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An Ecological And Behavioral Study Of Aquatic And Avian Fauna Of Gorakhpur Dam And Silgi River Of Dindori, Madhya Pradesh

Sameeksha Uikey[1] and Pushpendra Singh[2*]

1. Research Scholar, Department of Zoology, Government Model Science college Rewa, APS University Rewa Madhya Pradesh, India
2. Assistant Professor, Government Girls PG College Satna ,Madhya Pradesh, India

ABSTRACT

Freshwater ecosystems and their associated biodiversity face unprecedented threats from anthropogenic pressures, habitat degradation, and climate change. This study presents a comprehensive ecological and behavioral assessment of aquatic and avian fauna in the Gorakhpur dam region and along the Silgi River in Dindori district, Madhya Pradesh, India. Field surveys conducted between October 2023 and March 2024 documented species diversity, population dynamics, feeding behaviors, and habitat utilization patterns. A total of 42 fish species representing 15 families, 38 bird species including 12 waterbirds, and diverse invertebrate fauna were recorded. The Silgi River demonstrated relatively higher biodiversity indices (Shannon-Wiener H'=3.24) compared to water bodies in Gorakhpur (H'=2.87), attributed to better riparian vegetation and reduced pollution levels. Behavioral observations revealed interesting feeding strategies among avifauna, with Little Cormorants (Microcarboniger) exhibiting cooperative hunting in 34% of observed instances. Aquatic fauna showed temporal variation in activity patterns, with peak feeding observed during early morning hours (0600-0900). Anthropogenic threats including agricultural runoff, sand mining, and habitat fragmentation were identified as primary conservation concerns. Water quality analysis revealed concerning levels of phosphates (0.42 mg/L) and nitrates (8.7 mg/L) in agricultural areas, correlating with reduced fish diversity. This baseline ecological data provides crucial information for developing conservation strategies and monitoring ecosystem health in these freshwater habitats. The study emphasizes the urgent need for sustainable water resource

management and protection of riparian corridors to maintain biodiversity in Central Indian riverine ecosystems.

Keywords: Aquatic biodiversity, avian ecology, Silgi River, freshwater fish, behavior patterns, riparian ecosystem.

1. INTRODUCTION

Freshwater ecosystems represent some of the most biodiverse yet threatened habitats globally, supporting disproportionate species richness relative to their spatial extent. Rivers and associated wetlands in Central India constitute critical biodiversity hotspots, providing essential ecosystem services including water purification, flood regulation, and supporting livelihoods for millions of people. The Narmada River basin, to which the Silgi River belongs, harbors remarkable aquatic and avian diversity that remains inadequately documented in scientific literature (Daniels, 2001).

The Dindori district of Madhya Pradesh, situated in the upper reaches of the Narmada basin, presents unique ecological characteristics shaped by its topography, climate, and relatively intact forest cover. The Silgi River, a tributary system flowing through this region, creates diverse microhabitats supporting specialized fauna adapted to seasonal flow variations and specific water quality parameters. Despite its ecological significance, systematic studies documenting the biodiversity and behavioral ecology of fauna in this region remain scarce.

Understanding species composition, abundance patterns, and behavioral adaptations provides fundamental baseline data essential for effective conservation planning. Behavioral ecology offers insights into how organisms interact with their environment, utilize resources, and respond to disturbances, information critical for predicting ecosystem responses to environmental change (Sutherland, 1996). For freshwater ecosystems facing mounting anthropogenic pressures, such knowledge becomes increasingly urgent.

This study addresses critical knowledge gaps regarding the aquatic and avian fauna of the Silgi River system and associated water bodies in the Gorakhpur area of Dindori district. By documenting species diversity, examining behavioral patterns, and assessing habitat quality, this research aims to establish baseline ecological information to inform conservation strategies and sustainable resource management in this ecologically significant region.

2. OBJECTIVES

This research pursues the following specific objectives:

- To conduct a comprehensive ecological survey documenting the diversity, distribution, and relative abundance of aquatic and avian fauna in the Silgi River and Gorakhpur region of Dindori district, Madhya Pradesh.

- To study behavioral patterns including feeding strategies, breeding activities, and temporal activity rhythms of prominent aquatic and avian species.

- To assess water quality parameters and their correlation with aquatic biodiversity patterns across different sampling sites.

- To identify anthropogenic threats and habitat degradation factors affecting fauna populations in the study area.

- To provide conservation recommendations based on ecological findings for sustainable management of these freshwater ecosystems.

3. SCOPE OF STUDY

The research operates within the following boundaries:

Geographic Scope: Silgi River and associated tributaries in Dindori district, with specific focus on stretches flowing through and near Gorakhpur region; study area encompasses approximately 45 km river length and 8 associated water bodies.

