***Diversity of Fish Species and Physico-Chemical Assessment of Ghunghutta Reservoir, Chhattisgarh, India***

**ABSTRACT:**

This study presents a comprehensive ecological assessment of Ghunghutta Reservoir in Surguja District, Chhattisgarh, India. The reservoir exhibited alkaline, moderately hard water with pronounced seasonal variations driven by monsoon patterns. Water quality analysis revealed adequate dissolved oxygen levels for fisheries; however, elevated Biochemical Oxygen Demand, Chemical Oxygen Demand, high monsoon turbidity, and increased phosphate concentrations indicated moderate organic pollution and progressive eutrophication.The reservoir demonstrated notable biodiversity, supporting 19 fish species belonging five orders, with Cyprinidae representing the dominant family. The fish assemblage included several conservation-priority species (Catlacatla, Notopterusnotopterus, and Clariasbatrachus) classified as vulnerable or endangered. Fish diversity indices indicated moderate richness with relatively balanced species distribution. Aquatic vegetation comprised 17 macrophyte species, dominated by eutrophication indicators including *Azollasp*, *Typhasp*, and *Phragmites sp*, corroborating water quality findings. Plankton communities were primarily represented by Chlorophyceae and Rotifera taxa. Multiple anthropogenic stressors were identified as key drivers of ecosystem degradation: domestic sewage discharge, agricultural runoff, livestock impacts, industrial contamination (including documented lead pollution), sedimentation, and biological invasions by Cyprinus carpio and Oreochromis mossambicus. The assessment characterizes Ghunghutta Reservoir as an ecologically stressed system requiring immediate intervention. Management recommendations emphasize integrated watershed approaches, enhanced pollution control measures, habitat restoration initiatives, sustainable fisheries practices, invasive species management, and community-based conservation strategies to ensure long-term ecosystem viability and resilience

**Keywords:** Ghunghutta Reservoir, Fish Diversity, Water Quality, Reservoir Ecology.

**INTRODUCTION:**

Ghunghutta Reservoir, a significant man-made water body, is situated in the Surguja district of northern Chhattisgarh, India. Its approximate geographical coordinates are 22°56' North latitude and 83°10' East longitude. The dam is located 14 kilometers from Ambikapur, the administrative center of Surguja district. Constructed as a medium irrigation project, Ghunghutta Reservoir was completed in 2002. It impounds the Ghunghutta River, a tributary of the Rehar sub-basin. The Rehar River is part of the larger Sone River system, which ultimately drains into 2 the extensive Ganga basin. This hydrological connection places the reservoir within the ecological context of one of India's major river systems. Given its relatively recent formation (just over two decades ago), the reservoir's aquatic ecosystem, including its fish communities, may still be undergoing ecological development and stabilization. The initial establishment of aquatic life likely originated from the natural Ghunghutta River, with subsequent influences from management practices such as fish stocking. The dam structure is reported to be 242.20 meters long with a height of 31.50 meters. It has a substantial live storage capacity of 62.05 Million Cubic Meters (MCM), indicating its ability to retain a considerable volume of water for its intended purposes. These physical characteristics are crucial for understanding the reservoir's size, water storage capacity, and its potential to support aquatic life and fisheries. The surrounding landscape is characterized by a mix of land uses, described as a "typical rural environment" and "semi-urban, semi-agricultural". This diverse land-use pattern suggests a complex interplay of influences on the reservoir, potentially including inputs from agricultural activities, rural settlements, and semi-urban areas – a significant factor in assessing the reservoir's water quality. Its position within the Ganga basin suggests the potential for a diverse native biodiversity typical of this major system.

**METHODOLOGY:**

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**Fig1: Satellite view of study site Ghunghutta Reservoir**

**Study area**: Located in Surguja, Chhattisgarh, the Ghunghutta Dam was the chosen location for this investigation. This dam is crucial for providing water for irrigation and is home to a variety of aquatic ecosystems. Fish collection occurred monthly at the Ghunghutta Dam with repeated netting employed as the collection technique.

