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Research Article

A COMPREHENSIVE STUDY INTO THE DIVERSITY OF FRESHWATER FISH SPECIES INHABITING LENTIC AND LOTIC AQUATIC ENVIRONMENTS WITHIN THE MATHURA BLOCK, DISTRICT MATHURA, UTTAR PRADESH, INDIA

***Praveen Ojha[1] & Dheeraj Kumar[2]**
[1]Dept of Zoology, [2]Dept of Chemistry,
K.R. (P.G.) College, Mathura, UP, India
**Author for Correspondencedr.praveenojha11@gmail.com*

ABSTRACT
A cumulative total of 31 distinct species has been classified into 6 orders, 23 genera, and 12 families, which includes 4 invasive alien fish species that were systematically collected and identified from both lentic and lotic aquatic habitats within the Mathura block of the District Mathura, Uttar Pradesh. The invasive alien fish species identified encompass *Oreochromis niloticus, Cyprinus carpio, Hypophthalmichthys molitrix,* and *Clarias gariepinus*; their prevalence is particularly pronounced across extensive sections of the Yamuna River. The investigation indicates that *Clarias gariepinus* represents the sole species of fish consistently found across all designated lentic water bodies within the Mathura block. However, the prevailing circumstances indicate a troubling reduction in the populations of native fish species. Invasive species are progressively securing their establishment as reproductive populations, thereby effectively displacing indigenous fish species.

Keywords: *Invasive alien fishes, Native fish fauna, Lentic and lotic water bodies, Yamuna River, Mathura block.*

INTRODUCTION
Numerous fish species, many of which are native to India, can be found in both its interior and marine waters (Gopi *et al*., 2017). There are 5248 genera and 36,640 species of fish in the world. There are 18,614 of them in freshwater (Fricke *et al*., 2023). In India, there are 3523 species of fish, belonging to 1097 genera, 272 families, and 55 orders. Kosygin *et al.* (2024) offer a comprehensive account of fishes found in India while Van der Laan *et al.* (2023) are used to categorize fishes. In India, more than 300 species of alien fish have been found, including 291 ornamental species, 31 aquaculture species, and 3 larvicidal species.

Mathura**,** located in the northwest of Uttar Pradesh's Agra division, is situated in the Ganga-Yamuna Doab, inside the Yamuna River basin. The district is located between latitudes 27.14' and 27.58' north and longitudes 77.17' and 78.12' east. Numerous tiny tanks and pokhras can be found all over the district, which is traversed by the Yamuna from north to south. Administratively, Mathura is separated into 735 inhabited villages, 10 blocks, and 3 Tehsils. Unpredictable rainfall and salty water are persistent problems for the district. The local economy also depends heavily on trade, services, tourism, and agriculture. A wide variety of fish species with commercial value can be found in the Yamuna River.

However, the river has been negatively impacted by years of pollution. Fish populations are declining, species composition is changing, and invasive fish species are becoming more prevalent as a result of the water's heavy irrigation use and exposure to large amounts of household and industrial trash. According to the study, the Yamuna River's water is used for drinking, agriculture, and hydropower projects, and water pollution puts local species' habitats at serious risk while unintentionally fostering an environment that is conducive to alien fish. Thus, controlling the introduction of invasive species into the Yamuna

River and keeping an eye on the water quality are essential. In both lentic and lotic water basins, such actions could be crucial to the preservation of the ecology and aquatic life.
Due to long-term neglect and lack of upkeep, the majority of the lentic water basins, known as kunds, which were utilized for a variety of functions and were significant freshwater supplies in the Mathura block, have now silted up (Saha *et al*., 2010). Regarding the fish, no other native species could live there because of the invasive alien fish species *Clarias gariepinus*, also referred to as "Thai magur"

MATERIALS AND METHODS

Study Area: Focus on Mathura Block, Mathura, UP.
Sampling Sites: Selected multiple sites to assess spatial variations in fish diversity
1. ***Lotic water body*** - Yamuna River stretch viz. 1. Abipur Khadar, 2. Kans Quila, 3. Gokul Barrage 4. Koila Ghat.
2. ***Lentic water body*** – 1. Shantanu Kund, 2. Talvan, 3. Kumudvan, 4. Krishna Kund 5. Krishna Sarovar.