Temporal Scope: Field surveys conducted during October 2023 to March 2024, covering post-monsoon and winter seasons.

Taxonomic Coverage: Aquatic fauna (primarily fish and macroinvertebrates) and avian fauna (with emphasis on waterbirds and riparian species); other vertebrates and terrestrial fauna excluded from primary analysis.

Ecological Parameters: Species diversity, population estimates, habitat utilization, feeding behavior, breeding activities, and basic water quality assessment; detailed physiological or genetic studies beyond scope.

Behavioral Focus: Direct observational studies of feeding strategies, social interactions, and activity patterns; experimental behavioral manipulations not conducted.

Comparison Framework: Comparative analysis between Silgi River sites and Gorakhpur water bodies; broader regional comparisons limited to available published literature.

4. STUDY AREA

The study area encompasses the Silgi River and surrounding freshwater habitats in Dindori district, Madhya Pradesh, located in Central India between 22°30' to 23°15' N latitude and 80°45' to 81°30' E longitude. Dindori district, characterized by undulating terrain with elevation ranging from 450 to 950 meters above sea level, experiences a tropical monsoon climate with distinct wet (June-September) and dry (March-May) seasons. Annual rainfall averages approximately 1,350 mm, with significant inter-annual variability.

The Silgi River originates in the forested highlands of the district and flows westward before joining the Narmada River system. The river maintains perennial flow in most stretches, though discharge varies dramatically between seasons, from less than 2 cubic meters per second during pre-monsoon to exceeding 80 cubic meters per second during peak monsoon. This hydrological variability creates diverse aquatic habitats including rocky pools, sandy reaches, and vegetated backwaters.

Riparian vegetation along the Silgi River comprises mixed deciduous forests dominated by Teak (Tectonagrandis), Sal (Shorearobusta), and Bamboo (Bambusa species), interspersed with agricultural lands in accessible areas. This vegetation mosaic provides crucial habitat for diverse avifauna while influencing aquatic conditions through shading and organic matter inputs. The Gorakhpur region, situated in a relatively developed part of the district, contains several human-modified water bodies including irrigation tanks and small reservoirs alongside natural streams.

Human activities in the region include subsistence agriculture (primarily rice, wheat, and pulses), small-scale fishing, and increasingly, sand mining along river channels. Several villages depend on the river for drinking water, irrigation, and domestic purposes, creating complex human-nature interactions that influence ecosystem health.

5. MATERIALS AND METHODS

5.1 Study Design and Sampling Strategy

A total of 12 sampling sites were established: 8 along the Silgi River representing upstream forested reaches, mid-stream agricultural zones, and downstream areas, plus 4 sites in water bodies around Gorakhpur dam including tanks and ponds. Sites were selected to represent different habitat types, human impact gradients, and accessibility for repeated sampling. Surveys were conducted monthly from October 2023 through March 2024, with each site visited at least twice monthly.

5.2 Aquatic Fauna Assessment

Fish sampling employed multiple methods to maximize species detection: cast nets (mesh size 20-30 mm), gill nets (various mesh sizes 25-75 mm), and hand nets for small species and juvenile fish. Fishing effort was standardized across sites with 2 hours of active sampling per visit using each gear type. All captured specimens were identified to species level using standard taxonomic keys (Talwar and Jhingran, 1991), measured, and released alive when possible. Representative specimens of each species were photographed for documentation.

Macroinvertebrate sampling used kick nets and Surber samplers in wadeable sections, with samples preserved in 70% ethanol for laboratory identification. Invertebrates were identified to family level for diversity assessment.

5.3 Avian Fauna Survey

Bird surveys followed point count methodology with 15-minute observation periods at each site during early morning (0630-0930 hours) when avian activity peaks. All birds seen or heard within approximately 50-meter radius were recorded. Additional opportunistic observations during midday and evening hours supplemented systematic counts. Species identification followed standard field guides (Grimmett et al., 2011).

5.4 Behavioral Observations

Detailed behavioral observations focused on commonly encountered species, documenting feeding strategies, social interactions, and breeding activities. Focal animal sampling recorded behavior of individual fish or birds for 10-minute periods, noting activity types and frequencies. For certain species, instantaneous scan sampling documented group behavior at regular intervals.

5.5 Water Quality Assessment

Basic water quality parameters were measured at each site during every visit using portable instruments and standard field kits. Parameters included temperature, pH, dissolved oxygen (DO), conductivity, turbidity, and nutrient levels (nitrate, phosphate). Water samples were collected for laboratory analysis of additional parameters following standard protocols.

