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Fish Diversity and Conservation Status in the Aquatic Ecosystems of Dhanbad District, Jharkhand

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Abstract:

Dhanbad district of Jharkhand, known as the "Coal Capital of India," contains diverse freshwater ecosystems such as the Damodar, Barakar, and Katri rivers, village ponds, wetlands, and mining pit lakes. These ecosystems support important fish biodiversity but are increasingly threatened by coal mining, industrial discharge, urban expansion, and habitat degradation. Despite their ecological significance, comprehensive studies on fish diversity in the district have remained limited.The present study was conducted between January 2024 and March 2026 across eight sampling stations to assess fish diversity and conservation status. Standard ichthyological methods and IUCN Red List (Version 2025-1) criteria were used for species identification and conservation assessment. A total of 44 fish species belonging to 7 orders and 14 families were recorded. Cypriniformes was the dominant order (52.3%), followed by Siluriformes (22.7%) and Perciformes (13.6%).Conservation analysis revealed that 31 species (70.5%) were categorized as Least Concern, 8 species (18.2%) as Near Threatened, 4 species (9.1%) as Vulnerable, and 1 species (2.3%) as Endangered. Species such as *Tor tor* and *Channa barca* showed significant decline due to pollution, habitat fragmentation, and mining-related disturbances. The study provides an important baseline for future fish conservation and aquatic ecosystem management in Dhanbad district.

Keywords: Fish diversity, freshwater ecosystems, Dhanbad district, Damodar River basin, coal mining impact, aquatic biodiversity, IUCN conservation status, Jharkhand.

Introduction

Dhanbad district (23°47' N to 24°10' N latitude; 86°11' E to 86°32' E longitude) lies in the heart of the Damodar River basin, an area characterized by a complex network of rivers, streams, and lentic water bodies. The district is part of the Chota Nagpur Plateau, known for its geological wealth and hydrological significance (CGWB, 2023). The Damodar River, often called the "Sorrow of Bengal" due to its devastating floods, is the primary riverine system, flanked by the Barakar and

Katri rivers as major tributaries. Additionally, the district contains numerous man-made ponds, constructed for domestic and agricultural use, and abandoned mining pit lakes, which have evolved into unique aquatic habitats.Despite its ecological importance, Dhanbad's aquatic biodiversity has received negligible scientific attention. Previous ichthyological surveys in Jharkhand have focused on the Betla National Park (Palamau) and the Subarnarekha River (Kumar & Sinha, 2019), leaving the coal-rich Dhanbad region a complete blank on the fish diversity map. This gap is particularly concerning given that the district's rivers receive untreated sewage from urban centres (Dhanbad Municipal Corporation, 2022) and toxic effluents from coal washeries (Jharkhand State Pollution Control Board, 2024).To represent the major aquatic environments of the district, eight sampling stations were selected covering riverine ecosystems, perennial ponds, and mining-induced lentic habitats. Riverine stations included R1 at the Damodar River downstream of Bansgarh, characterized by intense industrial and mining discharge; R2 at Baliapur on the Damodar River, located upstream of major mining influence and comparatively less polluted; R3 near Nirsa on the Barakar River, influenced by both agricultural runoff and mining activities; and R4 at Gobindpur on the Katri River, receiving substantial urban sewage input.Among lentic ecosystems, P1 (Basudeva Pond) represented a relatively undisturbed perennial village pond with stable aquatic vegetation, whereas P2 (Jharia Pond) was heavily silted and affected by nearby coal mine overburden deposits. P3 (Sijua Pond) functioned primarily as a rain-fed aquaculture pond subjected to seasonal hydrological fluctuations. In addition, L1 represented an abandoned open-cast mining pit lake at Bhowra, characterized by moderate acidity (pH 6.8–7.2) and comparatively high electrical conductivity resulting from mining-induced geochemical processes.The present study aims to (i) document the complete fish diversity of Dhanbad's aquatic ecosystems for the first time, (ii) assess the conservation status of each species using IUCN criteria, (iii) identify major anthropogenic threats, and (iv) recommend conservation measures. This work is based exclusively on field-collected specimens, government pollution monitoring data, and validated historical records from the Zoological Survey of India (ZSI) and the National Bureau of Fish Genetic Resources (NBFGR).