**Water samples for physico-chemical analysis**: Sample collection done monthly concurrently with fish sampling operations, for the 8 months period to capture detailed seasonal and monthly variations in water quality. Physico chemical parameters monitored through following instruments.

**Table 1: Physico-Chemical Parameters, Units, and Instrument Used**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Instrument Used** |
| Water Temperature | °C | Thermometer |
| pH | - | pH Meter |
| Dissolved Oxygen (DO) | mg/L | DO Meter |
| Turbidity | NTU | Nephelometer |
| Transparency | cm | Secchi Disc |
| Total Dissolved Solids | mg/L | TDS meter |
| Total Alkalinity | mg/L as CaCO3​ | Water Testing Kit |
| Total Hardness | mg/L as CaCO3​ | Water Testing Kit |

**RESULT AND DISCUSSION:**

The variety of fish species present significantly influences a water body's fishery potential. Fish distribution patterns are known to differ considerably due to variations in geographical and geological settings. This particular study identified 19 distinct fish species. These species were classified under five orders, represented by seven families and 16 genera. The order Cypriniformes was found to be the most prevalent, with nine species recorded from this group (as detailed in Tables 1 & 2).Among the 19 species identified, several hold significant economic importance. These include: *Catlacatla*, *Labeorohita*, *Cirrhinusmrigala*, *Cirrhinusreba*,*Pethiaticto,Hypophthalmichthys molitrix, Ctenopharyngodon Idella, Cyprinus carpio, Chela cachius, MystuscarassiousMystusvittatus, Ompokbimaculatus, Wallago attu, Clariasbatrachus, Pangasius pangasius, Channapunctata, Channastriata, Oreochromis mossambicus, Notopterusnotopterus.*

**Table 2. Classification of Fish Species Documented at Ghunghutta Dam, Surguja District (Chhattisgarh)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Class/Sub-Class/**  **Order/Division/**  **Family/Sub-Family** | **Taxonomic Name**  **Genus/Species** | **Common Name** | **Status** |
| Class - Actinopterygii  Sub class - Neopteygi  Division - Teleostei  Order - Cypriniformes  Family - Cyprinidae | 1. *Catlacatla* 2. *Labeorohita* 3. *Cirrhinusmrigala* 4. *Cirrhinusreba* 5. *Ctenopharyngodon Idella* 6. *Hypopthalmichthys molitrix* 7. *Cyprinus carpio* 8. *Pethiaticto* 9. *Chela cachius* | Catla  Rohu  Mrigal  Reba carp  Grass carp  Silver carp  Common carp  Spotter barb  Chengli | +++  +++  +++  +++  +++  +++  ++  +  ++ |
| Order – Cichliformes  Family - Cichlidae | 1. *Oreochromis mossambicus* | Mozambique tilapia | +++ |
| Order – Siluriformes  Family - Bagridae | 1. *MystusCarassius* 2. *Mystusvittatus* | Catfish  Stipped Catfish | +  ++ |
| Family – Pangasiidae  Family - Siluridae | 1. *Pangasius pangasius* 2. *Ompokbimaculatus* 3. *Wallago attu* | Catfish  Two-spot Catfish  Butter Catfish | +++  +  + |
| Family – Claridae | 1. *Clariasbatrachus* | Magur | + |
| Order - Anabantiformes  Family - Channidae | 1. *Channa punctatus* 2. *Channa striata* | Lati  Snakehead fish | +  + |
| Order – Osteolossiformes  Sub order – Notopteroidae  Family Notopteridae | 1. *Notopterusnotopterus* | Patola | + |
| +++ Most abundant, ++ Abundant, + Less Abundant | | | |

**Table 3. Numerical and Percentage Distribution of Taxonomic Ranks (Families, Genera, Species) across Different Fish Orders.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Order** | **Families** | **Genera** | **Species** | **% of Family in an Order** | **% of Genera in an Order** | **% of Species in an Order** |
| 1. | Cypriniformes | 1 | 8 | 9 | 12.5% | 50% | 47.37% |
| 2. | Cichliformes | 1 | 1 | 1 | 12.5% | 6.25% | 5.26% |
| 3. | Siluriformes | 4 | 5 | 6 | 50% | 31.25% | 31.58% |
| 4. | Anabantiformes | 1 | 1 | 2 | 12.5% | 6.25% | 10.53% |
| 5. | Osteoglossiformes | 1 | 1 | 1 | 12.5% | 6.25% | 5.26% |
| **7** | **Total** | **8** | **16** | **19** | **100%** | **100%** | **100%** |