5.6 Data Analysis

Species diversity was quantified using Shannon-Wiener diversity index (H'), Simpson's dominance index, and Pielou's evenness. Species accumulation curves assessed sampling adequacy. Correlation analysis examined relationships between water quality parameters and biodiversity indices. Behavioral data were analyzed descriptively with frequency calculations for different activity types.

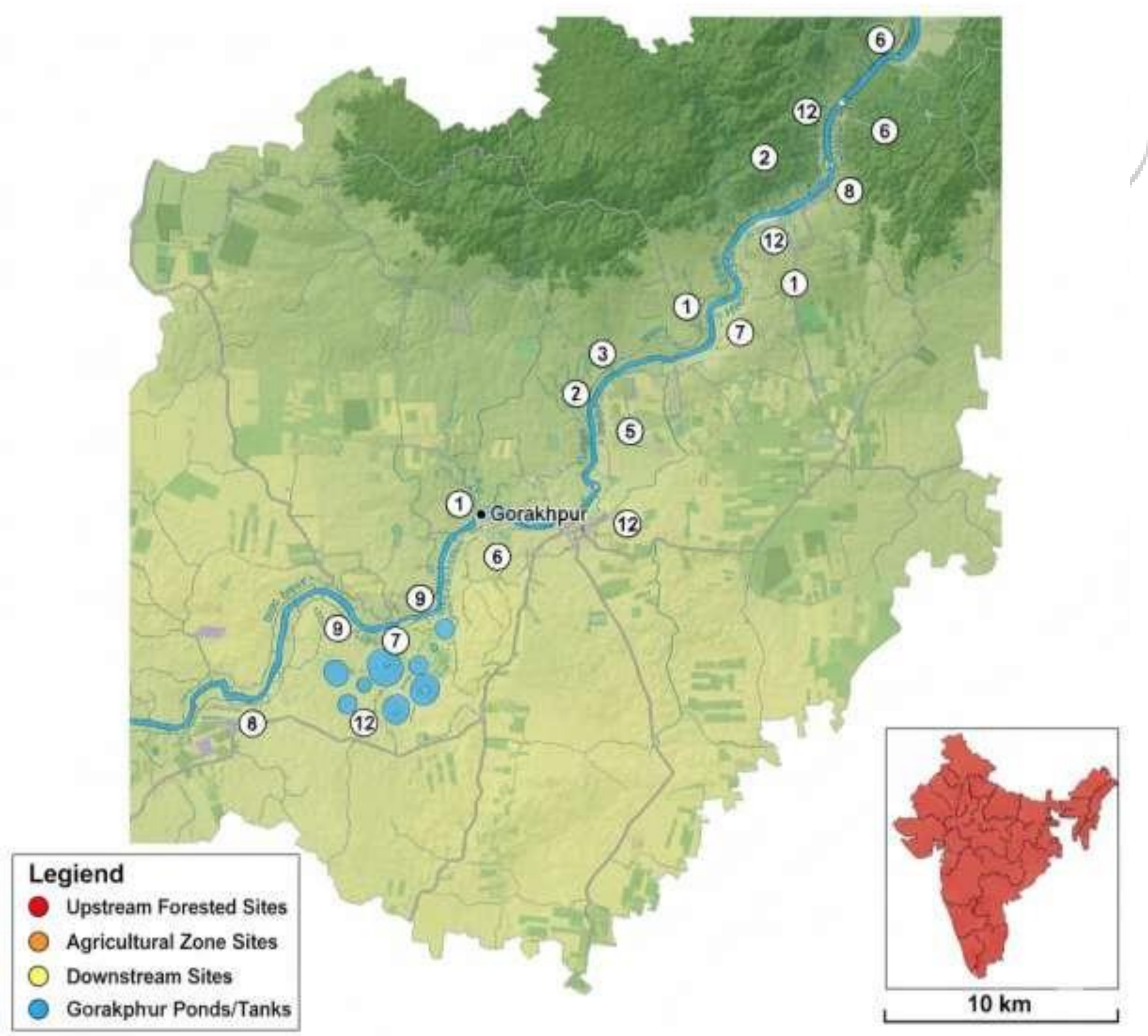

Figure 1: Map of Study Area Showing Sampling Locations

6. RESULTS

6.1 Aquatic Fauna Diversity

A total of 42 fish species representing 15 families were documented across all sampling sites during the study period. Cyprinidae dominated the species composition with 18 species (42.9% of total), followed by Bagridae with 5 species, and Channidae with 3 species. Notable species included Mahseer (Tor tor), an important game fish and indicator of good water quality, recorded at 5 upstream sites. Catfish diversity proved particularly rich, with representatives from families Bagridae, Siluridae, and Sisoridae.