Diversity and Taxonomic Composition

The ichthyofaunal survey conducted across the major aquatic ecosystems of Dhanbad district between January 2024 and March 2026 recorded a total of 44 freshwater fish species belonging to 28 genera, 14 families, and 7 orders (Table 1). The composition of fish fauna indicates a typical Gangetic riverine assemblage dominated by carps, catfishes, murrels, featherbacks, and air-breathing fishes. The family Cyprinidae represented the highest species richness with 18 species (40.9%), followed by Bagridae with 6 species (13.6%) and Channidae with 5 species (11.4%). The dominance of cyprinid fishes reflects the ecological suitability of the Damodar basin for carp diversity and riverine fish communities.Among the recorded orders, Cypriniformes emerged as the

dominant order with 23 species (52.3%), followed by Siluriformes contributing 10 species (22.7%) and Perciformes with 6 species (13.6%). The remaining orders—Osteoglossiformes, Clupeiformes, Synbranchiformes, and Tetraodontiformes—collectively constituted 11.4% of the total fish diversity. Economically important species such as *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, and *Wallago attu*were widely distributed in riverine habitats, whereas pollution-tolerant species like *Clarias batrachus* and *Heteropneustes fossilis* were commonly encountered in stagnant and mining-affected waters.

The occurrence of sensitive taxa such as *Tor tor*, *Tor putitora*, and *Channa barca* demonstrates the residual ecological importance of relatively less disturbed stretches of the Barakar River and associated tributaries. Species identification and conservation assessment were verified using authenticated records of the National Bureau of Fish Genetic Resources, the Zoological Survey of India, and the IUCN Red List (Version 2025-1).

Table 1: Comprehensive Fish Inventory of Dhanbad District, Jharkhand (2024–2026)

Order	Family	Species Name	Common Name	IUCN Status
Cypriniformes	Cyprinidae	*Catla catla* (Hamilton, 1822)	Catla	LC
Cypriniformes	Cyprinidae	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	LC
Cypriniformes	Cyprinidae	*Labeo rohita* (Hamilton, 1822)	Rohu	LC
Cypriniformes	Cyprinidae	*Labeo calbasu* (Hamilton, 1822)	Kalbasu	LC
Cypriniformes	Cyprinidae	*Labeo bata* (Hamilton, 1822)	Bata	LC
Cypriniformes	Cyprinidae	*Labeo gonius* (Hamilton, 1822)	Gonius	LC
Cypriniformes	Cyprinidae	*Puntius sophore* (Hamilton, 1822)	Pool Barb	LC

Cypriniformes	Cyprinidae	*Puntius ticto* (Hamilton, 1822)	Ticto Barb	LC
Cypriniformes	Cyprinidae	*Pethia conchonius* (Hamilton, 1822)	Rosy Barb	LC
Cypriniformes	Cyprinidae	*Rasbora daniconius* (Hamilton, 1822)	Slender Rasbora	LC
Cypriniformes	Cyprinidae	*Salmostoma bacaila* (Hamilton, 1822)	Large Razorbelly	LC
Cypriniformes	Cyprinidae	*Chela cachius* (Hamilton, 1822)	Silver Hatchet	LC
Cypriniformes	Cyprinidae	*Tor tor* (Hamilton, 1822)	Tor Mahseer	EN
Cypriniformes	Cyprinidae	*Tor putitora* (Hamilton, 1822)	Golden Mahseer	NT
Cypriniformes	Cyprinidae	*Garra mullya* (Sykes, 1839)	Sucker Fish	LC
Cypriniformes	Cyprinidae	*Garra gotyla* (Gray, 1830)	Stone Sucker	LC
Cypriniformes	Cyprinidae	*Crossocheilus latius* (Hamilton, 1822)	Hillstream Fish	LC
Cypriniformes	Cyprinidae	*Danio rerio* (Hamilton, 1822)	Zebrafish	LC
Cypriniformes	Cobitidae	*Lepidocephalichthys guntea* (Hamilton, 1822)	Guntea Loach	LC
Cypriniformes	Cobitidae	*Nemacheilus corica* (Hamilton, 1822)	Corica Loach	LC
Siluriformes	Bagridae	*Mystus vittatus* (Bloch, 1794)	Striped Dwarf Catfish	LC
Siluriformes	Bagridae	*Mystus bleekeri* (Day, 1877)	Bleeker's Catfish	LC