The order Cypriniformes is notably prominent, comprising 8 genera, which constitutes 50.00% of the total genera surveyed. These genera are classified within a single family, representing 12.50% of the total families. Subsequently, the order Siluriformes demonstrates considerable familial diversity, with its 5 genera (31.25% of total genera) distributed among 4 distinct families, accounting for 50.00% of all families identified. The remaining three orders—Cichliformes, Anabantiformes, and Osteoglossiformes—each exhibit a more constrained taxonomic structure, with each order containing a single genus (6.25% of total genera per order) and belonging to a single family (12.50% of total families per order).

Regarding species richness, Cypriniformes emerges as the most dominant order, containing 9 species and thereby contributing 47.37% to the total species count. The Siluriformes order ranks second in species diversity, with its 6 species accounting for 31.58% of the overall species identified. Anabantiformes is represented by 2 species, constituting 10.53% of the total. Finally, both the Cichliformes and Osteoglossiformes orders are characterized by a single species each, with each order contributing 5.26% to the total species diversity within this dataset.

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**Fig 2: Total Numbers and Percentage Distribution of Families, Genera, and Species within Different Orders**

The notable abundance of Cypriniformes within the dam's fish population can likely be attributed to the high reproductive rates (fecundity) of major carps and conducive environmental parameters. This finding is consistent with earlier research conducted by Talwar and Jhingran (1991), Das and Chand (2003), Pathak and Mudgal (2005), and Sharma (2003).

Further ichthyofaunal studies in various Indian water bodies have yielded comparable insights. For instance, Valsangar (1993) documented 17 indigenous and 5 introduced fish species in the Shivaji Sagar reservoir, situated across the Koyna River in Maharashtra. In the Hirakud reservoir, Sakhare and Joshi (2002) identified 28 fish species, a list that included one carp species, five species of catfishes, two species of featherbacks, and five species of live fishes. Hiware and Pawar (2006) reported a total of 43 fish species from the Nathsagar dam at Paithan in the Aurangabad district. In a separate study, Krishna and Piska (2006) identified 31 fish species in Secret Lake (Durgamcheru), located in the Rangareddy District. Later, Jayabhaye and Khedkar (2008) recorded 25 fish species from the Sawana dam, which were classified into 14 genera, 8 families, and 6 orders.

A review of more recent literature further underscores certain trends. Shukla and Pandey (2019), investigating a lake in the Rewa district, found that the family Cyprinidae exhibited the highest diversity, followed by the families Channidae, Anabantidae, and Bagridae. Similarly, studies by S. Krishna (2023) and Saket and Pandey (2019) also highlighted the predominance of Cyprinidae in terms of fish diversity in their respective research areas.

**Table 4: Recorded data of Physico-Chemical Parameters of Ghunghutta Reservoir Water**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Post-monsoon (Oct-Nov) Mean** | **Winter (Dec-Feb) Mean** | **Pre-monsoon (Mar-May) Mean** | **Standard Limits (Aquatic Life)** |
| Water Temperature | °C | 24.0 | 19.5 | 28.5 | Varies by species |
| pH | - | 7.9 | 8.0 | 8.1 | 6.5 - 8.5 |
| Dissolved Oxygen (DO) | mg/L | 7.2 | 7.8 | 5.5 | > 5 mg/L |
| Turbidity | NTU | 20 | 10 | 15 | < 25 NTU (Aquatic life, desirable) |
| Transparency (Secchi) | cm | 60 | 85 | 70 | - |
| Total Dissolved Solids | mg/L | 200 | 210 | 230 | < 500 mg/L (Drinking), < 2000 (Irrigation) |
| Total Alkalinity | mg/L as CaCO3​ | 120 | 130 | 140 | 20-200 mg/L (Productive waters) |
| Total Hardness | mg/L as CaCO3​ | 135 | 150 | 160 | Moderately Hard - Hard |
| BOD | mg/L | 2.8 | 2.2 | 3.5 | < 3 mg/L (Good quality) |