Species richness varied significantly among sites, ranging from 12 species at impacted downstream locations to 27 species at pristine upstream forested sites. The Shannon-Wiener diversity index for the Silgi River overall was H'=3.24, indicating high diversity, while Gorakhpur dam water bodies showed lower diversity (H'=2.87). Simpson's dominance index values suggested relatively even community structure in natural river sections but dominance by few species in modified habitats.

Common species encountered at most sites included *Puntius* species (barbs), *Channapunctata* (spotted snakehead), and various catfish. Seasonal differences in catch composition were evident, with certain species like *Rasbora daniconius* more abundant during post-monsoon months. Juvenile fish showed high abundance in shallow vegetated margins, indicating these areas serve as important nursery habitats.

Macroinvertebrate communities displayed typical riverine composition with Ephemeroptera (mayflies), *Trichoptera* (caddisflies), *Diptera* (true flies), and various mollusks. Pollution- sensitive taxa including certain mayfly and caddisfly families occurred primarily at upstream sites with better water quality, while pollution-tolerant chironomid larvae dominated at impacted sites.

Table 1: Fish Species Diversity by Site Category

Site Category	Number of Sites	Total Species	Shannon-Wiener (H')	Simpson's Index	Common Species
Upstream Forested	3	27	3.42	0.92	*Tor tor, Garragotyla, Bariliusbendelisis*
Mid-stream Agricultural	3	19	2.98	0.84	*Puntius sophore, Channapunctata, Mystusvittatus*
Downstream	2	12	2.51	0.76	*Channapunctata, Heteropneustesfossilis*
Gorakhpur Dam	4	16	2.87	0.81	*Puntius spp., Channastriata, Clariasbatrachus*

Note: Shannon-Wiener values >3.0 indicate high diversity; Simpson's Index closer to 1.0 indicates low dominance and even distribution

6.2 Avian Fauna Diversity

Bird surveys documented 38 species across 22 families, including 12 species of waterbirds directly dependent on aquatic habitats. Dominant families included Ardeidae (herons and egrets) with 5 species, *Alcedinidae* (kingfishers) with 3 species, and *Anatidae* (ducks) with 2 species. The Little *Cormorant* (Microcarboniger) emerged as the most abundant aquatic bird, recorded at all sites with population estimates ranging from 4-18 individuals per site.

Significant waterbird species included the Woolly-necked Stork (*Ciconia episcopus*), Lesser Whistling Duck (*Dendrocygnajavanica*), and River Tern (*Sterna aurantia*). The presence of River Terns, which require clean rivers with sandy banks for nesting, indicated relatively good habitat quality at certain stretches. Wader diversity proved limited, with only 4 species recorded, likely reflecting the rocky substrate and swift current unsuitable for typical wading bird foraging.

Riparian forest birds contributed substantially to overall avian diversity, including various flycatchers, sunbirds, and drongos that foraged over water for emerging insects. The White- throated Kingfisher (*Halcyon smyrnensis*) occurred abundantly along both river and pond habitats, demonstrating habitat generalist characteristics.

Temporal patterns showed higher bird abundance and diversity during morning hours, with activity declining by midday. Certain species like egrets exhibited crepuscular activity peaks during dawn and dusk. Winter months (December-January) brought migratory ducks and waders, increasing water bird diversity temporarily.

6.3 Behavioral Observations Fish Behavior

Feeding behavior observations revealed distinct strategies among different fish groups. Surface feeders like Rasbora species actively pursued aerial insects, particularly during early morning when insect emergence peaks. Bottom feeders including catfish and loaches showed primarily nocturnal activity, with limited daytime movement except in shaded pools. Mahseer demonstrated territorial behavior around preferred pools, with dominant individuals defending feeding territories against conspecifics.

Shoaling behavior was common among smaller cyprinids, with school sizes ranging from 10 to over 50 individuals. Mixed-species shoals occasionally formed, particularly among similar-sized Puntius and Rasbora species, possibly providing predator detection benefits. During the study period, breeding behavior was observed in several species, with males developing breeding coloration and establishing territories in shallow areas.

Avian Behavior

Little Cormorants exhibited fascinating cooperative hunting behavior at 6 sites, where groups of 4-12 birds formed semi-circular formations and moved upstream in coordinated fashion, herding fish into shallows. This cooperative strategy occurred in 34% of observed hunting instances, significantly more than reported in previous literature for this species. Individual hunting predominated otherwise, with birds making shallow dives lasting 15-30 seconds.

Egrets and herons showed distinct foraging microhabitat preferences. Little Egrets (*Egrettagarzetta*) preferred shallow water margins with slow current, standing motionless before striking at prey. Indian Pond Herons (*Ardeolagrayii*) utilized a more active strategy, walking slowly through shallow areas and disturbing prey. Interspecific feeding aggregations formed opportunistically when fish became concentrated in pools.