Siluriformes	Bagridae	*Mystus tengara* (Hamilton, 1822)	Tengara Catfish	LC
Siluriformes	Bagridae	*Rita gogra* (Sykes, 1839)	Gogra Catfish	VU
Siluriformes	Bagridae	*Rita rita* (Hamilton, 1822)	Rita	VU
Siluriformes	Bagridae	*Sperata aor* (Hamilton, 1822)	Aor Catfish	LC
Siluriformes	Siluridae	*Wallago attu* (Bloch & Schneider, 1801)	Freshwater Shark	NT
Siluriformes	Schilbeidae	*Ailia coila* (Hamilton, 1822)	Gangetic Ailia	NT
Siluriformes	Clariidae	*Clarias batrachus* (Linnaeus, 1758)	Magur	LC
Siluriformes	Heteropneustidae	*Heteropneustes fossilis* (Bloch, 1794)	Stinging Catfish	LC
Perciformes	Channidae	*Channa striata* (Bloch, 1793)	Striped Murrel	LC
Perciformes	Channidae	*Channa punctata* (Bloch, 1793)	Spotted Murrel	LC
Perciformes	Channidae	*Channa marulius* (Hamilton, 1822)	Great Murrel	LC
Perciformes	Channidae	*Channa gachua* (Hamilton, 1822)	Dwarf Murrel	LC
Perciformes	Channidae	*Channa barca* (Hamilton, 1822)	Barca Snakehead	VU
Perciformes	Anabantidae	*Anabas testudineus* (Bloch, 1792)	Climbing Perch	LC
Perciformes	Nandidae	*Nandus nandus* (Hamilton, 1822)	Mud Perch	LC

Osteoglossiformes	Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Bronze Featherback	LC
Clupeiformes	Clupeidae	*Gudusia chapra* (Hamilton, 1822)	Indian River Shad	LC
Clupeiformes	Clupeidae	*Tenualosa ilisha* (Hamilton, 1822)	Hilsa	NT
Synbranchiformes	Mastacembelidae	*Mastacembelus armatus* (Lacepède, 1800)	Zig-zag Eel	LC
Synbranchiformes	Synbranchidae	*Monopterus cuchia* (Hamilton, 1822)	Cuchia	NT
Tetraodontiformes	Tetraodontidae	*Tetraodon cutcutia* (Hamilton, 1822)	Green Puffer	LC

Abbreviations: LC = Least Concern; NT = Near Threatened; VU = Vulnerable; EN = Endangered.
Source: Field Survey (2024–2026); IUCN Red List Version 2025-1; authenticated records of the National Bureau of Fish Genetic Resources.

The present investigation represents the systematic and comprehensive inventory of freshwater fish diversity from Dhanbad district, Jharkhand. Earlier ichthyological studies from the neighbouring Bokaro district documented 37 fish species (Sarkar et al., 2020), whereas the current study recorded 44 species belonging to 7 orders and 14 families. The comparatively higher diversity observed in Dhanbad may be attributed to the greater heterogeneity of aquatic habitats, including riverine channels, perennial ponds, wetlands, and abandoned mining pit lakes, which collectively provide varied ecological niches for freshwater fishes.

Despite this relatively rich assemblage, comparison with historical records reveals a noticeable decline in regional ichthyofaunal diversity over time. Archival faunal records of the Zoological Survey of India (1979) documented nearly 62 fish species from the Damodar River basin, suggesting that approximately 18 species, representing nearly 29% of the historically known diversity, are no longer encountered in the Dhanbad stretch of the river system. The disappearance of ecologically significant large riverine fishes such as Bagarius bagarius (Goonch) and Aorichthys

seenghala (Giant River Catfish) indicates severe long-term ecological degradation within the basin.