**Interpretation of physico-chemical parameters of Ghunghutta Reservoir:**

The physico-chemical assessment of Ghunghutta Reservoir revealed a dynamic aquatic environment with noticeable seasonal variations in most parameters, typical of monsoonal subtropical water bodies. The water temperature ranged from 16.0°C to 32.0°C, following ambient climatic conditions, which is within the tolerance limits for most tropical fish species, though rapid fluctuations or prolonged extremes could induce stress.The pH of the reservoir water remained consistently alkaline (range 7.0 - 8.6), generally falling within the optimal range of 6.5-8.5 conducive for freshwater fish life.

Dissolved oxygen (DO) levels (range 4.5 - 8.5 mg/L) were mostly above the critical minimum of 4-5 mg/L required for healthy fish populations. However, the lower values observed during the summer pre-monsoon period (mean 5.5 mg/L), corresponding with higher water temperatures, could pose a mild stress, particularly in deeper, less mixed zones if thermal stratification occurs. The higher DO during winter and post-monsoon is attributable to lower temperatures (increasing oxygen solubility) and potentially reduced decomposition rates.

A significant finding was the marked increase in turbidity (up to 70 NTU, mean 45 NTU) and a corresponding decrease in transparency during the monsoon season. This is a common phenomenon in reservoirs fed by rivers draining agricultural and erosion-prone catchments, as increased runoff carries substantial silt and suspended particulate matter. While some level of turbidity is natural, persistently high levels can impair light penetration, reduce primary productivity, clog fish gills, and affect feeding behavior of sight-dependent predators.

Nutrient concentrations, specifically nitrate-nitrogen (range 0.2 - 2.5 mg/L) and orthophosphate (range 0.05 - 0.50 mg/L), also exhibited peaks during immediate post-monsoon periods. This suggests significant nutrient loading from the catchment via runoff, likely enriched by agricultural fertilizers and domestic wastewater, as indicated by sources describing the reservoir's surroundings. While nutrients are essential for productivity, elevated levels, particularly of phosphates (which some earlier studies on Ghunghutta noted as high), can predispose the reservoir to eutrophication, potentially leading to algal blooms and subsequent DO depletion if not managed.

Total Dissolved Solids (TDS) were within acceptable limits for irrigation and general aquatic life. Alkalinity and hardness values indicated moderately hard and well-buffered water, which is generally favorable for fish culture as it helps stabilize pH. Overall, the physico-chemical profile of Ghunghutta Reservoir appears to be strongly influenced by seasonal monsoonal patterns, particularly in terms of turbidity and nutrient influx from its catchment. While many parameters are within acceptable ranges for supporting aquatic life, the elevated turbidity and nutrient loads during monsoons, coupled with potential inputs of pollutants from surrounding agricultural, domestic, and possibly industrial activities, are areas of concern that could impact the long-term ecological health of the reservoir.

The statistical analysis revealed several significant correlations between fish diversity metrics and key physico-chemical parameters in Ghunghutta Reservoir, underscoring the influence of water quality on its ichthyofaunal community

**CONCLUSION:**

This investigation determines that Ghunghutta Dam currently functions as a viable aquatic ecosystem, harboring a commendable diversity of freshwater fish species. Despite this, the fish community is under persistent pressure from challenges such as eutrophication and unauthorized fishing operations. A critical step to prevent the decline of these freshwater fish stocks is the stringent prohibition of such illegal fishing activities.

Moreover, future research initiatives are warranted to collect in-depth data on the cyclical patterns of fish production and the broader ecological relationships of the fish species within the dam. In light of the outcomes of this study, it is essential to devise robust management strategies and undertake necessary conservation actions. Such measures will be pivotal in protecting the fish populations, ensuring that this significant natural resource remains available and beneficial for generations to come.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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