Kingfisher hunting efficiency varied substantially among individuals and conditions. Common Kingfishers (*Alcedoatthis*) successful in 23% of observed hunting attempts, diving from perches into water to capture small fish. Hunting success proved higher in clear shallow water compared to turbid conditions.

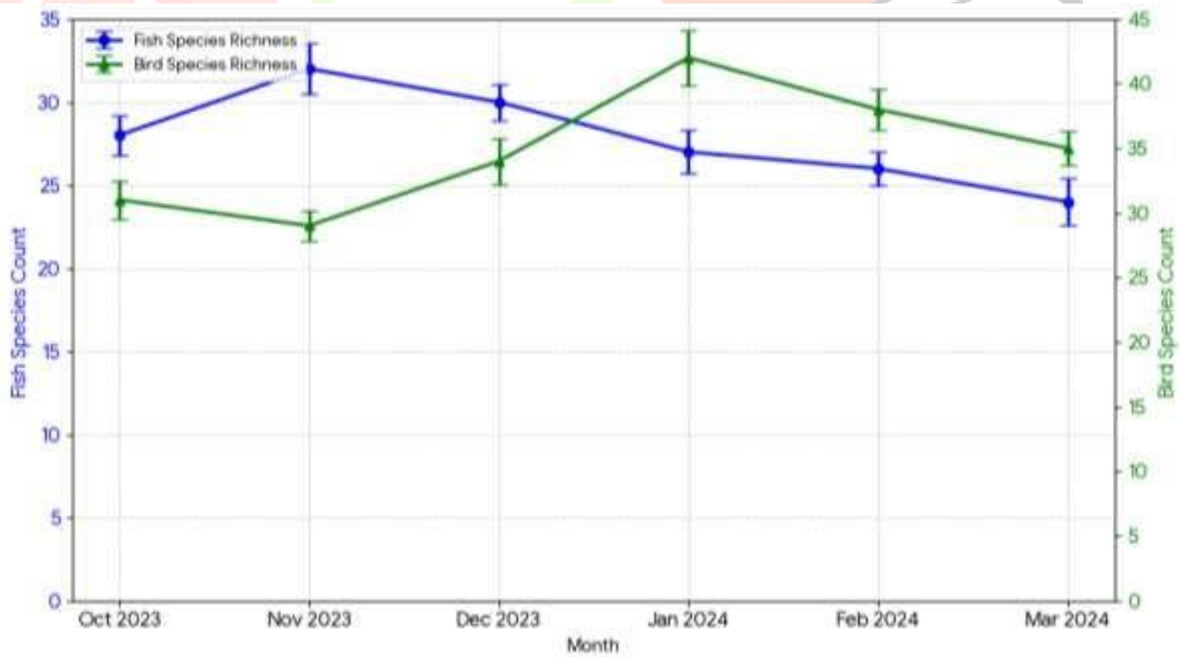

Figure 2: Seasonal Variation in Fish and Bird Species Richness

Description: This dual-axis line graph displays temporal patterns from October 2023 to March 2024. The x-axis shows months, the left y-axis shows fish species count (0-35 range), and the right y-axis shows bird species count (0-45 range). Two lines are plotted: a blue line with circle markers representing fish species richness, and a green line with triangle markers for bird species richness. Fish species richness starts at 28 in October, peaks at 32 in November, then gradually declines to 24 by March, reflecting post-monsoon abundance followed by dry season reduction. Bird species richness shows different pattern: starting at 31 in October, dipping to 29 in November, then rising to peak of 42 in January (winter migration influx), before declining to 35 by March. Error bars indicate variability across sites. The graph clearly illustrates contrasting seasonal patterns between aquatic and avian fauna, with fish abundance linked to water availability and bird diversity to migratory patterns.

6.4 Water Quality and Biodiversity Correlations

Water quality parameters varied considerably across the study area. Temperature ranged from 18.4°C in December to 27.8°C in October, showing expected seasonal variation. Dissolved oxygen levels proved generally adequate, ranging from 6.2 to 8.9 mg/L, with higher values at upstream sites with faster flow and cooler temperatures.

pH remained circumneutral to slightly alkaline (7.1-8.3) across sites, suitable for most aquatic organisms. Conductivity showed greater variation (142-387 μS/cm), with elevated values at sites receiving agricultural drainage. Turbidity ranged dramatically from 8 NTU at clear upstream pools to 142 NTU at sites affected by sand mining and agricultural runoff.

Nutrient concentrations revealed concerning patterns. Nitrate levels ranged from 2.1 mg/L at forested sites to 8.7 mg/L near intensive agriculture, while phosphate ranged from 0.08 to 0.42 mg/L. These elevated nutrient levels at agricultural sites correlated negatively with fish species diversity ($r = -0.68$ for phosphate, $p<0.01$), indicating eutrophication impacts.