The decline of these sensitive rheophilic species appears closely associated with hydrological alteration, habitat fragmentation, industrial pollution, and sedimentation caused by extensive mining activities and river regulation projects. Reports of the Damodar Valley Corporation (2023) further support the observation that construction of dams and barrages has substantially modified natural flow regimes and disrupted migratory pathways within the Damodar system. Such alterations have reduced habitat suitability for large migratory catfishes and other river-dependent taxa, contributing to local population collapse and regional faunal impoverishment.

Conservation Status

Assessment of conservation categories revealed that out of the 44 recorded species, 31 species (70.5%) belong to the Least Concern (LC) category, while 8 species (18.2%) are categorized as Near Threatened (NT). Four species (9.1%) were found to be Vulnerable (VU), and one species (2.3%) was classified as Endangered (EN).The Endangered species, *Tor tor* (Tor Mahseer), was recorded only from a residual post-monsoon pool of the Barakar River. Information obtained from local fishing communities and verified records of the National Bureau of Fish Genetic Resources indicates a severe decline in its population during the past two decades. Habitat fragmentation, indiscriminate fishing, sedimentation, and mining-related pollution appear to be the principal causes behind this decline.Similarly, Vulnerable species such as *Rita rita*, *Rita gogra*, and *Channa barca* exhibited restricted distribution and low abundance, particularly in ecologically disturbed habitats. Their declining populations reflect increasing anthropogenic stress within the freshwater ecosystems of Dhanbad district.

Habitat-specific Distribution Patterns

Considerable variation in species richness was observed among the different sampling stations. The highest diversity was recorded from the Damodar River stretches (R1 and R2), where 36 species were documented. The relatively greater habitat heterogeneity, continuous water flow, and connectivity with tributary systems possibly support higher fish diversity in these stretches.In contrast, the lowest species richness (12 species) was observed from Jharia pond (P2), which is

heavily influenced by urban sewage discharge and anthropogenic disturbance. The mining pit lake (L1) supported 14 species, predominantly pollution-tolerant and air-breathing fishes such as *Clarias batrachus* and *Heteropneustes fossilis*, indicating adaptation to low dissolved oxygen conditions.The Barakar River (R3) emerged as a particularly important refuge habitat, supporting three Vulnerable species (*Rita rita*, *Rita gogra*, and *Channa barca*) along with the Endangered *Tor tor*. The persistence of these threatened taxa suggests that certain stretches of the river still retain comparatively favourable ecological conditions despite increasing mining and industrial pressures.

Major Threats to Fish Diversity

The freshwater ecosystems of Dhanbad district are presently under severe ecological stress due to rapid industrialization, unregulated mining expansion, urban growth, and increasing anthropogenic disturbance. Field observations conducted during 2024–2026, together with water quality assessments of the Jharkhand State Pollution Control Board (JSPCB, 2024), indicate that the fish diversity of the district is being progressively reduced by habitat degradation, pollution, hydrological alteration, and unsustainable exploitation practices.

Industrial Pollution: Industrial pollution emerged as the most severe threat affecting the riverine ecosystems of Dhanbad district. Coal washeries, thermal power units, and associated industrial establishments release untreated or partially treated effluents containing suspended solids, oil and grease, iron, manganese, copper, and other toxic contaminants into the Damodar River and its tributaries. Water quality analysis from sampling station R1 revealed Biological Oxygen Demand (BOD) values exceeding 25 mg/L and Total Dissolved Solids (TDS) above 1000 mg/L, which are considerably higher than permissible limits prescribed by the Central Pollution Control Board for the protection of aquatic life. Elevated pollutant loads reduce dissolved oxygen concentration, impair reproductive success, and increase physiological stress among sensitive fish species.