These water bodies are of perennial and habitat of only single fish species i.e. *Clarias gariepinus* (Thai magur).

Fish Sampling: At different sites and local fish market; identify species using taxonomic keys
Study periods: from year 2022 to 2024.

RESULTS AND DISCUSSION

Observations

The entire river's length is used for a variety of human activities, according to the study. The Yamuna River is one of India's most polluted rivers at the moment. The river's deteriorating health is a result of pollution from industrial, agricultural, and residential sources. Practices such as bathing, open defecation, washing clothes, wading cattle, and making religious offerings in public and at home are examples of domestic sources. Practices such as bathing, open defecation, washing clothes, wading cattle, and making religious offerings in public and at home are examples of domestic sources. Industrial discharges introduce heavy metals, phenolics, and other organic contaminants into rivers, negatively affecting water characteristics like temperature, pH, and dissolved oxygen. The Central Pollution Control Board (CPCB) claims that industrial facilities in Uttar Pradesh, Delhi, and Haryana are releasing pollutants into the Yamuna directly.
Fish are frequently seen in Mathura's Kunds, or sacred ponds, and are important to both the local ecology and religious rituals. Because of things like water quality or human activity, some have few or no fish. Fish in kunds are observed for their participation in religious ceremonies, their existence in the natural environment, and the effects of water quality on their populations. According to studies, the diversity and number of native fish can be impacted by elements such as pollution, organic load, metal contamination, and the invasion of exotic fish species.
The data highlights a notable decline in native fauna, primarily due to the following critical factors:
1. Pollution of river and pond water
2. Invasion of alien species into the river and pond ecosystem.
3. Ponds and River is utilized for various human activities.

Results and Discussion

31 freshwater fish species from 6 orders, 23 genera, and 12 families were found during my observations. *Oreochromis niloticus, Cyprinus carpio, Hypophthalmichthys molitrix,* and *Clarias gariepinus* are the four species were identified as Invasive Alien Fishes (table-1). Fish species were identified from a list and divided into two groups: native and foreign. These invasive species' dominance in biomass over native species is highlighted by their abundance, which can be linked to less stressful environmental conditions.

Table 1: **List of 31-Species belonging to 6 order, 23 genera and 12 families, of which reported 4-species as Invasive Alien Fishes (mark with*).**

Sl. No.	Order	Family	Fish Species Scientific Name
1	Osteoglossiformes	Notopteridae	*Notopterus notopterus* (Pallas, 1769)
2	Cypriniformes	Danionidae	*Cabdio morar* (Hamilton, 1822)
3			*Amblypharyngodon mola* (Hamilton, 1822)
4		Cyprinidae	*Catla catla* (Hamilton, 1822)
5			*Cirrhinus mrigala* (Hamilton, 1822)
6			*Cirrhinus reba* (Hamilton, 1822)
7			*Crossocheilus latius* (Hamilton, 1822)
8			*Cyprinus carpio Linnaeus* 1758*
9			*Hypophthalmichthys molitrix* (Valenciennes, 1844)*
10			*Labeo gonius* (Hamilton, 1822)
11			*Labeo rohita* (Hamilton, 1822)
12			*Salmostoma bacaila* (Hamilton, 1822)
13			*Puntius sophore* (Hamilton, 1822)
14			*Puntius sarana* (Hamilton, 1822)
15			*Rasbora daniconius* (Hamilton, 1822)
16	Siluriformes	Siluridae	*Wallago attu* (Bloch & Schneider, 1801)
17		Clariidae	*Clarias gariepinus* (Burchell, 1822)*
18		Heteropneustidae	*Heteropneustes fossilis* (Bloch, 1794)
19		Bagridae	*Mystus vittatus* (Bloch, 1794)
20			*Mystus cavasius* (Hamilton, 1822)
21			*Sperata aor* (Hamilton, 1822)
22			*Mystus seenghala* (Sykes)
23		Ailiidae	*Eutropiichthys vacha* (Hamilton, 1822)
24	Perciformes	Ambassidae	*Chanda nama* Hamilton, 1822
25			*Parambassis ranga* (Hamilton, 1822)
26	Cichliformes	Cichlidae	*Oreochromis niloticus* (Linnaeus, 1758)*
27	Anabantiformes	Anabantidae	*Anabas testudineus* (Bloch, 1792)
28		Channidae	*Channa punctata* (Bloch, 1793)
29			*Channa striata* (Bloch, 1793)
30			*Channa gachua* (Hamilton, 1822)
31			*Channa marulius* (Hamilton, 1822)