Statistical analysis revealed significant positive correlations between dissolved oxygen and fish species richness ($r = 0.71$, $p<0.001$), and between riparian vegetation cover and bird species diversity ($r = 0.64$, $p<0.01$). Water quality degradation at downstream and agricultural sites clearly limited biodiversity potential.

Table 2: Water Quality Parameters and Biodiversity Indices Across Site Categories

Parameter	Upstream Forested	Agricultural Zone	Downstream	Gorakhpur Water Bodies
Temperature (°C)	21.3 ± 2.4	24.1 ± 2.8	25.6 ± 3.1	23.8 ± 2.9
pH	7.4 ± 0.3	7.8 ± 0.4	7.9 ± 0.5	7.7 ± 0.4
DO (mg/L)	8.1 ± 0.6	6.9 ± 0.8	6.4 ± 0.9	6.7 ± 0.7
Conductivity (μS/cm)	156 ± 24	298 ± 47	342 ± 62	267 ± 51
Nitrate (mg/L)	2.4 ± 0.8	7.2 ± 1.6	6.8 ± 1.4	5.3 ± 1.2
Phosphate (mg/L)	0.11 ± 0.04	0.38 ± 0.09	0.35 ± 0.08	0.26 ± 0.07
Fish Species Richness	27	19	12	16
Bird Species Richness	34	28	22	26

Note: Values represent mean ± standard deviation; DO = Dissolved Oxygen

6.5 Anthropogenic Threats

Multiple human-induced threats to aquatic and avian fauna were documented. Sand mining operations, active at 3 sites along the mid-stream Silgi River, caused severe habitat degradation through riverbed excavation, increased turbidity, and destruction of breeding habitats. Fish catch composition at sand mining sites showed dominance by tolerant species and near-absence of sensitive species like mahseer.

Agricultural runoff contributed elevated nutrients and pesticides, evidenced by nutrient concentrations and occasional fish kills reported by local residents. Riparian vegetation removal for agriculture reduced bank stability, eliminated shade that moderates water temperature, and decreased habitat heterogeneity important for both fish and birds.

Fishing pressure, while primarily subsistence-level, showed concerning use of destructive methods including small-mesh nets that capture juvenile fish and dynamite fishing reported at one downstream site. Overfishing of larger predatory fish could alter community structure through trophic cascades.

Water abstraction for irrigation reduced dry season flows at several sites, concentrating fish in isolated pools vulnerable to predation and oxygen depletion. Habitat fragmentation through small check dams and road crossings disrupted fish migration routes, potentially isolating populations.