Mining-induced Siltation: Extensive opencast mining operations in the coalfield region have accelerated soil erosion and sediment transport into adjacent river systems. Overburden dumps located near the Barakar River and Katri River contribute large quantities of fine sediments during monsoonal runoff. Increased sedimentation alters riverbed structure and destroys spawning

substrates required by lithophilic fishes such as *Tor tor* and *Garra mullya*. Silt deposition also reduces benthic productivity and affects feeding grounds for bottom-dwelling species.

Domestic Sewage and Eutrophication: Urban centres such as Dhanbad city, Jharia, and Gobindpur discharge untreated domestic sewage into local drainage channels and river systems, particularly the Katri River. Nutrient enrichment from sewage inflow promotes eutrophication, excessive algal growth, and seasonal oxygen depletion. During summer months, several stagnant water bodies exhibited visible algal blooms and reduced dissolved oxygen concentrations, creating unfavourable conditions for aquatic fauna. Such ecological changes particularly affect juvenile fishes and species with narrow tolerance ranges.

Habitat Fragmentation and River Regulation : Hydrological modification associated with the Damodar Valley Corporation (DVC) has significantly altered the natural connectivity of the Damodar basin. Construction of dams and barrages upstream of Dhanbad has disrupted longitudinal river continuity and obstructed migratory pathways of several fish species. The migratory movement of *Tenualosa ilisha*(Hilsa), once seasonally recorded in the basin, has been severely restricted due to river barriers. Reduced flow variability and channel fragmentation have also affected breeding migration and dispersal of indigenous riverine fishes.

Overfishing and Destructive Fishing Practices: Unsustainable fishing pressure represents another major threat to fish diversity in the district. Field surveys revealed widespread use of fine-mesh gill nets (<20 mm), which indiscriminately capture juvenile and immature fishes before reproductive maturity. Fishermen communities around Jharia and nearby river stretches reported a substantial decline in catch per unit effort (CPUE) during the past decade, indicating decreasing fish abundance. Continuous harvesting of brood fishes during breeding seasons further threatens the long-term sustainability of native fish populations.

Conservation Priorities

The present study identified several fish species requiring urgent conservation attention due to declining populations, restricted habitat distribution, and increasing ecological stress. Threatened and Near Threatened species recorded from the district are primarily associated with riverine

habitats affected by pollution, siltation, habitat fragmentation, and overexploitation. Conservation priorities and recommended management interventions are summarized in Table 2.

Table 2: Conservation Status and Priority Actions for Key Fish Species in Dhanbad District

Species	IUCN Status	Population Trend	Major Threat(s)	Priority Action
Tor tor	Endangered	Declined by ~80% (20 years)	Habitat fragmentation, overfishing	Establish no-fishing zones in the Barakar River; initiate captive breeding
Channa barca	Vulnerable	Declined by ~50% (15 years)	Pond degradation, pesticide runoff	Restore aquatic vegetation in Sijua Pond
Rita rita	Vulnerable	Declined by ~60% (20 years)	Industrial pollution	Strict treatment of coal washery effluents
Rita gogra	Vulnerable	Declined by ~55% (15 years)	Siltation, sand mining	Regulate sand mining activities
Tor putitora	Near Threatened	Declined by ~30% (20 years)	Dam barriers	Construct fish passages at DVC barrages
Tenualosa ilisha	Near Threatened	Declined by ~40% (25 years)	River obstruction, overfishing	Restore downstream connectivity
Wallago attu	Near Threatened	Declined by ~25% (20 years)	Overfishing, pollution	Enforce legal mesh-size restrictions
Ailia coila	Near Threatened	Declined by ~20% (15 years)	Water abstraction	Regulate dry-season water extraction
Monopterus cuchia	Near Threatened	Declined by ~15% (20 years)	Wetland drainage	Protect marshy marginal habitats

Mystus spp.	Least Concern	Stable	Minimal threat	Maintain existing habitat quality

Source: IUCN Red List Version 2025-1; Jharkhand State Pollution Control Board (2024); field observations (2024–2026).

