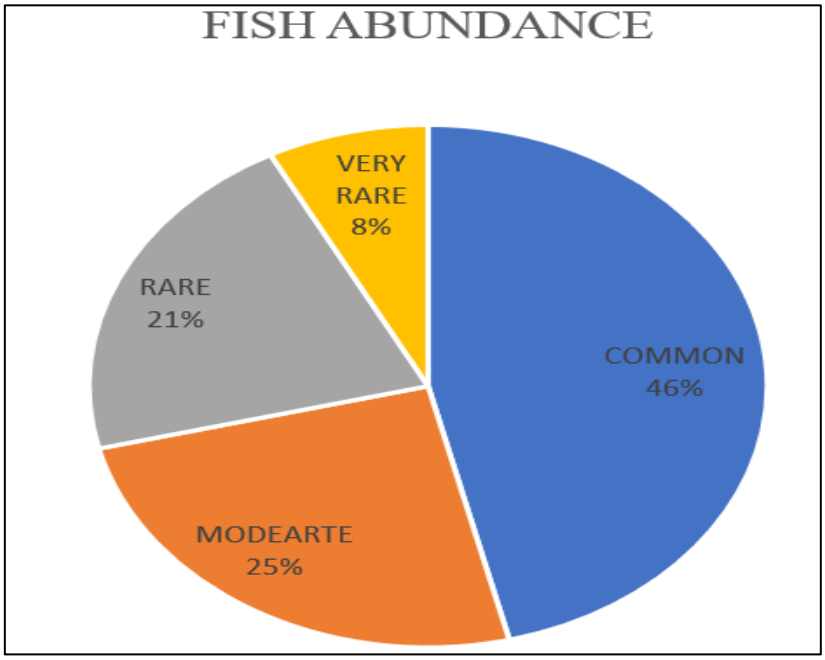

Fig 2 Percentage Distribution of Freshwater Fish Species According to their Abundance in the River Ecosystem.

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IV. DISCUSSION

The ichthyofaunal survey conducted in the Gomti River at Sultanpur presents a comprehensive overview of the region's freshwater biodiversity and highlights critical ecological and conservation insights. The identification of 57 unique fish species from 22 families reveals the ecological richness of the river ecosystem. By incorporating local nomenclature alongside scientific classification, the study not only emphasizes species diversity but also celebrates the cultural significance of the aquatic biota, thereby reinforcing the link between biodiversity and community heritage. The observed distribution of fish species across different ecological zones illustrates the influence of anthropogenic pressures on aquatic habitats. Species such as *Labeo rohita* (Rohu) and *Catla catla* (Catla) were predominantly found in upstream and urban zones, suggesting their adaptability to relatively favorable and managed aquatic environments. In contrast, the prevalence of pollution-tolerant species like *Clarias batrachus* (Mangur) in downstream areas reflects the deteriorated water quality and habitat conditions due to urban runoff and untreated waste discharge. The selective presence of sensitive species such as *Ompok pabda* (Pabda) in less disturbed, upstream regions further corroborates the detrimental impact of pollution and habitat fragmentation on sensitive taxa. The widespread occurrence of *Puntius sophore* (Pothia) across all sampling sites underscores its ecological resilience and adaptability, positioning it as a potential bioindicator for long-term monitoring of river health. From a conservation perspective, the classification of species based on the IUCN Red List categories reveals that while a majority (59.65%) of the fish species are currently of Least Concern (LC), a notable proportion falls under categories that signal varying levels of threat. The presence of Vulnerable (10.53%), Near Threatened (8.77%), and Endangered (7.02%) species highlights the pressing need for proactive conservation measures. Particularly concerning is the identification of species under the Endangered category, which demands urgent intervention through habitat restoration, pollution control, and regulatory enforcement to prevent irreversible biodiversity loss. Additionally, 8.77% of the species remain under the Not Evaluated (NE) category, indicating significant data deficiencies. These gaps call for focused taxonomic and ecological research to accurately assess species' conservation statuses and to formulate evidence-based management strategies. The abundance-based classification further elucidates the ecological dynamics of the river. Common species like *Channa striatus* (Sauri) and *Anabas testudinius* (Kawai) suggest ecological stability in certain segments of the river. Conversely, the limited presence of rare and very rare species, such as *Goniolosa manmina* (Majhali Suhia) and *Ompok bimaculatus* (Jalkapoor), signals declining populations likely due to overexploitation, pollution, and habitat degradation. These species warrant prioritized conservation actions, including captive breeding programs, habitat protection, and stringent regulation of fishing practices. Overall, the study underscores the urgent need for integrated conservation frameworks that align ecological assessments with community engagement and policy support. Sustained monitoring, pollution mitigation, and community-based conservation efforts can play pivotal roles in preserving the biodiversity and ecological integrity of the Gomti River. Addressing the threats faced by vulnerable and endangered species is essential not only for ecological sustainability but also for safeguarding the cultural and economic fabric associated with the region's aquatic biodiversity. The study reveals that anthropogenic pressures have significantly altered fish biodiversity in the Gomti River at Sultanpur. Pollution from untreated sewage, industrial effluents, and agricultural runoff has resulted in eutrophication, favoring pollution-tolerant species such as Mangur (*Clarias batrachus*) and Silver Carp (*Hypophthalmichthys molitrix*). These species demonstrate resilience to low dissolved oxygen levels and elevated nutrient loads. Conversely, sensitive species like Pabda (*Ompok pabda*) and Garua (*Clupisoma garua*) have become confined to upstream regions where water quality is relatively better (Singh & Singh, 2018). Additionally, habitat disruptions from sand mining, embankment construction, and reduced flow have fragmented critical breeding and feeding zones, exacerbating biodiversity loss. Seasonal variations also play a critical role, with post-monsoon periods showing higher species richness due to improved water quality and availability of spawning grounds. Similar findings have been reported globally and in India, where anthropogenic pressures are primary drivers of freshwater biodiversity loss (Dudgeon et al., 2006; Vass et al., 2020). This research emphasizes the need for integrated river basin management strategies, including pollution mitigation, habitat restoration, and regulated fishing practices. Without timely interventions, the Gomti River's ecological balance and biodiversity are at risk of irreversible damage, which would adversely affect local livelihoods and ecosystem services. have led to significant alterations in fish diversity in the Gomti River. Pollution from untreated sewage and agricultural runoff has favoured pollution-tolerant species such as Mangur (*Clarias batrachus*), while sensitive species like Pabda (*Ompok pabda*) are increasingly restricted to upstream zones. Habitat disruption from sand mining and embankment construction has further exacerbated biodiversity loss. These findings align with studies by Dudgeon et al. (2006) and Vass et al. (2020), emphasizing the urgent need for targeted interventions.

V. CONCLUSION

The Gomti River at Sultanpur serves as a vital habitat for diverse fish species, emphasizing its ecological significance and contribution to local livelihoods. However, this study highlights that escalating anthropogenic pressures—notably pollution, habitat degradation, and overfishing—are critically undermining the river's biodiversity. Sensitive species, such as Pabda (*Ompok pabda*) and Garua (*Clupisoma garua*), have become confined to upstream areas with better water quality, while pollution-tolerant species dominate in degraded zones. These findings resonate with global patterns of biodiversity loss due to human activities. To ensure the ecological sustainability of the Gomti River, it is imperative to implement integrated management strategies. This includes advanced pollution control technologies, habitat restoration projects, and community-led conservation initiatives. Long-term

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biodiversity monitoring and adaptive management are essential to balance environmental sustainability with developmental demands, safeguarding this critical freshwater ecosystem for future generations.

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