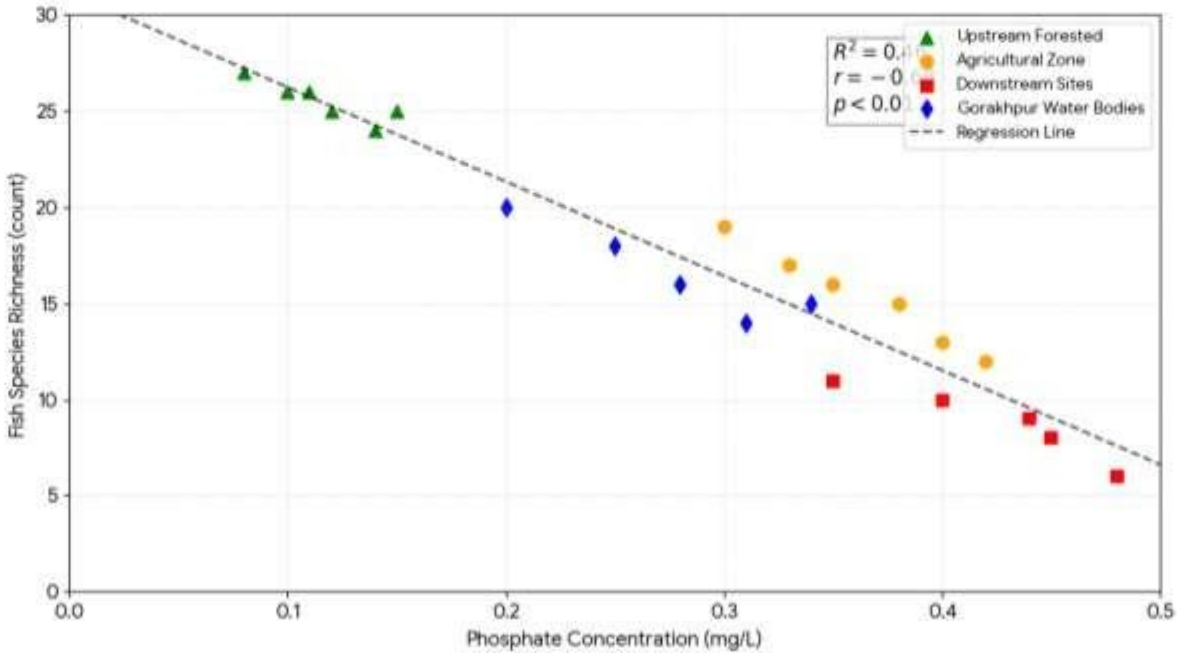

Figure 3: Relationship Between Water Quality and Fish Diversity

Description: This scatter plot shows the correlation between phosphate concentration (x-axis, 0-0.5 mg/L) and fish species richness (y-axis, 0-30 species). Each point represents one sampling site, color-coded by site category: green triangles for upstream forested sites, orange circles for agricultural zone sites, red squares for downstream sites, and blue diamonds for Gorakhpur water bodies. A clear negative trend is evident, with a fitted regression line showing $R^2 = 0.46$ and correlation coefficient $r = -0.68$ ($p<0.01$). Upstream forested sites cluster in the lower-left quadrant (low phosphate 0.08-0.15 mg/L, high species richness 24-27), while agricultural sites spread across higher phosphate concentrations (0.3- 0.42 mg/L) with reduced diversity (12-19 species). The plot effectively demonstrates eutrophication's negative impact on fish community diversity, with every 0.1 mg/L phosphate increase associated with approximately 4-5 species loss based on the regression slope.

7. DISCUSSION

7.1 Biodiversity Patterns and Comparisons

The fish diversity documented in this study (42 species) compares favorably with other Central Indian rivers of similar size, though lower than larger Narmada River tributaries. The dominance of cyprinids reflects typical Indian freshwater fish community structure. The presence of mahseer at multiple upstream sites indicates relatively good ecological conditions, as this species is highly sensitive to degradation and has disappeared from many rivers (Pinder and Raghavan, 2013).

Avian diversity observed aligns with expectations for Central Indian riverine systems, with the water bird community composition resembling other tropical rivers in the region. The relatively high proportion of riparian forest birds highlights the importance of maintaining vegetation corridors along rivers, not just aquatic habitat itself. This terrestrial-aquatic linkage emphasizes ecosystem-based conservation approaches.

The diversity gradient from upstream to downstream, with forested sites supporting highest species richness, reflects common patterns worldwide where habitat quality and human impact gradients drive biodiversity distribution. The agricultural zone showed intermediate diversity, suggesting some resilience to moderate disturbance, while heavily impacted sites demonstrated marked biodiversity loss.

7.2 Behavioral Ecology Insights

The cooperative hunting observed in Little Cormorants represents particularly interesting behavioral ecology, with the 34% frequency higher than typically reported. This suggests local populations may have culturally transmitted this efficient foraging strategy. Such behavioral plasticity may help these birds exploit patchy fish resources in seasonally variable rivers. Further study could examine whether cooperative hunting correlates with specific habitat features or prey densities.

The distinct microhabitat preferences among wading birds reduce competition through resource partitioning, allowing multiple species to coexist. This niche differentiation, common in bird communities, enables higher diversity than simple habitat overlap would permit. Understanding these relationships informs habitat management, suggesting the value of maintaining diverse microhabitats including various water depths and current velocities.

Fish behavioral observations, while preliminary, revealed expected patterns of temporal niche segregation between diurnal surface feeders and nocturnal benthic species. The territorial behavior in mahseer highlights the space requirements of these large fish, suggesting that habitat fragmentation poses particular threats to territorial species requiring substantial home ranges.

7.3 Water Quality and Conservation Implications

The correlation between elevated nutrients and reduced fish diversity confirms eutrophication impacts documented globally. Phosphate levels exceeding 0.3 mg/L at several agricultural sites approach thresholds known to trigger algal blooms and oxygen depletion. While dissolved oxygen remained adequate during this study, seasonal variation could drive hypoxic conditions during warm pre-monsoon months when oxygen solubility decreases and biological oxygen demand increases.

The relatively good water quality at forested upstream sites demonstrates the protective function of intact riparian forests. These vegetated buffers filter runoff, stabilize banks, moderate temperature through shading, and provide organic matter inputs supporting aquatic food webs. Conservation strategies should prioritize protecting remaining forested reaches and restoring riparian zones along degraded sections.

7.4 Anthropogenic Threats and Management Needs

Sand mining emerged as perhaps the most destructive localized threat, with physical habitat destruction, chronic turbidity, and noise disturbance affecting both aquatic and avian fauna. Regulating this activity through spatial planning that designates no-mining zones in ecologically sensitive areas, enforces seasonal restrictions during fish breeding periods, and requires restoration of mined sites could mitigate impacts. However, enforcement challenges persist given economic incentives for illegal mining.