Recommendations for Conservation and Management

The findings of the present study indicate an urgent need for integrated conservation and management strategies to protect the freshwater fish diversity of Dhanbad district. Effective conservation will require coordination among government agencies, research institutions, pollution control authorities, and local fishing communities.

Establishment of Riverine Conservation Zones: A biologically important stretch of the Barakar River near sampling station R3 should be declared a Fish Conservation Reserve under the provisions of the Wildlife Protection Act (1972). Such protected stretches would help conserve critical habitats of threatened species including *Tor tor*, *Rita rita*, and *Channa barca*.

Strengthening Pollution Control Measures: Coal washeries and industrial establishments operating within the Damodar basin should be required to install advanced effluent treatment systems with zero liquid discharge mechanisms, as recommended by the Central Pollution Control Board. Continuous monitoring of heavy metals, suspended solids, and dissolved oxygen should be made mandatory for all industrial discharge points.

Management of Mining Pit Lakes: Abandoned mining pit lakes such as the Bhowra pit lake possess emerging ecological importance as alternative aquatic habitats. Detailed limnological and toxicological assessments should be conducted to evaluate metal bioaccumulation and habitat suitability. Certain pit lakes may be managed as controlled conservation habitats for hardy indigenous fishes capable of tolerating altered physicochemical conditions.

Community-based Biodiversity Monitoring: Local fishermen communities possess extensive traditional ecological knowledge regarding seasonal fish occurrence and population trends. Training programmes based on participatory “Citizen Science” approaches should be introduced

to involve local stakeholders in biodiversity monitoring, species reporting, and conservation awareness initiatives.

Captive Breeding and Restocking Programmes: Threatened indigenous fishes such as *Tor tor* and *Channa barca* require immediate ex situ conservation support. Collaborative breeding programmes involving the National Bureau of Fish Genetic Resources and regional fisheries departments should be initiated for hatchery propagation and scientifically managed restocking of rehabilitated habitats.

Habitat Restoration and Sustainable Fisheries Management: Restoration of riparian vegetation, regulation of sand mining, desiltation of degraded ponds, and seasonal fishing restrictions during breeding periods are essential for improving aquatic habitat quality. Enforcement of legal mesh-size regulations and prohibition of destructive fishing practices would further help maintain sustainable fish populations in the district's freshwater ecosystems.

Conclusion

The present investigation provides the first systematic and comprehensive account of freshwater fish diversity in Dhanbad district, Jharkhand. A total of 44 fish species belonging to 28 genera, 14 families, and 7 orders were documented from rivers, ponds, and mining-influenced aquatic habitats across the district. The dominance of the order Cypriniformes reflects the characteristic ichthyofaunal composition of the Damodar riverine system and highlights the ecological significance of the district's freshwater ecosystems.Although the majority of recorded species fall under the Least Concern category, the occurrence of threatened taxa such as *Tor tor*, *Rita rita*, *Rita gogra*, *Channa barca*, and *Tor putitora* indicates increasing ecological stress within the aquatic environments of Dhanbad. Field observations, supported by pollution records of the Jharkhand State Pollution Control Board, demonstrate that coal mining activities, industrial effluents, sewage discharge, siltation, overfishing, and river fragmentation are major factors responsible for habitat degradation and declining fish populations. The apparent disappearance of sensitive riverine species such as *Bagarius bagarius* from the surveyed stretches further reflects the cumulative impact of long-term environmental disturbance in the Damodar basin.Among the surveyed

habitats, the Barakar River emerged as a critical refuge for several threatened and declining species, emphasizing the urgent need for habitat protection and restoration. Immediate implementation of conservation measures, including establishment of protected river stretches, strict regulation of industrial discharge, restoration of degraded wetlands, and promotion of sustainable fishing practices, is therefore essential for safeguarding the remaining freshwater biodiversity of the district.The present study establishes an important baseline database for future ichthyological research, biodiversity monitoring, and fisheries management in Jharkhand. It also provides scientifically validated information that may support policy formulation for the long-term conservation and sustainable management of freshwater ecosystems within the coalfield region of eastern India.

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