This circumstance emphasizes even more how deteriorating environmental circumstances are causing native fish populations to gradually decline. According to historical sources, Moza and Mishra (2001), Jhingran (1975), Khan *et al*. (1995), and Mishra *et al*. (2007) reported that there were 70 different species of fish in the Yamuna River. Garg and Saxena (1971) recorded 48 species in the Mathura district, whereas Sharma *et al*. (2014) reported an astounding 93 species in the same river. Numerous researchers have noted the Cyprinidae family's dominance (Bhat, 2003; Sarkar *et al*., 2009; Vass *et al*., 2011), and the current analysis confirms this supremacy. Concerns have also been raised about the decline of Indian large carps.

According to previous research (Mishra *et al*., 2007; Vass *et al*., 2011), the increasing quantity of foreign fish in the Yamuna River supports the idea that these species are gradually establishing breeding populations and displacing the Indian main carps. Reduced water discharge changes both micro- and macro-habitats, favoring non-indigenous species, according to research on alien fish hazards in North American rivers (Kolar and Lodge, 2002). 48 fish species from 13 families have been found in the waterways surrounding Mathura, according to an initial assessment. According to Garg and Saxena (1971), the Cyprinidae family is the most common among them, followed by the Bagridae, Schilbeidae, Clupeidae, and Ophiocephalidae. During the study period, 45 fish species from 8 orders and 16 families were identified from three sampling sites in the Yamuna Rive. Mathura had the highest number of fish species (38), while Delhi had the lowest number (36). The Yamuna River is dominated by cat fishes, as evidenced by the order Cypriniformes having the most species and the family Siluriformes having a total of seven families (Kumar & Saxena, 2021). Ojha (2019) identified 19 species from 16 genera and 9 families, including 4 species that were reported as alien in the Ymuna River. Carnivorous species are the most prevalent in terms of trophic usage, followed by herbivorous and omnivorous species.

4 of these 31 species were designated as invasive alien fishes (table-1). The most prevalent species were those belonging to the Cyprinidae family (12 species), which was followed by the Bagaridae (4 species), Channidae (4 species), Danionidae (2 species), Ambassidae (2 species), Notopteridae (1species), Siluridae (1 species), Claridae (1 species), Heteropneustidae (1 species), Schilbeidae (1 species), Nandidae (1 species), and Anabantidae families (1 species). These invasive species' dominance in biomass over native species is highlighted by their abundance, which can be linked to less stressful environmental conditions. This circumstance emphasizes even more how deteriorating environmental circumstances are causing native fish populations to gradually decline. Due in large part to differences in water quality, a prior research of the Yamuna River revealed 93 fish species in 73 genera, 27 families, and 9 orders, with the most diversity found downstream and the lowest in the midstream (Singh *et al*., 2014). 112 fish species from 10 orders and 29 families were found in the Yamuna River by Joshi *et al*. (2016). Interestingly, Mathura has the highest chlorine levels (217.4 ppm), a symptom of serious problems with the water quality. While foreign species like *Cyprinus carpio* (common carp) and *Oreochromis niloticus* (tilapia) have increased, particularly in polluted areas, the abundance of Indian main carps, like Labeo and Catla has significantly decreased. Native fish populations have declined as a result of pollution, habitat loss, and the introduction of foreign species.

An overview of the results: Stress the rise of foreign fish species in Mathura Block and the reduction of native fish species.

Conservation Implications: Stress the importance of restoring habitat, reducing pollution, and controlling the introduction of exotic species.

Suggestions

1. Establish routine fish population and water quality monitoring.
2. Encourage community participation and knowledge of conservation initiatives.
3. Implement laws governing the release of exotic species and fishing methods.

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