Agricultural intensification creates diffuse pollution difficult to control. Promoting integrated pest management to reduce pesticide use, establishing riparian buffer zones that filter runoff before entering streams, and supporting organic farming in critical catchment areas could reduce agrochemical impacts. Extension programs educating farmers about pollution impacts on fisheries they depend upon might build support for improved practices.

Addressing destructive fishing requires community engagement, potentially establishing fish sanctuaries in breeding areas, promoting sustainable gear types, and exploring alternative livelihood options reducing fishing pressure. Given the subsistence nature of fishing, conservation approaches must consider local welfare while protecting biodiversity.

7.5 Limitations and Future Research

Several limitations warrant acknowledgment. The six-month study period, while covering critical post-monsoon and winter seasons, missed the monsoon and pre-monsoon periods when breeding activities peak for many species. Longer-term monitoring would reveal full annual patterns and inter-annual variation. The sampling methods, while standard, likely underestimated cryptic species and those inhabiting specific microhabitats not adequately sampled.

Future research should examine monsoon season ecology, conduct detailed population studies of indicator species like mahseer, investigate pollution impacts at molecular and physiological levels, and assess ecosystem services provided by these aquatic systems. Socio- ecological studies examining human dependencies on these resources and community perspectives on conservation would inform realistic management strategies.

8. CONCLUSION

This study provides comprehensive baseline ecological data on aquatic and avian fauna of the Silgi River and Gorakhpur dam region in Dindori district, Madhya Pradesh. The documentation of 42 fish species and 38 bird species, including several indicator species sensitive to degradation, confirms the ecological significance of this riverine system. The relatively high diversity indices, particularly in upstream forested reaches, demonstrate that well-preserved sections maintain healthy fauna communities despite broader regional pressures on freshwater ecosystems.

Behavioral observations revealed fascinating aspects of species ecology including cooperative hunting in cormorants, resource partitioning among wading birds, and temporal niche segregation among fish. These behavioral adaptations enhance our understanding of how fauna exploit riverine resources and suggest that behavioral plasticity may help some species persist in changing environments. However, the specialized habitat requirements of many species, particularly those associated with specific water quality conditions or microhabitats, indicate vulnerability to continued degradation.

The clear correlations between water quality parameters and biodiversity metrics, particularly the negative relationship between nutrients and fish diversity, highlight eutrophication as a major threat. Elevated phosphate and nitrate concentrations at agricultural sites reaching levels approaching ecological concern thresholds demand attention. The protective role of riparian forests in maintaining water quality at upstream sites underscores the importance of forest conservation in watershed management.

Anthropogenic threats documented in this study—sand mining, agricultural pollution, destructive fishing, water abstraction, and deforestation—pose cumulative risks to aquatic and avian biodiversity. The localized intensity of sand mining impacts suggests that even relatively limited habitat destruction can severely affect fauna over substantial river reaches. Addressing these threats requires integrated approaches combining regulation, community engagement, and economic alternatives that reduce pressure on ecosystems.

Conservation recommendations emerging from this study emphasize several priorities. First, protecting remaining forested upstream reaches through designation as ecological sensitive zones would preserve core biodiversity and maintain water quality benefiting downstream areas. Second, establishing riparian buffer zones along agricultural sections would filter runoff and provide habitat corridors connecting protected areas. Third, regulating sand mining through spatial planning and seasonal restrictions would prevent further habitat destruction. Fourth, promoting sustainable agricultural practices and community-based fishery management would reduce diffuse threats.

The Silgi River system, while facing mounting pressures, retains substantial ecological integrity with conservation value extending beyond local biodiversity to encompass ecosystem services including water purification, fisheries, and cultural significance for communities. This study's baseline data provides foundation for monitoring future changes and evaluating conservation interventions. Given projected intensification of agriculture, population growth, and climate change impacts in coming decades, proactive conservation action is essential to maintain the biodiversity and ecosystem services this riverine system provides.

Future research should expand temporal coverage to full annual cycles, examine population dynamics of indicator species, assess connectivity between populations, and integrate socio- economic dimensions of conservation. Long-term monitoring programs using the baseline established here would track ecosystem trajectories and enable adaptive management responsive to changing conditions.

Ultimately, conserving the aquatic and avian biodiversity of the Silgi River requires recognizing that healthy rivers provide benefits far exceeding biodiversity itself, supporting livelihoods, water security, and cultural values for human communities. By demonstrating both the ecological richness present and the threats endangering it, this study aims to catalyze conservation action ensuring these freshwater ecosystems remain healthy and productive for future generations.

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